Health & Consumer Protection
Directorate-General

International Training Workshop on Welfare Standards Concerning the Stunning and Killing of Animals in Slaughterhouses or for Disease Control

26 – 29th September 2006
Bristol Marriott City Centre Hotel, Bristol, UK

Contents

Background

Health & Consumer Protection
Directorate-General

Humane Slaughter Association

International Training Workshop on Welfare Standards Concerning the Stunning and Killing of Animals in Slaughterhouses or for Disease Control

26th - 29th September 2006
Bristol Marriott Hotel City Centre

Background

The Humane Slaughter Association (HSA) is pleased to announce this international training workshop on welfare standards concerning the stunning and killing of animals in slaughterhouses or for disease control. This event is being organised by the HSA on behalf of the European Commission.

There have been remarkable scientific advances in recent years in the understanding of the capacity of livestock animals to experience fear and pain if not handled properly, in the knowledge of methods to humanely induce unconsciousness, and in the technology for stunning, slaughter and killing of these animals.

Based on these advances, standards and legislation for the humane slaughter and killing of livestock have been developed within the European Union and further afield.

EU Directive 93/119/EC on the protection of animals at the time of slaughter and killing sets out the Community rules and also provides that establishments in third countries which are approved to export to the Community must ensure that animals are killed under conditions offering guarantees of equivalent humane treatment, and meat must be accompanied by documentation certifying this.

The Aims of the Training Workshop

The context of the workshop is fostering the worldwide promotion of high standards of livestock welfare at slaughter and killing.

The aim is, by providing an opportunity for those active in the field to develop their interests through tuition from international experts and through sharing knowledge and experiences, to equip delegates to be able to assess, from the animal welfare perspective, that systems and operations have been well-designed, that good operating systems are in place, and that they are functioning properly.

Lecture room sessions and discussions will be complemented by a visit to a modern slaughterhouse to observe current methods and practices.

The programme will be valuable for delegates through:

- Helping to promote technology transfer programmes around the world
- Identifying current areas of concern
- Providing a network of contacts and resources to improve welfare at slaughter or killing

The workshop will include sessions on the following:

- Relevant EU legislation and international framework
- Scientific background on the principles of humane handling and slaughter
- Main stunning and killing techniques in slaughterhouses in Europe
- Inspection and auditing of automatic systems
- Biosecurity, environmental and food safety issues
- Methods of killing for control of animal disease epidemics
- Best practices and procedures for monitoring, proper enforcement, and evaluation of animal welfare
- Collection of specific information in order to contribute to the future development of internet-based learning activities for veterinarians in this field
- Observation of modern slaughterhouse methods and practices

This workshop is for:

The Workshop is for veterinarians or others responsible for livestock slaughter or killing practices and who wish to contribute to efforts to promote modern good standards for welfare in their own countries and around the world. Delegates attending the conference will have the enthusiasm and knowledge to help disseminate information about modern welfare standards to key stakeholders in their countries.

To ensure widespread dissemination of this important information, 65 fully funded places have been made avaiable to delegates from over 50 countries.

Speakers

Tutors and speakers include:

Barbara Alessandrini, OIE collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare. Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise, Italy
Tess Benson, Humane Slaughter Association, UK
Terence Cassidy, FVO European Commission, Ireland
Jane Downes, Meat Hygiene Service, UK
Professor Neville Gregory, Royal Veterinary College, UK
Gordon Hickman, State Veterinary Service, UK
Professor Pam Hullinger, Lawrence Livermore National Laboratory, USA
Professor Mac Johnston, Royal Veterinary College, UK
Dr Sarah Kahn, OIE, Paris
Dr James Kirkwood, Humane Slaughter Association & Universities Federation of Animal Welfare, UK
Mandy Lucas, Integra Food Secure Ltd., UK
Charles Mason, Humane Slaughter Association, UK
John Moffitt, State Veterinary Service, UK
Milorad Radakovic, Food Standards Agency, UK
Dr Mohan Raj, University of Bristol, UK
Dr Denis Simonin, FVO European Commission, Belgium
Natalie Smith, Humane Slaughter Association, UK
Kirk Thompson, Department for Environment, Food and Rural Affairs, UK
Dr Martin von Wenzlawowicz, bsi Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals, Germany

Programme

International Training Workshop on Welfare Standards Concerning the Stunning and Killing of Animals in Slaughterhouses or for Disease Control

Programme

Tuesday 26th September	
16:00 – 19:00	Registration and collection of delegate packs
19:00 – 20:00	Reception
20:00	Dinner

Wednesday 27th September	
Introduction	
08:30	The importance of animal welfare and of good design of facilities and systems. Dr James Kirkwood, HSA & UFAW

Session 1	**Relevant EU legislation and international framework**	
08:45	Protection of animals at slaughter and killing: A short overview of the European Union legislation.	Dr Terence Cassidy, *European Commission*
09:15	Protection of animals at slaughter and killing: International context.	Dr Denis Simonin, *European Commission*
09:45	Discussion	

Session 2	**Scientific basis for proper handling, stunning and killing of animals (animal behaviour and anatomy)**	
09:55	Anatomical and physiological principles relevant to handling, stunning and killing red meat species.	Professor Neville Gregory, *Royal Veterinary College*

10:25 – 10:55	**Break**	

10:55	Anatomical and physiological principles relevant to handling, stunning and killing white meat species.	Dr Mohan Raj, *University of Bristol*
10:25	Discussion	

Session 3	**Main stunning and killing techniques applied in slaughterhouses in Europe and in the context of killing for disease control situations** (for each method: conditions of proper use, critical points to check, advantages and disadvantages)	
11:35	Introduction to modern slaughter methods.	Charles Mason, *Humane Slaughter Association*
11:55	Application of modern methods for slaughter of red meat animals.	Tess Benson, *Humane Slaughter Association*
12:15	Application of modern methods for slaughter of poultry.	Natalie Smith, *Humane Slaughter Association*
12:30	Discussion	

12:40 – 13:40	**Lunch**	

13: 40	Application of modern methods for killing in disease control situations.	Kirk Thompson, *Defra*

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Wednesday 27th September continued		
Session 4	**Particular aspects relating to the inspection/auditing of automatic methods (electrical or gas system with no/limited human intervention**)	
14:10	Inspection and auditing of automated controlled atmosphere methods for slaughter for poultry.	Dr Martin von Wenzlawowicz, *bsi Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals*
14:40	Inspection and auditing of automated electrical methods for slaughter.	Natalie Smith and Charles Mason, *Humane Slaughter Association*
15:00	Discussion	

15:30 – 16:00	**Break**

Mini sessions on biosecurity, environmental and food safety issues		
16:00	Biosecurity.	Professor Mac Johnston, *Royal Veterinary College*
16:20	Environmental issues.	Gordon Hickman, *State Veterinary Service*
16:40	Welfare and food safety.	Milorad Radakovic, *Food Standards Agency*
17:00	Discussion	
Session 5	**Best practices and procedures to facilitate the monitoring and proper enforcement of relevant animal welfare requirements**	
17:10	Best practices and procedures for monitoring and enforcement of animal welfare requirements at individual organisation (slaughterhouse) level.	Dr Martin von Wenzlawowicz, *bsi Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals*
17:40	Discussion and preparation for slaughterhouse visits	

19:30	Dinner

Thursday 28th September

08:00 – 13:00	Slaughterhouse visits

13:00	Lunch

14:00	Questions for participants
14:30	Discussion in groups. Followed by presentations of brief summaries by rapporteurs and sharing of ideas and experiences between groups.

16:00	Break

16:30	Discussion period. (To include consideration of recommendations for the future, possible new welfare assessment methods, and welfare principles in slaughter without pre-stunning)

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Thursday 28th September continued		
Session 5 continued		
17:00	Best practices and procedures for monitoring and enforcement of animal welfare requirements at state level.	Jane Downes, *Meat Hygiene Service*

Session 6	**Experience gained in the context of animal disease epidemics, including perspective from third countries**	
17:30	Experience gained from dealing with Newcastle Disease.	Professor Pam Hullinger, *Lawrence Livermore National Laboratory*
18:00	Discussion	

19:30	Dinner

Friday 29th September		
Session 6 continued		
08:30	Experience gained from dealing with killing for control of Foot and Mouth Disease.	John Moffitt, *State Veterinary Service*

Session 7	**Auditing and reporting methods to evaluate animal welfare in slaughterhouses and killing under disease control situations**	
09:00	Auditing and reporting animal welfare in slaughterhouses – An independent auditor's perspective.	Ms Mandy Lucas, *Integra Food Secure Ltd.*
09:30	Reporting and evaluating animal welfare under disease control situations.	Professor Pam Hullinger, *Lawrence Livermore National Laboratory*
10:00	Evaluating welfare aspects of animal handling in slaughterhouses and at killing for slaughter.	Professor Neville Gregory, *Royal Veterinary College* and Tess Benson, *Humane Slaughter Association*

10:30 – 11:00	**Break**

Session 8	**Collection of specific information in order to contribute to the future development of learning activities based on internet for veterinarians both in Member States and in third countries**	
11:00	Collection of specific information to contribute to the development of internet learning facilities relating to humane slaughter and killing.	Dr Barbara Alessandrini, *OIE collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare. Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise*
12:00	Discussion and recommendations for the future (Concluding discussion, review of recommendations and closing comments)	

12:30 – 13:30	**Lunch**

13:30 – 15:00	Concluding discussion, review of recommendations (continued) and closing comments

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Presentations and Objectives

Introduction

Presentation 1: The importance of animal welfare and of good design of facilities and systems.
Dr James Kirkwood, Humane Slaughter Association & Universities Federation for Animal Welfare

Objectives:

- Welcome and introduction
- Animal sentience and animal welfare
- The scientific basis for concern for animal welfare and how this has contributed to growing global awareness of the need for high welfare standards.
- Principles of welfare assessment
- The importance of good design of facilities and systems
- The structure and aims of the Training Workshop

Session 1 Relevant EU legislation and international framework

Presentation 2: Protection of animals at slaughter and killing: A short overview of the European Union Legislation.
Dr Terence Cassidy, European Commission

Objectives:

- The EU legislation relating to livestock welfare at slaughter and killing for disease control
- Key welfare principles in this legislation
- Legal responsibilities under this legislation
- Systems for monitoring and enforcement

Presentation 3: How EU legislation relates to international legislation.
Dr Denis Simonin, European Commission

Objectives:

- International initiatives before the OIE
- The OIE and Animal Welfare
- Legal context and impact of OIE standards
- The OIE guidelines on slaughter and killing
- Relationship between OIE guidelines and the EU legislation

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Presentations and Objectives Cont.

Session 2 Scientific basis for proper handling, stunning and killing of animals (animal behaviour and anatomy)

Presentation 4: Anatomical and physiological principles relevant to handling, stunning and killing red meat species.
Professor Neville Gregory, Royal Veterinary College

Objectives:

- Criteria used in assessing humaneness of stunning and slaughter
- Critical features when stunning and slaughtering red meat species
- Problems associated with separation, restraint, application of stunning equipment, and efficiency of killing methods
- Key principles for humane handling and slaughter
- Future needs

Presentation 5: Anatomical and physiological principles relevant to handling, stunning and killing white meat species.
Dr Mohan Raj, University of Bristol

Objectives:

- Humane slaughter and killing of poultry: anatomical and physiological principles
- What sustains sensibility (e.g. to fear and pain) and what changes result in loss of sensibility
- Key principles for humane handling and slaughter
- Principles of assessment of sensibility
- Possible future developments

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Presentations and Objectives Cont.

Session 3 Main stunning and killing techniques applied in slaughterhouses in Europe and in the context of killing for disease control situations (for each method: conditions of proper use, critical points to check, advantages and disadvantages).

Presentation 6: Introduction to modern slaughter methods.
Charles Mason, Humane Slaughter Association

Objectives:

- How electrical methods stun and kill
- How controlled atmosphere methods stun and kill
- Captive bolt stunning
- Use of free-bullet firearms
- Advantages and disadvantages of these methods
- Possible future developments

Presentation 7: Application of modern methods for slaughter of red meat animals.
Tess Benson, Humane Slaughter Association

Objectives:

- Key principles for the use of electrical methods for red meat animals
- Key principles for the use of CAS methods
- Key principles for the use of captive bolt stunning
- Critical welfare issues in the use of these method and how to detect, monitor and tackle them
- Possible future developments

Presentation 8: Application of modern methods for slaughter of poultry.
Natalie Smith, Humane Slaughter Association

Objectives:

- Key principles for the use of electrical methods for poultry
- Key principles for the use of CAS methods
- Critical welfare issues in the use of these method and how to detect, monitor and tackle them
- Possible future developments

Presentation 9: Application of modern methods for killing in disease control situations.
Kirk Thompson, Defra

Objectives:

- Review of methods available for killing for disease control and their advantages and disadvantages
- Methods and logistics for small scale operations
- Methods and logistics for large scale operations
- Preparation of strategies and maintenance of preparedness
- Possible future developments

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Presentations and Objectives Cont.

Session 4 Particular aspects relating to the inspection/auditing of automatic methods (electrical or gas system with no/limited human intervention)

Presentation 10: **Inspection and auditing of automated controlled atmosphere methods for slaughter of poultry.**
Dr Martin von Wenzlawowicz, bsi Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals

Objectives:

- Challenges of welfare inspection & auditing of automated CAS systems
- Key points for observation regarding the equipment
- Key points for observation regarding systems of operation/working practices
- Key observations for welfare assessment of the birds
- Possible future developments

Presentation 11: Inspection and auditing of automated electrical methods for slaughter.
Natalie Smith and Charles Mason, Humane Slaughter Association

Objectives:

- Challenges of welfare inspection and auditing of automated electrical systems
- Key observations regarding the equipment
- Key points for observation regarding systems of operation/working practices
- Key observations for welfare assessment of the animals

Possible future developments

Mini sessions on biosecurity, environmental and food safety issues

Presentation 12: Biosecurity
Professor Mac Johnston, Royal Veterinary College

Objectives:

- Key principles of biosecurity at livestock slaughter and killing
- Sources of key information

Presentation 13: Environmental issues
Mr Gordon Hickman, State Veterinary Service

Objectives:

- Key environmental issues and responsibilities relating to livestock slaughter and killing
- Sources of key information

Presentation 14: Food safety
Milorad Radakovic, Food Standards Agency

Objectives:

- Key food safety principles and responsibilities at livestock slaughter
- Sources of key information
- Relationship between food safety and welfare

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Presentations and Objectives Cont.

Session 5 Best practices and procedures to facilitate the monitoring and proper enforcement of relevant animal welfare requirements

Presentation 15: Best practices and procedures for monitoring and enforcement of animal welfare requirements at state level.
Jane Downes, Meat Hygiene Service

Objectives:

- Why there needs to be a look across standards within the state
- How it can be done
- How it is done in the UK and elsewhere
- Identifying trends

Presentation 16: Best practices and procedures for monitoring and enforcement of animal welfare requirements at individual organisation (slaughterhouse) level.
Dr Martin von Wenzlawowicz, bsi Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals

Objectives

- Review and discuss systems and procedures for monitoring welfare requirements at individual organisation level
- Review and discuss systems and procedures for enforcement of welfare requirements at individual organisation level
- Common difficulties and approaches to their resolution
- Possible future developments

Session 6 Experience gained in the context of animal disease epidemics, including perspective from third countries

Presentation 17: Experience gained from dealing with Newcastle Disease.
Professor Pam Hullinger, Lawrence Livermore National Laboratory

Objectives:

- Review challenges of humane killing of poultry for disease control
- Organisation and logistics
- Choice of methods
- Key points for planning and implementation

Presentation 18: Experience gained from dealing with killing for control of Foot and Mouth Disease.
John Moffitt, State Veterinary Service

Objectives:

- Review challenges of humane killing of red meat animals for disease control
- Organisation and logistics
- Choice of methods
- Key points for planning and implementation

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Presentations and Objectives Cont.

Session 7 Auditing and reporting methods to evaluate animal welfare in slaughterhouses and killing under disease control situations

Presentation 19: Auditing and reporting animal welfare in slaughterhouses – An independent auditor's perspective.
Ms Mandy Lucas, Integra Food Secure Ltd.

Objectives

- Review the role of independent auditors in welfare assessment
- Review the role of retailers' quality assurance schemes in setting welfare standards
- How independent auditors work
- Areas of common interest, and differences, with state monitoring/inspection authorities

Presentation 20: Reporting and evaluating animal welfare under disease control situations.
Professor Pam Hullinger, Lawrence Livermore National Laboratory

Objectives:

- The need for evaluation and reporting welfare standards during killing for disease control
- Systems for welfare evaluation
- Logistics and maintaining preparedness

Presentation 21: Evaluating welfare aspects of animal handling in slaughterhouses and at killing for slaughter.
Professor Neville Gregory, Royal Veterinary College and Tess Benson, Humane Slaughter Association

Objectives:

- The need for assessment of the welfare of transport and handling of animals
- Methods for assessment of welfare of animals during handling
- Indices at post mortem relevant to assessment of welfare during handling
- Key points on design and operation of systems for animal handling to high welfare standards
- Possible future developments

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Presentations and Objectives Cont.

Session 8	**Collection of specific information in order to contribute to the future development of learning activities based on internet for veterinarians both in Member States and in third countries**

Presentation 22: Collection of specific information to contribute to the development of internet learning facilities relating to humane slaughter and killing.

Dr Barbara Alessandrini, OIE collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare. Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise

Objectives:

- Plans for internet learning facilities relating to slaughter and killing…
- …aims and…
- … how these facilities may be accessed and used
- How delegates can contribute

Guidelines

a. Introduction to the Guidelines for Animal Welfare
b. Guidelines for the Slaughter of Animals for Human Consumption
c. Guidelines for the Killing of Animals for Disease Control Purposes

OIE World Organisation for Animal Health: International Animal Health Code - 2006

INTRODUCTION TO THE GUIDELINES FOR ANIMAL WELFARE

Article 3.7.1.1.

Guiding principles for animal welfare

1. That there is a critical relationship between animal health and animal welfare.
2. That the internationally recognised 'five freedoms' (freedom from hunger, thirst and malnutrition; freedom from fear and distress; freedom from physical and thermal discomfort; freedom from pain, injury and disease; and freedom to express normal patterns of behaviour) provide valuable guidance in animal welfare.
3. That the internationally recognised 'three Rs' (reduction in numbers of animals, refinement of experimental methods and replacement of animals with non-animal techniques) provide valuable guidance for the use of animals in science.
4. That the scientific assessment of animal welfare involves diverse elements which need to be considered together, and that selecting and weighing these elements often involves value-based assumptions which should be made as explicit as possible.
5. That the use of animals in agriculture and science, and for companionship, recreation and entertainment, makes a major contribution to the wellbeing of people.
6. That the use of animals carries with it an ethical responsibility to ensure the welfare of such animals to the greatest extent practicable.
7. That improvements in farm animal welfare can often improve productivity and food safety, and hence lead to economic benefits.
8. That equivalent outcomes (performance criteria), rather than identical systems (design criteria), be the basis for comparison of animal welfare standards and guidelines.

Article 3.7.1.2.

Scientific basis for guidelines

1. Welfare is a broad term which includes the many elements that contribute to an animal's quality of life, including those referred to in the 'five freedoms' listed above.
2. The scientific assessment of animal welfare has progressed rapidly in recent years and forms the basis of these guidelines.
3. Some measures of animal welfare involve assessing the degree of impaired functioning associated with injury, disease, and malnutrition. Other measures provide information on animals' needs and affective states such as hunger, pain and fear, often by measuring the strength of animals' preferences, motivations and aversions. Others assess the physiological, behavioural and immunological changes or effects that animals show in response to various challenges.
4. Such measures can lead to criteria and indicators that help to evaluate how different methods of managing animals influence their welfare.

OIE World Organisation for Animal Health: International Animal Health Code - 2006

GUIDELINES FOR THE SLAUGHTER OF ANIMALS FOR HUMAN CONSUMPTION

Article 3.7.5.1.

General principles

1. Object

These guidelines address the need to ensure the welfare of food animals during pre-slaughter and slaughter processes, until they are dead.

These guidelines apply to those domestic animals commonly slaughtered in slaughterhouses, that is: cattle, buffalo, sheep, goats, deer, horses, pigs, ratites and poultry. Other animals, wherever they have been reared, should be managed to ensure that their transport, lairaging, restraint and slaughter is carried out without causing undue stress to the animals; the principles underpinning these guidelines apply also to these animals.

2. Personnel

Persons engaged in the unloading, moving, lairaging, care, restraining, stunning, slaughter and bleeding of animals play an important role in the welfare of those animals. For this reason, there should be a sufficient number of personnel, who should be patient, considerate, competent and familiar with thee guidelines outlined in the present Appendix and their application within the national context.

The management of the slaughterhouse and the Veterinary Services should ensure that slaughterhouse staff carry out their tasks in accordance with the principles of animal welfare.

3. Animal behaviour

Animal handlers should be experienced and competent in handling and moving farm livestock, and understand the behaviour patterns of animals and the underlying principles necessary to carry out their tasks.

The behaviour of individual animals or groups of animals will vary, depending on their breed, sex, temperament and age and the way in which they have been reared and handled. Despite these differences, the following behaviour patterns which are always present to some degree in domestic animals, should be taken into consideration in handling and moving the animals.

Most domestic livestock are kept in herds and follow a leader by instinct.

Animals which are likely to be hostile to each other in a group situation should not be mixed at slaughterhouses.

The desire of some animals to control their personal space should be taken into account in designing facilities.

Domestic animals will try to escape if an animal handler approaches closer than a certain distance. This critical distance, which defines the flight zone, varies among species and individuals of the same species, and depends upon previous contact with humans. Animals reared in close proximity to humans i.e. tame have no flight zone, whereas those kept in free range or extensive systems may have flight zones which may vary from one metre to many metres. Animal handlers should avoid sudden penetration of the flight zone which may cause a panic reaction which could lead to aggression or attempted escape.

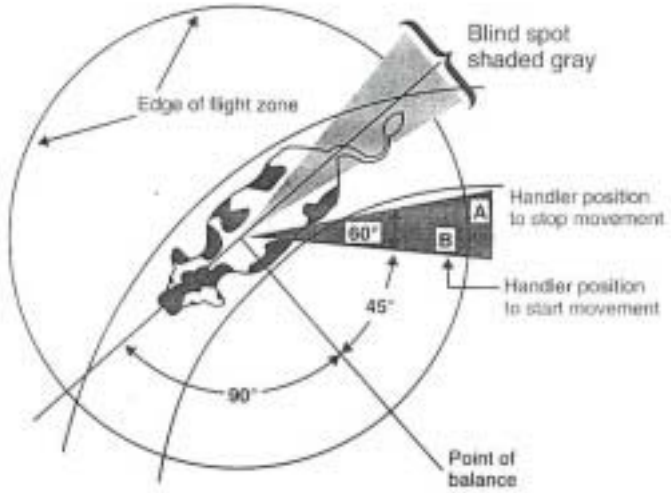
Animal handlers should use the point of balance at an animal's shoulder to move animals, adopting a position behind the point of balance to move an animal forward and in front of the point of balance to move it backward.

Domestic animals have wide-angle vision but only have limited forward binocular vision and poor perception of depth. This means that they can detect objects and movements beside and behind them, but can only judge distances directly ahead.

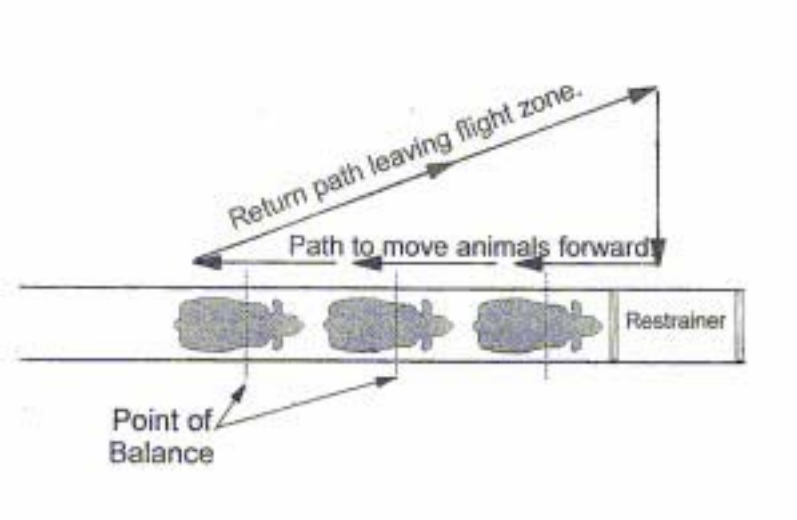
Although all domestic animals have a highly sensitive sense of smell, they react in different ways to the smells of slaughterhouses. Smells which cause fear or other negative responses should be taken into consideration when managing animals.

Domestic animals can hear over a greater range of frequencies than humans and are more sensitive to higher frequencies. They tend to be alarmed by constant loud noise and by sudden noises, which may cause them to panic.

An example of a flight zone (cattle)



Handler movement pattern to move cattle forward



4. Distractions and their removal

Distractions that may cause approaching animals to stop, baulk or turn back should be designed out from new facilities or removed from existing ones. Below are examples of common distractions and methods for eliminating them:

a. reflections on shiny metal or wet floors - move a lamp or change lighting;
b. dark entrances to chutes, races, stun boxes or conveyor restrainers - illuminate with indirect lighting which does not shine directly into the eyes of approaching animals;
c. animals seeing moving people or equipment up ahead - install solid sides on chutes and races or install shields;
d. chains or other loose objects hanging in chutes or on fences - remove them;
e. uneven floors or a sudden drop in floor levels at the entrance to conveyor restrainers – avoid uneven floor surfaces or install a solid false floor under the restrainer to provide an illusion of a solid and continuous walking surface;
f. sounds of air hissing from pneumatic equipment - install silencers or use hydraulic equipment;
g. clanging and banging of metal objects - install rubber stops on gates and other devices to reduce metal to metal contact;
h. air currents from fans or air curtains blowing into the face of animals - redirect or reposition equipment.

Article 3.7.5.2.

Moving and handling animals

1. General considerations

The following principles should apply to unloading animals, moving them into lairage pens, out of the lairage pens and up to the slaughter point:

a. The conditions of the animals should be assessed upon their arrival for any animal welfare problems.

b. Injured or sick animals, requiring immediate slaughter, should be killed humanely at the site where they are found.
c. The use of force on animals that have little or no room to move should not occur.
d. The use of instruments which administer electric shocks (e.g. goads and prods) and their power output should be restricted to that necessary to assist movement of the animals. If such use is necessary, it should be limited to the hindquarters of pigs and large ruminants, and never on sensitive areas such as the eyes, mouth, ears, anogenital region or belly. Such instruments should not be used on horses, sheep and goats of any age, or on calves or piglets, nor on animals that have little or no room to move.
e. Performance standards should be established in which numerical scoring is used to evaluate the use of such instruments and to measure the percentage of animals moved with an electric instrument. In properly designed and constructed facilities with competent animal handlers, it should be possible to move 75% or more of the animals without the use of electric instruments.
f. Useful and permitted aids for moving animals include panels, flags, plastic paddles, flappers (a length of cane with a short strap of leather or canvas attached), plastic bags and metallic rattles; they should be used in a manner sufficient to encourage and direct movement of the animals but without physical contact with them.
g. Shouting or yelling at animals to encourage them to move should not occur as such actions may make the animals agitated, leading to crowding or falling.
h. Implements which cause pain and suffering such as large sticks, sticks with sharp ends, metal piping, fencing wire or heavy leather belts should not be used to move animals.
i. Animals should be grasped or lifted in a manner which avoids pain or suffering and physical damage (e.g. bruising, fractures, dislocations). In the case of quadrupeds, manual lifting by a person should only be used in young animals or small species, and in a manner appropriate to the species; grasping or lifting such animals only by their wool, hair, feet, neck, ears or tails causing pain or suffering should not be permitted, except in an emergency where animal welfare or human safety may otherwise be compromised.
j. Conscious animals should not be thrown or dragged.
k. Animals should not be forced to move at a speed greater than their normal walking pace, in order to minimise injury through falling or slipping. Performance standards should be established where numerical scoring of the prevalence of animals slipping or falling is used to evaluate whether animal moving practices and/or facilities should be improved. In properly designed and constructed facilities with competent animal handlers, it should be possible to move 99% of animals without their falling.
l. Animal handlers should not force an animal to walk over the top of other animals.
m. Under no circumstances should animal handlers resort to violent acts to move animals, such as crushing or breaking animals' tails, grasping animals' eyes or pulling them by their ears. Animal handlers should never apply an injurious object or irritant substance to sensitive areas such as eyes, mouth, ears, anogenital region or belly.

2. <u>Provisions relevant to animals delivered in containers</u>

a. Containers in which animals are transported should be handled with care, and should not be thrown, dropped or knocked over. Where possible, they should be loaded and unloaded horizontally and mechanically.
b. Animals delivered in containers with perforated or flexible bottoms should be unloaded with particular care in order to avoid injury. Where appropriate, animals should be unloaded from the containers individually.

c. Animals which have been transported in containers should be slaughtered as soon as possible; mammals and ratites which are not taken directly upon arrival to the place of slaughter should have drinking water available to them from appropriate facilities at all times. Delivery of poultry for slaughter should be scheduled such that they are not deprived of water at the premises for longer than 12 hours. Animals which have not been slaughtered within 12 hours of their arrival should be fed, and should subsequently be given moderate amounts of food at appropriate intervals.

3. Provisions relevant to restraining and containing animals

   a. Provisions relevant to restraining animals for stunning or slaughter without stunning, to help maintain animal welfare, include:
      i. provision of a non-slip floor;
      ii. avoidance of excessive pressure applied by restraining equipment that causes struggling or vocalisation in animals;
      iii. equipment engineered to reduce noise of air hissing and clanging metal;
      iv. absence of sharp edges in restraining equipment that would harm animals;
      v. avoidance of jerking or sudden movement of restraining device.
   b. Methods of restraint causing avoidable suffering, such as the following, should not be used in conscious animals because they cause severe pain and stress:
      i. suspending or hoisting animals (other than poultry) by the feet or legs;
      ii. indiscriminate and inappropriate use of stunning equipment;
      iii. mechanical clamping of an animal's legs or feet (other than shackles used in poultry and ostriches) as the sole method of restraint;
      iv. breaking legs, cutting leg tendons or blinding animals in order to immobilise them;
      v. severing the spinal cord, for example using a puntilla or dagger, to immobilise animals using electric currents to immobilise animals, except for proper stunning.

Article 3.7.5.3.

Lairage design and construction

1. General considerations

The lairage should be designed and constructed to hold an appropriate number of animals in relation to the throughput rate of the slaughterhouse without compromising the welfare of the animals.

In order to permit operations to be conducted as smoothly and efficiently as possible without injury or undue stress to the animals, the lairage areas should be designed and constructed so as to allow the animals to move freely in the required direction, using their behavioural characteristics and without undue penetration of their flight zone.

The following guidelines may help to achieve this.

2. Design of lairages
   a. The lairage should be designed to allow a one-way flow of animals from unloading to the point of slaughter, with a minimum of abrupt corners to negotiate.
   b. In red meat slaughterhouses, pens, passageways and races should be arranged in such a way as to permit inspection of animals at any time, and to permit the

removal of sick or injured animals when considered to be appropriate, for which separate appropriate accommodation should be provided.

c. Each animal should have room to stand up and lie down and, when confined in a pen, to turn around. The lairage should have sufficient accommodation for the number of animals intended to be held. Drinking water should always be available to the animals, and the method of delivery should be appropriate to the type of animal held. Troughs should be designed and installed in such a way as to minimise the risk of fouling by faeces, without introducing risk of bruising and injury in animals, and should not hinder the movement of animals.
d. Holding pens should be rectangular rather than square, to allow as many animals as possible to stand or lie down against a wall. Where feed troughs are provided, they should be sufficient in number and feeding space to allow adequate access of all animals to feed. The feed trough should not hinder the movement of animals.
e. Where tethers, ties or individual stalls are used, these should be designed so as not to cause injury or distress especially when the animals are lying down, standing up, drinking and feeding.
f. Passageways and races should be either straight or slightly curved, as appropriate to the animal species. Passageways and races should have solid sides, but when there is a double race, the shared partition should allow adjacent animals to see each other. For pigs and sheep, passageways should be wide enough to enable two or more animals to walk side by side for as long as possible. At the point where passageways are reduced in width, this should be done by a means which prevents excessive bunching of the animals.
g. Animal handlers should be positioned alongside races and passageways on the inside radius of any curve, to take advantage of the natural tendency of animals to circle an intruder. Where one-way gates are used, they should be of a design which avoids bruising. Races should be horizontal but where there is a slope, they should be constructed to allow the free movement of animals without injury.
h. There should be a waiting pen, with a level floor and solid sides, between the holding pens and the race leading to the point of stunning or slaughter, to ensure a steady supply of animals for stunning or slaughter and to avoid having animal handlers trying to rush animals from the holding pens. The waiting pen should preferably be circular, but in any case, so designed that animals cannot be trapped or trampled.
i. Ramps or lifts should be used for loading and unloading of animals where there is a difference in height or a gap between the floor of the vehicle and the unloading area. The ramp should be well drained, non-slippery and adjustable to facilitate easy movement of animals without causing distress or injury.

3. <u>Construction of lairages</u>

a. Lairages should be constructed and maintained so as to provide protection from unfavourable climatic conditions, using strong and resistant materials such as concrete and metal which has been treated to prevent corrosion. Surfaces should be easy to clean. There should be no sharp edges or protuberances which may injure the animals.
b. Floors should be well drained and not slippery; they should not cause injury to the animals' feet. Where necessary, floors should be insulated or provided with appropriate bedding. Drainage grids should be placed at the sides of pens and passageways and not where animals would have to cross them. Discontinuities or changes in floor patterns or texture which could cause baulking in the movement of animals should be avoided.
c. Lairages should be provided with adequate lighting, but care should be taken to avoid harsh lights and shadows, which frighten the animals or affect their movement. The fact that animals will move more readily from a darker area into a

well-lit area might be exploited by providing for lighting that can be regulated accordingly.

d. Lairages should be well ventilated, and the air flow should be arranged so that odours and draughts do not adversely affect the health and welfare of the animals.
e. Care should be taken to protect the animals from excessively or potentially disturbing noises, for example by avoiding the use of noisy hydraulic or pneumatic equipment, and muffling noisy metal equipment by the use of suitable padding, or by minimising the transmission of such noise to the areas where animals are held and slaughtered.
f. Where animals are kept in outdoor lairages without natural shelter or shade, they should be protected from the effects of adverse weather conditions.

Article 3.7.5.4.

Care of animals in lairages

Animals in lairages should be cared for in accordance with the following guidelines:

1. As far as possible, established groups of animals should be kept together. Each animal should have enough space to stand up, lie down and turn around. Animals hostile to each other should be separated.
2. Where tethers, ties or individual stalls are used, they should allow animals to stand up and lie down without causing injury or distress.
3. Where bedding is provided, it should be maintained in a condition that minimises risks to the health and safety of the animals, and sufficient bedding should be used so that animals do not become soiled with manure.
4. Animals should be kept securely in the lairage, and care should be taken to prevent them from escaping and from predators.
5. Suitable drinking water should be available to the animals on their arrival and at all times to animals in lairages unless they are to be slaughtered without delay.
6. If animals are not to be slaughtered as soon as possible, suitable feed should be available to the animals on arrival and at intervals appropriate to the species. Unweaned animals should be slaughtered as soon as possible.
7. In order to prevent heat stress, animals subjected to high temperatures, particularly pigs and poultry, should be cooled by the use of water sprays, fans or other suitable means.
8. The lairage area should be well lit in order to enable the animals to see clearly without being dazzled. During the night, the lights should be dimmed.
9. The condition and state of health of the animals in a lairage should be inspected at least every morning and evening by a veterinarian or, under the latter's responsibility, by another competent person. Animals which are sick, weak, injured or showing visible signs of distress should be treated or humanely killed immediately.
10. Lactating dairy animals should be slaughtered as soon as possible. Dairy animals with obvious udder distension should be milked to minimise udder discomfort.
11. Pregnant animals giving birth during the journey or in the lairage should be slaughtered as soon as possible or provided with conditions which are appropriate for suckling and the welfare of the newborn.
12. Animals with horns or tusks capable of injuring other animals, if aggressive, should be penned separately.

Recommendations for specific species are described in detail in Articles 3.7.5.5. to 3.7.5.8.

Article 3.7.5.5.

Management of foetuses during slaughter of pregnant animals (under study)

The welfare of foetuses during slaughter of pregnant animals needs to be safeguarded.

Foetuses should not be removed from the uterus sooner than 5 minutes after the maternal neck or chest cut, to ensure absence of consciousness. A foetal heartbeat will usually still be present and foetal movements may occur at this stage, but these are only a cause for concern if the exposed foetus successfully breathes air.

If a live mature foetus is removed from the uterus, it should be prevented from inflating its lungs and breathing air (e.g. by clamping the trachea).

When uterine, placental or foetal tissues, including foetal blood, are not to be collected as part of the post-slaughter processing of pregnant animals, all foetuses should be left inside the unopened uterus until they are dead. When uterine, placental or foetal tissues are to be collected, where practical, foetuses should not be removed from the uterus until at least 15-20 minutes after the maternal neck or chest cut.

If there is any doubt about consciousness, the foetus should be killed with a captive bolt or a blow to the head with a suitable blunt instrument.

The above guidelines do not refer to foetal rescue. Foetal rescue, the practice of attempting to revive foetuses found alive at evisceration of the dam, should not be attempted during normal commercial slaughter as it may lead to serious welfare complications in the newborn animal. These include impaired brain function resulting from oxygen shortage before rescue is completed, compromised breathing and body heat production because of foetal immaturity, and an increased incidence of infections due to a lack of colostrum.

Article 3.7.5.6.

Summary of acceptable handling and restraining methods and the associated animal welfare issues

Summary of acceptable handling and restraining methods

	Presentation of animals	**Specific procedure**	**Specific purpose**	**Animal welfare concerns/ implications**	**Key animal welfare requirements**	**Applicable species**
No restraint	Animals are grouped	Group container	Gas stunning	Specific procedure is suitable only for gas stunning	Competent animal handlers in lairage; facilities; stocking density	Pigs, poultry
		In the field	Free bullet	Shooting distance, calibre and ballistics	Operator competence	Deer

		Group stunning pen	Head-only electrical Captive bolt	Uncontrolled movement of animals impedes use of hand operated electrical and mechanical stunning methods	Competent animal handlers in lairage and at stunning point	Pigs, sheep, goats, calves
	Individual animal confinement	Stunning pen/box	Electrical and mechanical stunning methods	Loading of animal; accuracy of stunning method, slippery floor and animal falling down	Competent animal handlers	Cattle, buffalo, sheep, goats, horses, pigs, deer, camelids, ratites
Restraining methods	Head restraint, upright	Halter/ head collar/bridle	Captive bolt Free bullet	Suitable for halter-trained animals; stress in untrained animals	Competent animal handlers	Cattle, buffalo, horses, camelids
Restraining methods (contd)	Head restraint, upright	Neck yoke	Captive bolt Electrical-head only Free bullet Slaughter without stunning	Stress of loading and neck capture; stress of prolonged restraint, horn configuration; unsuitable for fast line speeds, animals struggling and falling due to slippery floor, excessive pressure	Equipment; competent animal handlers, prompt stunning or slaughter	Cattle
	Leg restraint	Single leg tied in flexion (animal standing on 3 legs)	Captive bolt Free bullet	Ineffective control of animal movement, misdirected shots	Competent animal handler	Breeding pigs (boars and sows)
	Upright restraint	Beak holding	Captive bolt Electrical-head only	Stress of capture	Sufficient competent animal handlers	Ostriches
		Head restraint in	Electrical-head	Stress of capture and	Competent animal	Ostriches

		electrical stunning box	only	positioning	handler	
	Holding body upright-manual	Manual restraint	Captive bolt Electrical-head only Slaughter without stunning	Stress of capture and restraint; accuracy of stunning/ slaughter	Competent animal handlers	Sheep, goats, calves, ratites, small camelids, poultry
	Holding body upright mechanical	Mechanical clamp / crush / squeeze/ V-restrainer (static)	Captive bolt Electrical methods Slaughter without stunning	Loading of animal and overriding; excessive pressure	Proper design and operation of equipment	Cattle, buffalo, sheep, goats, deer, pigs, ostriches
	Lateral restraint – manual or mechanical	Restrainer/ cradle/cratch	Slaughter without stunning	Stress of restraint	Competent animal handlers	Sheep, goats, calves, camelids, cattle
Restraining methods (contd)	Upright restraint mechanical	Mechanical straddle (static)	Slaughter without stunning Electrical methods Captive bolt	Loading of animal and overriding	Competent animal handlers	Cattle, sheep, goats, pigs
	Upright restraint – manual or mechanical	Wing shackling	Electrical	Excessive tension applied prior to stunning	Competent animal handlers	Ostriches
Restraining and /or conveying methods	Mechanical - upright	V-restrainer	Electrical methods Captive bolt Slaughter without stunning	Loading of animal and overriding; excessive pressure, size mismatch between restrainer and animal	Proper design and operation of equipment	Cattle, calves, sheep, goats, pigs
	Mechanical-upright	Mechanical straddle – band restrainer (moving)	Electrical methods Captive bolt Slaughter without stunning	Loading of animal and overriding, size mismatch between restrainer and animal	Competent animal handlers, proper design and layout of restraint	Cattle, calves, sheep, goats, pigs
	Mechanical - upright	Flat bed/deck Tipped out of containers on to conveyors	Presentation of birds for shackling prior to	Stress and injury due to tipping in dump-module	Proper design and operation of equipment	Poultry

			electrical stunning Gas stunning	systems height of tipping conscious poultry broken bones and dislocations		
	Suspension and/or inversion	Poultry shackle	Electrical stunning Slaughter without stunning	Inversion stress; pain from compression on leg bones	Competent animal handlers; proper design and operation of equipment	Poultry
Restraining and /or conveying methods (contd)	Suspension and/or inversion	Cone	Electrical – head-only Captive bolt Slaughter without stunning	Inversion stress	Competent animal handlers; proper design and operation of equipment	Poultry
	Upright restraint	Mechanical leg clamping	Electrical – head-only	Stress of resisting restraint in ostriches	Competent animal handlers; proper equipment design and operation	Ostriches
Restraining by inversion	Rotating box	Fixed side(s) (e.g. Weinberg)	Slaughter without stunning	Inversion stress; stress of resisting restraint, prolonged restraint Keep restraint as brief as possible	Proper design and operation of equipment	Cattle
		Compressible side(s)	Slaughter without stunning	Inversion stress, stress of resisting restraint, prolonged restraint Preferable to rotating box with fixed sides Keep restraint as brief as possible	Proper design and operation of equipment	Cattle

Body restraint	Casting/ hobbling	Manual	Mechanical stunning methods Slaughter without stunning	Stress of resisting restraint; animal temperament; bruising. Keep restraint as short as possible	Competent animal handlers	Sheep, goats, calves, small camelids, pigs
Leg restraints		Rope casting	Mechanical stunning methods Slaughter without stunning	Stress of resisting restraint; prolonged restraint, animal temperament; bruising Keep restraint as short as possible	Competent animal handlers	Cattle, camelids
		Tying of 3 or 4 legs	Mechanical stunning methods Slaughter without stunning	Stress of resisting restraint; prolonged restraint, animal temperament; bruising Keep restraint as short as possible	Competent animal handlers	Sheep, goats, small camelids, pigs

Article 3.7.5.7.

Stunning methods

1. General considerations

   The competence of the operators, and the appropriateness and effectiveness of the method used for stunning are the responsibility of the management of the slaughterhouse, and should be checked regularly by a *Competent Authority*.

   Persons carrying out stunning should be properly trained and competent, and should ensure that:

   a. the animal is adequately restrained;
   b. animals in restraint are stunned as soon as possible;
   c. the equipment used for stunning is maintained and operated properly in accordance with the manufacturer's recommendations, in particular with regard to the species and size of the animal;

d. the instrument is applied correctly;
e. stunned animals are bled out (slaughtered) as soon as possible;
f. animals are not stunned when slaughter is likely to be delayed.

In addition, such persons should be able to recognise when an animal is not correctly stunned and should take appropriate action.

2. Mechanical stunning

Cattle

The optimum position for cattle is at the intersection of two imaginary lines drawn from the rear of the eyes to the opposite horn buds.

Pigs

The optimum position for pigs is just above the eyes and directing the shot down the line of the spinal cord.

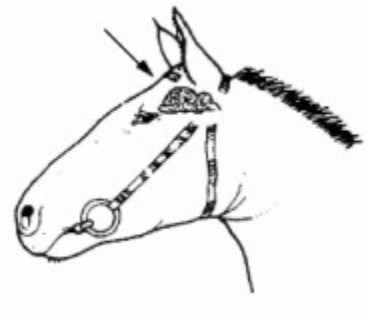
Sheep

The optimum position for hornless sheep and goats is on the midline, just above the eyes and directing the shot down the line of the spinal cord.

Goats

The optimum position for heavily horned sheep and horned goats is behind the poll, aiming towards the angle of the jaw.

Horses



Place the muzzle at right angles to the frontal surface well above the point where imaginary lines from eye to ear cross.

Signs of correct stunning using a mechanical instrument are as follows:

a. the animal collapses immediately and does not attempt to stand up;
b. the body and muscles of the animal become tonic (rigid) immediately after the shot;
c. normal rhythmic breathing stops; and
d. the eyelid is open with the eyeball facing straight ahead and is not rotated.

3. <u>Electrical stunning</u>
    a. General considerations

        An electrical device should be applied to the animal in accordance with the following guidelines.

        Electrodes should be designed, constructed, maintained and cleaned regularly to ensure that the flow of current is optimal and in accordance to manufacturing specification. They should be placed so that they span the brain. The application of electrical currents which bypass the brain is unacceptable unless the animal has been stunned. The use of a single current leg-to-leg is unacceptable as a stunning method.

        If, in addition, it is intended to cause cardiac arrest, the electrodes should either span the brain and immediately thereafter the heart, on the condition that it has been ascertained that the animal is adequately stunned, or span brain and heart simultaneously.

Electrical stunning equipment should not be applied on animals as a means of guidance, movement, restraint or immobilisation, and shall not deliver any shock to the animal before the actual stunning or killing.

Electrical stunning apparatus should be tested prior to application on animals using appropriate resistors or dummy loads to ensure the power output is adequate to stun animals.

The apparatus should incorporate a device which monitors and displays stunning current delivered to the animals.

Appropriate measures, such as removing excess wool or wetting the skin only at the point of contact, can be taken to minimise impedance of the skin and facilitate effective stunning.

The stunning apparatus required for electrical stunning should be provided with adequate power to achieve continuously the minimum current level recommended for stunning as indicate in the table below.

Species	Minimum current levels
Cattle	1.5 amps
Calves	1.0 amps
Pigs	1.25 amps
Sheep and goats	1.0 amps
Ostriches	0.4 amps

In all cases, the correct current level shall be attained within one second of the initiation of stun and maintained at least for between one and three seconds and in accordance with the manufacturer's instructions.

b. Electrical stunning of birds using a waterbath

In the case of birds suspended on a moving line, measures should be taken to ensure that the birds are not wing flapping at the entrance of the stunner. The birds should be secure in their shackle, but there should not be undue pressure on their shanks.

Waterbaths for poultry should be adequate in size and depth for the type of bird being slaughtered, and their height should be adjustable to allow for the head of each bird to be immersed. The electrode immersed in the bath should extend the full length of the waterbath. Birds should be immersed in the bath up to the base of their wings.

The waterbath should be designed and maintained in such a way that when the shackles pass over the water, they are in continuous contact with the earthed rubbing bar.

The control box for the waterbath stunner should incorporate an ammeter which displays the total current flowing through the birds.

The shackle-to-leg contact should be wetted preferably before the birds are inserted in the shackles. In order to improve electrical conductivity of the water it is recommended that salt be added in the waterbath as necessary.

Using waterbaths, birds are stunned in groups and different birds will have different impedances. The voltage should be adjusted so that the total current is the required current per bird as shown in the table hereafter, multiplied by the number of birds in the waterbath at the same time. The following values have been found to be satisfactory when employing a 50 Hertz sinusoidal alternating current.

Birds should receive the current for at least 4 seconds.

Species	Current (milliamperes per bird)
Broilers	120
Layers (spent hens)	120
Turkeys	150
Ducks and Geese	130

While a lower current may also be satisfactory, the current shall in any case be such as to ensure that unconsciousness occurs immediately and lasts until the bird has been killed by cardiac arrest or by bleeding. When higher electrical frequencies are used, higher currents may be required.

Every effort shall be made to ensure that no conscious or live birds enter the scalding tank.

In the case of automatic systems, until fail-safe systems of stunning and bleeding have been introduced, a manual back-up system should be in place to ensure that any birds which have missed the waterbath stunner and/or the automatic neck-cutter are immediately stunned and/or killed immediately, and they are dead before entering scald tank.

To lessen the number of unstunned birds, reaching neck cutters, steps should be taken to ensure that small birds do not go on the line amongst bigger birds and that these small birds are stunned separately.

4. Gas stunning
    a. Stunning of pigs by exposure to carbon dioxide (CO_2)

The concentration of CO_2 for stunning should be preferably 90% by volume but in any case no less than 80% by volume. After entering the stunning chamber, the animals should be conveyed to the point of maximum concentration of the gas and be kept until they are dead or brought into a state of insensibility which lasts

until death occur due to bleeding. Ideally, pigs should be exposed to this concentration of CO_2 for 3 minutes.

In any case, the concentration of the gas should be such that it minimises as far as possible all stress of the animal prior to loss of consciousness.

The chamber in which animals are exposed to CO_2 and the equipment used for conveying them through it shall be designed, constructed and maintained in such a way as to avoid injury or unnecessary stress to the animals. The animal density within the chamber should be such to avoid stacking animals on top of each others.

The conveyor and the chamber shall be adequately lit to allow the animals to see their surroundings and, if possible, each other.

It should be possible to inspect the CO_2 chamber whilst it is in use, and to have access to the animals in emergency cases.

The chamber shall be equipped to continuously measure and display register at the point of stunning the CO_2 concentration and the time of exposure, and to give a clearly visible and audible warning if the concentration of CO_2 falls below the required level.

b. Inert gas mixtures for stunning pigs (under study)

Inhalation of high concentration of carbon dioxide is aversive and can be distressing to animals. Therefore, the use of non-aversive gas mixtures is being developed.

Such gas mixtures include:

i. a maximum of 2% by volume of oxygen in argon, nitrogen or other inert gases, or
ii. to a maximum of 30% by volume of carbon dioxide and a maximum of 2% by volume of oxygen in mixtures with carbon dioxide and argon, nitrogen or other inert gases.

Exposure time to the gas mixtures should be sufficient to ensure that no pigs regain consciousness before death supervenes through bleeding or cardiac arrest is induced.

c. Gas stunning of poultry

The main objective of gas stunning is to avoid the pain and suffering associated with shackling conscious poultry under water bath stunning and killing systems. Therefore, gas stunning should be limited to birds contained in crates or on conveyors only. The gas mixture should be non-aversive to poultry.

Gas stunning of poultry in their transport containers will eliminate the need for live bird handling at the processing plant and all the problems associated with the electrical stunning. Gas stunning of poultry on a conveyor eliminates the problems associated with the electrical water bath stunning.

Live poultry should be conveyed into the gas mixtures either in transport crates or on conveyor belts.

i. Gas mixtures used for stunning poultry include:

- minimum of 2 minutes exposure to 40% carbon dioxide, 30% oxygen and 30% nitrogen, followed by a minimum of one minute exposure to 80% carbon dioxide in air; or
- minimum of 2 minutes exposure to any mixture of argon, nitrogen or other inert gases with atmospheric air and carbon dioxide, provided that the carbon dioxide concentration does not exceed 30% by volume and the residual oxygen concentration does not exceed 2% by volume; or
- minimum of 2 minutes exposure to argon, nitrogen, other inert gases or any mixture of these gases in atmospheric air with a maximum of 2% residual oxygen by volume; or
- minimum of 2 minutes exposure to a minimum of 55% carbon dioxide in air.

ii. Requirements for effective use are as follows:

- compressed gases should be vaporised prior to administration into the chamber;
- under no circumstances, should solid gases with freezing temperatures enter the chamber;
- gas mixtures should be humidified;
- appropriate gas concentrations should be monitored and displayed continuously at the level of the birds inside the chamber.

Under no circumstances, should birds exposed to gas mixtures be allowed to regain consciousness. If necessary, the exposure time should be extended.

5. Bleeding

From the point of view of animal welfare, animals which are stunned with a reversible method should be bled without delay and in any case within the following time limits:

Stunning method	**Maximum delay for bleeding to be started**
Electrical methods and non penetrating bolt	20 seconds
CO_2	60 seconds (after leaving the chamber)

All animals should be bled by incising both carotid arteries, or the vessels from which they arise (e.g. chest stick). However, when the stunning method used causes cardiac arrest, the incision of all of these vessels is not necessary from the point of animal welfare.

It should be possible for staff to observe, inspect and access the animals throughout the bleeding period. Any animal showing signs of recovering consciousness should be restunned.

After incision of the blood vessels, no scalding carcass treatment or dressing procedures should be performed on the animals for at least 30 seconds, or in any case until all brain-stem reflexes have ceased.

Article 3.7.5.8.

Summary of acceptable stunning methods and the associated animal welfare issues

Summary of acceptable stunning methods

Method	Specific method	Animal welfare concerns/ implications	Key animal welfare requirements applicable	Species	Comment
Mechanical	Free bullet	Inaccurate targeting and inappropriate ballistics	Accuracy; head shots only correct ballistics	Cattle, calves, buffalo, deer, horses, pigs (boars and sows)	Personnel safety
	Captive bolt - penetrating	Inaccurate targeting, velocity and diameter of bolt	Competent operation and maintenance of equipment; restraint; accuracy	Cattle, calves, buffalo, sheep, goats, deer, horses, pigs, camelids, ratites	(Unsuitable for specimen collection from TSE suspects). A back-up gun should be available in the event of an ineffective shot
	Captive bolt - non-penetrating	Inaccurate targeting, velocity of bolt, potentially higher failure rate than penetrating captive bolt	Competent operation and maintenance of equipment; restraint; accuracy	Cattle, calves, sheep, goats, deer, pigs, camelids, ratites	Presently available devices are not recommended for young bulls and animals with thick skull
	Manual percussive blow	Inaccurate targeting; insufficient power; size of instrument	Competent animal handlers; restraint; accuracy. Not recommended for general use	Young and small mammals, ostriches and poultry	Mechanical devices potentially more reliable. Where manual percussive blow is used, unconsciousness should be achieved with single sharp blow delivered to central skull bones
Electrical	Split application: 1. across head then head to chest; 2. across head then	Accidental pre-stun electric shocks; electrode positioning; application of a current to the body while animal	Competent operation and maintenance of equipment; restraint; accuracy	Cattle, calves, sheep, goats and pigs, ratites and poultry	Systems involving repeated application of head-only or head-to-leg with short current durations (<1 second) in the first application should

	across chest	conscious; inadequate current and voltage			not be used. Where cardiac arrest occurs, the carcass may not be suitable for Halal slaughter
	Single application: 1. head only; 2. head to body; 3. head to leg	Accidental pre-stun electric shocks; inadequate current and voltage; wrong electrode positioning; recovery of consciousness	Competent operation and maintenance of equipment; restraint; accuracy	Cattle, calves, sheep, goats, pigs, ratites, poultry	Where cardiac arrest occurs, the carcass may not be suitable for Halal slaughter
	Waterbath	Restraint, accidental pre-stun electric shocks; inadequate current and voltage; recovery of consciousness	Competent operation and maintenance of equipment	Poultry only	Where cardiac arrest occurs, the carcass may not be suitable for Halal slaughter
Gaseous	CO_2 air/O_2 mixture; CO_2 inert gas mixture	Aversiveness of high CO_2; respiratory distress; inadequate exposure	Concentration; duration of exposure; design, maintenance and operation of equipment; stocking density management	Pigs, poultry	Gaseous methods may not be suitable for Halal slaughter
Gaseous (contd)	Inert gases	Recovery of consciousness	Concentration; duration of exposure; design, maintenance and operation of equipment; stocking density management	Pigs, poultry	Gaseous methods may not be suitable for Halal slaughter

Article 3.7.5.9.

Summary of acceptable slaughter methods and the associated animal welfare issues

Summary of acceptable slaughter methods

Slaughter methods	Specific method	Animal welfare concerns/ implications	Key requirements	Species	Comments
Bleeding out by severance of blood vessels in the neck without stunning	Full frontal cutting across the throat	Failure to cut both common carotid arteries; occlusion of cut arteries	A very sharp blade or knife, of sufficient length so that the point of the knife remains outside the incision during the cut; the point of the knife should not be used to make the incision. An incision which does not close over the knife during the throat cut.	Cattle, buffalo, horses, camelids, sheep, goats, poultry, ratites	This method is applicable to Halal and Kosher slaughter for relevant species
Bleeding with prior stunning	Neck stab followed by forward cut	Ineffective stunning; failure to cut both common carotid arteries; impaired blood flow; delay in cutting after reversible stunning	Prompt and accurate cutting	Camelids, sheep, goats, poultry, ratites	
Bleeding with prior stunning (contd)	Neck stab alone	Ineffective stunning; failure to cut both common carotid arteries; impaired blood flow; delay in cutting after reversible stunning	Prompt and accurate cutting	Camelids, sheep, goats, poultry, ratites	
	Chest stick into major arteries or hollow-tube knife into	Ineffective stunning; Inadequate size of stick wound inadequate	Prompt and accurate sticking	Cattle, sheep, goats, pigs	

	heart	length of sticking knife; delay in sticking after reversible stunning			
	Neck skin cut followed by severance of vessels in the neck	Ineffective stunning; Inadequate size of stick wound; Inadequate length of sticking knife; delay in sticking after reversible stunning	Prompt and accurate cutting of vessels	Cattle	
	Automated mechanical cutting	Ineffective stunning; failure to cut and misplaced cuts. Recovery of consciousness following reversible stunning systems	Design, maintenance and operation of equipment; accuracy of cut; manual back-up	Poultry only	
	Manual neck cut on one side	Ineffective stunning; recovery of consciousness following reversible stunning systems	Prior non-reversible stunning	Poultry only	N.B. slow induction of unconsciousness under slaughter without stunning
Bleeding with prior stunning (contd)	Oral cut	Ineffective stunning; recovery of consciousness following reversible stunning systems	Prior non-reversible stunning	Poultry only	N.B. slow induction of unconsciousness in non-stun systems
Other methods without stunning	Decapitation with a sharp knife	Pain due to loss of consciousness not being immediate		Sheep, goats, poultry	This method is only applicable to Jhatka slaughter
	Manual neck dislocation and decapitation	Pain due to loss of consciousness not being immediate; difficult to achieve in large	Neck dislocation should be performed in one stretch to sever the spinal cord	Poultry only	Slaughter by neck dislocation should be performed in one stretch to sever the spinal cord

		birds			
Cardiac arrest in a waterbath electric stunner	Bleeding by evisceration		Induction of cardiac arrest	Quail	
	Bleeding by neck cutting			Poultry	

Article 3.7.5.10.

Methods, procedures or practices unacceptable on animal welfare grounds

1. The restraining methods which work through immobilisation by injury such as ‘puntilla’, breaking legs and ‘leg tendon cutting’, cause severe pain and stress in animals. Those methods are not acceptable in any species.
2. The use of the electrical stunning method with a single application leg to leg is ineffective and unacceptable in any species, as it is likely to be painful. The animal welfare concerns are:
    a. accidental pre-stun electric shocks;
    b. inadequate current and voltage;
    c. wrong electrode positioning;
    d. recovery of consciousness.
3. The slaughter method of brain stem severance by piercing through the eye socket or skull bone is not acceptable in any species.

OIE World Organisation for Animal Health: International Animal Health Code - 2006

GUIDELINES FOR THE KILLING OF ANIMALS FOR DISEASE CONTROL PURPOSES

Article 3.7.6.1.

General principles

This Appendix is based on the premise that a decision to kill the animals has been made.

1. All personnel involved in the humane killing of animals should have the relevant skills and competencies.
2. As necessary, operational procedures should be adapted to the specific circumstances operating on the premises and should address, apart from animal welfare, operator safety, biosecurity and environmental aspects.
3. Following the decision to kill the animals, killing should be carried out as quickly as possible and normal husbandry should be maintained until the animals are killed.
4. The handling and movement of animals should be minimised and when done, it should be done in accordance with the guidelines described below.
5. Animal restraint should be sufficient to facilitate effective killing, and in accordance with animal welfare and operator safety requirements; when restraint is required, killing should follow with minimal delay.
6. When animals are killed for disease control purposes, methods used should result in immediate death or immediate loss of consciousness lasting until death; when loss of consciousness is not immediate, induction of unconsciousness should be non-aversive and should not cause anxiety, pain, distress or suffering in the animals.
7. For animal welfare considerations, young animals should be killed before older animals; for biosecurity considerations, infected animals should be killed first, followed by in-contact animals, and then the remaining animals.
8. There should be continuous monitoring of the procedures to ensure they are consistently effective with regard to animal welfare, operator safety and biosecurity.
9. When the operational procedures are concluded, there should be a written report describing the practices adopted and their effect on animal welfare, operator safety and biosecurity.
10. To the extent possible to minimise public distress, killing of animals and carcass disposal should be carried out away from public view.
11. These general principles should also apply when animals need to be killed for other purposes such as after natural disasters.

Article 3.7.6.2.

Organisational structure

Disease control contingency plans should be in place at a national level and should contain details of management structure, disease control strategies and operational procedures; animal welfare considerations should be addressed within these disease control contingency plans. The plans should also include a strategy to ensure that an adequate number of personnel trained in the humane killing of animals is available.

Disease control contingency plans should address the animal welfare issues that may result from animal movement controls.

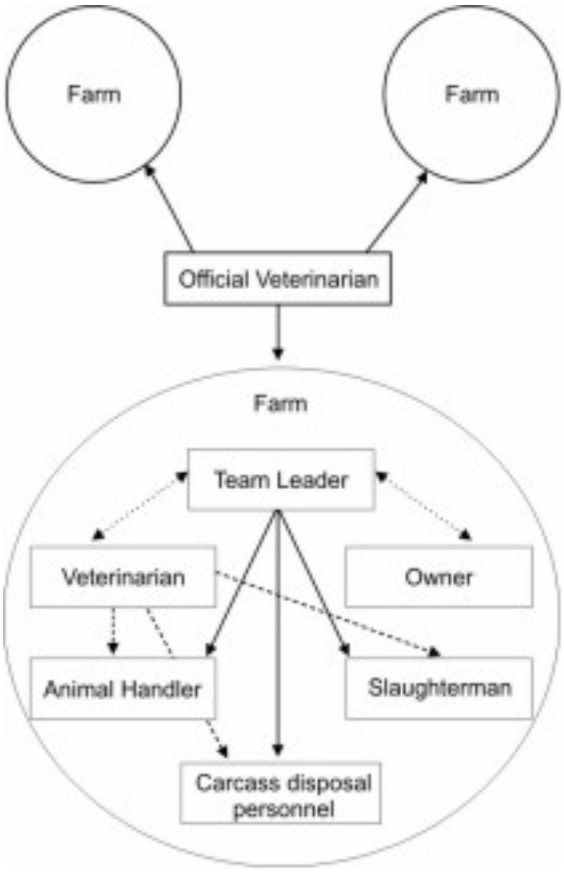
The operational activities should be led by an official veterinarian who has the authority to appoint the personnel in the specialist teams and ensure that they adhere to the required animal welfare and biosecurity standards. When appointing the personnel, he/she should ensure that the personnel involved has the required competencies.

The official veterinarian should be responsible for all activities across one or more affected premises and should be supported by coordinators for planning (including communications), operations and logistics to facilitate efficient operations.

The official veterinarian should provide overall guidance to personnel and logistic support for operations on all affected premises to ensure consistency in adherence to the OIE animal welfare and animal health guidelines.

A specialist team, led by a team leader answerable to the official veterinarian, should be deployed to work on each affected premises. The team should consist of personnel with the competencies to conduct all required operations; in some situations, personnel may be required to fulfil more than one function. Each team should contain a veterinarian.

In considering the animal welfare issues associated with killing animals, the key personnel, their responsibilities and competencies required are described in Article 3.7.6.3.



Article 3.7.6.3.

Responsibilities and competencies of the specialist team

1. Team leader
    a. Responsibilities
        i. plan overall operations on an affected premises;
        ii. determine and address requirements for animal welfare, operator safety and biosecurity;
        iii. organise, brief and manage team of people to facilitate humane killing of the relevant animals on the premises in accordance with national regulations and these guidelines;
        iv. determine logistics required;
        v. monitor operations to ensure animal welfare, operator safety and biosecurity requirements are met;
        vi. report upwards on progress and problems;
        vii. provide a written report at the conclusion of the killing, describing the practices adopted and their effect on animal welfare.
    b. Competencies
        i. appreciation of animal welfare and the underpinning behavioural, anatomical and physiological processes involved in the killing process;
        ii. skills to manage all activities on premises and deliver outcomes on time;
        iii. awareness of psychological effects on farmer, team members and general public;
        iv. effective communication skills.
2. Veterinarian
    a. Responsibilities
        i. determine and implement the most appropriate killing method to ensure that animals are killed without avoidable pain and distress;
        ii. determine and implement the additional requirements for animal welfare, including the order of killing;
        iii. minimise the risk of disease spread within and from the premises through the supervision of biosecurity procedures;
        iv. continuously monitor animal welfare and biosecurity procedures;
        v. in cooperation with the leader, prepare a written report at the conclusion of the killing, describing the practices adopted and their effect on animal welfare.
    b. Competencies
        i. ability to assess animal welfare, especially the effectiveness of stunning and killing and to correct any deficiencies;
        ii. ability to assess biosecurity risks.
3. Animal handlers
    a. Responsibilities
        i. review on-site facilities in terms of their appropriateness;
        ii. design and construct temporary animal handling facilities, when required;
        iii. move and restrain animals.
    b. Competencies

An experience of animal handling in emergency situations and in close confinement is required.

4. Slaughterers
    a. Responsibilities

        A humane killing of animals through effective stunning and killing should be ensured.

    b. Competencies
        i. when required by regulations, licensed to use necessary equipment or licensed to be slaughterers;
        ii. competent to use and maintain relevant equipment;
        iii. competent to use techniques for the species involved;
        iv. competent to assess effective stunning and killing.
5. Carcass disposal personnel
    a. Responsibilities

        An efficient carcass disposal (to ensure killing operations are not hindered) should be ensured.

    b. Competencies

        The personnel should be competent to use and maintain available equipment and apply techniques for the species involved.

6. Farmer/owner/manager
    a. Responsibilities
        i. assist when requested.
    b. Competencies
        i. specific knowledge of his/her animals and their environment.

Article 3.7.6.4.

Considerations in planning the humane killing of animals

Many activities will need to be conducted on affected premises, including the humane killing of animals. The team leader should develop a plan for humanely killing animals on the premises which should include consideration of:

1. minimising handling and movement of animals;
2. killing the animals on the affected premises; however, there may be circumstances where the animals may need to be moved to another location for killing; when the killing is conducted at an abattoir, the guidelines in the Chapter on slaughter of animal for human consumption should be followed;
3. the species, number, age and size of animals to be killed, and the order of killing them;
4. methods of killing the animals, and their cost;
5. housing and location of the animals;
6. the availability and effectiveness of equipment needed for killing of the animals;
7. the facilities available on the premises that will assist with the killing;

8. biosecurity and environmental issues;
9. the health and safety of personnel conducting the killing;
10. any legal issues that may be involved, for example where restricted veterinary drugs or poisons may be used, or where the process may impact on the environment; and
11. the presence of other nearby premises holding animals.

In designing a killing plan, it is essential that the method chosen be consistently reliable to ensure that all animals are humanely and quickly killed.

Article 3.7.6.5.

Table summarising killing methods described in Articles 3.7.6.6.-3.7.6.17.

The methods are described in the order of mechanical, electrical and gaseous, not in an order of desirability from an animal welfare viewpoint.

Summary of killing methods

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Cattle	all	free bullet	no	non-lethal wounding	3.7.6.6.
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning	3.7.6.7.
	adults only	captive bolt - non-penetrating, followed by bleeding	yes	ineffective stunning, regaining of consciousness before killing	3.7.6.8.
	calves only	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	3.7.6.10.
	calves only	electrical, single application (method 1)	yes	ineffective stunning	3.7.6.11.
	all	injection with barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	3.7.6.15.
Sheep and goats	all	free bullet	no	non-lethal wounding	3.7.6.6.
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning, regaining of consciousness before killing	3.7.6.7.
Sheep and goats (contd)	all except neonates	captive bolt - non-penetrating, followed by bleeding	yes	ineffective stunning, regaining of consciousness before killing	3.7.6.8.
	neonates	captive bolt - non-penetrating	yes	non-lethal wounding	3.7.6.8.

	all	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	3.7.6.10.
	all	electrical, single application (method 1)	yes	ineffective stunning	3.7.6.11.
	neonates only	CO_2 / air mixture	yes	slow induction of unconsciousness, aversiveness of induction	3.7.6.12.
	neonates only	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	3.7.6.13.
	neonates only	nitrogen and/or inert gases	yes	nitrogen and/or inert gases	3.7.6.14.
	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	3.7.6.15.
Pigs	all	free bullet	no	no-lethal wounding	3.7.6.6.
	all except neonates	captive bolt - penetrating, followed by pithing or bleeding	yes	ineffective stunning	3.7.6.7.
	neonates only	captive bolt - non-penetrating	yes	non-lethal wounding	3.7.6.8.
	all[1.]	electrical, two stage application	yes	pain associated with cardiac arrest after ineffective stunning	3.7.6.10.
	all	electrical, single application (method 1)	yes	ineffective stunning	3.7.6.11.
Pigs (contd)	neonates only	CO_2 / air mixture	yes	slow induction of unconsciousness, aversiveness of induction	3.7.6.12.
	neonates only	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	3.7.6.13.
	neonates only	nitrogen and/or inert gases	yes	slow induction of unconsciousness,	3.7.6.14.
	all	injection with barbiturates and other	yes	non-lethal dose, pain associated with injection site	3.7.6.15.
Poultry	adults only	captive bolt - non-penetrating	yes	ineffective stunning	3.7.6.8.
	day-olds and eggs only	maceration	no	non-lethal wounding, non- immediacy;	3.7.6.9.
	adults only	electrical, single application (method 2)	yes	ineffective stunning	3.7.6.11.

	adults only	electrical, single application, followed by killing (method 3)	yes	ineffective stunning; regaining of consciousness before killing	3.7.6.11.
	all	CO_2 / air mixture Method 1 Method 2	 yes no	slow induction of unconsciousness, aversiveness of induction	3.7.6.12.
	all	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	3.7.6.13.
	all	nitrogen and/or inert gases	yes	slow induction of unconsciousness	3.7.6.14.
	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	3.7.6.15.
Poultry (contd)	adults only	addition of anaesthetics to feed or water, followed by an appropriate killing method	no	ineffective or slow induction of unconsciousness	3.7.6.16

Article 3.7.6.6.

Free bullet

1. Introduction

    a. A free bullet is a projectile fired from a shotgun, rifle, handgun or purpose-made humane killer.
    b. The most commonly used firearms for close range use are:
        i. humane killers (specially manufactured/adapted single-shot weapons);
        ii. shotguns (12, 16, 20, 28 bore and .410);
        iii. rifles (.22 rimfire);
        iv. handguns (various calibres from .32 to .45).
    c. The most commonly used firearms for long range use are rifles (.22, .243, .270 and .308).
    d. A free bullet used from long range should be aimed to penetrate the skull or soft tissue at the top of the neck of the animal, to cause irreversible concussion and death and should only be used by properly trained and competent marksmen.

2. Requirements for effective use

    a. The marksman should take account of human safety in the area in which he/she is operating.
    b. The marksman should ensure that the animal is not moving and in the correct position to enable accurate targeting and the range should be as short as possible (5 –50 cm for a shotgun) but the barrel should not be in contact with the animal's head.
    c. The correct cartridge, calibre and type of bullet for the different species age and size should be used. Ideally the ammunition should expand upon impact and dissipate its energy within the cranium.
    d. Shot animals should be checked to ensure the absence of brain stem reflexes.

3. Advantages

    a. Used properly, a free bullet provides a quick and effective method for killing.
    b. It requires minimal or no restraint and can be use to kill from a distance.
    c. It is suitable for killing agitated animals in open spaces.

4. Disadvantages

    a. The method is potentially dangerous to humans and other animals in the area.
    b. It has the potential for non-lethal wounding.
    c. Destruction of brain tissue may preclude diagnosis of some diseases.
    d. Leakage of bodily fluids may present a biosecurity risk.
    e. Legal requirements may preclude or restrict use.
    f. There is a limited availability of competent personnel.

5. Conclusions

    The method is suitable for cattle, sheep, goats and pigs, including large animals in open spaces.

Figure 1. The optimum shooting position for cattle is at the intersection of two imaginary lines drawn from the rear of the eyes to the opposite horn buds.

Figure 2. The optimum shooting position for hornless sheep and goats is on the midline, just above the eyes and directing the shot down the line of the spinal cord.

Figure 3. The optimum shooting position for heavily horned sheep and horned goats is behind the poll.

Figure 4. The optimum shooting position for pigs is just above the eyes and directing the shot down the line of the spinal cord.

Article 3.7.6.7.

Penetrating captive bolt

1. Introduction

   A penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

   The captive bolt should be aimed on the skull in a position to penetrate the cortex and mid-brain of the animal. The impact of the bolt on the skull produces unconsciousness. Physical damage to the brain caused by penetration of the bolt may result in death, however pithing or bleeding should be performed as soon as possible after the shot to ensure the death of the animal.

2. Requirements for effective use

   a. For cartridge powered and compressed air guns, the bolt velocity and the length of the bolt should be appropriate to the species and type of animal, in accordance with the manufacturer's recommendations.
   b. Captive bolt guns should be frequently cleaned and maintained in good working condition.
   c. More than one gun may be necessary to avoid overheating and a back-up gun should be available in the event of an ineffective shot.

d. Animals should be restrained; at a minimum they should be penned for cartridge powered guns and in a race for compressed air guns.
e. The operator should ensure that the animal's head is accessible.
f. The operator should fire the captive bolt at right angles to the skull in the optimal position (see figures 1, 3 & 4. The optimum shooting position for hornless sheep is on the highest point of the head, on the midline and aim towards the angle of the jaw).
g. To ensure the death of the animal, pithing or bleeding should be performed as soon as possible after stunning.
h. Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

3. Advantages

a. Mobility of cartridge powered equipment reduces the need to move animals.
b. The method induces an immediate onset of a sustained period of unconsciousness.

4. Disadvantages

a. Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor animal welfare.
b. Post stun convulsions may make pithing difficult and hazardous.
c. The method is difficult to apply in agitated animals.
d. Repeated use of a cartridge powered gun may result in over-heating.
e. Leakage of bodily fluids may present a biosecurity risk.
f. Destruction of brain tissue may preclude diagnosis of some diseases.

5. Conclusions

The method is suitable for cattle, sheep, goats and pigs (except neonates), when followed by pithing.

Article 3.7.6.8.

Captive bolt - non-penetrating

1. Introduction

A non-penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

The gun should be placed on the front of the skull to deliver a percussive blow which produces unconsciousness in cattle (adults only), sheep, goats and pigs, and death in poultry and neonate sheep, goats and pigs. In mammals, bleeding should be performed as soon as possible after the blow to ensure the death of the animal.

2. Requirements for effective use

a. For cartridge powered and compressed air guns, the bolt velocity should be appropriate to the species and type of animal, in accordance with the manufacturer’s recommendations.
b. Captive bolt guns should be frequently cleaned and maintained in good working condition.
c. More than one gun may be necessary to avoid overheating and a back-up gun should be available in the event of an ineffective shot.

d. Animals should be restrained; at a minimum mammals should be penned for cartridge powered guns and in a race for compressed air guns; birds should be restrained in cones, shackles, crushes or by hand
e. The operator should ensure that the animal's head is accessible.
f. The operator should fire the captive bolt at right angles to the skull in the optimal position (figures 1-4).
g. To ensure death in non-neonate mammals, bleeding should be performed as soon as possible after stunning.
h. Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

3. Advantages

a. The method induces an immediate onset of unconsciousness, and death in birds and neonates.
b. Mobility of equipment reduces the need to move animals.

4. Disadvantages

a. As consciousness can be regained quickly in non-neonate mammals, they should be bled as soon as possible after stunning.
b. Laying hens in cages have to be removed from their cages and most birds have to be restrained.
c. Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor animal welfare.
d. Post stun convulsions may make bleeding difficult and hazardous.
e. Difficult to apply in agitated animals; such animals may be sedated in advance of the killing procedure.
f. Repeated use of a cartridge powered gun may result in over-heating.
g. Bleeding may present a biosecurity risk.

5. Conclusions

a. The method is suitable for poultry, and neonate sheep, goats and pigs.
b. If bleeding does not present a biosecurity issue, this is a suitable method for cattle (adults only), and non-neonate sheep, goats and pigs.

Article 3.7.6.9.

Maceration

1. Introduction

Maceration, utilising a mechanical apparatus with rotating blades or projections, causes immediate fragmentation and death in day-old poultry and embryonated eggs.

2. Requirements

a. Maceration requires specialised equipment which should be kept in excellent working order.
b. The rate of introducing the birds should not allow the equipment to jam, birds to rebound from the blades or the birds to suffocate before they are macerated.

3. Advantages

a. Procedure results in immediate death.
b. Large numbers can be killed quickly.

4. Disadvantages

    a. Specialised equipment is required.
    b. Macerated tissues may present a biosecurity issue.

5. Conclusion

The method is suitable for killing day-old poultry and embryonated eggs.

Article 3.7.6.10.

Electrical – two stage application

Figure 5 Scissor-type stunning tongs

Article 3.7.6.11.

Electrical – single application

1. Method 1

Method 1 comprises the single application of sufficient electrical current to the head and back, to simultaneously stun the animal and fibrillate the heart. Provided sufficient current is applied in a position that spans both the brain and heart, the animal will not recover consciousness.

a. Requirements for effective use

    i. The stunner control device should generate a low frequency (30–60 Hz) current with a minimum voltage of 250 volts true RMS under load.
    ii. Appropriate protective clothing (including rubber gloves and boots) should be worn.
    iii. Animals should be individually and mechanically restrained close to an electrical supply as the maintenance of physical contact between the stunning electrodes and the animal is necessary for effective use.
    iv. The rear electrode should be applied to the back, above or behind the heart, and then the front electrode in a position that is forward of the eyes, with current applied for a minimum of 3 seconds.
    v. Electrodes should be cleaned regularly between animals and after use, to enable optimum electrical contact to be maintained.
    vi. Water or saline may be necessary to improve electrical contact with sheep.
    vii. An effective stun and kill should be verified by the absence of brain stem reflexes.

b. Advantages

    i. Method 1 stuns and kills simultaneously.
    ii. It minimises post-stun convulsions and therefore is particularly effective with pigs.
    iii. A single team member only is required for the application.

iv. Non-invasive technique minimises biosecurity risk.

c. Disadvantages

i. Method 1 requires individual mechanical animal restraint.
ii. The electrodes must be applied and maintained in the correct positions to produce an effective stun and kill.
iii. Method 1 requires a reliable supply of electricity.

d. Conclusion

Method 1 is suitable for calves, sheep, goats, and pigs (over one week of age).

2. Method 2

Method 2 stuns and kills by drawing inverted and shackled poultry through an electrified waterbath stunner. Electrical contact is made between the 'live' water and earthed shackle and, when sufficient current is applied, poultry will be simultaneously stunned and killed.

a. Requirements for effective use

i. A mobile waterbath stunner and a short loop of processing line are required.
ii. A low frequency (30-60 Hz) current applied for a minimum of 3 seconds is necessary to stun and kill the birds.
iii. Poultry need to be manually removed from their cage, house or yard, inverted and shackled onto a line which conveys them through a waterbath stunner with their heads fully immersed.
iv. The required minimum currents to stun and kill dry birds are:
- Quail - 100 mA/bird
- Chickens – 160 mA/bird
- Ducks & Geese – 200 mA/bird
- Turkeys – 250 mA/bird.

A higher current is required for wet birds.

v. An effective stun and kill should be verified by the absence of brain stem reflexes.

b. Advantages

i. Method 2 stuns and kills simultaneously.
ii. It is capable of processing large numbers of birds reliably and effectively.
iii. This non-invasive technique minimises biosecurity risk.

c. Disadvantages

i. Method 2 requires a reliable supply of electricity.
ii. Handling, inversion and shackling of birds are required.

d. Conclusion

Method 2 is suitable for large numbers of poultry.

3. Method 3

Method 3 comprises the single application of sufficient electrical current to the head of poultry in a position that spans the brain, causing unconsciousness; this is followed by a killing method (Article 3.7.6.17.).

a. Requirements for effective use

i. The stunner control device should generate sufficient current (more than 300 mA/bird) to stun.
ii. Appropriate protective clothing (including rubber gloves and boots) should be worn.
iii. Birds should be restrained, at a minimum manually, close to an electrical supply.
iv. A stunning current should be applied in a position that spans the brain for a minimum of 3 seconds; immediately following this application, the birds should be killed (Article 3.7.6.17.).
v. Electrodes should be cleaned regularly and after use, to enable optimum electrical contact to be maintained.
vi. Birds should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

b. Advantages

Non-invasive technique (when combined with neck dislocation) minimises biosecurity risk.

c. Disadvantages

i. Method 3 requires a reliable supply of electricity.
ii. The electrodes must be applied and maintained in the correct position to produce an effective stun.

d. Conclusion

Method 3 is suitable for small numbers of poultry.

Article 3.7.6.12.

CO_2 / air mixture

1. Introduction

Controlled atmosphere killing is performed by exposing animals to a predetermined gas mixture, either by placing them in a gas-filled container or apparatus (Method 1) or by the gas being introduced into a poultry house (Method 2).

Inhalation of carbon dioxide (CO_2) induces respiratory and metabolic acidosis and hence reduces the pH of cerebrospinal fluid (CSF) and neurones thereby causing unconsciousness and, after prolonged exposure, death.

2. Method 1

a. Requirements for effective use in a container or apparatus

i. Containers or apparatus should allow the required gas concentration to be maintained and accurately measured.

ii. When animals are exposed to the gas individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
iii. Animals should be introduced into the container or apparatus after it has been filled with the required CO_2 concentration, and held in this atmosphere until death is confirmed.
iv. Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
v. Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

b. Advantages

i. CO_2 is readily available.
ii. Application methods are simple.

c. Disadvantages

i. The need for special equipment
ii. The aversive nature of high CO_2 concentrations
iii. No immediate loss of consciousness
iv. The risk of suffocation due to overcrowding
v. Difficulty in verifying death while the animals are in the container or apparatus.

d. Conclusion

Method 1 is suitable for use in poultry and neonatal sheep, goats and pigs.

3. <u>Method 2</u>

a. Requirements for effective use in a poultry house

i. Prior to introduction of the CO_2, the poultry house should be appropriately sealed to allow control over the gas concentration.
ii. The house should be gradually filled with CO_2 so that all birds are exposed to a concentration of >40% until they are dead; a vaporiser may be required to prevent freezing.
iii. Devices should be used to accurately measure the gas concentration at the highest level of birds.

b. Advantages

i. Applying gas to birds *in situ* eliminates the need to manually remove live birds.
ii. CO_2 is readily available.
iii. Gradual raising of CO_2 concentration minimises the aversiveness of the induction of unconsciousness.

c. Disadvantages

i. It is difficult to determine volume of gas required to achieve adequate concentrations of CO_2 in some poultry houses.
ii. It is difficult to verify death while the birds are in the poultry house.

d. Conclusion

Method 2 is suitable for use in poultry in closed-environment sheds.

Article 3.7.6.13.

Nitrogen and/or inert gas mixed with CO2

1. Introduction

   CO_2 may be mixed in various proportions with nitrogen or an inert gas eg argon, and the inhalation of such mixtures leads to hypercapnic-hypoxia and death when the oxygen concentration by volume is ≤2%. This method involves the introduction of animals into a container or apparatus containing the gases. Such mixtures do not induce immediate loss of consciousness, therefore the aversiveness of various gas mixtures containing high concentrations of CO_2 and the respiratory distress occurring during the induction phase, are important animal welfare considerations.

   Pigs and poultry appear not to find low concentrations of CO_2 strongly aversive, and a mixture of nitrogen or argon with ≤30% CO2 by volume and ≤2% O_2 by volume can be used for killing poultry and neonatal sheep, goats and pigs.

2. Requirements for effective use

   a. Containers or apparatus should allow the required gas concentrations to be maintained, and the O_2 and CO_2 concentrations accurately measured.
   b. When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
   c. Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with ≤2% O_2), and held in this atmosphere until death is confirmed.
   d. Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
   e. Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

3. Advantages

   Low concentrations of CO_2 cause little aversiveness and, in combination with nitrogen or an inert gas, produces a fast induction of unconsciousness.

4. Disadvantages

   a. A properly designed container or apparatus is needed.
   b. It is difficult to verify death while the animals are in the container or apparatus.
   c. There is no immediate loss of consciousness.
   d. Exposure times required to kill are considerable.

5. Conclusion

   The method is suitable for poultry and neonatal sheep, goats and pigs.

Article 3.7.6.14.

Nitrogen and/or inert gases

1. Introduction

   This method involves the introduction of animals into a container or apparatus containing nitrogen or an inert gas such as argon. The controlled atmosphere produced leads to unconsciousness and death from hypoxia.

   Research has shown that hypoxia is not aversive to pigs and poultry, and it doesn't induce any signs of respiratory distress prior to loss of consciousness.

2. Requirements for effective use

   a. Containers or apparatus should allow the required gas concentrations to be maintained, and the O_2 concentration accurately measured.
   b. When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
   c. Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with $\leq$2% O_2), and held in this atmosphere until death is confirmed.
   d. Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
   e. Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

3. Advantages

   Animals are unable to detect nitrogen or inert gases, and the induction of hypoxia by this method is not aversive to animals.

4. Disadvantages

   a. A properly designed container or apparatus is needed.
   b. It is difficult to verify death while the animals are in the container or apparatus.
   c. There is no immediate loss of consciousness.
   d. Exposure times required to kill are considerable.

5. Conclusion

   The method is suitable for poultry and neonatal sheep, goats and pigs.

Article 3.7.6.15.

Lethal injection

1. Introduction

   A lethal injection using high doses of anaesthetic and sedative drugs causes CNS depression, unconsciousness and death. In practice, barbiturates in combination with other drugs are commonly used.

2. Requirements for effective use

   a. Doses and routes of administration that cause rapid loss of consciousness followed by death should be used.
   b. Prior sedation may be necessary for some animals.
   c. Intravenous administration is preferred, but intraperitoneal or intramuscular administration may be appropriate, especially if the agent is non-irritating.
   d. Animals should be restrained to allow effective administration.
   e. Animals should be monitored to ensure the absence of brain stem reflexes.

3. Advantages

   a. The method can be used in all species.
   b. Death can be induced smoothly.

4. Disadvantages

   a. Restraint and/or sedation may be necessary prior to injection.
   b. Some combinations of drug type and route of administration may be painful, and should only be used in unconscious animals.
   c. Legal requirements may restrict use to veterinarians.

5. Conclusion

   The method is suitable for killing small numbers of cattle, sheep, goats, pigs and poultry.

Article 3.7.6.16.

Addition of anaesthetics to feed or water

1. Introduction

   An anaesthetic agent which can be mixed with poultry feed or water may be used to kill poultry in houses. Poultry which are only anaesthetised need to be killed by another method such as cervical dislocation.

2. Requirements for effective use

   a. Sufficient quantities of anaesthetic need to be ingested rapidly for effective response.
   b. Intake of sufficient quantities is facilitated if the birds are fasted or water is withheld.
   c. Must be followed by killing (see Article 3.7.6.17.) if birds are anaesthetised only.

3. Advantages

   a. Handling is not required until birds are anaesthetised.

b. There may be biosecurity advantages in the case of large numbers of diseased birds.

4. Disadvantages

a. Non-target animals may accidentally access the medicated feed or water when provided in an open environment.
b. Dose taken is unable to be regulated and variable results may be obtained.
c. Animals may reject adulterated feed or water due to illness or adverse flavour.
d. The method may need to be followed by killing.
e. Care is essential in the preparation and provision of treated feed or water, and in the disposal of uneaten treated feed/water and contaminated carcasses.

5. Conclusion

The method is suitable for killing large numbers of poultry in houses.

Article 3.7.6.17.

Killing methods in unconscious animals

1. Method 1: Cervical dislocation (manual and mechanical)

a. Introduction

Poultry may be killed by either manual cervical dislocation (stretching) or mechanical neck crushing with a pair of pliers. Both methods result in death from asphyxiation and/or cerebral anoxia.

b. Requirements for effective use

i. Killing should be performed either by manually or mechanically stretching the neck to sever the spinal cord or by using mechanical pliers to crush the cervical vertebrae with consequent major damage to the spinal cord.
ii. Consistent results require strength and skill so team members should be rested regularly to ensure consistently reliable results.
iii. Birds should be monitored continuously until death to ensure the absence of brain stem reflexes.

c. Advantages

i. It is a non-invasive killing method.
ii. It can be performed manually on small birds.

d. Disadvantages

i. Operator fatigue
ii. The method is more difficult in larger birds.

e. Conclusion

This method is suitable for killing unconscious poultry.

2. Method 2: Decapitation

a. Introduction

Decapitation results in death by cerebral ischaemia using a guillotine or knife.

b. Requirements for effective use

The required equipment should be kept in good working order.

c. Advantages

The technique is effective and does not require monitoring.

d. Disadvantages

The working area is contaminated with body fluids.

e. Conclusion

This method is suitable for killing unconscious poultry.

3. Method 3: Pithing

a. Introduction

Pithing is a method of killing animals which have been stunned by a penetrating captive bolt. Pithing results in the physical destruction of the brain and upper regions of the spinal cord, through the insertion of a rod or cane through the bolt hole.

b. Requirements for effective use

i. Pithing cane or rod is required.
ii. An access to the head of the animal and to the brain through the skull is required.
iii. Animals should be monitored continuously until death to ensure the absence of brain stem reflexes.

c. Advantages

The technique is effective in producing immediate death.

d. Disadvantages

i. A delayed and/or ineffective pithing due to convulsions may occur.
ii. The working area is contaminated with body fluids.

e. Conclusion

This method is suitable for killing unconscious animals which have been stunned by a penetrating captive bolt.

4. Method 4: Bleeding

a. Introduction

Bleeding is a method of killing animals through the severance of the major blood vessels in the neck or chest that results in a rapid fall in blood pressure, leading to cerebral ischaemia and death.

b. Requirements for effective use

   i. A sharp knife is required.
   ii. An access to the neck or chest of the animal is required.
   iii. Animals should be monitored continuously until death to ensure the absence of brain stem reflexes.

c. Advantages

   The technique is effective in producing death after an effective stunning method which does not permit pithing.

d. Disadvantages

   i. A delayed and/or ineffective bleeding due to convulsions may occur.
   ii. The working area is contaminated with body fluids.

e. Conclusion

   This method is suitable for killing unconscious animals.

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1. The only preclusion against the use of this method for neonates is the design of the stunning tongs that may not facilitate their application across such a small-sized head/body.

Directive

Directive

Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing

COUNCIL DIRECTIVE 93/119/EC

of 22 December 1993
on the protection of animals at the time of slaughter or killing

THE COUNCIL OF THE EUROPEAN UNION

Having regard to the Treaty establishing the European Community, and in particular Article 43 thereof,

Having regard to the proposal from the Commission (1),

Having regard to the opinion of the European Parliament (2),

Having regard to the opinion of the Economic and Social Committee (3),

Whereas Council Directive 74/577/EEC (4) established rules on the stunning of animals before slaughter;

Whereas the European Convention for the Protection of Animals for Slaughter was approved on behalf of the Community by Council Decision 88/306/EEC (5); whereas the scope of the Convention is wider than existing Community rules on the matter;

Whereas national laws concerning the protection of animals at the time of slaughter or killing have an impact on the conditions of competition and accordingly on the operation of the common market in agricultural products;

Whereas there is therefore a need to establish common minimum standards for the protection of animals at the time of slaughter or killing in order to ensure rational development of production and to facilitate the completion of the internal market in animals and animal products;

Whereas at the time of slaughter or killing animals should be spared any avoidable pain or suffering;

Whereas, however, it is necessary to allow for technical and scientific experiments to be carried out and to take account of the particular requirements of certain religious rites;

Whereas the rules should also ensure satisfactory protection, at the time of slaughter or killing, for animals not covered by the Convention;

Whereas in the declaration on the protection of animals annexed to the Final Act of the Treaty on European Union, the Conference calls upon the European Parliament, the Council and the Commission, as well as the Member States, when drafting and implementing Community legislation on the common agricultural policy, to pay full regard to the welfare requirements of animals;

Whereas in so doing Community action must comply with the requirements arising out of the principle of subsidiarity laid down in Article 3b of the Treaty;

Whereas Directive 74/577/EEC should be repealed,

HAS ADOPTED THIS DIRECTIVE:

CHAPTER I General provisions

Article 1

1. This Directive shall apply to the movement, lairaging, restraint, stunning, slaughter and killing of animals bred and kept for the production of meat, skin, fur or other products and to methods of killing animals for the purpose of disease control.

2. It shall not apply to:

- technical or scientific experiments relating to the procedures mentioned in paragraph 1, carried out under the supervision of the competent authority,
- animals which are killed in cultural or sports events,
- wild game killed in accordance with Article 3 of Directive 92/45/EEC.

Article 2

For the purposes of this Directive the following definitions shall apply:

1. slaughterhouse: any premises, including facilities for moving or lairaging animals, used for the commercial slaughter of animals referred to in Article 5 (1);

2. movement: unloading of animals or driving of them from unloading platforms, stalls or pens at slaughterhouses to the premises or place where they are to be slaughtered;

3. lairaging: keeping animals in stalls, pens, covered areas or fields used by slaughterhouses in order to give them any necessary attention (water, fodder, rest) before they are slaughtered;

4. restraint: the application to an animal of any procedure designed to restrict its movements in order to facilitate effective stunning or killing;

5. stunning: any process which, when applied to an animal, causes immediate loss of consciousness which lasts until death;

6. killing: any process which causes the death of an animal;

7. slaughter: causing the death of an animal by bleeding;

8. competent authority: the central authority of a Member State competent to carry out veterinary checks or any authority to which it has delegated that competence.

However, in the Member States, the religious authority on whose behalf slaughter is carried out shall be competent for the application and monitoring of the special provisions which apply to slaughter according to certain religious rites. As regards the said provisions, that authority shall operate under the responsibility of the official veterinarian, as defined in Article 2 of Directive 64/433/EEC.

Article 3

Animals shall be spared any avoidable excitement, pain or suffering during movement, lairaging, restraint, stunning, slaughter or killing.

CHAPTER II Requirements applicable to slaughterhouses

Article 4

The construction, facilities and equipment of slaughterhouses, and their operation, shall be such as to spare animals any avoidable excitement, pain or suffering.

Article 5

1. Solipeds, ruminants, pigs, rabbits and poultry brought into slaughterhouses for slaughter shall be:

(a) moved and if necessary lairaged in accordance with the provisions of Annex A;

(b) restrained in accordance with the provisions of Annex B;

(c) stunned before slaughter or killed instantaneously in accordance with the provisions of Annex C;

(d) bled in accordance with the provisions of Annex D.

2. In the case of animals subject to particular methods of slaughter required by certain religious rites, the requirements of paragraph 1(c) shall not apply.

3. With due regard for the general rules of the Treaty, the competent authorities of the Member States may, for establishments qualifying for derogations pursuant to Articles 4 and 13 of Directive 64/433/EEC, Article 4 of Directive 91/498/EEC and Articles 7 and 18 of Directive 71/118/EEC, grant derogations from paragraph 1(a) in respect of cattle, and from paragraph 1(a) and from the methods for stunning and killing referred to in Annex C in respect of poultry, rabbits, pigs, sheep and goats, provided that the requirements laid down in Article 3 are met.

Article 6

1. Instruments, restraint and other equipment and installations used for stunning or killing must be designed, constructed, maintained and used in such a way as to achieve rapid and effective stunning or killing in accordance with the provisions of this Directive. The competent authority shall check that the instruments, restraint and other equipment used for stunning or killing comply with the above principles and shall check regularly to ensure that they are in a good state of repair and will allow the aforementioned objective to be attained.

2. Suitable spare equipment and instruments must be kept at the place of slaughter for emergency use. They shall be properly maintained and inspected regularly.

Article 7

No person shall engage in the movement, lairaging, restraint, stunning, slaughter or killing of animals unless he has the knowledge and skill necessary to perform the tasks humanely and efficiently, in accordance with the requirements of this Directive.

The competent authority shall ensure that persons employed for slaughtering possess the necessary skill, ability and professional knowledge.

Article 8

Inspections and controls in slaughterhouses shall be carried out under the responsibility of the competent authority, which shall at all times have free access to all parts of slaughterhouses in order to ascertain compliance with this Directive. However, such inspections and controls may be carried out at the same time as controls carried out for other purposes.

CHAPTER III Slaughter and killing outwith slaughterhouses

Article 9

1. Where animals referred to in Article 5 (1) are slaughtered outwith slaughterhouses, Article 5 (1)(b), (c) and (d) shall apply.

2. Member States may, however, grant derogations from paragraph 1 in respect of poultry, rabbits, pigs, sheep and goats slaughtered or killed outwith slaughterhouses by their owner for his personal consumption, provided that Article 3 is complied with and that pigs, sheep and goats have been stunned in advance.

Article 10

1. Where animals referred to in Article 5 (1) are to be slaughtered or killed for purposes of disease control, this shall be carried out in accordance with Annex E.

2. Animals farmed for their fur shall be killed in accordance with Annex F.

3. Surplus day-old chicks, as defined in Article 2 (3) of Directive 90/539/EEC, and embryos in hatchery waste shall be killed as rapidly as possible in accordance with Annex G.

Article 11

Articles 9 and 10 shall not apply in the case of an animal which has to be killed immediately for emergency reasons.

Article 12

Injured or diseased animals must be slaughtered or killed on the spot. However, the competent authority may authorize the transport of injured or diseased animals for the purpose of slaughter or killing provided that such transport does not entail further suffering for the animals.

CHAPTER IV Final provisions

Article 13

1. If necessary, rules on the protection of animals at the time of slaughter or killing other than those in this Directive shall be adopted by the Council acting by a qualified majority on a proposal from the Commission.

2. (a) The Annexes to this Directive shall be amended by the Council acting on a proposal from the Commission, in accordance with the procedure laid down in paragraph 1, in particular in order to adapt them to technological and scientific progress;

(b) in addition, and no later than 31 December 1995, the Commission shall submit to the Council a report drawn up on the basis of an opinion from the Scientific Veterinary Committee together with appropriate proposals concerning the use, in particular, of:

- free bullet pistols, applied to the brain, or of gases other than those referred to in Annex C or combinations thereof for stunning and more particularly carbon dioxide for stunning poultry,

- gases other than those referred to in Annex C or combinations thereof for killing,

- any other scientifically recognized procedure for stunning or killing.

The Council shall act by a qualified majority on these proposals;

(c) by way of derogation from (a), and no later than 31 December 1995, the Commission, in accordance with the procedure laid down in Article 16, shall submit to the Standing Veterinary Committee a report drawn up on the basis of an opinion from the Scientific Veterinary Committee, together with appropriate proposals, with a view to laying down:

(i) the strength and duration of use of the current necessary to stun the various species concerned;

(ii) the gas concentration and length of exposure necessary to stun the various species concerned;

(d) pending implementation of paragraphs (b) and (c), national rules in the matter shall apply, in compliance with the general provisions of the Treaty.

Article 14

1. Commission experts may make on-the-spot checks in so far as is necessary to ensure uniform application of this Directive. In order to do this, they may check a representative sample of establishments to ensure that the competent authority is checking that the said establishments are fulfilling the requirements of this Directive.

The Commission shall inform the Member States of the result of the checks carried out.

2. The checks referred to in paragraph 1 shall be carried out in collaboration with the competent authority.

3. A Member State in whose territory a check is being carried out shall give all the necessary assistance to the experts in carrying out their duties.

4. The detailed rules for implementing this Article shall be determined in accordance with the procedure laid down in Article 16.

Article 15

In the course of the inspection of slaughterhouses or establishments which have been or are to be approved in third countries for the purpose of being able to export to the Community in accordance with Community rules, the Commission experts shall ensure that the animals referred to in Article 5 have been slaughtered under conditions which offer guarantees of humane treatment at least equivalent to those provided for in this Directive.

To enable meat to be imported from a third country the health certificate accompanying such meat must be supplemented by an attestation certifying that the above requirement has been met.

Article 16

1. Where the procedure laid down in this Article is to be followed, the matter shall without delay be referred to the Standing Veterinary Committee by its chairman, either on his own initiative or at the request of the representative of a Member State.

2. The representative of the Commission shall submit to the committee a draft of the measures to be taken. The committee shall deliver its opinion on the draft within a time limit which the chairman may lay down according to the urgency of the matter. The opinion shall be delivered by the majority laid down in Article 148 (2) of the Treaty in the case of decisions which the Council is required to adopt on a proposal from the Commission. The votes of the representatives of the Member States within the committee shall be weighted in the manner set out in that Article. The chairman shall not vote.

3. (a) The Commission shall adopt the intended measures when they are in accordance with the opinion of the committee.

(b) Where the intended measures are not in accordance with the opinion of the committee, or if no opinion is delivered, the Commission shall without delay submit to the Council a proposal relating to the measures to be taken. The Council shall act by a qualified majority.

If, on the expiry of a period of three months from the date on which the matter was referred to it, the Council has not acted, the proposed measures shall be adopted by the Commission, save where the Council has decided against the said measures by a simple majority.

Article 17

Directive 74/577/EEC shall be repealed with effect from 1 January 1995.

Article 18

1. Member States shall bring into force the laws, regulations and administrative provisions, including any penalties, necessary to comply with this Directive on 1 January 1995. They shall forthwith inform the Commission thereof.

When Member States adopt these measures, they shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. The methods of making such reference shall be laid down by Member States.

2. However, as from the date laid down in paragraph 1, Member States may, with due regard for the general rules of the Treaty, maintain or apply in their territory more stringent provisions than those contained in this Directive. They shall inform the Commission of any such measures.

3. Member States shall communicate to the Commission the texts of the main provisions of national law which they adopt in the field governed by this Directive.

Article 19

This Directive is addressed to the Member States.

Done at Brussels, 22 December 1993.

For the Council

The President

J.-M. DEHOUSSE

(1) OJ No C 314, 5. 12. 1991, p. 14.

(2) OJ No C 241, 21. 9. 1992, p. 75.

(3) OJ No C 106, 27. 4. 1992, p. 15.

(4) OJ No L 316, 26. 11. 1974, p. 10.

(5) OJ No L 137, 2. 6. 1988, p. 25.

ANNEX A

REQUIREMENTS FOR THE MOVEMENT AND LAIRAGING OF ANIMALS IN SLAUGHTERHOUSES

I. General requirements

1. Every slaughterhouse coming into operation after 30 June 1994 must have suitable equipment and facilities available for the purpose of unloading animals from means of transport, and all existing slaughterhouses must comply with these requirements by 1 January 1996.

2. Animals must be unloaded as soon as possible after arrival. If delay is unavoidable they must be protected from extremes of weather and provided with adequate ventilation.

3. Animals which might injure each other on account of their species, sex, age or origin must be kept and lairaged apart from each other.

4. Animals must be protected from adverse weather conditions. If they have been subjected to high temperatures in humid weather they must be cooled by appropriate means.

5. The condition and state of health of the animals must be inspected at least every morning and evening.

6. Without prejudice to the provisions laid down in Chapter VI of Annex I to Directive 64/433/EEC, animals which have experienced pain or suffering during transport or upon arrival at the slaughterhouse, and unweaned animals, must be slaughtered immediately. If this is not possible, they must be separated and slaughtered as soon as possible and at least within the following two hours. Animals which are uanble to walk must not be dragged to the place of slaughter, but must be killed where they lie or, where it is possible and does not entail any unnecessary suffering, transported on a trolley or movable platform to the place of emergency slaughter.

II. Requirements for animals delivered other than in containers

1. Where slaughterhouses have equipment for unloading animals, such equipment must have non-slip flooring and, if necessary, be provided with lateral protection. Bridges, ramps and gangways must be fitted with sides, railings or some other means of protection to prevent animals falling off them. Exit or entry ramps must have the minimum possible incline.

2. During unloading, care must be taken not to frighten, excite or mistreat the animals, and to ensure that they are not overturned. Animals must not be lifted by the head, horns, ears, feet, tail or fleece in such a way as to cause them unnecessary pain or suffering. When necessary, they must be led individually.

3. Animals must be moved with care. Passageways must be so constructed as to minimize the risk of injury to animals, and so arranged as to exploit their gregarious tendencies. Instruments intended for guiding animals must be used solely for that purpose, and only for short periods. Instruments which administer electric shocks may be used only for adult bovine animals and pigs which refuse to move, provided that the shocks last no more than two seconds, are adequately spaced out and that the animals have room ahead of them in which to move. Such shocks may be applied only to the muscles of the hindquarters.

4. Animals must not be struck on, nor shall pressure be applied to, any particularly sensitive part of the body. In particular, animals' tails must not be crushed, twisted or broken and their eyes must not be grasped. Blows and kicks must not be inflicted.

5. Animals must not be taken to the place of slaughter unless they can be slaughtered immediately. If they are not slaughtered immediately on arrival they must be lairaged.

6. Without prejudice to derogations granted pursuant to Articles 4 and 13 of Directive 64/433/EEC, slaughterhouses must be equipped with a sufficient number of pens for adequate lairaging of the animals with protection from the effects of adverse weather.

7. In addition to complying with requirements already laid down in Community rules, lairages must have:

- floors which minimize the risk of slipping and which do not cause injury to animals in contact with them,

- adequate ventilation, taking into account the extremes of temperature and humidity which may be expected. Where mechanical means of ventilation are required, provision must be made for emergency back-up facilities in the event of breakdown,

- artificial lighting at a level sufficient to permit inspection of all animals at any time; if necessary, adequate back-up lighting must be available,

- where necessary, equipment for tethering animals,

- where necessary, adequate supplies of a suitable bedding material for all animals kept in the lairage overnight.

8. Where, in addition to the lairages referred to above, slaughterhouses also have field lairages without natural shelter or shade, appropriate protection from adverse weather must be provided. Field lairages must be maintained in such condition as to ensure that animals are not subjected to physical, chemical or other health hazards.

9. Animals which are not taken directly upon arrival to the place of slaughter must have drinking water available to them from appropriate facilities at all times. Animals which have not been slaughtered within 12 hours of their arrival must be fed, and must subsequently be given moderate amounts of food at appropriate intervals.

10. Animals which are kept for 12 hours or more at a slaughterhouse must be lairaged and, where appropriate, tethered, in such a way that they can lie down without difficulty. Where animals are not tethered, food must be provided in a way which will permit the animals to feed undisturbed.

III. Requirements for animals delivered in containers

1. Containers in which animals are transported must be handled with care, and must not be thrown, dropped or knocked over. Where possible, they must be loaded and unloaded horizontally and mechanically.

2. Animals delivered in containers with perforated or flexible bottoms must be unloaded with particular care in order to avoid injury. Where appropriate, animals must be unloaded from the containers individually.

3. Animals which have been transported in containers must be slaughtered as soon as possible; otherwise they must if necessary be watered and fed in accordance with point II.9.

ANNEX B

RESTRAINT OF ANIMALS BEFORE STUNNING, SLAUGHTER OR KILLING

1. Animals must be restrained in an appropriate manner in such a way as to spare them any avoidable pain, suffering, agitation, injury or contusions.

However, in the case of ritual slaughter, restraint of bovine animals before slaughter using a mechanical method intended to avoid any pain, suffering or agitation and any injuries or contusions to the animals is obligatory.

2. Animals' legs must not be tied, and animals must not be suspended before stunning or killing. However, poultry and rabbits may be suspended for slaughter provided that appropriate measures are taken to ensure that, on the point of being stunned, they are in a sufficiently relaxed state for stunning to be carried out effectively and without undue delay.

Furthermore, holding an animal in a restraint system may in no circumstances be regarded as suspension.

3. Animals which are stunned or killed by mechanical or electrical means applied to the head must be presented in such a position that the equipment can be applied and operated easily, accurately and for the appropriate time. The competent authority may, however, in the case of solipeds and cattle, authorize the use of appropriate means to restrain head movements.

4. Electrical stunning equipment must not be used as a means of restraint or immobilization or to make animals move.

ANNEX C

STUNNING OR KILLING OF ANIMALS OTHER THAN ANIMALS REARED FOR FUR

I. PERMITTED METHODS

A. Stunning

1. Captive bolt pistol

2. Concussion

3. Electronarcosis

4. Exposure to carbon dioxide

B. Killing

1. Free bullet pistol or rifle

2. Electrocution

3. Exposure to carbon dioxide

C. The competent authority may, however, authorize decapitation, dislocation of the neck and the use of a vacuum chamber as a method of killing for certain specific species, provided that Article 3 is complied with and that the specific requirements laid down in point III of this Annex are met.

II. SPECIFIC REQUIREMENTS FOR STUNNING

Stunning must not be carried out unless it is possible to bleed the animals immediately afterwards.

1. Captive bolt pistol

(a) Instruments must be positioned so as to ensure that the projectile enters the cerebral cortex. In particular, it is prohibited to shoot cattle in the poll position.

Sheep and goats may be shot in the poll position if the presence of horns prevents use of the crown position. In such cases the shot must be placed immediately behind the base of the horns and aimed towards the mouth, and bleeding must commence within 15 seconds of shooting.

(b) When using a captive bolt instrument, the operator must check to ensure that the bolt retracts to its full extent after each shot. If it does not so retract, the instrument must not be used again until it has been repaired.

(c) Animals must not be placed in stunning pens unless the operator who is to stun them is ready to do so as soon as the animal is placed in the pen. Animals must not be placed in head restraint until the slaughterman is ready to stun them.

2. Concussion

(a) This is only permitted using a mechanically-operated instrument which administers a blow to the skull. The operator must ensure that the instrument is applied in the proper position and that the correct strength of cartridge is used, in accordance with the manufacturer's instructions, to produce an effective stun without fracture of the skull.

(b) However, in the case of small batches of rabbits, where a non-mechanical blow to the skull is used, that operation must be carried out in such a way that the animal is immediately rendered unconscious and remains so until its death and in compliance with the general provisions of Article 3.

3. Electronarcosis

A. Electrodes

1. Electrodes must be so placed that they span the brain, enabling the current to pass through it. Appropriate measures must also be taken to ensure that there is good electrical contact, in particular by removing excess wool or wetting skin.

2. Where animals are stunned individually, the apparatus must:

(a) incorporate a device which measures the impedance of the load and prevents operation of the apparatus if the minimum required current cannot be passed;

(b) incorporate an audible or visible device indicating the length of time of its application to an animal;

(c) be connected to a device indicating the voltage and the current under load, positioned so as to be clearly visible to the operator.

B. Waterbath stunners

1. Where waterbath stunners are used to stun poultry, the level of the water must be adjustable in order to ensure that there is good contact with the bird's head.

The strength and duration of the current used in this case will be determined by the competent authority so as to ensure that the animal is immediately rendered unconscious and remains so until death.

2. Where poultry are stunned in groups in a waterbath, a voltage sufficient to produce a current strong enough to ensure that every bird is stunned must be maintained.

3. Appropriate measures must be taken to ensure that the current passes properly, in particular good electrical contacts and wetting the shackle-to-leg contact.

4. Waterbaths for poultry must be adequate in size and depth for the type of bird being slaughtered, and must not overflow at the entrance. The electrode which is immersed in the water must extend the length of the waterbath.

5. If necessary, manual back-up must be available.

4. Exposure to carbon dioxide

1. The concentration of carbon dioxide for stunning pigs must be at least 70 % by volume.

2. The chamber in which pigs are exposed to the gas, and the equipment used for conveying the pigs through it, must be so designed, constructed and maintained as to avoid injury to the pigs and compression of the chest and enable them to remain upright until they lose consciousness. Adequate lighting must be provided in the conveying mechanism and the chamber to allow pigs to see other pigs or their surroundings.

3. The chamber must be fitted with devices for measuring the gas concentration at the point of maximum exposure and for giving a clearly visible and audible warning if the concentration of carbon dioxide falls below the required level.

4. Pigs must be placed in pens or containers in which they can see each other and conveyed into the gas chamber within 30 seconds from their entry into the installation. They must be conveyed as rapidly as possible from the entrance to the point of maximum concentration of the gas and must be exposed to it for long enough to ensure that they remain unconscious until they have been killed.

III. SPECIFIC REQUIREMENTS FOR KILLING

1. Free bullet pistol or rifle

These methods, which may be used to kill various species, in particular large farmed game and deer, are subject to authorization by the competent authority, which must ensure in particular that they are used by duly qualified staff and in compliance with the general provisions of Article 3 of this Directive.

2. Decapitation and dislocation of the neck

These methods, which are to be used only for killing poultry, are subject to authorization by the competent authority, which must ensure in particular that they are used by duly qualified staff and in compliance with the general provisions of Article 3 to this Directive.

3. Electrocution and carbon dioxide

The competent authority may authorize the killing of various species by these methods provided that, in addition to the general provisions of Article 3, the specific provisions laid down in point II (3) and (4) of this Annex are complied with. It shall also, to achieve this, lay down the strength and duration of the current used and the concentration and length of exposure to carbon dioxide.

4. Vacuum chamber

This method, which is to be used only for the killing without bleeding of certain animals for consumption belonging to farmed game species (quail, partridge and pheasant), is subject to authorization by the competent authority, which shall ensure, in addition to compliance with the requirements laid down in Article 3, that:

- the animals are placed in an airtight chamber in which a vacuum is swiftly achieved by means of a powerful electric pump,

- the vacuum is maintained until the animals are dead,

- the animals are held in groups in transport containers which can be placed in the vacuum chamber, which is designed for that purpose.

ANNEX D

BLEEDING OF ANIMALS

1. For animals which have been stunned, bleeding must be started as soon as possible after stunning and be carried out in such a way as to bring about rapid, profuse and complete bleeding. In any event, the bleeding must be carried out before the animal regains consciousness.

2. All animals which have been stunned must be bled by incising at least one of the carotid arteries or the vessels from which they arise.

After incision of the blood vessels, no further dressing procedures nor any electrical stimulation may be performed on the animals before the bleeding has ended.

3. Where one person is responsible for the stunning, shackling, hoisting and bleeding of animals, that person must carry out those operations consecutively on one animal before carrying them out on another animal.

4. Manual back-up must be available where poultry is bled by means of automatic neck-cutters so that, in the event of a breakdown, birds may be slaughtered immediately.

ANNEX E

KILLING METHODS FOR DISEASE CONTROL

Permitted methods

Any method permitted under Annex C which causes certain death.

In addition, the competent authority may, in compliance with the general provisions of Article 3 of this Directive, permit the use of other methods for killing conscious animals, ensuring in particular that:

- if methods are used which do not cause immediate death (for example, captive bolt shooting), appropriate measures are taken to kill the animals as soon as possible, and in any event before they regain consciousness,

- nothing more is done to the animals before it has been ascertained that they are dead.

ANNEX F

METHODS OF KILLING FUR ANIMALS

I. Permitted methods

1. Mechanically-operated instruments which penetrate the brain.

2. Injection of an overdose of a drug with anaesthetic properties.

3. Electrocution with cardiac arrest.

4. Exposure to carbon monoxide.

5. Exposure to chloroform.

6. Exposure to carbon dioxide.

The competent authority shall decide on the most appropriate method of killing for the different species concerned in compliance with the general provisions of Article 3 of this Directive.

II. Specific requirements

1. Mechanically-operated instruments which penetrate the brain

(a) Instruments must be positioned so as to ensure that the projectile enters the cerebral cortex.

(b) This method is permitted only if it is followed by immediate bleeding.

2. Injection of an overdose of a drug with anaesthetic properties

Only those anaesthetics, doses and applications which cause immediate loss of consciousness followed by death may be used.

3. Electrocution with cardiac arrest

Electrodes must be placed so that they span the brain and the heart and the minimum current level used must lead to immediate loss of consciousness and cardiac arrest.

However, for foxes, where electrodes are applied to the mouth and rectum, a current of an average value of 0,3 amps must be applied for at least 3 seconds.

4. Exposure to carbon monoxide

(a) The chamber in which the animals are exposed to the gas must be designed, constructed and maintained in such a way as to avoid injury to the animals and allow them to be supervised.

(b) The animals must be introduced into the chamber only after it has been filled with a concentration of carbon monoxide of at least 1 % by volume, supplied by a source of 100 % carbon monoxide.

(c) The gas produced by an engine specially adapted for that purpose may be used to kill mustelids and chinchillas provided that tests have shown that the gas used:

- has been suitably cooled,

- has been sufficiently filtered,

- is free from any irritant matter or gas,

- and that the animals cannot be placed in the chamber until the concentration of carbon monoxide has reached at least 1 % by volume.

(d) When inhaled the gas must first induce deep general anaesthesia and must then cause certain death.

(e) The animals must remain in the chamber until they are dead.

5. Exposure to chloroform

Exposure to chloroform may be used to kill chinchillas provided that:

(a) the chamber in which the animals are exposed to the gas is designed, constructed and maintained in such a way as to avoid injury to the animals and allow them to be supervised;

(b) the animals are introduced into the chamber only if it contains a saturated chloroform-air compound;

(c) when inhaled, the gas first induces deep general anaesthesia and then causes certain death;

(d) the animals remain in the chamber until they are dead.

6. Exposure to carbon dioxide

Carbon dioxide may be used to kill mustelids and chinchillas provided that:

(a) the chamber in which the animals are exposed to the gas is designed, constructed and maintained in such a way as to avoid injury to the animals and allow them to be supervised;

(b) the animals are introduced into the chamber only when the atmosphere contains the highest possible concentration of carbon dioxide supplied by a source of 100 % carbon dioxide;

(c) when inhaled, the gas first induces deep general anaesthesia and then causes certain death;

(d) the animals remain in the chamber until they are dead.

ANNEX G

KILLING OF SURPLUS CHICKS AND EMBRYOS IN HATCHERY WASTE

I. Permitted methods for the killing of chicks

1. Use of a mechanical apparatus causing rapid death.

2. Exposure to carbon dioxide.

3. However, the competent authority may permit the use of other scientifically recognized killing methods provided that they comply with the general provisions of Article 3.

II. Specific requirements

1. Use of a mechanical apparatus producing rapid death

(a) The animals must be killed by an apparatus which contains rapidly rotating mechanically operated killing blades or expanded polystyrene projections.

(b) The capacity of the apparatus must be sufficient to ensure that all animals are killed immediately, even if they are handled in large numbers.

2. Exposure to carbon dioxide

(a) The animals must be placed in an atmosphere with the highest obtainable concentration of carbon dioxide, supplied by a source of 100 % carbon dioxide.

(b) The animals must remain in this atmosphere until they are dead.

III. Permitted method for the killing of embryos

1. To kill any living embryos instantaneously, all hatchery waste must be treated by the mechanical apparatus mentioned in point II (1).

2. However, the competent authority may permit the use of other scientifically recognized killing methods provided that they comply with the general provisions of Article 3.

Biographies

Health & Consumer Protection
Directorate-General

Humane Slaughter Association

International Training Workshop on Welfare Standards Concerning the Stunning and Killing of Animals in Slaughterhouses or for Disease Control

26 – 29th September 2006
Bristol Marriott City Centre Hotel, Bristol, UK

Tutor Biographies

Dr Barbara Alessandrini

OIE Collaborating Centre for Veterinary Training, Epidemiology, Food Safety, and Animal Welfare. Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise

Barbara is responsible for the "Staff and international training Unit" of Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "Giuseppe Caporale"(Teramo - Italy), where she has been working for 15 years. After graduating in law, she completed successfully an executive master in "Educational Processes Management". Her main current responsibility is the development of eLearning programmes for veterinarians and other health professionals.

Her key qualifications are:

- Management and technical training
- eLearning (methodologies, tools, skills, content delivery)
- EU Project management
- Quality management of training centres
- She is member of the Italian Association of Trainers (AIF), and of the European Institute for eLearning (EifEL).

Her most recent publication is: 'Global perspectives on animal welfare: Europe'
Caporale V., Alessandrini B., Dalla Villa P., & S. Del Papa, Rev. Sci. Tech. Off. Int. Epiz., 2005, 24 (2), 567 - 577

Tess Benson BSc

Humane Slaughter Association

Tess studied for a degree in Agriculture with Honours in Animal Production science at Newcastle University. Following graduation in 1998, Tess worked for a large pig abattoir gaining experience in all aspects of pig slaughter and livestock transport management. In 1999 Tess joined the HSA as a Technical Officer with particular responsibility for red meat, fish and horses. Since joining the HSA, she has gained a wider experience in the slaughter industry, including practical involvement with FMD in 2001. Her work at the HSA has involved the production of technical books, best practice guidelines and more recently the development of a training course for smaller abattoirs. In addition, Tess has been responsible for the technology transfer for a number of government funded projects and organised practical demonstrations of new equipment. Outside of the UK, Tess has worked in North and South America, New Zealand and various parts of the EU. She also holds a full slaughter licence.

Terence Cassidy

FVO, European Commission

Jane Downes BVSc MRCVS

Meat Hygiene Service

Jane qualified at the School of Veterinary Science, University of Bristol, in 1978 and began her career in general mixed practice, settling in Thirsk, a rural market town in North Yorkshire. This post offered the opportunity to gain experience in all aspects of veterinary work, with a focus on farm animal and veterinary public health work. The practice came to public attention because one of the partners was James Herriot, author and vet. Being part of such an internationally renowned practice required the development of specialist skills in order to manage working with a literary and TV celebrity. Jane took a break from her full-time career to bring up children, but continued with a variety of part-time locum work, in particular providing veterinary supervision in a number of slaughterhouses. She later set up her own veterinary practice, providing veterinary services to local authorities. In 1995 Jane joined the Meat Hygiene Service as a Principal Official Veterinary Surgeon (POVS) in the North Region. In 2002 she was appointed as Veterinary and Technical Director, with responsibility for veterinary policy, technical instruction and training, customer contract management, and internal audit. Jane now combines her operational experience, veterinary knowledge and leadership skills to enhance and facilitate the delivery of official controls required in approved fresh meat premises. She has been an active member of the British Veterinary Association and is a former President of the Veterinary Public Health Association. Jane is an RCVS examiner in veterinary public health at diploma level.

Professor Neville Gregory BSc PhD

Royal Veterinary College

Neville Gregory is Professor of Animal Welfare Physiology at the Royal Veterinary College, UK. He was formerly Head of the Abattoir Section at the Meat Research Institute, Bristol, and Science Director of the Meat Industry Research Institute New Zealand. He has been researching stunning and slaughter methods in red and white meat species since 1979. His present research projects are on carotid ballooning in cattle, effectiveness of captive bolt guns in cattle in relation to noise of their discharge, and floor slipperiness in lairages and stunning pens. He is also writing a textbook, with Temple Grandin as a co-author, on Animal Welfare and Meat Production. This book is aimed at Developing Countries as well as industrialised meat producing nations.

Gordon Hickman

State Veterinary Service

Gordon has an honours degree in agriculture from Reading University. He joined the Agricultural Development and Advisory Service (ADAS), then the extension agency of the Ministry of Agriculture Fisheries and Food (MAFF) in 1984 and worked as an agricultural adviser in the South East specialising in business management and waste and environmental management. In May 2001 he was seconded to the Ministry of Agriculture Fisheries and Food to assist with the disposal operations during the 2001 FMD outbreak.
In 2004 Gordon joined Defra and is now head of branch in the State Veterinary Service (SVS) Contingency Planning and Disposals Division where he is responsible for contingency field operations planning including implementing Defra's culling and disposal policy and the production of guidance on cleansing and disinfection.

Professor Pam Hullinger, DVM, MPVM, DACVPM

Lawrence Livermore National laboratory

Dr. Hullinger received both her Bachelors Degree in Animal Science ('87) and her Degree in Veterinary Medicine ('90) from UC Davis. She practiced at Cotati Large Animal Hospital in Sonoma County for three years before returning to UC Davis to complete a residency in large animal internal medicine. She spent ten years working for the California Department of Food and Agriculture, initially focusing on Livestock Welfare and later as the University and laboratory liaison. She completed a Masters in Preventive Veterinary Medicine (MPVM) in 2001 and is board certified in preventive veterinary medicine. She has served on the Animal Welfare committees for the American Veterinary Medical Association, California Veterinary Medical Association, Livestock Conservation Institute and the United States Animal Health Associations. She has served on scientific advisory committees for both the American Humane Association (Free Farmed Program) and the Humane Farm Animal Care (Certified Humane Program). Dr. Hullinger recently accepted a position with Lawrence Livermore National laboratory where she works in the areas of Agricultural and biological defense. She has approximately 25 scientific publications, participated in over 40 scientific programs and provided more than 200 hours of presentations to local, state and national audiences.

Professor Mac Johnston
OBE BVM&S DVetMed Dip ECVPH HonFRCVS
Royal Veterinary College

Mac Johnston graduated from the University of Edinburgh in 1968 and worked in large animal practice in Scotland before joining the staff of the Royal Veterinary College in 1979. He attained the status of RCVS Specialist in Veterinary Public Health in 1994 and was elected to Honorary Fellowship of the Royal College of Veterinary Surgeons in 1997, in recognition of special eminence in and services to the cause of veterinary science. His particular interests lie in issues related to food of animal origin, and he received the Ward Richardson Award of the Royal Society for the Promotion of Health for outstanding and innovative work in the field of food hygiene. He is veterinary adviser to the Humane Slaughter Association. He has been an independent expert on a number of committees including the EU Scientific Veterinary Committee for Matters Relating to Public Health and EFSA Biological Hazards Panel. He has also worked closely with consumer associations and industry. His research has included the use of longditudinally integrated systems from farm to abattoir, the microbiological assessment of carcases and application of HACCP in the abattoir, alternative meat inspection systems, studies on the use of antibiotics on pig farms, and lameness in both cattle and pigs. He is the author, and has contributed chapters, of a number of books.

Dr Sarah Kahn
OIE, World Organisation for Animal Health

Dr James Kirkwood BVSc PhD FIBiol MRCVS
Humane Slaughter Association and Universities Federation for Animal Welfare

James Kirkwood (BVSc PhD FIBiol MRCVS) graduated from Bristol University Veterinary School in 1975. He is Chief Executive and Scientific Director of the Humane Slaughter Association (HSA) and of the Universities Federation for Animal Welfare (UFAW), Visiting Professor in the Department of Pathology and Infectious Diseases at the Royal Veterinary College, and Editor of the quarterly scientific journal Animal Welfare. For 12 years, prior to taking up his posts at HSA and UFAW in 1996, he was Head of the Veterinary Science Department at the Zoological Society of London. Among other responsibilities, he is Chairman of the Zoos Forum and Deputy Chairman of the Companion Animal Welfare Council. He has published some 150 papers in the scientific literature on aspects of the biology, diseases, welfare and conservation of animals.

Mandy Lucas
Intergra Food Secure Ltd

Mandy graduated from the University Of Reading in 1985 with a degree in Physiology and Biochemistry of Farm Animals. Throughout her childhood she was actively involved in an 800-acre arable farm, managed by her father. This encompassed a small holding which included most species of poultry, sheep and goats where she developed a strong affinity with both the animals and the agricultural community. On leaving university, Mandy became an animal nutritionist for a leading feed compounder, maintaining day to day contact with farmer customers.

In 1997, she was seconded on a 3 month contract to a new project, responsible for establishing the working procedures for a new inspection business, Integra Food Secure Ltd. Nine years later and she is now the Managing Director of this independent inspection business, which specialises in animal welfare inspections across all farmed livestock species. Responsible for coordinating an ever increasing number of inspectors, her specialty is the poultry sector. Here she is still carrying out welfare inspections throughout Europe, South America and Asia which helps to maintain a hands-on approach to developing new inspection techniques.

Charles Mason HND M. Inst. M
Humane Slaughter Association

After graduating from Harper Adams Agricultural College in 1980, Charlie spent five years working with livestock on various farms. This was then followed by three years in livestock marketing. Charlie Joined the HSA in 1988 and became Technical Director in 2001. His main role is advisory and teaching work concerning the correct use and maintenance of various firearms, associated with the slaughter and emergency killing of farm animals. He is a regular speaker on firearms and slaughter equipment at veterinary conferences and runs a number of training courses for all levels of the industry. Outside the UK, he has helped introduce new slaughter equipment to the meat industries of Brazil, Turkey, Taiwan and, most recently, the Philippines. In addition to holding a full slaughter licence, Charlie has a broad knowledge of livestock handling and transport and is currently producing guidelines for minority species such as bison and wild boar.

John Moffitt BVM&S MRCVS

State Veterinary Service

Graduated in 1969 from the University of Edinburgh and after a year in practice in Oxfordshire and a further year as a veterinary officer with Birmingham Corporation moved back to practice in Kirkby Lonsdale, South Cumbria, in October 1971. Worked as an assistant for four years before becoming the senior partner of the four person mixed practice. During time in practice maintained an interest in meat hygiene and held LVI panel appointments for the export of red and white meat as well as being a recognised Official Veterinary Surgeon (OVS). Prior to 1995 held contracts with local authorities to carry out meat inspection work. With the advent of the Meat Hygiene Service (MHS) the practice took on several contracts to work in red and white meat low throughput abattoirs. Left practice in 1999 but continued to work as a contract OVS for the MHS until 2001 when Foot and Mouth Disease (FMD) 'struck' the UK. Worked as a Temporary Veterinary Inspector (TVI) from early March 2001 based at Carlisle Animal Health Divisional Office, with secondment to Yorkshire in May and June, until the end of October 2001. After gaining experience in 'clinical FMD' was asked to lead the slaughter advisory team at Carlisle, providing support and guidance for less experienced TVIs on cull sites. On returning to Carlisle in July 2001 set up and led the biosecurity team, again working mainly on cull sites. During 2001 was present on 74 farms where the culling of cattle and sheep took place.

After fifteen months on fixed term contract as a Veterinary Officer (VO) took up a full time, permanent post as a VO with Defra in February 2003. Is the Divisional Lead VO, still based at Carlisle, for Tuberculosis and for the Welfare of Farmed Livestock.

Milorad Radakovic BVSC, CertVPH (MH), MRCVS

Food Standards Agency

Milorad graduated from Zagreb University, Croatia as a veterinarian in 1989. In the UK, he obtained a full membership with the Royal College of Veterinary Surgeons by examination, and is also a holder of Veterinary Public Health (Meat Hygiene) Certificate. He is an active member of Veterinary Public Health Association. Work experience varies from small & large animal practice. In the UK he has spent most of his veterinary career working in the sector of Veterinary Public Health; from practical on-line meat hygiene inspection to performing duties of an Official Veterinary Surgeon (OVS), Principal Official Veterinary Surgeon (POVS) for the Meat Hygiene Service (MHS). Currently, working as a Veterinary Adviser for the Food Standards Agency in London, duties include the provision of Veterinary advice to policy makers and liaison with other government departments and academic institutions nationally and internationally. Milorad is actively involved in developing many projects that are necessary for the successful implementation of new EU Hygiene Regulations. During his career he has had several high profile court appearances as a veterinary witness and is a visiting lecturer at Cambridge Veterinary School.

Dr Mohan Raj BVSc MVSc PhD

University of Bristol

Dr Raj is a Senior Research Fellow based at the Division of Farm Animal Science, School of Clinical Veterinary Science, University of Bristol, in the United Kingdom. He specialises in research into animal welfare during stunning and slaughter or killing. To date he has published over 50 peer reviewed papers in international scientific journals and been an invited speaker at 22 international conferences. He is a member of the European Food Safety Authority (EFSA) working groups on welfare of animals during stunning or killing and euthanasia of animals used in research, the OIE ad hoc working group on animal welfare during stunning and slaughter, and British Veterinary Association / Federation of Veterinarians of Europe working group on welfare of animals during killing or slaughter.

Dr Denis Simonin

European Commission

Since 1999 Denis Simonin has been working at the European Commission in charge of developing European legislation on animal welfare in the framework of the Directorate General for Health and Consumer Protection. His main responsibility is now the revision of the legislation on the slaughter and killing of animals. He has also been working on the transport of animals (Regulation (EC) No 1/2005). The preparation of the legislation implies wide consultation with experts from the Member States of the European Union and the major stakeholders. He contributed to the first web consultation of the Commission on the welfare of transported animals. Prior to his current position, he worked since 1985 for the state veterinary services in the French Ministry of Agriculture, occupying different positions related to food safety and international veterinary issues. He has also worked in Québec (Canada) and South Africa. Born in 1959, he grew up near Paris, France, graduated as a veterinary surgeon at the National Veterinary School of Nantes and obtained an MBA from Laval University in Québec City (Canada).

Natalie Smith Bsc

Humane Slaughter Association

Natalie graduated in 1999 from the University of Lincoln with BSc (Hons) Animal Science (behavioural studies). Whilst travelling around Australia, Natalie gained work experience at Taronga Zoo, Sydney/Western Plains Zoo, and Kakadu National Park, Darwin. In 2001 she joined the Cobb Breeding Company, based in Essex. Working as a Trial Co-ordinator, she was responsible for running a trials site focussing on nutritional, lighting, breeding trials. In 2003 Natalie joined the HSA as a Technical Officer with particular responsibility for white meat. Her role involves providing practical advice, training and guidance on poultry handling, capture, transport and slaughter. During the past year her work has concentrated on producing a training DVD for the poultry industry covering all aspects of capture, transport and handling. Natalie regularly speaks at poultry conferences and more recently has been involved in training the industry and State Veterinary Service in emergency killing techniques. Natalie is a member of the Quality British Turkey - Technical Advisory Committee. She also holds a full poultry slaughter licence.

Kirk Thompson BSc BVM&S MRCVS

Defra

Kirk graduated from the University of Edinburgh in 1993 with degrees in neuroscience and veterinary medicine and surgery. After being awarded a Wellcome Veterinary Scholarship, he subsequently spent four years working in the laboratory of Prof Colin Blakemore in the Physiology Laboratory of the University of Oxford, researching aspects of visual neuroscience. Kirk then joined SmithKline Beecham as the first Resident in Laboratory Animal Sciences in the UK and progressed a career as a Named Veterinary Surgeon for almost five years in academic, pharmaceutical and government medical research, largely based at the Royal Veterinary College, University of London. In 2003, Kirk joined the Animal Welfare Division of Defra as veterinary adviser in welfare at slaughter. His responsibilities have enlarged to include welfare at transport and markets, and he is now also Head of Slaughter Policy and transport/markets/slaughter research and development.

Dr Martin von Wenzlawowicz

bsi Schwarzenbeck

Dr von Wenzlawowicz graduated in 1989 from the Free University of Berlin. After working four years as a veterinarian for cattle and horses he became an associate of the Training and Consultancy Institute for careful handling of breeding and slaughter animals (bsi) in Schwarzenbek, Germany since 1993. He is chairman of the working group "Stunning and Slaughter" of the German Veterinarian Union for Animal Welfare and member of a working group on welfare aspects of animal stunning and killing methods of the European Food Safety Authority (EFSA). His main work is focused on animal welfare training of transport and slaughter personnel as well as consulting technical suppliers for transport and slaughter equipment, slaughterhouses and veterinarians. The research activities refer to all kind of aspects related to animal welfare in transport and slaughter under practical conditions. His recent studies are on effectiveness of electrical stunning systems for pigs and poultry using high frequency currents and application of reversible stunning methods for religious slaughter.

Health & Consumer Protection
Directorate-General

International Training Workshop on Welfare Standards Concerning the Stunning and Killing of Animals in Slaughterhouses or for Disease Control

26 – 29th September 2006
Bristol Marriott City Centre Hotel, Bristol, UK

Abstracts

Introduction: Presentation 1

Introduction: the importance of animal welfare and of good design of facilities and systems

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There is strong scientific evidence, on the basis of behavioural and of neuro-anatomical and physiological similarity, that, like humans, other vertebrates have the capacity to experience pleasant and unpleasant feelings. The lives of other vertebrate animals (and possibly those of some invertebrates also) are almost certainly characterised, as are ours, by complex mixes of feelings associated with brain states induced by various sensory inputs and cognitive processes. As, since Darwin, science has provided growing evidence for this, there has been a corresponding increase in public concern, around the world, for animal welfare and that animals under human care should be protected as far as possible from unpleasant feelings such as pain and fear.

Very large numbers of livestock animals are slaughtered for food and other reasons. At the time of slaughter or killing, there is the potential for causing major and unnecessary suffering both through inappropriate handling and through use of inappropriate stunning or killing methods. The humane ideal is to induce loss of consciousness, without fear, pain or other unpleasant feelings, and to ensure that death occurs prior to any recovery of consciousness. During the past 100 years there have been great advances in the science and technology of humane killing and slaughter of livestock and other animals. Techniques and systems have been developed which permit the achievement, much more closely than used to be possible using some traditional techniques, the ideal of causing loss of consciousness and death without significant fear, and with high levels of reliability. There is increasing global agreement that these high standards should be pursued and this has been reflected in legislation (for example, EU Directive 93/119/EC on the protection of animals at the time of slaughter and killing) and, more recently, in wider international adoption of the World Animal Health Organisation (OIE, Paris) standards.

The aims of this international workshop are, through sharing knowledge and experiences, to equip delegates to be able to assess, from the animal welfare perspective, that well-designed systems and operations for slaughter or killing for disease-control purposes are in place and functioning properly. We will consider also how initiatives may be developed to further promote advances in this field around the world.

Session 1: Presentation 2

Protection of animals at slaughter and killing: a short overview of the European Union Legislation

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European Union legislation for the protection of animals at slaughter exists for more than thirty years. Currently, the main legal text on this issue is Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing[1], which requires that animals bred or kept for the production of meat, fur or other products are spared any avoidable excitement, pain or suffering during movement, lairaging, restraint, stunning, slaughter or killing.

To ensure harmonized level of protection of animals at slaughter or killing in Member States of the European Union, Council Directive 93/119/EC lays down the technical rules that operators or farmers must apply when slaughtering or killing small or large number of animals whether inside or outside slaughterhouses and whether in routine circumstances (e.g. in slaughterhouses) or in emergency situations (e.g. killing animals for disease control purposes or killing sick animals). Lists of methods and equipment suitable for restraint, stunning, bleeding or killing animals are provided and specific requirements on the knowledge of the personnel and the maintenance of equipment involved in the slaughtering or killing process are laid down.

Additionally, Council Directive 93/119/EC requires that Member States check that these technical rules are followed by establishing a system of controls in slaughterhouses and farms, and that these systems of controls are evaluated by Commission Experts. Results of the evaluations carried out by the Commission Experts from the Food and Veterinary Office[2] in the 25 Member States over the last 3 years, have shown that when the national competent authorities ensure a high level of supervision of the controls performed in slaughterhouses by training their official veterinarians, by requiring that the results of inspections are recorded and reported, by asking the official veterinarians to check the training of slaughter men and the maintenance of stunning and killing equipment, a better level of implementation of the requirements of Council Directive 93/119/EC is achieved. Equally an inspection programme for checks of farms, plus follow-up action on information obtained at slaughterhouses, results in adequate control of the killing on farm. To kill large numbers on farm during disease outbreaks requires especially detailed planning, with particular attention needed on practicalities such as the number of animals that can be humanely killed per hour with each method of killing.

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[1] Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing, OJ L 340, 31.12.1993, p 21.

[2] http://europa.eu.int/comm/food/fvo/index_en.htm

Presentation 2 Continued.

Council Directive 93/119/EC therefore provides a comprehensive legal framework to ensure the protection of animals at the time of slaughter or killing. However, some of the technical rules listed for stunning and killing animals need to be updated to take into account recent scientific opinions on slaughter and recent experiences acquired in killing large number of animals during outbreaks of contagious diseases. A revision of the Directive would allow the use of new and more animal welfare friendly methods to be used for stunning or killing animals. Moreover, since the first of January 2006, a higher level of supervision from the Member States on the way animal welfare controls during the slaughter of animals are carried out has become a requirement with the new hygiene package. In particular, Council Regulations N°882/2004[3] and N° 854/2004[4] require that official veterinarians or auxiliaries performing the controls should be specifically trained on animal welfare issues and should perform regular and documented controls on the welfare of the animals slaughtered, from their arrival at the slaughterhouse till their death.

[3] Regulation (EC) n°882/2004 of the European Parliament and of the council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules OJ L 165, 30.04.2004 corrected and republished in OJ L 191, 28.05.2004, p.1.

[4] Regulation (EC) n° 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption OJ EU L 139, 30.04.2004 corrected and republished OJ L 226, 25.06.2004 p.83.

Session 1: Presentation 3

Protection of animals at slaughter and killing: International context

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Legislation to protect animals at slaughter or killing is the oldest legislation applicable to farm animals. A first national legislation on slaughter was identified in 1933 (UK) and the first international legislation was adopted in 1974 by the European Community. However the first worldwide initiative was taken by the World Organisation for Animal Health (OIE[5]) in 2005. The OIE is an intergovernmental organisation initially created to exchange information on animal health issues between veterinary services around the world. Since 2002, its role has also extended to animal welfare. One of the guiding principles of the OIE is to establish standards and guidelines based on scientific data. OIE standards are recognised throughout the world and by the World Trade Organization. In 2005 the OIE adopted five guidelines on animal welfare as part of the Terrestrial Animal Health Code. Two guidelines relate to the slaughter and the killing of animals. As regards the guideline for slaughter for human consumption, emphasis is made on understanding animals' behaviour in order to properly design lairage facilities as well as in order to handle animals correctly and safely. Monitoring tools to measure the level of animal welfare during handling operations are presented in the guideline. Proper restraint techniques are recommended to optimise the implementation of stunning methods. Restraint or stunning procedures that hide or generate pain are not acceptable on animal welfare grounds. The guideline also provides extensive descriptions of several acceptable restraining, stunning and slaughter methods. The guideline for killing animals for disease control purposes insists on the importance of defining a pre-planned organisational structure with a clear definition of the respective responsibilities of each member of the team. Excellent logistical preparedness and efficiency is the key element to perform a killing without unnecessary suffering or pain. The guideline also describes a list of validated methods to kill animals in this context. In comparison the current EU legislation is already applying similar concepts in particular for slaughterhouses. However due to technical developments in the recent years, the EU legislation needs to be updated. Provisions related to killing for disease control purposes needs further expansion to be in line with the corresponding OIE guideline.

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[5] The "*OIE*" stands for "*Office International des Epizooties*" the former name of the organisation.

Session 2: Presentation 4

Anatomical and physiological principles relevant to handling, stunning and killing red meat species.

Professor Neville Gregory
Royal Veterinary College

Session 2: Presentation 5

Scientific basis for proper handling, stunning and killing: Anatomical and physiological principles relevant to poultry species

Dr Mohan Raj
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Fossil records show that birds evolved about 160 million years ago with some unique anatomical and physiological features, which not only makes them sentient but also vulnerable to suffer pain and distress during handling, stunning and killing. People performing these tasks should be aware of this and take responsibility to avoid causing pain and distress. Some of the salient features are highlighted in this presentation.
Birds do not have muscular diaphragm and therefore the abdominal organs and contents would exert pressure on heart when they are inverted, for example, while carrying by hand or hung on shackle lines for stunning and slaughter.

Birds have nociceptors in their scaly skin covering meta tarsal bones and hence any pressure applied either during catching and carrying or shackling prior to stunning and slaughter will cause severe pain and suffering.

Birds do not have neocortex (convoluted cerebrum) but the cerebrum is functionally very similar to the mammalian brain. Therefore, it is not surprising that they seek to fulfil their behavioural and functional needs. More importantly, electrical stunning, which involves passing an electrical current of sufficient magnitude through the brain, induces epileptiform activity in the brains of mammals and birds alike. Epileptiform brain activity is a pathological state and hence incompatible with the persistence of consciousness and sensibility. The occurrence of epileptiform brain activity is determined by the waveform, frequency and amount of current delivered to the brain.

Birds have chemical receptors in their lungs and are known as intrapulmonary chemoreceptors (IPCs). The IPCs are acutely sensitive to carbon dioxide but insensitive to hypoxia or anoxia. Stimulation of IPCs depresses breathing. In addition, like mammals, birds have central (brain) and peripheral (e.g. carotid body) chemoreceptors that respond to changes in blood gases. Stimulation of these receptors with carbon dioxide leads to apnoea, which is also described as breathlessness or a sense of suffocation. It is therefore hardly surprising that, given a free choice, chickens and turkeys avoid an atmosphere containing high concentrations of carbon dioxide but succumb to hypoxia or anoxia created using inert gases (e.g. argon, nitrogen). Addition of oxygen or humidification of carbon dioxide does not help to overcome the propensity to suffer pain and distress.

It is hoped that our improved knowledge and understanding of anatomical and physiological features should help to avoid causing unnecessary pain and suffering in birds.

Session 2: Presentation 6

Introduction to modern slaughter methods

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Generally speaking, slaughter is a two-stage process: animals are first rendered insensible to pain, a process commonly referred to as 'stunning', before being killed by exsanguination – voiding the carcase of blood. Death is caused by the brain being deprived of oxygen. Under the current European legislation – *Council Directive 93/119/EC on the protection of animals at the time of slaughter or killing* – livestock for human consumption may be stunned using three basic methods: percussive stunning, electrical stunning and by the inhalation of gas mixtures. Percussive and electrical stunning, when performed correctly, induce immediate unconsciousness; whereas the inhalation of gas mixtures (otherwise known as controlled atmosphere stunning or CAS) may take up to 15 seconds to cause complete insensibility. For the slaughter to be humane and comply with legislation, the state of insensibility in the animal must persist until death supervenes. As well as effective stunning, therefore, it is equally important that animals are bled without delay to prevent any possible onset of recovery, however rudimentary.

Percussive stunning is carried out using mechanical equipment which operates on the 'captive-bolt' principle and delivers a severe blow to the head; captive-bolt stunners may be penetrative or non-penetrative and can be used effectively on all species, although older animals of some species may present difficulties. A variation is the use of free-bullet weapons, which effectively stun the animals first and then kill them by destroying the brain stem. These weapons are rarely used in commercial slaughter, but come into their own in some disease-control situations. Electrical stunning and stun/kill systems can be used with all species and may be administered manually or automatically. At present, CAS systems are only commercially available for pigs and poultry, and are fully automatic. However, manual systems are currently being developed for the on-farm killing of poultry for disease control purposes.

Session 2: Presentation 7

Application of modern methods for slaughter of red meat animals.

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Despite there being only three common types of stunning available at the time of slaughter, recent scientific and technological developments have led to a variety of methods currently applied in the industry. These variations all have the same aim; to render animals instantaneously insensibly until death is caused but do so in various ways and as such all have different welfare implications and considerations.

With each of the methods, the animal is first stunned and then killed. However, with some methods such as electrocution or free bullet these two stages occur in very quick succession and are often seen as one action.

Although the methods have the same aim, careful consideration is needed to decide the most appropriate method of slaughter is employed by individual plants. These choices will be influenced by abattoir size, staff ability, investment available, species slaughtered and possible quality implications amongst other issues.

This presentation will highlight the main developments and principles associated with the use of captive-bolt stunning, electronarcosis, electrical killing and carbon dioxide anaesthesia. In addition the main welfare implications of the methods described above will be discussed and best practice suggested for their use.

Useful monitoring techniques to highlight effective and ineffective systems will also be introduced to help staff and management optimise animal welfare at this critical stage in the slaughter process.

Session 3: Presentation 8

Application of modern methods of slaughter of poultry

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Every year millions of birds are reared for food and the slaughter of these birds must be carried out in a way which causes no unnecessary pain or suffering. A number of systems have been developed to facilitate the humane slaughter or killing of poultry. The main principle of all these methods is to stun the bird so that it becomes immediately unconscious and insensible to pain; this condition must persist until the bird is dead.
The majority of birds slaughtered in processing plants throughout the world are either stunned using an electrical waterbath system and then bled, or killed by Controlled Atmosphere Stunning (CAS).

Electrical stunning is used widely in the slaughter of broilers, hens, turkeys, ducks, geese and quail. Modern equipment controls the voltage, frequency and waveform of the electric current delivered to stun the birds. Despite the increasing complexity of electrical stunning equipment, it is still the responsibility of the operator to ensure that every bird is humanely stunned and killed. Poorly maintained, or incorrectly used, electrical equipment can result in unnecessary suffering for the animal, and can also compromise operator safety.

The killing of poultry with gas mixtures does not result in an immediate loss of consciousness, therefore it is important to ensure that the induction of unconsciousness does not cause distress to the birds. In addition to this, the type of gas used must be suitable for a commercial environment.
The use of gas systems for poultry killing has a number of welfare and commercial advantages in comparison to conventional electrical waterbath stunning. These include:

- birds are not inverted and shackled live
- birds are killed within their crates
- the possibility of pre-stun shocks is eliminated
- the possibility of birds receiving inadequate current levels is eliminated
- the killing of birds using gas mixtures is associated with a lower incidence of broken bones compared to electrical waterbath stunning, which can improve carcase quality

Some disadvantages of gas killing include:

- more moving parts in the system compared to electrical waterbath stunners
- the initial cost of fitting the equipment is high
- although argon is an excellent gas to use for these systems, it is more expensive than other gases available
- the gas systems take up more space than electrical waterbath equipment
- gas killing systems require you to use the specialised bird handling systems

Although gas systems have the potential to eliminate a number of welfare concerns associated with electrical waterbath stunning, it is not a system which can currently be used in smaller processing plants or on-farm sites due to the size and expense of equipment. The Humane Slaughter Association (HSA) therefore feels it is essential to ensure that further research and development on alternative stunning/killing systems continues along with improvements to the standard electrical waterbath system.

Session 3: Presentation 9

Application of Modern Methods for Killing in Disease Control Situations

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The concerns over the possibility of avian influenza (AI) infection reaching Europe has caused governments to examine and enhance their operational readiness to combat any outbreak. The most effective means available at present of stamping out any outbreak is still the culling of infected birds and dangerous contacts.

Most of us will have seen images from the Far East, and more recently Turkey, where some birds have been killed by burial or burning in plastic bags in pits. In Turkey, some mobile gassing units (presumably using carbon dioxide) were also employed.

There are only a limited number of effective methods of killing large numbers of birds for disease control and none are ideal when benchmarked against welfare, health and safety, or throughput criteria. Available techniques include: neck dislocation; decapitation; electrocution; concussion killing; lethal injection; free bullet killing, and exposure to lethal gases or gas mixtures (either in poultry sheds, or in mobile containers). A range of techniques, appropriate to the different circumstances that governments will be confronted with, is necessary to provide a flexible and effective approach to any cull.

In combating any outbreak of notifiable disease, in particular, AI, it is necessary to be clear of priorities. These are: to protect public health; to stamp out disease swiftly and effectively; and to cull birds using humane techniques that can be deployed rapidly. Any culling techniques that are developed must take account of these priorities and relevant European and domestic legislation.

To this end, Defra, and its Scottish equivalent, SEERAD, have sponsored work to examine, refine and develop new or existing techniques of killing birds humanely that employ gases or gas mixtures. The development and application of the Containerised Gassing Unit (CGU) will be described in this presentation. The CGU system applies an anoxic gas mixture (80% argon, 20% carbon dioxide) in a container to birds previously caught and placed into industry standard transport modules. The system is robust, easy to use and has a throughput of 5000 birds per hour (for two units). This system has been adopted by the State Veterinary Service, a training package is being rolled out to state veterinarians, and CGUs will be deployed where needed as part of the UK contingency plan to combat any outbreak of AI.

Session 4: Presentation 10

Inspection and auditing of automated controlled atmosphere methods for slaughter for poultry

Dr Martin von Wenzlawowicz, bsi Schwarzenbek
Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals

Handling and restraining of live birds before electrical stunning can be potentially painful and stressful. Stunning of poultry in automated controlled atmosphere systems can be beneficial for animal welfare if it is done properly. Worker safety is also improved because handling stunned birds is much easier. For the economics of the slaughter industry these systems seem to be beneficial too due to higher slaughter speed and better meat quality.

So far controlled atmosphere systems with defined composition of gases like 40%CO_2/30%O_2/30%N_2 followed by 80%CO_2 in N_2 or 30%CO_2/60%Ar10%N_2 and systems with CO_2 in air are used to stun chicken and turkeys. The effectiveness and impact of the used gases and gas concentrations on poultry should be based on sound science.

The necessary welfare inspections and audits must be done according to the operating mode of the system. The inspection encloses the following issues:

a) Good welfare during bird supply to the system to reduce excitement and warrant a gentle induction of the stunning process,
b) Compliance with scientifically based induction conditions and corresponding clinical appearance, which can be verified under slaughterhouse conditions,
c) Sufficient depth of stunning assuring that in combination with given stun-stick interval and quality of neck-cutting no animal regains consciousness before dying and
d) Suitable process control and monitoring of welfare relevant parameters including possibilities for easy checks by the competent authority or quality assurance.

The means of inspection are:

- Visual inspection of the behaviour and reactions of the birds during supply, induction of anaesthesia, after leaving the system, before and during bleeding.
- Measuring the features of the system, such as exposure time, gas concentration and stun to stick interval
- Comparing the collected data with the companies own data and in relation to alarm settings.
- Checking if the personnel responsible for the stunning area is capable of managing the system properly, e.g. asking for an action plan in the case of an emergency.
- Checking the monitoring system and documents by the company in order to see if the relevant data are collected.

Presentation 10 Continued.

In order to get access to the installation assistance by the company is necessary. Measuring gas concentrations with own equipment requires preparation of the stunning facilities or the use of special devices, which pass the system when measuring the gas concentrations. Knowledge of technical descriptions and instruction of the auditors are mandatory before an inspection is carried out.

It can be assumed that the advantages of stunning systems for poultry in automated controlled atmosphere systems will further increase the number of installations. One of the next steps into further mechanisation might be automated shackling, which requires relaxed carcasses. Stunning in controlled atmosphere systems will be a pre-requisite for this step.

Session 4: Presentation 11

Inspection and auditing of automated electrical methods for slaughter

Natalie Smith & Charlie Mason
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Poor maintenance, adjustment and calibration of electrical waterbath stunners for poultry can cause a number of problems in relation to animal welfare and product quality. These include:

- Different designs of electrical waterbath stunners deliver different wave forms which need different settings and can cause confusion as to what the suitable voltage and current levels are
- Birds may receive pre-stun shocks, due to poor design of the bath entry
- Birds can receive too low a current due to poor electrical contact with the shackle
- Water conductivity fluctuation can affect stun currents
- Intermittent electrical contact will cause an intermittent current to flow through the bird and affect meat quality

Fully-automatic electrical systems for red meat animals cater for cattle and pigs; as yet there are no fully automatic systems available for sheep. Cattle systems are based on the traditional 'stunning-box', as used in conjunction with captive-bolt equipment, and animals are stunned or stun/killed individually. There are two systems for pigs, both delivering individual animals to the stunning point by a conveyor. Batches of pigs may differ in size, so it is important that the equipment is adjusted accordingly and that:

- the animals are restrained in a position which allows accurate placement of the electrodes
- an adequate current is applied for the correct amount of time
- in stun/kill systems, the animals are effectively stunned before the cardiac arrest cycle takes place

The slaughterman's job, when working with fully-automatic systems, is to continually monitor the stunned animals and look for signs of ineffective stunning and/or recovery and take action if necessary.

In addition to this, equipment must be regularly checked and adjusted by the plant engineers, and accurate records kept of these inspections for scrutiny by the Official Veterinarian (OV) and Animal Welfare Officer/Poultry Welfare Officer (AWO/PWO).

Mini sessions: Presentation 12

Biosecurity

Professor Mac Johnson
Royal Veterinary Collage

Disease challenge by viruses, bacteria, parasites and fungi present a major threat to profitable animal production. The greatest disease threat to animals is from other animals, whether through direct contact or through surfaces, equipment or people contaminated by diseased animals. Livestock haulage, markets and places where animals from different sources gather, such as the abattoir lairage, provide an excellent opportunity for disease spread.

Biosecurity means taking measures at all stages in the food chain to ensure that good hygiene and general cleanliness practices are in place to prevent the spread of animal disease. Good agricultural practice must be based on biosecurity with case-control study of risk factors and “strict hygienic barriers”. Good biosecurity is essential for anima health, human health and animal welfare reasons.

Mini sessions: Presentation 13

Environmental Issues

Mr Gordon Hickman
State Veterinary Service

Mini sessions: Presentation 14

Welfare and Food Safety

Milorad Radakovic BVSc, Cert VPH (MH), MRCVS
Meat Hygiene & Veterinary Division, Food Standards Agency, United Kingdom.

The primary objective of the new EU Hygiene Regulations is ' the pursuit of a high level of protection of human life and human health' whilst the primary objective of Council Directive 93/119/EC on the protection of animals at the time of slaughter or killing is that 'animals shall be spared any avoidable excitement, pain or suffering during movement, lairaging, restraint, stunning, slaughter or killing'.

Food Hygiene Regulations, in the spirit of Hazard Analysis and Critical Control Point (HACCP) principles, aim to prevent, eliminate or to reduce food borne hazards in products of animal origin to an acceptable level. Realistically an absolute prevention or elimination of food borne hazards may not always be achieved, but there should be no reason why every attempt cannot be made to apply practices that would reduce the risk to an acceptable level.
Similar principles may be applied where Welfare Directive requires that 'animals shall be spared of any avoidable excitement, pain or suffering…'

For example an absolute prevention of animals' stress cannot always be achieved, but in reality again, there should be no justifiable reason why it cannot be brought down to an avoidable level.

The primary responsibility for Hygiene and Welfare, from farm to fork, rests with the Food Business Operator (FBO), including farmers who are recognised as FBOs under the Hygiene Regulations.

The Official Veterinarian (OV) in the abattoir is responsible for verifying the FBOs' responsibilities, through an effective and risk based ante/post mortem inspection and auditing system.

The hygiene regulatory framework provides flexibility that some species (poultry, farmed game, and bison) and all species in an emergency can, under certain conditions, be slaughtered on farm. This practice, although desirable from the welfare point of view, is not realistic – it means that is not always possible to meet the hygiene standards on farm level.

Animals are usually transported to the slaughterhouses. Handling of animals 'from farm to abattoir, however humane, inevitably causes various degrees of stress. As a consequence the quality of the final product (meat) may be affected with some conditions such as Pale Soft Exudative meat (PSE) and Dried Firm Beef (DFD). Post mortem inspection may also discover the various degrees of bruises on carcases. Such lesions will have to be trimmed before meat is sold for human consumption, and as a consequence the FBO would suffer financial loss. Stressed animals are more likely to shed larger number of pathogens that may be present in clinically healthy animals (E. Coli, Salmonella). This is significant for food safety because the increased risk of cross contamination of these pathogens; both between live animals, and from animals to meat during dressing.

Presentation 14 Continued.

Stunning and bleeding of animals must be done humanely and hygienically. An example of this could be that chest stick compared to transverse cut would be beneficial for welfare of animals (faster bleeding) and public health (minimal neck contamination). However, there are some other cases where the perceived hygiene and welfare benefits may not pull to the same direction. For example it is known that animals that have been reared in a welfare friendly environment (outdoors) carry a higher number of food borne pathogens, e.g. Campylobacter, Salmonella, compared to indoor farming.

Good Welfare and Food Safety start on farm level. The talk will attempt to give an overview of both, and address some of the relevant issues in the interests of two main players, the people and animals.

There should not be much argument in saying that healthy animals produce safer food. But is it always a case?

Session 5: Presentation 15

Best practices and procedures for monitoring and enforcement of animal welfare requirements at state level

Jane Downes
Meat Hygiene Service

Session 5: Presentation 16

Best practices and procedures for monitoring and enforcement of animal welfare requirements at individual organization (slaughterhouse) level.

Dr Martin von Wenzlawowicz
Bsi. Schwarzenbeck, Training and Consultancy Institute for Careful Handling of Breeding and Slaughter Animals

Animal welfare in the slaughterhouse depends on the animals, the personnel and the existing technical and constructional prerequisites. Quality of handling and technical lay out is not depending on the size of the enterprise.

Animal welfare is best in those slaughterhouses where the attitude towards humane methods of slaughtering is incorporated, whereas if this attitude is not apparent, a lot of offences against enforcement of animal welfare rules and regulations and resulting expenditures can be found.

Procedures for the assessment of animal welfare in the slaughterhouse should be focussed on all possible kinds of impact leading to stress, unnecessary suffering or pain before or during slaughter. For each species and stunning system certain key points exist, where regular monitoring is mandatory. However there are different rankings concerning the importance of these key points (from general to detail). One of the very general key points is stunning effectiveness, a parameter which summarizes the quality of several factors like stress level of driving system, properties of stunning devices and alarm systems, skills of stunning and sticking personnel. Each of these factors has to be checked more carefully if stunning effectiveness is not satisfying.

Monitoring welfare requirements either through human spot checks or using technical support like video surveillance or measuring, protocol and alarm devices can only be effective, if people are skilled and measurements are done correctly and reasonable. The use of checklists and control samples can help to standardise the procedure. However many data are collected without leading to detect and avoid deficiencies. If results are not analysed, and clear responsibilities are missing any enforcement of animal welfare will lack from the beginning.

In terms of welfare enforcement a good cooperation between animal welfare officers and competent official veterinarians is beneficial. Possible dependency between companies and competent authorities can be antagonised by superior independent inspections. Auditors and inspectors must be competent and apply the same standards to everyone. Requisitions and audits by the retail industry support the efforts by the company and official surveillance.

A common problem is that bad animal welfare (e.g. driving systems and races) often is based on mistakes during planning and construction of slaughter plants. Careful planning and good consulting service can avoid these mistakes, which often later on can only be solved by spending a lot of money.

The level of knowledge of the personnel as well as the responsible veterinarians is not always as good as it should be. Further education can prevent this insufficiency.

Presentation 16 continued:

Economic pressure can cause a lot of problems. E.g. bad handling caused by low-cost workers of subcontractors - often not able to understand the language - is a recent problem. Also these workers have to be properly trained and licensed if they work with living animals - a challenge for the industry as well as for the official supervision.

Until now legislation has not been enforced by all member states of the EU to ensure proper handling and effective stunning of every animal slaughtered. The diversity or even errors in interpretation of the present EU directive makes it difficult for the official vets to realise and avenge offences.

In the future regulations should be improved to provide clear guidelines to the industry about what is expected to safeguard animal welfare as well as to facilitate enforcement.

Session 6: Presentation 17

Experience gained from dealing with Newcastle Disease

Professor Pam Hullinger
Lawrence Livermore National Laboratory

Session 6: Presentation 18

Experience gained from dealing with killing for control of Foot and Mouth disease

John Moffitt BVM&S MRCVS
Veterinary Officer, State Veterinary Service, Carlisle Animal Health Division Office

This presentation will give delegates the opportunity to be given information on the 'first hand' experiences of a veterinary surgeon who worked as a Temporary Veterinary Inspector (TVI) during the Foot and Mouth Epidemic in the United Kingdom in 2001. Information will be given on the challenges faced when culling / killing red meat animals for disease control purposes along with the problems in organisation and logistics required to complete that operation.

The methods used for culling cattle and sheep in Cumbria and Yorkshire in 2001 will be explained and a summary will highlight the key points faced 'in the field', under difficult conditions, in matters of planning and implementation.

The use of a 'field abattoir' and mass burial site, to deal with the disposal of a large number of carcases, at Great Orton, Cumbria, will be discussed.

Session 7: Presentation 19

Auditing and reporting animal welfare in slaughterhouses – An independents auditor's perspective.

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Objectives

- Understand how independent auditors work
- Review the role of independent auditors in welfare assessment
- Review the role of retailers' quality assurance schemes in setting welfare standards
- Areas of common interest, and differences, with state monitoring/inspection authorities

Whatever we call it to most it means adding stress to an already fraught process. How can we ensure that an independent audit adds value to our business rather than cost?

Typical Audit Flow

- Appointment
- Opening Meeting – what is going to happen and why?
- Inspect the process
- Inspect and verify records
- Inspector's "quiet" time
- Closing Meeting – Feedback and signing off.

Everyone who is being audited has the right to understand the process, preferably before it starts. They have the right to question and understand what is being observed and the conclusions or issues it raises. Most importantly they also have the right to be respected, ensuring that their views are being listened to and acknowledged.

During an audit we are working with you to demonstrate compliance against a known standard, we are not looking to catch you out. Non conformances are most often raised because the requirement was misunderstood, rather than because a business is not willing to comply. Use an audit to understand the interpretation of the standard and the reasoning behind it. A competent auditor must be able to explain both what they are looking for and why. Hiding behind the phrase "because it says so" is a sign of a weak auditor.

At the end of an audit you should have a clear understanding of your strengths and weaknesses as well as understanding what is required to improve. An auditor will not provide solutions, this is your job. Our role is to ensure you understand why what you are doing does not comply and why compliance is important. Your management team is then the right group to decide how sustainable compliance will best be achieved for your circumstances.

Presentation 19 continued:

Retailer standards aim at providing a level playing field, across their supply base. Commonly based on the law of the land and production methods employed in the country in which their consumers reside. Ensuring that customer expectations are met, despite the fact that product may be sourced globally. Retailers have the power to influence at all levels; this can be used positively to improve animal welfare standards worldwide.

Basing standards on UK law will often create conflict with local customs and laws, putting independent auditors at odds with state enforcement agencies. Within Europe, often the difference is interpretation of EU Directives by different member states or different implementation strategy. Outside the European Union it is rare for a local law to prevent compliance with UK welfare law; it perhaps just doesn't encourage it. However, conflicts between Health & Safety or Food Safety laws and Animal Welfare law is more likely to work against improving welfare standards, particularly in countries which have yet to address the legislative rights of animals at slaughter.

Session 7: Presentation 20

Reporting and evaluating animal welfare under disease control situations.

Professor Pam Hullinger
Lawrence Livermore National Laboratory

Session 7: Presentation 21

Auditing welfare standards at red meat abattoirs.

Neville Gregory[1] & Tess Benson[2]
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This presentation considers how standards during transport, handling and slaughter can be monitored. It describes some current methods used in various parts of the world. It includes the critical control points of various systems, what should be evaluated and ways in which these evaluations can be done. Although much of this assessment is by subjective visual observations, a number of objective assessments can be used including post mortem examination of the carcases.

The defects that auditing detects can relate to design of the facilities and problems which occur due to staff error.

Throughout the presentation key points in facility design, staff training and operating procedures will be described to enable the audience to formulate there own standards, checklists and assessments which are specific to your own industry/system.

Session 8: Presentation 22

Collection of specific information to contribute to the development of internet learning facilities relating to humane slaughter and killing

Dr Barbara Alessandrini
OIE Collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Weflare. Instituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise

Manuscripts

Session 1: Presentation 1

Introduction: The importance of animal welfare and of good design of facilities and systems

Dr James Kirkwood
Humane Slaughter Association & Universities Federation for Animal Welfare

Welcome and Introduction

We welcome everyone to the city of Bristol and to this International Training Workshop on welfare at slaughter and killing for disease control. We are very pleased to have delegates from so many countries (at time of writing we are expecting delegates from 56 countries) and to have such expertise and experience among the participants in the subjects of livestock slaughter for food production and of killing for disease control reasons. This meeting provides an opportunity to share knowledge of recent advances and of experiences gained in these subjects and we hope that all participants will contribute actively to the workshop.

Around the world, concern for the welfare of animals - the quality of their lives, as they experience them - has been growing. Although interest in the subject is certainly not new - respect for and kindness to animals have been advocated through history in many cultures – the remarkable drive for systematic development of welfare legislation and standards that has occurred in many countries, particularly during the last 25 years, is unprecedented. Why is the subject being given such increasing prominence? Various factors may have played a part in this, but perhaps the most important of these has been the growing scientific evidence and consensus that the capacity for sentience - for conscious awareness of feelings - is not limited to humans alone but is present also, at least, in those animals that share the vertebrate central nervous system design. It is now accepted that, like us, livestock animals have the capacity to consciously experience pleasant and unpleasant feelings. With the recognition of this has come a widespread awakening to (or re-emphasis of) our moral responsibility to carefully take animal=s feelings into account, as far as possible, in all our dealings with them. Although some variation in attitudes may remain among individuals, cultures and nations in the weighting given to concern for animal welfare, it is clear that this new science-based emphasis on animal welfare has already become a global phenomenon.

My aim, in this introductory paper is to briefly outline the scientific basis of concern for animal welfare and some principles of welfare assessment, emphasise the importance of welfare at slaughter and killing for disease control and, especially, the need for good design of facilities and systems, and finally, to outline the structure of the training workshop.

Animal sentience and animal welfare

Discussion about animal welfare is often complicated by differences in understanding of what exactly concern for animal welfare is a concern about (Fraser et al, 1997). So it is worth discussing this briefly here.

There seems now to be quite a widespread consensus amongst welfare scientists that concern for an animal=s welfare is concern for its feelings - concern for the quality of its life as it consciously experiences it. This is in line with the view also held commonly among the general public. Thus, I have suggested that welfare is: *the balance, now or through life, of the quality of the complex mix of subjective feelings associated with brain states induced by various sensory inputs and by cognitive and emotion processes* (Kirkwood, 2004). This capacity to consciously feel or experience something is called sentience. Except when deeply asleep or in some pathological states, the lives of us humans are characterised by many kinds of feelings. Some of these, including sights, sounds, tastes, warmth and cold,

and the various sensations arising from touch, are associated with our external sensors. Others are associated with internal sensors that provide our brains with information about the states of our bodies. The latter include general, non- or only vaguely- localised feelings such as exhaustion, malaise, nausea or delight, and localised feelings such as specific aches and pains. Furthermore, we experience a spectrum of feelings associated with the thoughts and emotions that may be prompted either by the inputs from these internal and external sensing devices or (it seems) by the constant internal conversations - some conscious, some subconscious - of our brains.

We can expect that the nature and range of feelings experienced by animals vary between species depending on their sensory and cognitive capacities. For example, bats have a capacity that we absolutely lack, in that they may be able to form a conscious awareness of their environments using echo-location rather than using sight. To give another example, the unpleasant feeling of embarrassment, which depends upon having the cognitive capacity to make inferences what others may be thinking about us, may be uniquely human (or limited to humans and our closest relatives only). However, there is very strong evidence that that the capacity to experience negative and positive feelings relating to basic functions of existence (eg pain, fear, warmth, satiation) evolved early and are widespread in the animal kingdom, including all the vertebrate species kept as livestock.

Concern for animals' welfare is concern for their feelings and adoption of the ethical position that it is wrong for us to cause other animals to endure unpleasant feelings, at least unnecessarily. Concern for welfare is not focused primarily on physical health or evolutionary fitness but on their consequences as experienced by the animal. Health and evolutionary fitness are, however, usually of uppermost importance to animal welfare because threats and insults to them are typically associated with very unpleasant feelings.

Historically, at least in the west, there has been controversy, led by a number of religious and philosophical authorities about animal sentience (as reviewed, for example, by Rollin, 1989), and doubts about this were antagonistic to concerns for animal welfare. However, there is now a strong scientific consensus that sentience is not limited to humans as I will briefly outline below.

The scientific basis for concern for animal welfare

The Judaeo-Christian religion taught that humans were separately created by God (in his own image). It was easy, within this framework, to believe that humans were quite different and distinct from animals. It was widely believed that humans had immortal souls but that animals did not. The philosopher René Descartes (1596-1650), the founder of modern western philosophy, argued that only humans had minds and that animals were merely machines whose behaviour was purely reflex and automatic. Influential religious and philosophical authorities, in teaching that animals have no feelings and that concern for them was therefore misguided, seriously undermined the rationale for kindness to animals. Such doubts about animal sentience were widespread in Europe until quite recently and undermined the basis of concern for animal welfare. However, this view of animals as insentient machines became increasingly inconsistent with the emerging evidence from a range of fields of science over the last 150 years or so, as I will now briefly outline.

Charles Darwin=s *Origin of the Species*, published in 1859, provided a crucial new insight. In showing that we have a common ancestry with other animals it became apparent that we were not fundamentally different from them. It opened the door to the possibility that sentience may have evolved long before humans and that it might be widespread in the animal kingdom.

Until relatively recently, it was believed widely that investigation of consciousness or sentience, of the subjective experience feelings, and of the nature of these feelings and how they could be generated, was beyond the scope of science. However, about 25 years ago, this view began to be challenged. It was argued that, since we know from our personal experiences that sentience exists, then:

- it must depend upon some neuronal >machinery= and that it might be possible to determine this, and
- it is likely to confer some evolutionary advantage and it may be possible to explore this also.

These ideas suggested approaches to the scientific investigation of sentience and its neuroanatomical basis. During the last 25 years there have been remarkable advances in pursuit of these lines of thought.

Evidence that other animal species are sentient comes from a variety of scientific fields as illustrated below.

(i) Similarities in neural structure, architecture and function between humans and other animals

Although the human brain, and especially the cortex, the part that plays an important role in cognition (thinking), is larger in relation to body size than brains of other animals, there are very great similarities between humans and other mammals in the design and function of the nervous system.

Remarkable progress is being made in efforts to determing which parts of the brain are involved in the generation of conscious feelings (sentience). The approach pursued by Crick and Kock in their quest to understand the basis of consciousness has been to focus on the neural correlates of visual consciousness - to determine the essential components (Koch, 2004). What are thought to be the key elements at the present time? Parvisi and Damasio (2001) suggest that representations in various brainstem nuclei, of the current state of the organism, form key input to more rostral brain structures (the cortex) for the generation of more composite representations of the state of the organism in relation to its environment and that these representations coincide with sentience. Koch (2004) has suggested that the conscious perception of objects may be associated with electrical activity circulating between particular nerve cell populations in the inferior temporal cortex or the medial temporal lobe and the prefrontal cortex. Current theories tend to the idea that conscious awareness is likely to depend on the activity of recurrent circuits between parts of the brain stem and somatosensory and cingulate cortices (Damasio, 1999), between the cortex and thalamus (Churchland, 1996; Edelman & Tonini, 2000) and within the cortex. Debate continues about the point during evolution when sentience evolved (Kirkwood, 2006). Edelman (2004) proposed that the point in evolution at which the necessary reciprocal connections between the thalamus and cortex appeared was around 300 million years ago. However, there is a widespread view that the capacity for conscious awareness (sentience) may have arisen considerably before then – prior to the divergence of mammal and avian lineages, maybe associated with the emergence of fish and perhaps prior to that.

(ii) Self-administration with analgesics

It has been shown that some species of mammals and birds with chronically painful conditions (arthritis) can learn to self-administer analgesics (eg Danbury et al, 2002). It is highly plausible that self-administration of analgesics in these circumstances is evidence of consciousness of pain.

(iii) Behavioural studies

To be sentient is to have the capacity to be aware of something - to have something in mind. One approach to detecting sentience is to find ways to get animals to report or reveal what they have in mind (thus confirming that they have one). Koch (2004) has proposed that sophisticated actions that require retention of information over seconds (between receipt of information and the start of a response) might be a useful practical test for consciousness in animals.

One approach to asking animals what they have in mind is that used by Inman and Shettleworth (1999) and by Hampton (2001) to enquire of pigeons and macaques respectively whether or not they >know= when they remember an image they had recently been shown (the macaques could). Of course, this particular approach aims to test for consciousness of memory, and would not tell us about consciousness of other phenomena such as feelings of fear or pain.

(iv) Evidence from study of the effects of natural or induced damage to parts of the brain

Another compelling demonstration of an animal directly reporting of what it is conscious of comes from investigations of a brain defect resulting in the condition of 'blindsight'. Humans with blindsight, in which there is loss of sight in part of the visual field continue to be able deal appropriately with visual information in this part of the field (Weiskrantz, 1997). Effectively their minds are blind but their bodies can see to some extent, using visual processing systems that are not consciously accessible. Such patients can for example, if asked, correctly point to a source of light, whilst reporting that they see nothing. Cowey and Stoerig (1995) discovered that, macaque monkeys with blindsight could, after learning the test methods, likewise respond appropriately to visual stimuli whilst reporting, by pressing a pad, that they did not see the stimulus. Some of the other ingenious approaches to trying to devise ways to enable animals to reveal whether or not they have the capacity for consciousness have been reviewed recently by Griffin and Speck (2004).

(v) Consideration of the design and complexity of neural architecture

Paul Churchland (1996), addressing the problem from the perspective of the science of artificial neural networks, has argued that the neural equipment, the type of circuitry, that is thought likely to be necessary for important elements of consciousness (or at least some aspects of it, namely: short-term memory, independence of sensory inputs, steerable attention, capacity for alternative explanations of complex or ambiguous data, and others) is present in all higher vertebrates. In his view: *>On the best evidence and theory currently available, the higher animals are just as conscious as we are=*.

In the light of the compelling evidence that has emerged, it has come to be generally accepted that sentience evolved long before humans. This is reflected in the historic agreement by the European Heads of State at the Amsterdam Summit in June 1997, to make provision in the Treaty of Rome (which established the European Community in 1957) *'…to ensure improved protection and respect for the welfare of animals as sentient beings.'* Although it remains difficult to be certain where the boundary line between sentient and insentient species lies (Kirkwood & Hubrecht, 2001), there is consensus (reflected in modern animal welfare legislation) that all vertebrates should be considered to be sentient.

The growing importance attached to animal welfare by societies and nations around the world can be attributed, at least in part, to this new and robust scientific foundation for belief in animal sentience. Sentience implies the capacity to experience unpleasant feelings and thus the capacity to suffer, and societies have widely adopted the stance that we should do all we can to avoid causing suffering to animals.

Principles of welfare assessment

This Workshop is focused on welfare at slaughter and killing for disease control. It is appropriate to include here some introductory comments about the assessment of welfare.

We cannot directly gain access to or measure how other animals (or other humans) feel. We have to make inferences about this based on behavioural, clinical or other observations of the animal and in the light of knowledge of its biology and of our own experiences of pleasant and unpleasant feelings. The process of welfare assessment involves two steps. The first involves making an, ideally comprehensive, scientific description of the factors that may impact upon the animal's welfare: its state of biology, health and behaviour. The second stage involves making a judgement about the possible impact of these measurable parameters on how the animal feels (Kirkwood et al, 1994). The first step deals with objectively measurable parameters; the second involves making a subjective judgment. The subjectivity cannot be avoided but the problems associated with this can be minimised by making the bases for the judgements as explicit as possible. For example, if it is observed that an animal has a midshaft fracture of a limb bone, shows very marked lameness as a result, it is reasonable to conclude that it's welfare is compromised by severe pain. Similarly, if an animal is hypersensitive to sudden movements or sounds, shows extreme efforts to flee, and intense and frequent vocalisations, it may be reasonable to conclude that it is experiencing strong fear.

This process involves detailed knowledge of the clinical and pathological effects of the feature under scrutiny and an assessment of its impact on the animal's feelings based on observations and knowledge of their impact on its behaviour, and in the light of how similar conditions feel to humans.

A wide range of clinical, behavioural and post mortem observations can inform judgements about welfare. These include: grossly apparent signs of injury or disease, physiological changes (eg elevated respiratory or heart rate), changes in cellular, biochemical or endocrine concentrations in the blood, and changes in behaviour.

The quality of feelings may range from intensely unpleasant (as in severe pain or fear) to intensely pleasurable. The point, along this spectrum, at which feelings can be judged to be *unacceptably* negative, can be a difficult judgement. Pleasant and unpleasant feelings are (it appears) 'carrots and sticks' that motivate animals to perform valuable behaviours and to avoid, or minimise the adverse effects of various threats. In an animal's natural habitat these feelings are to some extent unavoidable side effects of the very business of living.

Generally, challenges that cause unpleasant feelings (eg fear or pain) that are brief, mild and not repetitive, or at least not frequently repeated, are not considered to have a significant impact on welfare. Welfare becomes a matter of greater concern when unpleasant feelings are more severe, and/or of longer duration, and when the animal is unable to react to limit them, either because it is prevented from doing so by its circumstances or because it lacks the capacity to do so.

However, these are matters of judgement, and it may not be easy to identify a point at which welfare challenges move from acceptable to unacceptable. Societies' views appear not always to be consistent but to vary according to circumstances, greater welfare insults being apparently accepted in the course of rodent control programmes, for example, than in the handling of animals at slaughter.

In practice, assessment of welfare, and the auditing the quality of animals' environments for their welfare, usually involves checking a combination of both 'resource-based indices' and 'animal-based indices'. Resource-based indices are features of the environment, for

example: suitable non-slip flooring, availability of fresh water in lairage, and use of appropriate, well maintained, stunning equipment. Animal-based indices are indices of the welfare of the animals themselves, such as: presence or absence of pain-causing disease or injury or of behavioural or other signs that may be indicative of poor welfare.

Resource-based indices are relatively straightforward to check, easily measurable and quantifiable but provide no direct information about animals' welfare. Animal-based indices can be inherently more difficult to obtain, because, for example, it is quicker and easier to check that drinking water is provided than that the animal is drinking it. Furthermore, using animal-based indices may involve making subjective judgments about, for example, whether or not certain behavioural or other signs are indicative of compromised welfare.

Grandin (2005) has reported the value of using key animal based indices in welfare improvements at slaughterhouses in the USA (these were: percentage of animals stunned on first attempt, percentage rendered insensible (had to be 100%), percentage falling during handling, percentage vocalizing during handling, and percentage moved with no electric goad). As Grandin (2006a) points out: '*An effective core criterion…*' (animal based index) '*…measures more than one problem*'. For example, focusing on keeping slipping rate below a set level, requires plants to address *all* the factors that may contribute to slipping (eg floor quality, lairage design, handling practices, and staff training).

Welfare at slaughter and killing

The drive to improve standards of animal welfare at slaughter that has gathered momentum around the world in recent decades can be attributed, partly, to the change in attitudes outlined above. This drive has lead to considerable investment, in a number of countries, in science aimed at understanding the principles of humane slaughter and in developing new technology. Important pioneering work in this field was undertaken in France (with the development of the bouterolle) and in Germany (with the development of specialised firearms) in the late nineteenth century (Heiss, 1903). Methods of handling, stunning and slaughter have been developed which approach the ideal of causing loss of consciousness and death without significant pain or fear, and with high levels of reliability, much more closely than used to be possible using traditional techniques (Grandin, 2000, 2006b; Gregory, 1998).

These modern methods have been adapted or used also for killing for disease control reasons. Dealing with outbreaks of infectious diseases of livestock that can seriously affect production or which are threats also to human health has become an increasing challenge associated with the large scale of livestock production and with environmental and demographic changes that may increase the likelihood and potential severity of these threats. Rapid, large scale culling is a key component of strategies for dealing with some of these threats such as Foot and Mouth Diseases and highly pathogenic strains of Avian Influenza (e.g. Raj et al, 2006), and for dealing also, at times, with knock-on potential welfare problems arising due to livestock movement restrictions for disease control reasons.

Methods of slaughter and killing for disease control reasons are very important animal welfare issues because of the extremely large numbers of animals involved. There are now over 6.5 billion of us humans (US Census Bureau, 2006) and we now keep more than 23 billion domesticated livestock animals for food production (Table 1). Each day tens of millions of these animals are slaughtered or killed and their welfare depends entirely upon the quality of the methods and practices used.

Table 1. World populations of livestock animals 2005 (FAO, 2006)

Species	Population (millions)
Cattle	1,355
Sheep	1,081
Goats	807
Pigs	960
Chickens	16,740
Ducks	1,046
Geese	302
Turkeys	280
Rabbits	537

The drive to improve and ensure welfare standards has led also to the development of quality assurance systems and it may be that consumer pressures will act to maintain or drive these standards higher. Consumers like to be confident that the products that they buy are from animals that have been well cared for throughout their lives and humanely slaughtered. Consumer pressure has become a powerful force in some countries and increasingly, international trade is likely to be possible only where there is evidence that agreed welfare standards have been observed. The recent OIE initiative (OIE, 2006a), resulting in the OIE Guidelines (OIE, 2006b; OIE, 2006c) is an important step in promoting good standards worldwide.

Food, space and other resources are limited on earth and the great challenge that we all now face is to try to meet the requirements of the large and growing human population whilst protecting biodiversity and the welfare interests of the animals with which we interact. High standards of welfare are very important and, at least in the context of animal welfare at slaughter, are achievable in practice.

The aims and structure of the Training Workshop

This workshop is an initiative towards fostering the worldwide promotion of high standards of livestock welfare at slaughter and killing.

The aims are, through providing an opportunity for those active in the field to develop their interests through tuition and through sharing knowledge and experiences to equip delegates to be able to assess, from the animal welfare perspective, that systems and operations have been well-designed, that good operating systems are in place, and that they are functioning properly.

The workshop includes sessions on the following:

- Relevant EU legislation and international framework
- Scientific background on the principles of humane handling and slaughter
- Main stunning and killing techniques in slaughterhouses in Europe
- Inspection and auditing of automatic systems
- Biosecurity, environmental and food safety issues
- Methods of killing for control of animal disease epidemics
- Best practices and procedures for monitoring, proper enforcement, and evaluation of animal welfare

- Collection of specific information in order to contribute to the future development of internet-based learning activities for veterinarians in this field
- Observation of modern slaughterhouse methods and practices

We hope also that workshop will assist in:

- developing a network of contacts and information resources to improve welfare at slaughter or killing and for
- helping to promote technology transfer programmes around the world, and for
- identifying current areas of concern and subjects for further research or action

All delegates have been circulated with the programme and the organisers will be available to advise about the arrangements for the lecture room sessions and the slaughterhouse visits.

The importance of good design of facilities and systems

One of the points we are keen to emphasise at this workshop is the importance to the welfare of animals of good design of facilities (buildings, slaughter/killing equipment) and the management systems used in running them. We hope that the course, including the slaughterhouse visits, will stimulate thinking on this subject and that, through liaison with contacts made at this workshop, we may all be able to help work towards further improvements to systems in the future.

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Session 1: Presentation 2

Protection of animals at slaughter and killing: a short overview of the European Union Legislation

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Background

EU legislation on the protection of animals at slaughter exists for more than thirty years. The current text on this issue is Council Directive 93/119/EC on the protection of animals at the time of slaughter or killing[1], which was adopted in 1993. The position of animal welfare within the body of EU legislation was subsequently strengthened in 1997 with the inclusion of a protocol on the protection and welfare of animals in the Treaty of Amsterdam (amending the EU Treaty)[2], which requires that in formulating and implementing relevant EU policies full regard must be given to animal welfare requirements, recognising that animals are sentient beings. The new EU hygiene and control rules applicable since 2006[3], the so called "hygiene package", include animal welfare and further define the responsibilities of both the food business operator and the Competent Authority (CA) and requires that clear procedures are established for checks and for corrective actions which may be subsequently necessary.

Key principles and responsibilities

Directive 93/119/EC requires that animals bred or kept for the production of meat, fur or other products are spared any avoidable excitement, pain or suffering during movement, lairaging, restraint, stunning, slaughter or killing. The primary responsibility for respecting this principle rests with the operators of the sites where animals are killed or slaughtered. The role of the CA is to organise and implement a control system to ascertain compliance with these rules. In slaughterhouses in particular, the Official Veterinarians are accountable for ensuring that animal welfare provisions are respected.

Council Directive 93/119/EC lays down minimum standards that apply to both day to day procedures in slaughterhouses and to situations where animals are killed outside slaughterhouses such as for disease control purposes. In slaughterhouses facilities and equipment must be constructed and operated so that the principle of avoidance of pain or excitement is respected. Staff working with live animals must have the knowledge and skill to perform their work humanely and efficiently and suitable methods and equipment for restraint, stunning, bleeding or killing must be used as listed in the legislation. In relation to killing during disease outbreaks, the CA may permit methods other than those listed, provided that these do not infringe the general principle of avoiding unnecessary excitement or pain.

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[1] Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing, Official Journal L 340, 31.12.1993, p 21.

[2] Treaty of Amsterdam amending the Treaty on European Union, the Treaties establishing the European Communities and certain related acts - Protocol annexed to the Treaty of the European Community - Protocol on protection and welfare of animals, Official Journal C 340, 10.11.1997, p. 110

[3] Regulation (EC) n° 852/2004 of the European Parliament and of the Council of 29 April 2004 on hygiene of food stuffs OJ L 139, 30.04.2004 p 3, as corrected OJ L 226, 25.06.2004 p.3-21.
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Regulation (EC) n° 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for food of animal origin OJ L 139, 30.04.2004 p. 83, as corrected OJ L 226, 25.06.2004 p.3-21.

Monitoring and enforcement of activities in the slaughterhouse

In order to ensure that the technical rules are followed, the CA of each Member State has established a system of control. Commission experts from the Food and Veterinary Office (FVO) have evaluated such systems and where gaps have been identified, have made recommendations for actions to be taken by the CAs. The FVO reports are published on the website of The Directorate General Health and Consumer Protection [4].

Although not all the EU animal welfare requirements are relevant for the approval of establishments, when giving their approval for a slaughterhouse to operate, the CA must ensure that the food business operator has taken into account aspects such as the size and design of the lairage. The CA needs to regularly monitor the maintenance of facilities and equipment so that over the course of their use these continue to remain in adequate repair. Regarding the competence of slaughterhouse staff, either the CA has a system for licensing slaughtermen or alternatively they ensure that these people have the necessary knowledge and skill through close supervision on a day to day basis.

The coming into force of the "hygiene package" in 2006 has required changes to training and supervision programmes, which are being progressively introduced. A higher level of supervision is required, in particular as the provisions of Council Regulations (EC) No 882/2004 and No 854/2004 require that official veterinarians or auxiliaries performing the checks should be specifically trained on animal welfare issues and should perform regular documented checks from the time of arrival of the animals at the slaughterhouse until their death. Better performance of checks and recording of the results should allow the CAs to develop strategies to achieve better compliance and better plan their inspection activities, which will be part of a single integrated multi-annual control plan addressing all the activities of the CA in relation to the "hygiene package".

Monitoring and enforcement outside the slaughterhouse

The same methods listed for slaughterhouses must also be used outside the slaughterhouse, but the CA can grant a derogation from these methods for poultry, rabbits, pigs, sheep and goats killed for the owner's personal consumption, again provided that the principle of avoidance of pain or suffering is respected. There are specific requirements in the legislation for specific sites where animals are routinely killed, such as on fur farms where killing takes place at the end of the production cycle or in poultry hatcheries.

On most farms, the killing of animals is not a common occurrence; however, situations do arise where animals become sick or injured and must be killed on the spot. This is more likely on farms where there are large numbers of animals and arrangements made will differ depending on whether the carcase is intended for human consumption of not. In either case it will have to be ensured that animals are spared any avoidable pain or suffering, and where the carcase is destined for human consumption a veterinarian will carry out an ante-mortem inspection prior to slaughter. Checks of animal welfare on farms are carried out to fulfil the requirements of other EU legislation concerning standards of housing and management and such visits also provide the CA with an opportunity to assess arrangements for killing animals on farm. By monitoring the condition of animals arriving at slaughterhouses, the CA can also detect cases where animals should have been killed on the farm rather than being transported for slaughter. Animals arriving with conditions which should have precluded them from transport prompt an investigation by the CA with a view to possible enforcement action.

To kill large numbers of animals on farm during disease outbreaks requires significant planning, with prior arrangements made to ensure that there is adequate equipment and personnel available. Details of the chosen killing methods do not have to be included in contingency plans at present but those CAs who have previous experience of such

[4] See http://ec.europa.eu/food/fvo/specialreports/index_en.htm

problems, have given particular attention to practicalities such as, depending on the method, the number of animals that can be humanely killed per hour and have analysed data from previous outbreaks to improve their ability to react to any such future scenarios.

Future developments

Some of the technical rules listed for stunning and killing animals in Council Directive 93/119/EC need to be updated to take into account recent scientific opinions on slaughter and recent experiences acquired in killing large number of animals during outbreaks of contagious diseases. The European Food Safety Authority (EFSA) opinion and report on stunning and killing[5] is being considered in the context of a future proposal to amend EU legislation on this topic. In addition to providing detailed information on the advantages and disadvantages of each method of killing, the EFSA report also acknowledges that any potential conflict between animal welfare and hygiene requirements needs to be considered if requirements are to be successfully implemented.

Conclusion

National competent authorities have ensured a better level of compliance with the requirements of Directive 93/119/EC where they have trained their inspection staff and established a documented system of checks. In slaughterhouses it is important that official veterinarians check the competence of staff and the maintenance and performance of stunning equipment. In relation to killing outside slaughterhouses the CA need to work closely with other bodies to ensure that adequate arrangements are in place and practical evaluations carried out of the killing methods.

([5]) see, http://www.efsa.eu.int/science/ahaw/ahaw_opinions/495_en.html

Session 1: Presentation 3

Protection of animals at slaughter and killing: International context

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Introduction

The process of killing animals is one of the most brutal types of relationship that humankind can establish with animals. Although it appears to many of us that killing is necessary and justifiable in several instances, this process undeniably raises ethical issues. Some people totally reject this principle and do not even accept killing animals for their meat. However if slaughtering animals for human consumption is acceptable to the majority of people, it does not necessarily follow that those same people consider killing animals exclusively for their fur is also justifiable. For most consumers killing is only acceptable if it is properly and humanely done. This is probably why, among legislation applicable to farm animals, the legislation to protect animals at slaughter or killing[6] is the oldest one. Legislation on this area is still a challenge today because of the variety of species concerned, the diversity of techniques used and the constant evolution of technology. In some religions and cultures, slaughtering methods are also governed by particular rules and traditions, and these often form a central element of their faith or heritage.

A short history

The first European legislation on slaughter probably originated in the UK in 1933 where stunners became compulsory for the slaughtering of cattle, calves and pigs[7]. However, the first international legislation came only in 1974 with the adoption by the European Community of Directive 74/577/EEC[8]. In 1979 the Council of Europe adopted the European Convention on the Protection of Animals for Slaughter (ETS No 102)[9]. In 1993 the European Community adopted a new Directive (Directive 93/119/EC)[10] which not only provides more detailed provisions applicable to slaughterhouses but also extends the scope of the EU legislation to the killing or slaughter taking place outside slaughterhouses. The first worldwide initiative on this issue was taken by the World Organisation for Animal Health (OIE[11]) in 2005 where the OIE international Committee adopted among other animal welfare standards two guidelines on slaughter and killing.

The World Organisation for Animal Health (OIE)[12]

The OIE is an intergovernmental organisation initially created[13] to exchange information on animal health issues between veterinary services of the member countries. Its role has progressively evolved in particular following the signature of Sanitary and Phyto-Sanitary (SPS) Agreement in 1995, one of the fundamental agreements of the World Trade Organisation. For animal health and zoonoses, the standards, guidelines and

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6 The wording "*slaughter*" is used here for the process of killing animals for human consumption while "*killing*" is used for any process leading to death whatever the purpose.

7 See http://www.hsa.org.uk/

8 Council Directive 74/577/EEC of 18 November 1974 on stunning of animals before slaughter **(***Official Journal L 316 , 26/11/1974 p. 10 -11).*

9 http://www.coe.int/T/E/Legal_affairs/Legal_co-operation/Biological_safety%2C_use_of_animals/Slaughter/A_texts_documents.asp#TopOfPage

10 Council Directive 93/119/EC of 22 December 1993 on the protection of animals at the time of slaughter or killing **(***Official Journal L 340 , 31/12/1993 p. 21 – 34)*

11 The "*OIE*" stands for "*Office International des Epizooties*" the former name of the organisation.

12 Information of this section originates from the OIE website where further details can be consulted: http://www.oie.int/eng/en_index.htm

13 The OIE was created in 1924.

recommendations developed by the OIE provides the benchmark under which global trade in live animals and animal products is carried out under the SPS Agreement.

One of the guiding principles of the OIE is to establish standards and guidelines on scientific data. OIE standards are recognised throughout the world and by the World Trade Organization. They are prepared by elected specialist commissions and by working groups bringing together internationally renowned scientists, most of whom are experts within the network of 156 collaborating centres and reference laboratories that also contribute towards the scientific objectives of the OIE. These standards are adopted by the International Committee (where today 167 member countries are represented). The most famous documents internationally known by nearly all veterinary services around the globe are the International Animal Health Codes (Terrestrial and Aquatic) and the Manuals of Diagnostic Tests (one for Terrestrial Animals and another one for Aquatic Animals).

The OIE and Animal Welfare[14]

A permanent Working Group on Animal Welfare was established in 2002 to coordinate and manage the animal welfare activities of the OIE. The five OIE regions of the world (Africa, Americas, Asia Far-East and Oceania, Europe and Middle-East) are represented in this working group taking into account a large variety of beliefs and religious faiths.

Animal welfare was identified as a priority in the 2001-2005 OIE Strategic Plan. OIE member countries had decided that, as the international reference organisation for animal health and zoonoses, the OIE must provide international leadership on animal welfare. Even though animal welfare is not covered by the WTO SPS Agreement, member countries wished to have guidelines and recommendations to assist them.

The International Committee had decided that the OIE would give priority to the welfare of animals used in agriculture and aquaculture, and that, within that group, the topics of transportation, humane slaughter and killing for disease control purposes would be addressed first, followed by housing and management. Other topics, such as research animals and wildlife, would be addressed as resources permitted.

In 2005 the OIE adopted five guidelines on animal welfare as part of the Terrestrial Animal Health Code (Section 3.7 of the Code). Three guidelines relate to the transport of animals while two concern the slaughter and the killing of animals.
The Code is revised every year including the animal welfare chapter.

OIE guidelines on the welfare of animals at slaughter or killing

It is not the purpose of this paper to reiterate the OIE guidelines as these provide comprehensive information in their own right. The short overview will be presented here only in order to illustrate the main ideas contained in the guidelines. However it should be stressed that ensuring the protection of animals at slaughter or when killing for disease control purposes requires a highly specialised knowledge and skill and the complete reading of the OIE guidelines is strongly recommended. These guidelines have no direct legal effect as there is today no international agreement referring to them. However they represent a very useful basis for establishing national standards or bilateral agreements in this field.

Guideline for the slaughter of animals for human consumption

This guideline is organised following a logical order starting from the arrival of the animals in the slaughterhouse to the final bleeding (moving and handling animals, lairaging, restraint, stunning, bleeding). A particular article is dedicated to the management of foetuses during slaughter as some industries may collect uterine, placental or foetal tissues. The guideline is concluded by a list of unacceptable practices of restraint, stunning or slaughter.

[14] Information of this section also mainly originates from the OIE website (see footnote 7).

One of the general principles of the guideline is to establish a strong link between animals' behaviour and the way handling procedures are carried out and facilities are designed and constructed. Depending on the species, animals have different perception and understanding of their environment (in particular compared to mankind). Most farm animals are social and do not like to be isolated, they usually have a more developed sense of smell and hearing while their visual sense is sometimes limited in distance. All those differences are particular critical in the way facilities are designed in order to unload and drive the animals until the lairage or to the slaughtering place. Knowledge of the staff of animals' behaviour and perception is also essential to ensure proper protection of the animals as well as workers' safety. The guideline provides examples of monitoring tools to assess the level of animal welfare during those operations. Recommendations are made to shorten the waiting times before animals are unloaded and before being slaughtered. One of the noticeable elements to ensure good welfare at this stage is to sort animals immediately after being unloaded, and to act promptly and efficiently where specific requirements are necessary such as emergency killing (killing on the spot animals that suffer), priority slaughter or providing special care (e.g. milking cows). The use of violent acts or shouting at animals is not recommended as animals get agitated and less controllable.

The guideline lists several restraining techniques necessary to optimise the stunning procedure. Procedures that hide or limit the expression of pain of the animals (electro-immobilisation, "*puntilla*") or their ability to move (leg tendon cutting) are not considered as acceptable on animal welfare grounds.

Detailed recommendations on the stunning methods are provided in the guideline for the main livestock species with the most essential parameters as regards mechanical, electrical and gas stunning methods. The guideline also contains useful information regarding bleeding techniques (two carotids, stun-to-stick intervals and minimum waiting time before applying further procedures).

<u>Guideline for the killing of animals for disease control purposes</u>
This guideline insists on the need to include animal welfare concerns in contingency plans for disease control purposes. It is in particular critical to identify in advance a sufficient number of personnel properly trained and skilled to perform the required killing.

Killing for disease control almost always occurs in emergency situations where usually a high number of animals should be killed and destroyed in a short period of time. It may also be necessary to carry out slaughter in premises that may not be fully developed for such operations. The level of preparedness is therefore essential to ensure a smooth implementation of the operations. As a consequence it is necessary to integrate in the contingency plan the animal welfare dimension at the same level of importance as other factors (epidemiological, environmental, financial and social).

The guideline suggests a specific organisational structure and defines the respective responsibilities of the different operators of the team involved with the killing operations.

Detailed recommendations on the killing methods are provided in the guideline for the main livestock species with the most essential parameters as regards mechanical, electrical and gas killing methods.

<u>EU legislation and OIE guidelines</u>
The EU legislation shares the same principles of the OIE guidelines. However the EU legislation covers presently a slightly wider scope than the OIE Code (killing of fur animals and surplus day-old-chicks are for example covered by the EU legislation).

As regards slaughter for human consumption, the EU legislation is very close to the corresponding OIE guidelines. However, the EU places more emphasis on the need for competent and skilled personnel, and this element could be usefully developed further by OIE. EU provisions also particularly stress the importance of proper maintenance of the equipment used for restraining and stunning animals, as well as the need for back-up methods. However the current EU Directive has not been amended since its adoption in 1993 and a number of technical and scientific developments have taken place since then. In particular some technical parameters need to be updated. Following a request from the European Commission, the European Food Safety Authority (EFSA) adopted in June 2004 an opinion related to the welfare aspects of the main systems of stunning and killing the main commercial species of animals[15]. This scientific opinion contains recommendations that the European Commission will consider when revising the EU legislation. In particular the present EU rules does not contain many technical requirements on the killing of animals for disease control purposes while there is an increasing demand in this field in Europe.

Conclusion

Animal welfare is a growing concern throughout the world. Although it is sometimes perceived among some veterinary officials as a luxury for a minority of consumers from developed countries, the recent interest of the OIE in this field indicates that this concern is shared in different parts of the world, by citizens with various historical, cultural and religious backgrounds.

The act of slaughter has always been considered by human societies as unsavoury, but also as a necessity given that most people wish to eat meat. As meat becomes affordable, its acceptance continues to be more closely linked to the compliance with animal welfare rules in particular at slaughter. Food safety inspectors working in slaughterhouses have a special role to play in this regard. *Ante-mortem* inspection is already required for reasons of food safety, and animal welfare should be integrated into this process.

Killing animals for disease control is increasingly less accepted in Europe. It often involves the use of public money and the general public does not always perceive the benefit of such massive killing, in particular for animal diseases that are not transmissible to humans (e.g. foot-and-mouth disease). Therefore killing animals for disease control should be carried out in the most professional way, complying with the highest possible welfare standards for both the sake of the animals, but also to prevent further erosion of public confidence in the need for killing for disease control purposes.

In this regard the OIE guidelines have achieved an enormous step in this direction by providing practical and achievable standards by all regions of the world. They not only provide an excellent science-based reference for international agreements in this field but a solid source of inspiration for industries and veterinary services which want to establish their own standards in this area.

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[15] Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to welfare aspects of the main systems of stunning and killing the main commercial species of animals, *The EFSA Journal* (2004), 45, 1-29.

Session 2: Presentation 4

Anatomical and physiological principles relevant to handling, stunning and killing red meat species.

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Pre-slaughter handling

When animals are put up for slaughter they are usually confined, separated and restrained. This allows controlled application of the stunning equipment. Separation is achieved with the animal

- free-standing on its own in a stunning pen or a confined situation
- restrained on its own in a stunning pen
- restrained in a conveyor

The animal may try to avoid being isolated from its pen mates, and it needs to be stunned quickly once it has been separated. Otherwise they can panic and behaviour becomes unpredictable. Selecting an animal for stunning which is free-standing amongst a group of animals in a stunning pen involves less stress than complete isolation. However, if the whole group becomes disturbed this system can be chaotic, and applying the stunning equipment is less controlled.

Loading a stunning pen can present problems if the animal refuses to enter. Refusal is usually due to a front wall, giving the impression of a dead end. One solution at a pig abattoir was to have vertical bars at the front of the pen, which were set about one metre from the wall. This provided sufficient view ahead to stop the pigs balking.

Individual animal restrainers are used for small stock and deer. Some have pneumatically operated side walls that serve as a V-restrainer. Designs used for pigs include:-

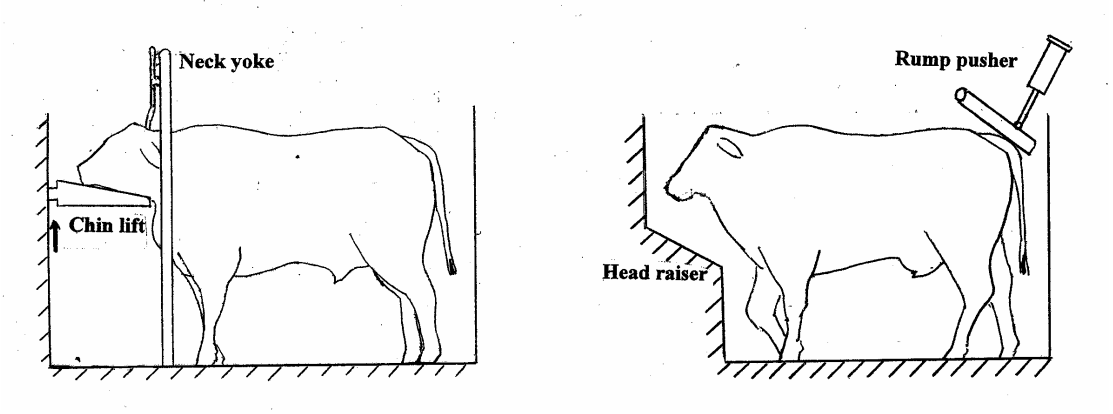
- V-restrainer with tilting floor and one lifting side
- V-restrainer with one lifting side and the opposite side pivoted to eject the pig
- Lifting V-restrainer with a pivoted side allowing the pig to be dropped onto a horizontal bleeding table.

When installing these restrainers in pig abattoirs it helps if there is no change in floor material at the entrance, otherwise loading the animal can be difficult.

Supplying animals at an even unhurried pace to a restraining conveyor, and loading them into the conveyor, can also be difficult. If the rate at which they are being stunned at the other end of the conveyor is slower than the speed of the conveyor, the conveyor has to be started and stopped for each animal. This stop-go situation is highly disruptive for animals in the raceway leading to the conveyor, and in the case of pigs they have to be bullied, often with a goad, to get them to move at the right time. Heel bars are often used to stop pigs backing up raceways. These can be effective but at some plants they are set too high above the floor, making it difficult for some pigs to walk over them when moving forwards.

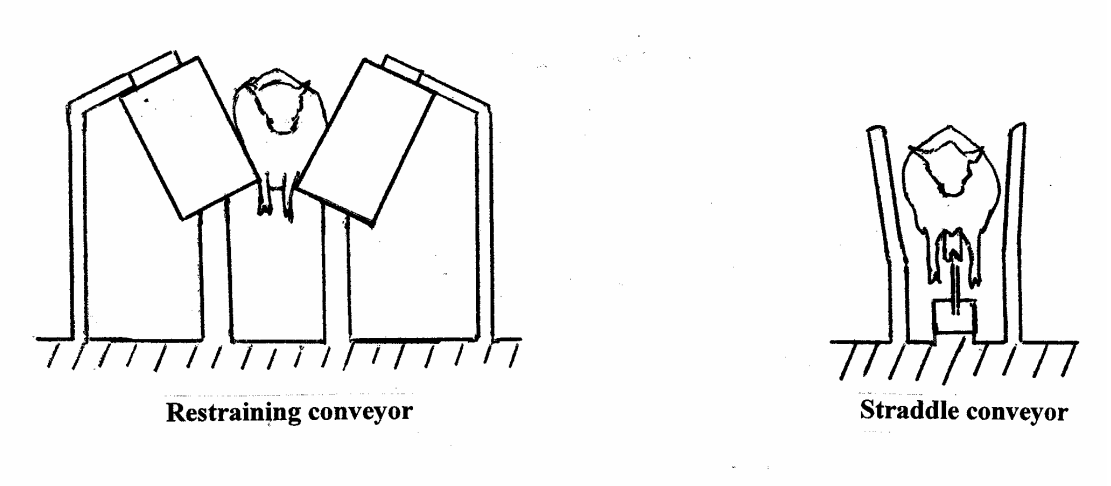
Head restraint and head raising are used for holding cattle during electrical stunning, and sometimes during captive bolt stunning. Four systems of head capture and restraint are used. They are V-yokes, upright bar yokes, chin lifters and head raisers. V-yokes can be hand operated with a single moving bar brought towards a static bar, or they can be two pneumatically operated moving bars. In one of the pneumatically operated versions the apex of the V is lifted forwards and upwards to raise the chin of the head-locked animal. This allows sticking as well as stunning whilst the animal is head restrained. Stunning can be either by captive bolt, or by electricity through the arms of the V-yoke. Chin lifters are used after the

head has been locked either to prevent movement during slaughter without stunning, or to allow application of a nose electrode with nose to neck-yoke electrical stunning systems. Head raisers are static blocks or buttresses projecting from the front wall that force the animal to raise its head when it is forced towards the front of the pen, for example with a rump pusher. This makes the animal present its head more quickly for a captive bolt stun. Cattle can react badly to being held by the neck, but simultaneous body restraint reduces struggling.



The stunning pen floor needs to provide good foot grip, otherwise there is a risk of untimely slips and falls. This seems obvious but it is not always followed. For example, at one abattoir in Europe, the skid resistance value for a calf stunning pen was found to be 22, which is equivalent to the slipperiness of steel plate. About 40% of beef stunning pens in the UK have steel checker plate floors. When wet they are very slippery (skid resistance values between 25 and 30), and there is a risk the animal will slip or slide as it runs into the pen.

Sheep and pig abattoirs that have high throughputs usually use restraining conveyors. Straddle conveyors have been used but are less common. The pressure exerted by the sides of the restraining conveyor is determined partly by the angle of the two sides. Inappropriate setting of the angle has sometimes been blamed for high levels of shoulder bloodsplash or bruising. This may be linked to struggling whilst restrained. Lambs tend to struggle if they can see a wide open space at the end of the conveyor. This can be controlled by blocking the view with vertically suspended strips of plastic curtain.



Stunning & Slaughter

Unconsciousness means different things to different people. Anaesthetists think of it in terms of reflex behaviour, psychologists in terms of emotions and intellect, neurologists as impaired neural pathways, and slaughtermen focus mainly on spontaneous behaviour. The science behind stunning and slaughter blends these approaches in producing cogent and relevant arguments.

The criteria that have been used most in producing recommendations on how to stun and slaughter animals are:

- presence of an electroplectic fit, indicating unconsciousness in the context of electrical stunning. This has been very useful in establishing minimum currents that produce an effective stun
- presence of EEG amplitudes and frequencies that are symptomatic of unconsciousness. This has been useful in determining the duration of consciousness during CO_2 stunning, and the onset of loss of consciousness following sticking
- absence of primary evoked cortical responses in the brain, indicating interference of specific pathways at a level that is a prerequisite for perception of the stimulus. Evoked responses have been used for comparing the relative effectiveness of different stunning and slaughtering procedures, and for estimating minimum stunning currents for poultry
- behavioural signs such as collapse, seizure activity, and absence of brain stem reflexes

Concussion stunning

Captive bolt guns are either trigger-fired or contact-firing, and their bolts are either recessed or protrude from the muzzle. The advantages and disadvantages of these designs are discussed elsewhere and the choice of gun will depend on the type of animal and the situation in which it is used (Gregory 1998). The intention is to concuss the animal through transfer of energy to its head, and a successful stun depends on using a gun which fires the bolt at sufficient velocity for the size of animal.

Concussion with a captive bolt gun is used mainly in cattle and horses. When positioned correctly, and when the right cartridges are used for the class of animal, it produces an immediate and irreversible stun.

A deep form of concussion is present when the animal shows the following signs immediately after the stun

- the animal collapses:
- breathing is absent
- the muscles in the back and legs are in spasm. The forelegs and hindlegs should be flexed, and after about 5 seconds the forelegs will straighten and become extended. If the muscles are flaccid immediately after stunning, this is a sign that the stun is not as deep and there is a risk that the animal will regain consciousness
- the eye is not rotated in the eye socket. Rolled eyes have been associated with persistent evoked cortical potentials following stunning. Instead, the eyes should be pointing forwards in the normal position.

These signs are associated with immediate absence of evoked cortical responses in the brain. Absence of primary cortical evoked responses indicates failure in neurotransmission at a level that occurs before conscious perception of the stimulus. Conceptually this is a useful indicator of a deep stun, as it indicates deafferentation before signals can reach the association cortex, where signals associated with consciousness are integrated. Unlike evoked responses, the spontaneous EEG is not as reliable as an indicator of brain disturbance following captive bolt stunning, and evoked responses are preferred (Daly 1987).

Slow and shallow rhythmic breathing is sometimes seen after captive bolt and cardiac arrest-electrical stunned cattle have been bled out (Daly 1987). Provided the corneal reflex is absent at this time there is no need for concern that the animal might be conscious. Jaw relaxation is another useful sign. This can be tested by prising the jaws apart manually, or it may be seen from the tongue hanging out on its own accord in the suspended carcass.

Guns with low bolt velocities (up to 47 $m.sec^{-1}$ for cattle) are less likely to produce an effective stun, as they impart insufficient energy to the cranium (Table 2). The transfer of energy to the head, and the depth of stun, are improved when bolt diameter is 16 mm or more (Table 3). In cattle, shooting in the poll position (caudal to the nuchal crest) is less effective than a frontal shot. In sheep, both frontal and poll shooting are effective initially, but there is a greater risk of recovery of consciousness following a poll shot (Daly and Whittington 1986). Percussion bolt stunning can be as effective as captive bolt stunning, but because the bolt does not invade the brain, there is less likelihood of intracerebral haemorrhage and an irreversible stun. For this reason, the percussion bolt is accepted by some Islamic authorities as an acceptable preslaughter stunning method for halal. In halal slaughter, the slaughterman must kill the animal through the cut delivered to the neck.

Young bulls are difficult to stun by captive bolt. In a study in the UK, over 50% of bulls did not have a deep form of concussion (Table 1). These animals either received more than one shot, or were breathing rhythmically shortly after the shot, or had a rolled eye.

Table 1. Prevalence of poor stunning in cattle in a survey of UK abattoirs

	Total number of cattle examined	**% poor stunning ‡**
Steers and heifers	1284	6.6
Cull cows	628	1.7
Young bulls	32	53.1

‡ outright failure to stun, or breathing shortly after the stun, or rolled eyes.

Following this study it was recommended that the minimum bolt velocity (when fired in air) for guns used on young bulls should be 70 $m.sec^{-1}$. The usual recommendation for steers, heifers and cull cows is not less than 55 $m.sec^{-1}$ (Daly and Whittington, 1989).

Head restraint can improve shooting accuracy. In an abattoir in New Zealand where an underpowered gun was being used on bulls, the prevalence of repeat stunning was 19% when no head restraint was used, but it was about 2% when the animals were held in a headbail. However, use of the headbail should be left to the discretion of the slaughterman because in some cases it is stressful for the animal. If the animal presents its head as soon as it enters the stunning pen, it is better to stun it straight away, rather than attempting head restraint.

Animals that move about within the pen, and even attempt to climb out of the pen are difficult to shoot. At one abattoir the prevalence of repeat stunning in the highly active animals was 53%, whereas in the quieter types it was 19%.

Table 2. Effect of bolt velocity, shooting position and gun type on the elimination of visual evoked responses (VERs) in cattle

	Captive bolt				**Percussion bolt**
Gun position	Frontal			Poll	Frontal
Bolt velocity $m.sec^{-1}$	47	55	72	55	NA
Number of animals	7	11	9	8	8
Prevalence of VERs % †	57	9	11	75	13

† during the first 4 seconds following the shot

Table 3. Effect of bolt diameter and speed on energy imparted during stunning (joules ± se) and the elimination of visual evoked responses (VERs) in cattle

	Bolt speed m.sec^{-1}			
Bolt diameter mm	47		55	
	Energy imparted	VER prevalence % †	Energy imparted	VER prevalence % †
12	97 ± 17	50	124 ± 25	13
14	125 ± 18	25	139 ± 25	13
16	158 ± 20	14	186 ± 30	0

† during the first 4 seconds following the shot

The ideal shooting position in the head is the cross-over point between two imaginary lines drawn between the base of each horn and the opposite eye. When shooting accuracy deviated beyond 2 cm from the ideal frontal position, there has been a significant increase in the incidence of poor stunning (Table 4). Shooting accuracy becomes more critical when using low powered cartridges. Shooting accuracy is sometimes poorer with contact-firing guns (35% of young bulls) compared to pistol grip guns (23%).

Table 4. Effect of shot accuracy on the prevalence of poor stunning when using 3 grain cartridges

	Shooting accuracy – distance from the ideal position	
	< 2 cm	**> 2 cm**
Number of young bulls	242	90
% poor stunning ‡	11.5	35.5

‡ outright failure to stun, or breathing shortly after the stun, or rolled eyes.

Spring-powered captive bolts guns are available for rabbits. Skin slip can lead to inaccurate shooting. Some rabbits vocalise during the shot, even though they are unconscious. It is linked to sudden compression of the thoracic cavity at the onset of the tonic spasm. It is thought that if the bolt strikes a bone suture in young rabbits, there can be a higher risk of poor stunning.

Electrical stunning

The recommended minimum currents for stunning with a 50 or 60 Hz current are listed in Table 5.

Table 5. Minimum recommended stunning currents

	Minimum stunning current amp
Cattle	1.15
Calves	1.00
Pigs	1.25
Sheep	0.50
Rabbits	0.14
Ostrich	0.40

The standards for sheep and cattle are sometimes given as 1.0 and 1.50 amp. Those currents induce a cardiac arrest when current simultaneously flows through the body, and are higher than the minimum currents producing unconsciousness (Lambooy 1982; Wotton *et al* 2000). Electrical stunning is not commonly used in deer, but currents of 1.3 and 1.0 amp are recommended for red and fallow deer respectively with the head-only system.

It is usually recommended to apply the current for at least 3 sec. This is not a validated standard. The advantage with long application times is that the current rises as impedance is broken down during current flow. For example, during head-only stunning in pigs, electrical impedance starts at about 380 Ω and falls to about 160 Ω within 10 sec (Troeger and Woltersdorf 1988).

Head-only electrical stunning is reversible. In other words the animal can regain consciousness. This has two consequences. Firstly, the animal has to be killed soon after head-only stunning to ensure that it does not recover. Secondly, head-only electrical stunning can be acceptable to some halal slaughter authorities as it does not kill the animal.

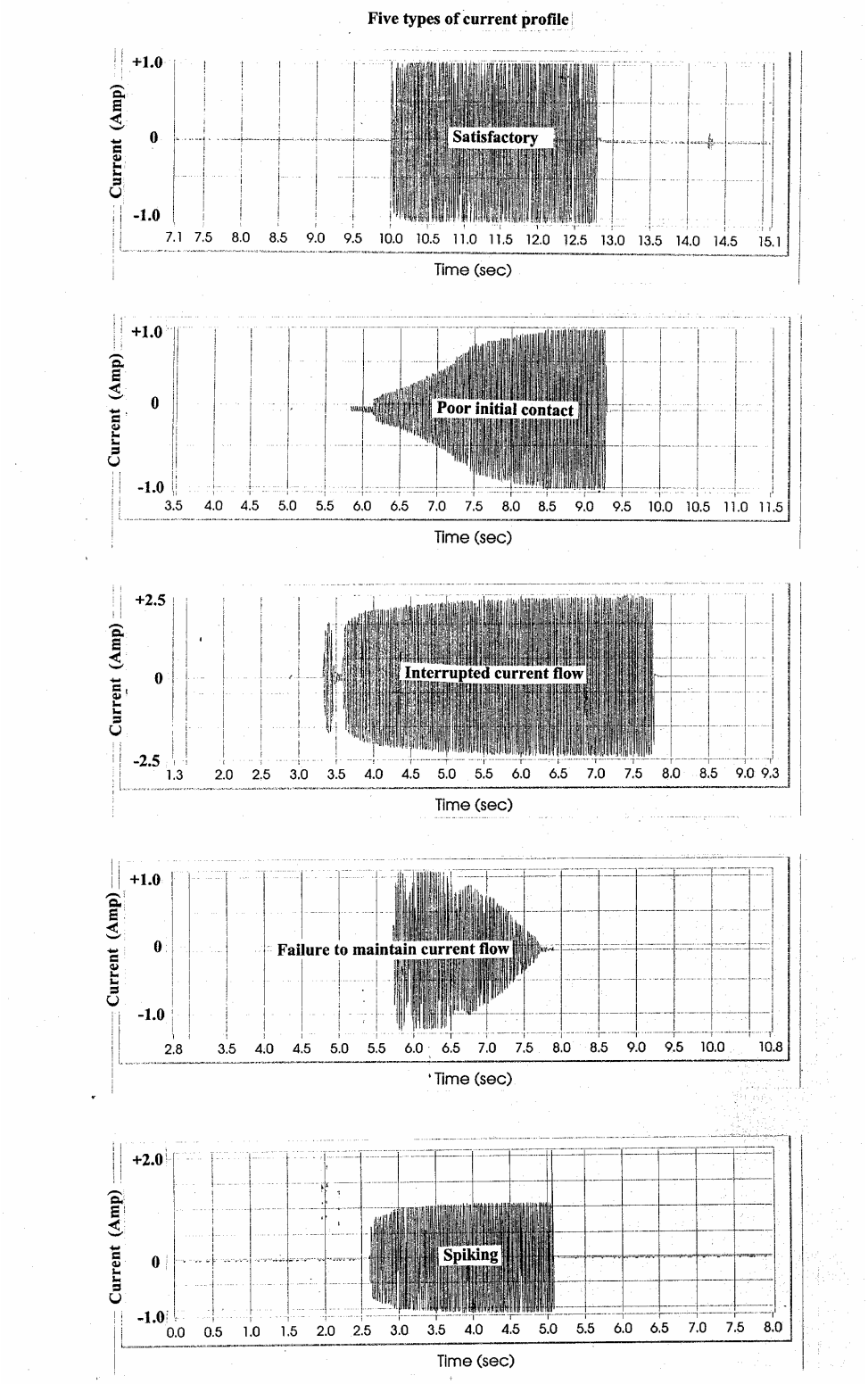
The duration of unconsciousness provided by head-only electrical stunning depends on the current that is used and the length of time it is applied (Table 6). If 0.5 amp is delivered for 3 seconds, which in the case of sheep is the recommended minimum current (Lambooy 1982), the duration of insensibility would on average be 62 seconds. If the time between stunning and sticking at an abattoir is, say 23 seconds, and the time to brain failure following sticking is 14 seconds (Gregory and Wotton 1984), the required duration of unconsciousness is on average 37 seconds. So at that abattoir the 'average' animal would not regain consciousness and there would be 25 seconds (62 minus 37 seconds) margin for error and unusual events. If a lower current was applied briefly (e.g. 0.3 amp for < 1 second) there would be a greater risk of recovery of consciousness. This is because the duration of unconsciousness provided by the current (33 seconds) is shorter than the required duration (23 + 14 seconds). The corresponding durations of apparent unconsciousness for pigs and calves when using their recommended minimum stunning currents are 58 and 67 seconds (Anil 1991; Gregory *et al* 1996).

Table 6. Duration of insensibility in seconds (sd) according to current level and duration following electrical stunning in sheep

Current level amp	**Current duration sec (sd)**		
	<1	3	6
< 0.3	33 (9)	52 (13)	49 (20)
0.3 to 0.66	34 (12)	62 (14)	71 (18)
> 0.66	39 (6)	63 (16)	87 (25)

These values are based on averages. In sheep stunned with 0.3 to 0.66 amp for 3 sec, the quickest time to recovery in one of the animals was 41 sec. The required duration of unconsciousness (37 sec) is still shorter than this period. On this basis, it can be recommended that the stun to stick interval should be 23 sec or less. It is possible that the required duration of unconsciousness given above is an overestimate, because electrical stunning itself could hasten the time to brain failure following sticking through its exhausting effect on brain metabolism (Bager *et al* 1992).

Prompt sticking is no longer important if a cardiac arrest is induced at or shortly after electrical stunning. Blood flow to the brain is brought to a standstill by the cardiac arrest, and so sticking only serves the purpose of releasing blood from the carcass. There is a practical advantage to so-called cardiac arrest-stunning. It produces a still carcass that is easy to handle (Fehrenberg *et al* 1991).



There are two risks when using low stunning currents. First, a proportion of animals may not be effectively stunned. Second, and more commonly, the duration of insensibility is shorter in some animals. For example, in calves receiving 100 volts head-only stunning, the calf with the quickest time to recovery was substantially faster than for calves receiving higher voltages, even though the average durations of insensibility for the different voltages were about the same (Table 7). Similar effects have been observed for lambs, pigs and poultry. Increasing the duration of application of a low current can extend the duration of insensibility.

Table 7. Effect of stunning voltage on time to recovery in calves

Stunning voltage V	Time to onset of head righting seconds	
	Average	Range
100	78	24 to 114
150	63	44 to 83
200	67	44 to 115
250	71	59 to 84

Most modern electrical stunning equipment used for cattle, sheep and pigs has a low voltage circuit which senses the impedance between the electrodes before switching to the stunning voltage. The intention is to ensure that the electrodes are in adequate contact with the animal. If the impedance is too high, because of poor contact, the stunning current will not be engaged by the control box. In principle this is a good system, but if slow switch gear is used the animal may object to the pressure applied by the electrodes and start struggling before it is stunned.

It sometimes happens that an animal has to be re-stunned. For example, if an electrically stunned pig drops from its shackle before it is stuck, it is either shot and then bled or it may be electrically stunned again and then stuck. It has been thought that a second epileptiform episode might be shorter lasting than the first, but recent research has shown that this is not the case (McKinstry and Anil 2004). In other words, the duration of insensibility following repeat electrical stunning should be similar to that experienced following a single application of current. Repeat stunning will increase the risk of blood splash (Kirton and Frazerhurst 1983).

When monitoring electrical stunning in a plant, examining the current profile can be useful in recognising interruption in current flow at the time the electrodes are applied (Troeger and Woltersdorf 1988). Examples of current profiles and the problems they depict are shown in the figure.

Gas stunning

The main concern with CO_2 stunning is that it induces breathlessness before the animal is stunned. Set against this, the pig does not need to be restrained in a conveyor, nor do birds need to be shackled before they are stunned. This eliminates some of the preslaughter stress.

CO_2 is a potent activator of breathlessness, and it is aversive (Raj and Gregory 1995). However, when used at high concentrations it produces a quick induction. This was shown in studies on the pigs' EEG. The time at which high amplitude low frequency activity in the EEG increases has been used as an indicator of the onset of unconsciousness. During 90 % CO_2 stunning, delta (2-4 Hz) and theta (4-8 Hz) frequency activity is beginning to rise at 6 sec following immersion in the gas, and by 30 sec these waveforms are significantly raised (Martoft *et al* 2002). Although the precise rise that reflects the onset of unconsciousness is not known, it is thought that unconsciousness sets in following 10 to 30 sec exposure to this concentration of gas. Many authorities consider that even though breathlessness will occur during this period, CO_2 stunning is acceptable because of its other welfare benefits. For example, when pigs are lowered into a pre-filled well of CO_2 as a group, there is less stress in comparison with forcing pigs into restraining conveyors. If less stressful restraining methods are developed for electrical stunning, this outlook might change, and CO_2 could become less acceptable.

The handling system used in getting the pigs to the CO_2 stunner is critical. For example, at one plant where electric goads were used and the pigs were moved along a single file race to a Compact stunner, the prevalence of PSE was 50%. Whereas, at another plant where the

pigs were driven as groups in a less stressful manner using a semi-automated moving gate and then loaded in batches of 4 to 6 onto a platform above the stunner, the prevalence was only 13% (Franck *et al* 2003). Trying to get large pigs into a Compact stunner is not always easy. They are too big for the entrance especially when there is a heel bar they have to jump over.

Gas stunning has been trialled with mixed success in sheep. In one study on suckling lambs, it resulted in more tender meat than electrical stunning or no stunning (Vergara *et al* 2005). It is used for rabbits in a plant in Spain.

Slaughter

The main slaughter methods are neck sticking and chest sticking. Chest sticking is done mainly in cattle and pigs, and is used for sheep in some North American plants. Neck sticking is used for sheep, goats, calves and poultry.

When animals are given a reversible stun, they should be bled immediately. The intention is to render them insensible by stunning and to deflect blood away from the brain to ensure prompt loss of brain function without recovery of consciousness. The recommended maximum stun-to-stick intervals following low frequency electrical stunning in pigs, sheep and calves are 23, 27 and 27 sec respectively. Working within these values will ensure that the animals do not regain consciousness. They are based on the reasoning given in the sub-section on electrical stunning, and using data on the time to return of neck tension or head righting as the onset of return of consciousness. They apply to chest sticking for pigs and calves, and neck sticking for sheep.

If neck cutting is used as the slaughter method in calves and cattle, the situation can be complex. There is a greater risk of recovery of consciousness because cattle and calves have a collateral blood supply to the brain through an occipito-vertebral anastomosis, which can allow extended perfusion of the brain if the carotid arteries do not bleed freely (Bager *et al* 1988). The severed ends of the carotid arteries in calves and cattle are prone to developing ballooning. The ballooned ends of arteries contain trapped blood, which disrupts bleeding-out (Anil *et al* 1995). This occurs in 16% of cattle and 25% of calves following neck cutting. Ballooning increases the risk of resumption of consciousness following reversible electrical stunning, and it extends the period of consciousness following sticking when there has been no stunning (Blackmore 1984).

When head only electrical stunning is used in large cattle, it is usually recommended that the neck is cut within 10 seconds of stunning. The animal is rolled out of the stunning pen onto a bleeding cradle so that it can be promptly bled, instead of being hoisted before bleeding. Even so, it can be difficult to achieve a rapid cut, and in practice it is usually done between 9 and 24 seconds.

When irreversible stunning methods are used, the stun-to-stick time is not critical, and it does not need to be specified. It is advisable to stick the animal within 3 minutes of heart failure, otherwise there is a risk of a poorer bleed out.

The size of the sticking wound can influence bleeding rate in pigs (Anil *et al* 2000). When a long sticking wound (11 cm) was made in the skin, the pigs took 72 seconds to bleed out, whereas for a short sticking wound (5 cm) it was about 84 seconds. The longer sticking wound could require more trimming but the unrestricted blood flow with this method should improve confidence in achieving prompt death.

Suggestions for the future

There are some fundamental problems in present preslaughter handling systems, but there are few inexpensive and practical alternatives. The problems are

1. most animals are separated from each other to allow controlled application of the stunning equipment. Social isolation plus confinement can lead to escape behaviour. Escape attempts can lead to injuries and poor application of the stunning equipment.
2. escape attempts are managed by close confinement or restraint. Stressed animals are reluctant to enter confined situations. Loading stunning pens and restrainers can be difficult.
3. loading restraining conveyors can also be difficult if they stop and start in time with the stunning of animals at the other end.
4. checking ear tags with animal passport numbers. Cattle are confined in crushes to allow tag reading, and this can be stressful.

Presently, the best alternative to separation and restraint is to gas stun animals in groups. Stunning free-standing animals individually (with a captive bolt or electrically) whilst they are penned as a group can avoid isolation and restraint, but application of the gun or tongs can at times be haphazard.

Problems with stunning and slaughter are

1. poor head presentation when cattle are held in stunning pens
2. adequacy of existing captive bolt guns for bulls
3. adequacy of existing stunning methods for breeding pigs
4. electrode placement in pigs
5. breathlessness prior to unconsciousness when using carbon dioxide
6. impaired bleed out from carotid aneurysms in cattle
7. quality problems associated with electrical stunning, especially blood splash
8. carcass kicking and worker safety

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Session 2: Presentation 5

Anatomical and physiological principles relevant to handling, stunning and killing white meat species

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Fossil records show that birds evolved about 160 million years ago with some unique anatomical and physiological features, which not only makes them sentient but also vulnerable to suffer pain and distress during handling, stunning and killing. People performing these tasks should be aware of this and take responsibility to avoid causing pain and distress. For example, birds do not have muscular diaphragm and therefore the abdominal organs and contents would exert pressure on heart when they are inverted, for example, while carrying by hand or hung on shackle lines for stunning and slaughter.

Birds have nociceptors in their scaly skin covering meta tarsal bones and hence any pressure applied either during catching and carrying or shackling prior to stunning and slaughter will cause severe pain and suffering (Gentle and Tilston, 2000). Inevitably, the pain and distress induced by shackling causes severe wing flapping which, in turn, increases the prevalence of dislocated joints and broken bones (Gregory and Wilkins, 1989 and 1990). The pain and suffering during shackling is likely to be worse in birds suffering from painful lameness due to diseases or abnormalities of leg joint / bone (Butterworth, 1999). This pain is also likely to be significant in birds suffering from dislocation of joints and / or fracture of bones induced by rough handling during catching, crating and uncrating.

Birds do not have neocortex (convoluted cerebrum) but the cerebrum is functionally very similar to the mammalian brain. Therefore, it is not surprising that they seek to fulfil their behavioural, physiological and functional needs. More importantly, electrical stunning, which involves passing an electrical current of sufficient magnitude through the brain, induces epileptiform activity in the brains of mammals and birds alike. Epileptiform brain activity is a pathological state and hence incompatible with the persistence of consciousness and sensibility. The occurrence of epileptiform brain activity is determined by the waveform, frequency and amount of current delivered to the brain (Mouchonière et al., 1999 and 2000; Beyssen et al., 2004; Raj et al., 2006a, 2006b and 2006c).

Birds have chemical receptors in their lungs and are known as intrapulmonary chemoreceptors (IPCs) (Tschorn and Fedde, 1974; Hempleman et al., 1992, 1994 and 2000; Fedde et al., 2002). The IPCs are acutely sensitive to carbon dioxide but insensitive to hypoxia or anoxia. Stimulation of IPCs depresses breathing. In addition, like mammals, birds have central (brain) and peripheral (e.g. carotid body) chemoreceptors that respond to changes in blood gases. Stimulation of these receptors with carbon dioxide leads to apnoea, which is also described as breathlessness or a sense of suffocation. It is therefore hardly surprising that, given a free choice, chickens and turkeys avoid an atmosphere containing high concentrations of carbon dioxide but succumb to hypoxia or anoxia created using inert gases (e.g. argon, nitrogen). Addition of oxygen or humidification of carbon dioxide does not help to overcome the propensity to suffer pain and distress.

It is hoped that our improved knowledge and understanding of anatomical and physiological features should help to avoid causing unnecessary pain and suffering in birds.

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Session 3: Presentation 6

Introduction to modern slaughter methods

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This workshop is about animal welfare at slaughter or during killing for disease control purposes. To most people, unconnected with the meat and livestock industries, the concepts of humane slaughter and animal welfare are generally thought to be post-World War Two, western European perspectives, born out of relative affluence and concern about industrial livestock production. However, early documented references to animal welfare can be found in some books of the Old Testament, notably Leviticus and Deuteronomy. Parts of Leviticus, in fact, read like an ancient manual of meat hygiene and food safety! Within the Holy Koran is a reference to giving animals as little pain as possible when killing them. Inscribed above the entrance to a large, German slaughterhouse were the words: *"THINE IS A TASK OF BLOOD, DISCHARGE THAT TASK WITH MERCY, LET THY VICTIM KNOW NO PAIN, BUT LET THE SUDDEN BLOW BRING DEATH, SUCH DEATH AS THOU THYSELF WOULDST ASK"* (Heiss 1903). These sentiments are reflected in the current European legislation relating to the welfare of animals at slaughter – *Council Directive 93/119/EC on the protection of animals at the time of slaughter or killing* – "…any process which, when applied to an animal, causes immediate loss of consciousness which lasts until death…" This directive permits three methods of causing immediate unconsciousness: mechanical (percussive) stunning, electrical stunning or by the inhalation of gas mixtures. Details of these methods can be found in the Humane Slaughter Association (HSA) publications, Guidance Notes and Best Practice Guidelines, which are provided in your delegate pack.

Mechanical (percussive) stunning

Mechanical stunning is carried out in its simplest form in many parts of the globe: that is by delivering a heavy blow to an animal's head with a hammer or an iron bar. With luck, this can be very effective and humane. However, it is very difficult to consistently reproduce a blow of sufficient magnitude, in the correct position, because of the potential for the animal to move. For this reason the captive-bolt instrument was developed early in the last century and is now used throughout the world for the humane stunning of cattle and other species. Mechanical, or percussive, stunning works by imparting kinetic energy from the bolt to the animal's brain and causing massive internal trauma and neuronal dysfunction. It can be used to stun all the common meat species, but is not usually used for pigs because, in these animals, it causes an immediate violent kicking spasm, which can last for several minutes and makes shackling the animals safely almost impossible. The captive-bolt is also used widely by the veterinary profession for on-farm euthanasia and has been an essential tool in carrying out mass culls for disease-control purposes. A variation is the use of free-bullet weapons, which effectively stun and kill simultaneously by destroying the brain stem. Free-bullet weapons are rarely used in commercial slaughter, but do have an application in some disease-control situations and when killing minority farmed species such as bison and wild boar.

Captive-bolt instruments can be defined as *cartridge or air-powered equipment, in which a metal bolt is projected at high speed through an aperture in the muzzle end of the barrel. The bolt does not leave the barrel completely, but is retained and may be returned to its pre-firing position.* Captive-bolt stunners may be penetrative or non-penetrative and can be used effectively on all the common meat species, although older animals of some species may present difficulties. It is important to appreciate that captive-bolt instruments are humane stunners, not humane killers and, by law, their use must be backed up by destruction of the brain stem (pithing) or by exsanguination (voiding the carcase of blood). In order to

administer the captive-bolt effectively, it is normal practice to restrain the animal by some means: this varies from manual restraint of small animals (pigs, sheep and goats) to the use of purpose-built boxes for limiting the movement of adult cattle.

The consistent reproduction of a sufficiently powerful blow from the bolt is dependent on daily cleaning and regular maintenance. After every period of use the stunner should be cleaned to prevent corrosion and hardening of carbon deposits. This is essential to ensure maximum bolt velocity and effective stunning. Stunners should be taken apart and cleaned, following manufacturer's guidelines, after every day's use and all worn parts replaced when necessary.

When an animal has been effectively stunned using captive-bolt equipment it will collapse immediately and stop breathing. Its front legs and neck will be extended and the hind legs will flex into the lower abdomen. There will be a fixed, glazed expression on the eyes with no corneal reflex. In cattle especially, the lower jaw may drop and the tongue protrude. The foremost sign of the onset of recovery is a resumption of normal rhythmic breathing; if an animal continues to breathe immediately post-stun, the stun has been ineffective and the animal should be stunned again immediately.

To summarise this section:

- Consistent, effective percussive stunning is dependent on the:
    - use of appropriate, well-maintained equipment
    - use of the correct powerload for the age and species
    - stun being applied in the correct position according to the species
- Monitor all animals to ensure they are exhibiting the physical symptoms of effective stunning
- Monitor the condition of the stunning equipment throughout the period of use

Electrical Stunning

Electrical stunning works by passing an electric current through an animal's brain to induce an epileptiform seizure. It can be applied to all the common meat species in commercial situations by various systems: manual, semi-automatic and fully automatic. Not all of these systems can be used for all species, eg cattle can only be electrically stunned using purpose-built, fully automatic equipment, whereas all three variations can be used to stun pigs. Electrical stunning may be applied to the head only, normally a reversible process, or to the head and body simultaneously which is a stun/kill operation.

Electrical stunning systems vary in their output and application. Low-voltage systems, operating at outputs of up to 150 volts are still in existence and widely-used, but they are no longer recommended by the HSA as they may not induce instantaneous insensibility, but cause a brief and very painful period of paralysis. High-voltage systems operating at 200 volts and above are now recommended and research is underway into higher voltages, the use of which may become common. The electrical currents used for stunning may vary in their frequency and waveform, but the most common one is a standard frequency (50 Hz) alternating current with a sinusoidal waveform.

The capacity of an electrical current to stun effectively is dependent on the voltage (the electrical pressure driving the current) and the resistance of the body tissues through which the current has to pass. At a given resistance, in order to increase the amount of current, the voltage will have to be increased accordingly. This relationship is known as Ohm's Law and

is expressed as I = V/R: where I = current (measured in amps A); V = potential difference (measured in volts V); and R = resistance (measured in ohms Ω). It is not possible to reduce the resistance of an animal's body tissues, through which the current has to flow, but it is possible to reduce the contact resistance between the electrodes the animal's skin, for example by keeping the electrodes clean and regularly wire-brushing them to remove any carbon deposits. Electrical stunning equipment works at a constant voltage output: the amount of current delivered to each animal will therefore depend on the resistance of individual animals. For instance, if one amp of current is needed for an effective stun and the output is 200 volts, an animal with a resistance of 200 ohms or less will receive sufficient current to render it immediately insensible, but an animal with a resistance of more than 200 ohms will initially receive less than the one amp required and possibly suffer in the process.

The physical symptoms of an effective electrical stun are those of a grand mal epileptic fit. Initially the animal will collapse, become rigid and it will stop breathing. The head may be raised, with the forelegs extended and the hind legs flexed into the body. This may last for up to 20 seconds, depending on the species, and is known as the 'tonic' phase. Following this, the muscles will visibly relax and there will be paddling of the legs and involuntary kicking, which may be severe at times. At the same time there may be downward movement of the eyeballs and urination and/or defaecation. This may last between 15 and 50 seconds and is known as the 'clonic' phase. If the animal is bled it will enter the 'recovery' phase, the foremost sign of which is a return to normal rhythmic breathing. Ideally animals should be bled whilst still in the tonic phase in order to ensure that they die before the recovery phase is reached.

Inhalation of gas mixtures

Gas mixtures are currently used only in the slaughter of pigs and poultry. Pigs are immersed in high concentrations of carbon dioxide (CO_2), which initially anaesthetizes them and, if exposure continues for long enough, then kills them. The law requires that the concentration of CO_2 must be at least 70% in air, but most modern systems operate at >90%. It takes approximately 15 seconds for pigs to become unconscious and there is an excitation period during which some pigs show increased levels of activity. Carbon dioxide is an aversive gas at concentrations in excess of about 30% and its use has caused much debate among scientists and animal welfarists worldwide. However, the handling systems associated with modern CO_2 systems are less taxing on the animals compared to the restraints associated with some fully-automatic electrical systems and they produce a relaxed carcase which is easy and safe to handle compared to pigs stunned by electrical means. There are also fewer meat quality problems, eg blood splash and broken bones, associated with carcases produced by CO_2 systems compared with electrical stunning.

Controlled Atmosphere Stunning (CAS) systems have recently been developed for the slaughter of poultry. These systems use mixtures of carbon dioxide, nitrogen and argon which are less aversive than pure carbon dioxide; however, the major animal welfare advantage of these systems, compared to electrical waterbaths, is that there is no handling, inversion or suspension of live birds. Research is currently ongoing to see if it is possible to use these less aversive gas mixtures effectively on pigs in the commercial situation.

Exsanguination (bleeding)

The commercial slaughter of livestock for human or animal consumption is a two-stage process: animals are first rendered insensible to pain, before being killed by exsanguination (voiding the carcase of blood) – death is caused by the brain being deprived of oxygen. For the slaughter to be humane and comply with legislation, the state of insensibility in the animal must persist until death supervenes. As well as effective stunning, therefore, it is equally

important that animals are bled without delay to prevent any possible onset of recovery of conscious awareness.

Animals are bled by severing the carotid arteries in the neck, or the blood vessels from which they arise. The time to brain death following bleeding differs between species, due to anatomical differences in the blood supply, and according to the technique used. Current legislation requires at least one carotid artery to be severed, but this is not satisfactory and could lead to animals beginning to regain consciousness before dying of blood loss. For these reasons, the Humane Slaughter Association recommends thoracic sticking (severing the brachiocephalic trunk) of all red meat species.

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Session 3: Presentation 7

Application of modern methods for slaughter of red meat animals

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The key objectives of any kind of stunning and slaughter system are the same with regard to the way in which they work. This presentation will highlight the key targets required for effective stunning and slaughter in the more commonly used methods employed in abattoirs around the world.

Much of the finer details of the presentation can be found in the booklets in your information packs. The aim of this brief presentation is to recap on the important targets and remind ourselves of the ways in which we should be maximising animal welfare by careful and considerate use of the equipment. The critical welfare issues will also be covered along with ways in which to monitor and improve them.

There are five key principles that should always be remembered when working in the abattoir with any stunning system. These are:

Utilise natural behaviour of animals; anything that makes the movement of animals easier will in turn make handling the animals easier. This has two effects; it keeps the animals stress free and also the staff. When staff has an easier time, they are less likely to become over tired and will remain patient with the animals.

Minimise handling where possible. It is important to remember that however good a system is, it is inevitable that animals will be exposed to a number of stressors whilst in the lairage, not least being exposed to unfamiliar surroundings and people. By minimising handling and interaction between animals and staff, it is more likely that the animals will remain calm and easier to handle. It also reduces any risk of human error that may occur.

Maintain equipment regularly: it will only work effectively if it is maintained on a routine basis in accordance with the manufacturers' instructions. Unfortunately, one of the more common reasons for welfare compromise at the point of stunning is due to ineffective equipment not resulting an immediate unconscious reaction, a problem which should not and need not occur in today's environment.

Use appropriately trained staff. All staff should undergo formal training before they are left alone to work with animals. However, experience of handling and stunning animals should never be underestimated. Often the formal training is more about getting the right certificates than actually teaching staff new skills. Experience is unique to every individual and this is why the term appropriate is of paramount importance when looking at staff skills. A slaughterman working with a captive bolt in an abattoir with a restraint system may be excellent at his job; this does not mean however, that he is capable of using free bullet weapons out in the field.

Make use of standard operating procedures: staff should all know what they are doing and who is responsible for what particular function. By having detailed operating procedures and clear lines of responsibility staff, can be more effective and confident that they are doing the job right. When the procedures are drawn up they should be done in consultation with the staff and any changes should be explained to staff immediately.

Electrical Stunning

The application of electrical stunning techniques has four main targets, the correct current, applied in the correct position for the right duration. It is also essential that the animals are moved to the bleed point without delay.

The correct current being applied is dependent on the contact resistance, power available and condition of the electrodes. The resistance of an animal is due to the skin fat and bone, and in the case of sheep wool. It is not possible to lower the resistance of an animal's natural tissues. However, contact resistance is also affected by the other factors such as presence of water and the condition of the electrodes – both of which can be influenced by the operator. The addition of water to sheep prior to stunning can help reduce contact resistance, but for those animals that are heavily fleeced, or have horns preventing full access to the correct tong position, an alternative such as the captive bolt should be considered.

As shown in the previous presentation the amount of current received by the animal is dependent on the voltage and resistance. As it is very difficult to alter the resistance, it is important to provide enough voltage so that the current level is high enough. The HSA recommends that to ensure all animals receive the correct current hand held electrical equipment, supplying over 250 volts is used. Anything below this should be replaced as soon as possible. Electrode maintenance is just as important and can not be emphasised enough. In addition to cleaning with a wire brush on a regular basis throughout the day's use, electrodes should be kept sharp at all times. Tongs which have a centre point in the electrodes should not have these removed, as they will lose effectiveness, especially when used on pigs.

The correct position of tongs is essential for effective stunning; the most obvious way to achieve the objective is to have skilled and experienced staff that can work at the relevant speed of the plant. Staff should be rotated on a regular basis, firstly to keep them alert and competent in the role, but also to prevent tiredness causing unnecessary welfare compromises.

Appropriate restraint can also be used to help the positioning of tongs, often this can be animals restricting each other, or the area available to animals. It can also be physical in terms of holding an animal against the pen side or holding the animal between the legs or with both hands if two people are working in the pen.

Having tongs that can reach all parts of the pen means that the slaughtermen don't have to work with restricted movement and are not tempted to grab at the animals in an attempt to catch and restrain them. In addition to this, eliminating areas where the animals can take refuge or get stuck helps prevent them becoming unreachable. Simple use of stock board or metal plates has been used in many plants to block the empty space behind conveyors.

The exact stunning position for each species can be found in your information packs in the booklet, Guidance Notes No 4 *Electrical Stunning of Red Meat Animals*. The position for sheep is always the same; however that for pigs can be variable. This is mainly due to the difficulty in applying tongs in the optimum position on pigs because of the shape of their heads and the obstructive nature of their ears.

The duration of a stun is important to ensure that the animal remains unconscious for long enough for death to occur as a result of bleeding. The correct duration depends on the system being used, but generally a minimum of three seconds is recommended for high-voltage systems.

Automatic timers can help control the duration as they inform the staff when the stun is over, rather having to rely on human guesswork. Trained staff will know by watching the animals

and the feel of them when the right time is to remove the tongs. Equally as important is an appropriate kill rate. Expecting the staff to work at fast rates, or by paying on a headage basis, may run the risks of staff taking shortcuts, working faster than they should and cutting time by reducing the time the tongs are applied to the head.

Having stunned the animals, it is imperative that they are delivered to the sticking point without delay. More often than not, the time from removing the tongs to sticking the animal is determined by the equipment and facilities available.

A well-designed pen will aid the speed of the operators, so they can work in the pen and minimise the shackling time and lifting the animals on to the elevator. The elevator speed has the main impact on this and should work quickly enough to get animals out of the pen. There should also be enough pushers on the elevator so that staff don't have to wait a long time for a pusher to come, or try lifting animals to catch a pusher that has just passed. Once out of the pen, the distance to the point of bleeding should also be short so that the time is minimised. A person should be available to bleed the animals without delay. This should be checked verbally before the start of any batch.

As explained, electrical killing works on similar principles as stunning, but has a second stage which kills the animal. This is mainly used on pigs and sheep, but more recently has been introduced into some large cattle plants. When using killing methods it is essential that animals are restrained so that accurate placement of the electrodes can be made. Incorrect placement of head-to-back electrodes will cause electrocution without stunning and will be extremely painful for the animal.

Restrainer conveyors are therefore an essential piece of equipment for both sheep and pigs. The ease of use of these conveyors depends on the species, they are extremely difficult to load pigs into, but sheep work very well in them. when used in conjunction with a forcing pen at the entrance. To improve the situation with pigs, a labyrinth system which helps breaks the pigs down into single file can be useful, but it still does not help getting pigs into the actual restrainer.

<u>Gas stunning/killing</u>
Gas killing has a number of advantages when killing large numbers of pigs, mainly as it removes the chance of human error, but it does have a minor downside due to the aversive nature of the gas as already mentioned.

To achieve the highest level of welfare with gas, important consideration must be given to the entry system, animals drop straight into a high level of carbon dioxide, the dwell time is sufficient to cause a long enough period of insensibility that the animals remain unconscious until death, stun-to-stick is again short and that there is always monitoring of the system
New systems have alleviated some of the original concerns associated with gas, and when a system is used correctly it can be good in terms of welfare. One of these improvements is the use of group entry. Previously animals had to walk into the gondola in single file, with only one other animal being able to fit into the same gondola. This often meant goads were needed to keep the momentum up and the machine moving quick enough. Now, group systems take advantage of the loose association pigs have with each other. The side entry also means the pigs are made to walk in one direction with a clear way ahead and are then gently pushed into the gondola. This means that there is far less handling, goads are not required and the animals stay in groups that they are used to; all of which will help keep stress levels down.

The unknown and variable levels of carbon dioxide at the first stop used to be a concern with the older systems. However, new systems are now capable of controlling a stable and known value of carbon dioxide at the first stop point that the animals reach. This means that the

animals will start the induction phase immediately, and although it is aversive it will be at sufficient quantities to start the anaesthesia process. This first stop is where the carbon dioxide levels are monitored and it is here where the alarm sensors are also set. The other advantage to this is that if there is a stop in the cycle for any particular reason no pig is left at sub-optimal levels of carbon dioxide.

Sufficient dwell time is vital as the effects of carbon dioxide can quickly wear off when the animal is exposed to normal air. The cycle of a gas system should be set by the management team and locked so that it cannot be speeded up by the operators. Obviously there will be some variation in the cycle if the line speeds alters due to a breakdown etc, or problems loading pigs, but in a well organised system these slight variations should be minimal. Common practice is for one cycle to take around 2 ½ minutes ie 25 seconds at each stage.

Captive-bolt

As with electrical stunning the stun-to-stick time needs[T1] to be minimal, in case any pigs are not killed in the gas. When calculating the stun-to-stick time it is important to remember that the last pig out to the sticking point is the vital one as this will be the longest. To help reduce the time, the distance from exit to bleed point should be minimal; enough shackles must be present so that the operators are not held back. The table design where shackling will take place is also important. Systems seen to be working very effectively actually have a conveyor that can move forwards and backwards. This means the animals can be positioned exactly, with little effort from the shackling staff. This is good as it speed up shackle time, but is also good for health and safety of the operator.

Constant monitoring is essential when using gas as there is a possibility that the pigs may recover if things were to go wrong. Constant monitoring in terms of the display is easy and this information can be held on computer for a long time, helping to provide good records for audits etc. but it should not be the only monitoring that is relied on. Visual checks should be made, and all operators using the machine should be trained in the signs of effective and ineffective stunning/killing. These visual checks should also be carried out by the QA staff at regular intervals throughout the day.

Captive-bolt equipment

As with electrical stunning, position and power are two of the most important factors when using the captive-bolt. Appropriate restraint and the recognition of what is an effective and ineffective stun.

The correct position is dependent on the species and the age of an animal. All of the positions can be found in the booklet guidance Notes no 2 *Captive-Bolt Stunning of Livestock* With cattle the position is the same regardless of age, the only time it would change is if a non-penetrative bolt was being used, in which case the target would be slightly higher up the skull. Likewise a second shot, should the first fail, would also be slightly different to take into account the swelling from the first impact.

The presence of horns will also have an effect on the position. In sheep this means two different positions are recommended, but with goats, regardless of the presence of horns, the position is always in the back of the head, due to the presence of a large bony mass on the top of the head.

Correct power is simply related to the cartridge size and the condition of the gun. With a well maintained gun the manufacturer's advice on recommended cartridge power should always be followed. For Cash instruments this can be generally classed as pinks for smalls, purple for medium sized animals, green for the larger cattle and horses and black for bulls and other heavy-skulled animals. Again a full list can be found in the captive bolt booklet. However, if a

gun is not maintained correctly, the actual impact energy produced by the cartridge will not be maximised and animals may not receive enough power to cause immediate insensibility.

Appropriate restraint is important; animals that are calm and passive need not be subjected to heavy restraint methods which will cause them to get more stressed. In an ideal situation, stunning can take place relatively quickly when the animal is only just getting used to the surroundings and hasn't had time to think of an escape route. However, in some circumstances and especially with more lively animals, restraint is needed. The restrainer conveyor works well for sheep and does provide a better chance of accurate stunning. Group stunning passively restrain animals and can work well when set up properly.

Head restraint can be a contentious issue and a technical note is provided in the delegate packs. Overall the HSA prefers restraint that restricts the movement of the head without actually holding the animal. This has been proven to increase accuracy without increasing stress levels (Head Restraint at Slaughter: A Practical dilemma Eubank R, Parker M, Mason C Animal Welfare Journal 1990)

The signs of an effective captive bolt stun are very clear and it is essential that all staff understand these signs and know what to do if they are not seen.

<u>Critical welfare issues.</u>
Whilst working in abattoirs around the UK and further a field, the HSA sees certain problems on a regular basis. These can compromise welfare significantly and are more often than not easily rectifiable. The main points of concern are:

- Incorrect placement of equipment
- Incorrect power supply
- Slow stun-to-stick time when using stun only methods
- Lack of contingency planning
- Lack of back-up equipment
- Lack of staff training/understanding

The first problem is directly related to staff experience and training. There is no excuse for this problem and it should be rectified immediately. However, when observing staff it is important to watch them work for a while, and if possible from a non – intrusive position. This should allow them to work normally.

Incorrect power supply is generally down to maintenance and management investment.

Slow stun-to-stick time, as already mentioned is more related to the equipment than the staff, although they will have an impact. No matter how quickly staff can work and get animals onto the elevator, if they have a long way to travel, a slow elevator etc, then the stun to stick time will be delayed and will cause welfare compromises.

It is often a good representation of an abattoir to watch what the staffs do when things go wrong. Do they know what alarms mean and exactly what to do when they are set off? Those that do will be efficient and minimise welfare compromises if something goes wrong, those that don't may cause an adverse impact to a number of animals.

Back-up equipment should always be available and ready to use at the point of the stunning. This can be in the form of another set of tongs/electrical supply, but more often than not a captive-bolt is the instrument of choice. Not having a back up may mean animals have pain inflicted without stunning, and no means to resolve the matter.

All of the above relate to the final point of staff training, Without staff knowing how to a job competently, when to do the job and what they are responsible for, nobody can blame them

for not working effectively. Training staff to be skilled and have empathy with the animals is not an easy task, stock management is much more of a natural talent and less of a learned one and as such, choice of staff for particular roles should be done carefully.

Monitoring a system will catch any of the above problems early on and stop them becoming welfare issues. Observing staff stunning can identify if they are starting to slip with position etc, monitoring the equipment would again highlight any deficiencies before they become serious.

Recording information provides data of the regular running of the system. Any alterations in these results can be suggestive of the beginnings of problems. The use of historical data can help maintain a high standard. The collection of this data may also identify any team member that may not be reaching the right standard.

Staff working in the relevant areas are the correct people to do the majority of the observations as they should be the people that will recognise problems. However, when working in an environment continuously it is easy to accept certain problems as the norm and standards will eventually slip. This could be a slow process but will have a negative effect on animal welfare in the long run. For these reasons it is important to have management and QA do these checks also.

Getting external staff to do observations and critically monitor the individual system can help identify any problems large or small as they are independent of the system.

Session 3: Presentation 8

Application of modern methods for slaughter of poultry

Natalie Smith
Humane Slaughter Association

In 2004 in the UK alone, over 929 million birds were slaughtered for human consumption. This number amounts to around 850 million broilers, 36 million end-of-lay hens, 23 million turkeys and 20 million ducks. For broilers alone that works out at over 3 million birds every working day, nearly 38 every second!

It is difficult to ensure, when killing this number of birds, that each individual's welfare is not being compromised, however it must be remembered that the slaughter of these birds must be carried out in a way which causes no unnecessary pain or suffering. A number of systems have been developed to facilitate the humane slaughter or killing of poultry. The main principle of all these methods is to stun the birds so they become immediately unconscious and insensible to pain; this condition must persist until the birds are dead.

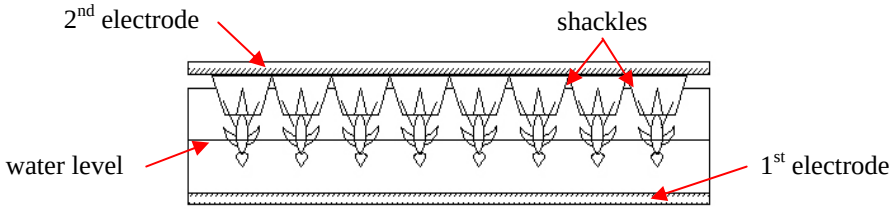
The majority of birds slaughtered in processing plants throughout the world are either stunned using an electrical waterbath system and then bled, or killed by Controlled Atmosphere Stunning (CAS).

When stunning birds we want to affect the brain and make sure they are unconscious and therefore unable to feel pain. The stunning method should then be followed by a killing method such as bleeding. When killing birds in one process, we want to permanently destroy the brain so they do not recover.

Electrcal waterbath stunning

Electrical stunning in poultry is conventionally carried out by passing the birds' heads through a waterbath which contains a live electrode. Each bird's head is fully submerged in the water, allowing the electrical current to pass through its body up to the shackle and overhead rails, which are earthed. For electrical stunning to be effective and humane, birds must remain unconscious until death occurs through loss of blood.

Figure 1. Diagram of electrical waterbath stunner



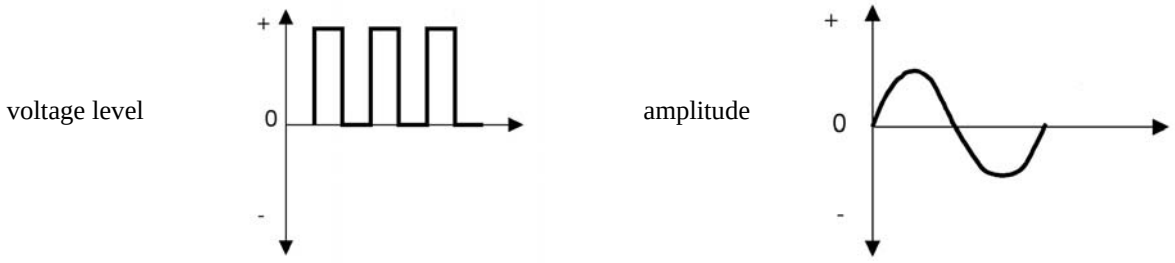
Effective electrical stunning of poultry depends on the correct current, passing through the brain and being applied for a sufficient length of time. Current is measured in amps, voltage in volts and resistance in ohms. The current and voltage used by electrical waterbaths are displayed by the voltmeter and ammeter respectively. Current (I) = the flow of electricity through an object, Voltage (V) = the driving force (electrical pressure) and Resistance (R) = the properties which limit current flow. The current flowing through each bird depends upon overall voltage and resistance. So if the voltage is too low or the resistance is too high, birds will not receive enough current to render them insensible to pain. The voltage could always be increased to combat this problem but if there isn't good electrical contact then this is not

going to help. Also by increasing the voltage you're much more likely to get meat quality issues as well as health and safety issues. A system has not yet been developed to increase voltage depending on the birds' resistance etc. So all systems used are constant voltage, therefore variation will be due to the resistance of individual birds.

Electrical waterbaths tend to have several birds passing through the water at any time. It is important to be aware that the information displayed on the ammeter (measuring current) shows the total current flowing through the waterbath, not through the individual bird. A rough guide to the amount of current each bird is receiving can be found by dividing the figure on the ammeter by the number of birds which are in the bath at any one time. The exact figure cannot be calculated because the current received by individual birds can vary greatly due to differences in their electrical resistances.

The waveform of a current describes the shape of one cycle of the current. Electrical current can be generated either as alternating current (AC) where the direction of the current flow changes, or as pulsed current (DC) which flows in one direction.

Figure 2. Diagram showing direct current (DC) and alternating current (AC) waveforms



pulsed direct current (DC) (3 waveforms)

alternating current (AC) (1 waveform)

The frequency of the current, measured in hertz (Hz) is how many times one cycle of the waveform is repeated per second. Mains electricity in the UK has a frequency of 50Hz, therefore the cycle repeats itself 50 times per second. Waterbaths can deliver either standard (50Hz) or higher (greater than 50Hz) frequency current. Standard frequency current waterbaths will cause the majority of birds to die (90%) while waterbaths set to deliver a higher frequency electrical current are unlikely to kill birds unless the current is significantly higher.

To produce an effective stun for each bird there must be enough current and that means there must be a high enough voltage to drive it. With electrical waterbath stunning the height of the waterbath must be adjusted to ensure the head of the smallest bird passing through is fully submerged in the water, even if this means submerging bigger birds quite deeply. The waterbath must be an adequate size and depth for the type of bird being stunned and the waterbath electrode must extend the whole length of the bath to ensure birds are stunned as soon as their heads drop into the water. Measures must also be taken to prevent birds receiving pre-stun shocks. These occur when birds receive a painful electric shock which does not cause them to become immediately unconscious and insensible to pain. Pre-stun shocks can occur when the birds' wings make contact with the waterbath before the head, or from the side of the waterbath as the birds enter or when electrically live water flows out of the waterbath and onto the entry ramp. Measures which can alleviate this include an angled entry ramp into the waterbath, which allows birds to swing down into the water in one swift motion.

It must be remembered that the higher the voltage, the greater the amount of current that can pass through the brain. The current within the waterbath must pass efficiently and effectively

through the bird therefore, it must be ensured that there are good electrical contacts and that shackle-to-leg contacts are kept wet. Care must also be taken to ensure that there is good and continuous contact between shackles and the earth-rubbing bar. Electrical stunning equipment should be tested daily to ensure that it is delivering a current sufficient to effectively stun all birds that pass through it. This can be done using a meter that tests current flow through a model that simulates the resistance of a bird.

The time interval between stunning and bleeding is critical – it must be kept to a minimum. Birds must not go through the electrical waterbath stunner until it is certain that they can be bled without delay. Before bleeding, the operator must check that birds show signs indicating they have been properly stunned. If there are signs that a bird has not been properly stunned, it must be killed or re-stunned immediately and effectively, using a back-up method, before the neck is cut. Signs that a bird has been effectively stunned include:

- absence of third eyelid (nictitating membrane) reflex
- no rhythmic breathing
- constant rapid body tremors
- wings held tightly against the body

Signs that a bird has been effectively killed are:

- absence of a third eyelid (nictitating membrane) reflex
- no rhythmic breathing
- dilated pupils
- wings drooping

Signs that a bird has been ineffectively stunned or killed include:

- rhythmic breathing (look at movements in the vent area immediately after the bird leaves the waterbath)
- tension in the neck (able to control the movement of its head)
- the presence of a third eyelid (nictitating membrane) reflex

Presence of a nictitating membrane reflex must be acted upon immediately. It does not necessarily indicate full consciousness, but the return of this reflex after stunning is a sign of some brain function returning and it indicates the possibility that consciousness may also be returning.

It must be remembered that electrical waterbath stunning must be followed by a killing method as soon after stunning as possible. Birds that are stunned will remain unconscious for a short period of time only, therefore their necks must be cut as soon after assessment of effective stunning as possible and within a maximum of 15 seconds; or within 10 seconds when using a higher frequency electrical waterbath stunner.

Controlled Atmoshpere Stunning (CAS)

Controlled Atmosphere Stunning or CAS systems are a new concept which are beginning to be taken up in the poultry industry. They were developed around 1995 and are now used in the UK and mainland Europe for the killing of broilers, turkeys, ducks and more recently the first end-of-lay hen gas system was installed.

Controlled Atmosphere Stunning or gas killing systems have the potential to eliminate some of the welfare issues associated with electrical waterbath stunning including the:

- stress of uncrating birds
- stress of shackling and inverting live birds
- problem of pre-stun shocks when stunning with electrical waterbath systems
- possibility of variation in current within a multiple-bird electrical waterbath
- possibility of birds missing the electrical waterbath stunner
- possibility of birds recovering consciousness either prior to or during bleeding

Every person involved in gas killing must be properly instructed and trained in the operation of the gas system. This must include the procedure for flushing the chamber with atmospheric air, and the procedure for evacuation of the birds from the chamber.

CAS systems kill birds by exposure to an anoxic gas mixture. This is a gas mixture that does not contain sufficient oxygen to sustain life and rapidly renders birds insensible to pain and distress. Although the name 'CAS system' suggests that birds are only stunned whilst in the gas, UK legislation demands that birds must be killed whilst they are still in the gas mixture and before they are shackled.

Operators who are involved with the stunning, slaughtering or killing of poultry in the UK have a legal obligation to 'spare animals any avoidable pain, injury or suffering'.

Gas mixtures which can be used in the UK are either:

- any mixture of argon, nitrogen or other inert gases with a maximum of 2% oxygen by volume (2% total oxygen by volume is the proportion of oxygen in a 90% inert gas, 10% air mixture, as the amount of oxygen in air is 20.9%) OR

- carbon dioxide with any mixture of argon, nitrogen or other inert gases with a maximum of 2% oxygen by volume, provided that the carbon dioxide does not exceed 30%

Legislation also requires that devices must be fitted so that carbon dioxide or oxygen (as appropriate) can be measured by volume at the point of maximum concentration. Once in the chamber, the bird has to be conveyed to the point of maximum concentration of the gas mixture within a maximum period of ten seconds. A mechanism must be in place which stops the entry of birds into the chamber if gas concentrations rise:

- above 2% for oxygen OR
- above 30% for carbon dioxide

There must be a means of visually monitoring birds in the chamber. Visible and audible warning systems must indicate when:

- oxygen levels rise above 2% for more than 30 seconds in the inert gas mixture OR
- carbon dioxide levels rise above 30% for more than 30 seconds in the other mixture

There must also be a means of flushing the chamber with atmospheric air with the minimum of delay. Birds must be killed by the gas to prevent them being shackled before they are dead. Once birds have left the CAS system, they must be checked to ensure they have been killed before they are shackled. If any indicators of consciousness are seen, the bird(s) must be killed immediately using a back-up system, eg electrical stunning or the Cash Poultry Killer, and the loading of new birds into the system stopped until the problem has been rectified.

Any birds still within the system should be removed immediately and killed using a back-up method. The signs that a bird has been killed are:

- absence of a third eyelid (nictitating membrane) reflex
- no rhythmic breathing
- dilated pupils
- wings drooping

The signs that a bird has not been killed are:

- rhythmic breathing (look at movements in the vent area immediately after the bird leaves the waterbath)
- tension in the neck (ability to control the movement of the head)
- the presence of a third eyelid (nictitating membrane reflex)

Although the system will give audible and visible warnings if the gas concentration falls below the required level, you should always be on the look-out for signs of recovery. The system must be monitored and the birds checked to ensure they are dead. Back-up stunning/killing equipment must be available and ready for emergencies and it should be checked daily to ensure it is in good working order. There are currently two major companies which produce CAS systems in Europe: Anglia Autoflow and Stork PMT. One major difference between the two systems currently available is that one kills the birds in the containers, while the other has a tipping system which tips the birds out of the module and carries them loose by conveyor to the gas unit. The second major difference is the type of gas mixture used by the different systems.

Anglia Autoflow uses a one-phase process and depending on the species being killed uses either 90% argon (or other inert gas) in atmospheric air or 30% CO_2 and and 60% nitrogen (or other inert gas) in atmospheric air. These gas mixtures kill the birds by anoxia (lack of oxygen). Stork PMT uses a two-phase system where the first phase is humidified and uses 40% CO_2, 30% O_2 and the second phase is 70-80% CO_2 in air. Phase I has a one minute dwelling time and is used to initially anaesthetise the birds, while Phase II has a two minute dwelling time and irreversibly stuns the birds.

All gas systems have the potential to eliminate a number of welfare concerns associated with electrical waterbath stunning in large-scale slaughterhouses. However, it is not a system which can currently be used in smaller processing plants or on-farm sites due to the size and expense of equipment. The HSA therefore feels it is essential to ensure that further research and development on both affordable CAS systems and alternative stunning/killing systems continues for use in smaller processing plants or on-farm sites.

References

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Session 3: Presentation 9

Application of modern methods for killing in disease control situations

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Defra

Introduction

The global threat of Avian Influenza (AI)I with its potential, as a zoonotic disease, to pose a substantial public health risk and cause significant morbidity and mortality to birds, has driven a re-examination of the methods available for culling birds. The increased size of modern poultry units with houses often containing tens of thousands of birds has added to the importance of ensuring that we have killing methods available for disease control that are effective, humane, efficient and capable of dealing with these large units quickly, so that resources that might be needed elsewhere are not tied up for days on end at a single unit.

It is important to be clear about what you are aiming to achieve *before* decisions are made as to how to operate the cull. Defra has, in its preparations for an outbreak of AI in domestic or wild birds, identified three ranked priorities. These are:

1. To protect public and poultry worker health from infection with AI
2. To stamp out disease as quickly as possible and reduce onward spread of infection
3. To cull birds using humane techniques that deliver acceptable welfare

Public and poultry worker health is protected in a number of ways: stamping out infection as rapidly as possible; reducing exposure of humans to infected birds and other material; and where human exposure is unavoidable, providing appropriate and effective PPE. Where the cull is operated successfully, the reservoir of infection is eliminated and further spread of the disease is prevented.

The logistics of any large scale cull presents significant challenges in terms of the deployment of both human and technical resources; health and safety issues, including – for AI – the risk of exposure of humans to infectious agent; and risks to the welfare of animals being culled. Welfare can be compromised: as a result of the effects of disease; during catching and handling; and during slaughter or killing.

Consequently, consideration of the impact of the cull on animal welfare is essential in the planning stages. The aim should be to minimise the negative welfare impact on animals throughout the culling operation:

- kill clinically affected birds as soon as practicable and preferably before death from AI infection results
- ensure that effective biosecurity is implemented on infected premises to prevent further spread of disease
- reduce (or more preferably, eliminate) handling of birds to the minimum that is consistent with ensuring a rapid and effective kill
- kill birds using techniques that produce either immediate unconsciousness that lasts until death, or where this is not achievable (for example, when birds are killed by exposure to gas), use techniques that minimise the negative welfare impact upon the birds, until unconsciousness is induced

It must be realised however, that in a disease control situation, there are competing and inter-connected priorities. This is clearly demonstrated in the ranked priorities that the UK has identified. The weighting or ranking of each priority may vary between countries, and

cultural, political, and economic issues can impact upon priorities and have ramifications for control strategies that are based solely on medical and veterinary epidemiological principles. There are clear differences in the public health significance of human infection with H5 serotypes versus H7 serotypes. Culling strategies need to be adapted to take into account the significantly greater risk to human health posed by H5 outbreaks in poultry. These risks, whether real or perceived, may restrict the availability of catchers prepared to handle birds. A clear change in strategy, such as ruling out the use of any culling method that involves direct contact between humans and birds where H5 infections are encountered, might be required. This has clear consequences for the planning, procurement and execution of any cull. Culling techniques that address the priorities of the control strategy must be selected. The risks and benefits associated with using mass techniques that reduce or eliminate bird handling need to be balanced against the expected benefits to and the need to protect human and animal health. The adoption of working practices that address both human health and bird welfare can mitigate against these risks and help to deliver culling strategies that deliver the most humane outcome for birds identified for culling.

Legislation and Guidelines that Apply to Culling Operations

The UK proscribes methods available for the slaughter or killing of animals for disease control purposes in Schedule 9 of the Welfare of Animals (Slaughter or Killing) Regulations 1995 (http://www.opsi.gov.uk/si/si1995/Uksi_19950731_en_16.htm#sdiv9). This complies with the Council Directive 93/119/EC on the protection of animals at the time of slaughter or killing.

Recently, the World Organisation for Animal Health, or OIE, has turned its attention to welfare. In Paris in 2004, guidelines for the welfare of animals during killing for disease control were adopted in the Terrestrial Animal Health Code, chapter 3.7.6 (http://www.oie.int/eng/normes/mcode/en_chapitre_3.7.6.htm). This text is redrafted on an annual basis to reflect scientific and technical advances, together with comments arising from any OIE members. The chapter reflects current knowledge on the best practice of applying a range of different killing methods in the field. Readers are urged to familiarise themselves with this document.

Modern Methods Available for Culling Birds

The sheer number of birds that might have to be culled in any disease control operation dictates that culling methods should be high throughput. Conventional techniques for killing birds such as neck dislocation, decapitation, use of free bullet, and lethal injection neither meet throughput needs nor the requirement to minimise handling.

This has led to an interest in the use of gas for killing birds on farm. The technology available for achieving and maintaining effective gas concentrations that stun or stun/kill birds in chambers in abattoirs has advanced rapidly over the last 10 years. A number of gas or gas mixtures – including argon or nitrogen, mixtures of argon or nitrogen with carbon dioxide, and a two phase application of a highly oxygenated mixture of carbon dioxide and nitrogen - have been used in commercial abattoirs for some time in a process known as Controlled Atmosphere Stun / Kill or CASK. Aspects of this technology, and the science that underpins it, have been drawn upon in developing techniques that can be used on farm to expose birds to lethal gases for disease control purposes.

The use of gas is attractive for several reasons. Several gases or gas mixtures have been shown to induce rapid unconsciousness and death in birds when the birds are exposed to effective concentrations for adequate periods of time in controlled conditions. The gases used are relatively cheap and readily available across the world. Gas can be supplied to large numbers of birds simultaneously, so high throughputs can be achieved. With some

methods of delivery, birds do not have to be handled before exposure, eliminating the welfare cost to the birds of handling, whilst enabling poultry workers to avoid exposing themselves to infected birds and other material. Although the technology and science that underpins the use of gas is complex, and the use of gas on farm does present significant technical hurdles, the process of exposing birds to gas – once implemented – is relatively automated, reducing the requirement for training of large numbers of personnel in practical techniques, and the likelihood of human error having negative welfare consequences.

However, the translation of what has been effective in the slaughterhouse (i.e. CASK) to the on-farm situation poses some significant hurdles. In particular:

- The ability to procure and mobilise adequate quantities of gas from suppliers to infected premises
- The ability to supply gas from the bulk on-farm store (e.g. an articulated lorry or bank of gas cylinders) to the 'chamber' in which the birds are to be exposed in a controlled fashion at acceptable temperatures and pressures
- The ability to create or adapt chambers where effective concentrations of gas can be maintained and monitored
- The ability to monitor the responses of birds and the welfare of the cull
- Consideration of the health and safety implications of the use of lethal concentrations of gas in enclosed spaces in field situations

A further scientific and welfare debate exists, centring around the effects of the gas on birds prior to their death. A substantial body of research now exists on how birds respond to the inhalation of gases before and during the induction of unconsciousness. Research has shown that an array of responses are seen and that these depend on the gas or gas mixture inhaled, the duration of exposure, the species and age of bird, and the concentration of the gas or gases to which the birds are exposed. The adverse responses that have been observed include: gaping, open mouth breathing, head shaking, movement away from the gas, respiratory disturbances, loss of posture, wing flapping, and more profound convulsions. In the controlled environment where gas is applied in a chamber in an abattoir, these responses are relatively short lived, before the induction of unconsciousness which generally occurs within 30s after exposure to gas. In the field situation, where the precise control of the time and concentration of gas exposure is more difficult, these 'aversive' responses may be more significant. These are issues that must be considered when assessing welfare costs and benefits against control strategy priorities.

Readers are directed to other relevant publications (for example, those published by Lambooij E, McKeegan D, Raj M and Wathes C) for a discussion of the merits of individual gases or gas mixtures and the welfare advantages and disadvantages of exposing birds to such gases. An excellent starting place is the output of a workshop held at Silsoe Research Institute, Bedfordshire, UK in 2004 (and a subsequent follow-up workshop at the British Veterinary Association in 2005) which can be viewed at: http://www.ufaw.org.uk/volume14-reports.php#r028. It should be noted that the majority of research currently available that has assessed the welfare of birds in response to the inhalation of gases, has been undertaken under relatively controlled laboratory conditions. Whilst results can be extrapolated to the field situation, field trials have yet to be repeated to the same level of sophistication.

The concept of applying gas is simple and consistent: administer gas to birds contained within a chamber until an effective lethal concentration is reached that renders the birds unconscious and subsequently dead. Gas should be administered in such a way as to achieve a rapid induction of unconsciousness whilst minimising any adverse effects to the birds: both the aversive responses the gases produce in the birds upon inhalation and the welfare impact of physically exposing the bird to gas in a sealed chamber.

The gas mixtures and methods of application that have been shown to be effective in the field are:

- Wheelie Bins: placing birds in wheelie bins pre-filled with high concentrations of carbon dioxide
- Containerised Gassing Units (CGU's): exposing birds loaded into standard poultry transport crates to a mixture of 80% argon: 20% carbon dioxide in steel boxes
- Whole House Gassing (WHG): injecting 40-45% carbon dioxide in air into poultry houses

The potential application of fire fighting foam for delivering modified gaseous environments will also be discussed.

1. The 'Wheelie Bin' System

The wheelie bin system works on the simple principle of adding birds to a portable steel 'wheelie bin' or similar container which is pre-charged with a lethal concentration of carbon dioxide gas.

The wheelie bin is a stainless steel container with one or more gas inlets at the base of the chamber, through which carbon dioxide gas is injected into the bin. Carbon dioxide gas is fed into the bin from a bank of gas cylinders attached to a manifold system. The system is usually operated as a bank of cylinders supplying gas continuously to between four and eight bins connected in series. The lid of the bin is a stainless steel roof with two upstanding entry ports with hinged flaps, through which birds are placed into the gaseous atmosphere inside the bin.

Although the system is relatively simple to operate, it does lack sophistication, and a number of welfare concerns are associated with its use. The ability to effectively control the concentration of carbon dioxide gas in the bin is minimal, and as birds are added, gas is displaced that needs to be replaced.. This can result in large variations in the gas concentration and the possibility of birds being exposed to variable or sub-lethal concentrations and the possibility of delays to onset of unconsciousness. Insertion of the birds through the hinged flaps of the bins is potentially traumatic, and physically demanding for catchers. Injuries to the birds can result from contact with the metal edges of the insertion port, and then subsequently as the birds are 'dropped' onto the floor of the bin. More crucially, it is difficult to monitor the progress of the cull in each bin as visualisation of the birds is difficult and doing so (by looking through entry ports) can allow gas to escape. Consequently, there is the risk that birds in the previous layer added to the bin can be smothered and asphyxiated by addition of subsequent birds, where insufficient time is allowed between the addition of successive layers.

Despite these concerns, the system is easy to use, and with sufficient personnel, can achieve high throughputs. Bins are easily transported and carbon dioxide gas is readily available in a range of cylinder sizes. A good example of their use was in the recent AI outbreak in Turkey, where stand-alone systems were located on the back of pick-up trucks parked in streets. Catchers caught birds in the back yards of houses along the street and carried them to the truck, where the birds were placed inside the bin. These advantages allow wheelie bins to be used in many situations where other gas methods would not be possible. They are however very manpower dependent and using them in a large poultry unit would result in a killing operation taking many days

2. The Containerised Gassing Unit (CGU)

Development of the CGU was instigated by Defra following perceived weaknesses and welfare concerns with wheelie bins, and the desire to expose birds to a less aversive gas mixture. The project was initiated at the University of Bristol in the form of a study to investigate the practical considerations of exposing birds to a mixture of 80% argon and 20% carbon dioxide in containers. Subsequent collaborative development work between university staff, Defra officials and the UK State Veterinary Service (SVS) resulted in the production of the finished product.

This gas mixture was selected because the predominant component is argon, a gas which poultry are known to show minimal aversion to. Inhalation of argon in birds results in rapid induction of unconsciousness (in approximately 15s) followed by death from anoxia approximately 90-120s later. The low level of carbon dioxide produces minimal aversion, but reduces the time of exposure before birds become unconscious compared to using argon alone. The gas mixture is readily available worldwide and is relatively inexpensive as it used for commercial welding.

The disease control unit comprises: 2 CGUs; 2 industry standard poultry transport modules into which poultry are loaded by catchers from the poultry shed; a bank of gas cylinders and a manifold system via which gas is fed from the supply cylinders through one of two regulators into the high pressure hosing that conduits gas into either of the CGU's. Gas is fed through one regulator to one CGU at a time, to permit concurrent operation (one CGU is filling, whilst the other is already full). The use of the manifold system connected to two regulators allows the gas flow to be switched between the two regulators on alternate CGU fills. This reduces problems associated with regulators freezing as the expanding gas from the cylinders draws heat from the environment.

The CGU itself is an empty steel chamber with a hinged door with a rubber seal into which the gas mixture is injected around the base of the container through a series of diffusers. Poultry are exposed to the gas mixture in the transport modules that are loaded into the CGU with a forklift. Once the module is in place and the CGU door closed, gas is fed into the CGU under relatively low pressure (both to reduce problems with freezing of gas delivery apparatus, and to reduce turbulence and noise inside the CGU). Addition of the gas displaces air inside the through two evacuation ports located in the roof of the CGU. A tube to an oxygen monitor is fed through the hinged door and located at the same level as the highest tier of draws in the transport module (where the oxygen concentration would be expected to be highest). The oxygen monitor continuously samples and displays the oxygen concentration. Gas is added (usually for a period of 90-120s) until a terminal concentration of less than 5% oxygen is displayed. The gas is switched off and a further 60s allowed for birds to continue inhaling the gas mixture.

Monitoring of the birds is possible by listening for auditory cues that can be heard through the wall of the CGU. Shortly after induction of unconsciousness, birds begin to convulse. This can be clearly heard through the wall of CGU as shaking. This persists for approximately 90s after which this noise rapidly and consistently falls away to nothing. The cessation of movement equates to the onset of death in the birds. Birds remain *in situ* for a further minute before the door is opened and the module removed. Immediate checks for death are undertaken by trained staff by observation of birds in drawers; in the unlikely event that a live bird is identified, it is killed by dislocation of the neck. Birds are subsequently removed from drawers either by hand or by tipping into secure containers for subsequent rendering or incineration.

The development of the CGU was overseen by Defra Health and Safety representatives. Safe working procedures have been developed as the project has progressed and are

embodied in standard operating procedures which require personnel to avoid gas exposure, never to lone work, and to wear personal gas exposure meters to indicate when adverse gas concentrations are encountered.

The CGU has undergone significant field testing within the SVS. Trials with end of lay hens, spent breeder birds, and small numbers of ducks and geese, have resulted in 100% kill rates. Although a period of training and familiarisation to operation of the equipment is required, this can be achieved rapidly, after which an optimal throughput using two CGU's in excess of 5000 birds per hour can be achieved. This is roughly the rate at which one catching gang (of five individuals) will catch birds in a commercial setting.

Use of the CGU affords several welfare and practical advantages: the handling of birds is reduced compared to the wheelie bin system; birds are exposed to a relatively non-aversive gas mixture; kill rates are consistently 100%; monitoring of birds and gas concentrations is achievable; the system makes use of industry standard equipment that will be available on most poultry farms; operation of the system is routine once appropriate training has been given; a relatively high throughput of 5000 birds per hour is achievable. The major disadvantage is that live birds require to be caught and loaded into transport modules, and subsequently emptied from the draws as carcases, potentially exposing staff to infected material. However, appropriate use of PPE can be made to reduce the likelihood of worker exposure. Modular systems that enable birds to be tipped out *en masse*, thus eliminating the handling of carcases, are available.

50 CGU's have now been procured by the SVS and stand ready to be deployed for disease control purposes. They were used successfully in the H7 outbreak in Norfolk earlier this year. A training video demonstrating operation of the system has also been produced and veterinary and animal health officers throughout the UK have now been trained in the use of this equipment.

3. Whole House Gassing (WHG)

3a. Technique

WHG involves the addition of a gas or gas mixture to a poultry house made (relatively) gas-tight until a lethal concentration is reached; birds are rendered unconscious by inhalation of the gas; continued inhalation results in death. The technique has been implemented successfully in several locations, e.g. in the Dutch AI outbreak in 2003, over 90% of all poultry were killed using WHG.

3b. Candidate Gases

In theory, a variety of lethal gases could be used for WHG

Anoxic Gases: The inert gases, nitrogen and argon are attractive candidate gases because they induce minimal aversion in poultry when inhaled. However, nitrogen is lighter than air and would be difficult to contain within a poultry house. Even if containment were feasible, the gas could pool towards the roof, rendering it useless for killing floor-housed birds, or birds housed in lower cages. Argon is heavier than air and so could be better contained. However, argon is significantly more expensive than nitrogen and carbon dioxide, and is less readily available. The author is not aware that WHG trials have been performed using inert gases.

Mixtures of Anoxic Gases and Carbon Dioxide: depending on the relative proportions of the component gases, these may or may not be readily containable. Mixtures with argon are however likely to be prohibitively expensive, given the huge quantity of the gas that is required. Trials have not been performed.

Carbon Monoxide: Carbon monoxide is another candidate gas that is lethal when birds are exposed to low concentrations over short periods of time. The gas is considered to be a relatively humane option for euthanasia. There is minimal information pertaining to its application in WHG, although anecodatally, the gas has been generated from poorly tuned petrol engines and fed into poultry houses to kill birds. Future use is unlikely as it is difficult to procure or generate in sufficient pure quantity, it is highly toxic to man, but most importantly, it is explosive at concentrations little more than what is required for euthanasia

Carbon Dioxide: To date, only carbon dioxide has been used extensively in WHG. It is produced as a by-product of the brewing and fertiliser industries and is readily available and inexpensive. It is available from suppliers in a variety of forms: liquid carbon dioxide; gaseous carbon dioxide; and dry ice. Birds begin to become unconscious when inhaling a concentration of around 20%. To ensure death, a minimum concentration of 40-45% is recommended in sheds.

3c. Technical Hurdles

WHG presents two main technical challenges. The first is to 'create' a chamber into which gas can be fed, and contained in a relatively controlled manner. The second pertains to the physical characteristics of carbon dioxide itself which creates challenges when the gas is used in the farm situation.

In order to achieve a controlled delivery of gas and effective concentrations, the poultry shed must be converted into a relatively gas tight chamber. This generally means sealing doorways, deficits in the building fabric, and ventilation shafts with plastic sheeting and tape. This is not overly problematic with sheds of modern construction, but can be more difficult in poorly constructed or maintained sheds. The timing of the sealing of ventilation shafts is critical. Adequate ventilation must be maintained through the shed to ensure the birds' thermal comfort until the very last moment before gas is added. Reducing airflow at an earlier timepoint risks raising the shed environmental temperature and predisposing birds to hyperthermia. A further problem is posed by the size and / or design of the sheds that will be encountered. Modern sheds may have internal volumes in the order of 10,000 cubic metres. Cage systems are often mounted on slatted floors that overlie pits, sometimes 2 metres deep, where manure collects. A huge quantity of carbon dioxide is required to achieve concentrations of 40-45% gas by volume in sheds of such size, and ensuring homogenous dispersion of gas and a rapid enough rise in concentration is difficult. Because carbon dioxide is denser than air, it will in theory sink to the ground, raising questions about its efficacy at higher levels where caged birds may be housed.

These considerations, and others impact on the physical nature of carbon dioxide that is applied. The use of liquid carbon dioxide is the only realistic option for delivering adequate quantities to farm premises. It is generally transported on articulated vehicles carrying pressurised chambers of the liquid at –78C. The liquid must be vapourised into a gas for effective application. Although steam or electrical vapourisers are available that could in theory achieve this, the logistics of undertaking this, and the energy that would be required, make this option unrealistic. Consequently, most WHG work has involved the drainage of the liquid gas into the shed. This creates a further set of problems. Firstly, the complex physical properties of liquid carbon dioxide mean that, when delivered through tubing or nozzles, solid frozen carbon dioxide (known as 'snow') forms readily and can cause blockages. Secondly, when vapourising in the shed, energy is extracted from the environment, resulting in substantial, although transient, falls in temperature within the shed. There are clear potential welfare implications for the birds.

3d. Advantages of WHG

The major attraction of WHG is that there is no requirement for humans to handle (or even come into close contact with) live birds. The negative welfare impact of handling is avoided, and human exposure to sources of potential infection is eliminated. Many thousands of birds can be killed simultaneously, and the technique, once ‘set up’, is relatively automated. The mass cull is achieved remotely from personnel involved in its execution, and the emotional impact of culling such large numbers of animals may be lessened. Although preparations can be lengthy, time required for gas application may be as short as 15-30 minutes. A further unexpected result from a WHG trial was that carcases were preserved for three days without any signs of decomposition. This could reduce the urgency with which carcase removal must be achieved.

3e. Experience with CO2 WHG

The UK and others have been active in researching WHG with a view to understanding better the complex processes involved and the ultimate aim of refining protocols to make the technique more controllable, safe, effective and welfare-friendly . Work on empty sheds has assessed the impact of delivery of liquid carbon dioxide. Two concerns have been identified, namely the substantial but transient drop in environmental temperature that can result, and the potential for physical trauma from the ‘blasting’ effect of the ingress of liquid, and turbulence that results from rapid vapourisation. Studies have examined several delivery systems (involving one of more injection ports and different sized terminal nozzles) and shown that temperature drops are clearly affected by utilising different numbers of injection sites, presumably because of the differing rates at which liquid is added. Concentrations just in excess of 50% carbon dioxide have been reliably achieved throughout the shed, although concerns remain about the potential for ‘pockets’ of lower concentration to form, where birds may be unaffected.

Despite the many theoretical and technical difficulties, the practical application has yielded more welcome results and the effective application of WHG in the field is a reality. Effective concentrations have been achieved in sheds, including those overlying manure pits. The time of gas delivery has been relatively short (15-30 minutes). The gas has been contained effectively within the shed during application, and subsequently dispersed effectively when the shed is unsealed. Floor housed birds and birds in battery cages have been exposed to effective concentrations and 100% kill rates have been observed. Physical and histopathological examinations of carcases have not identified signs of physical trauma or thermal injury. Bird heads have been observed lying in food hoppers, suggesting normal feeding behaviour until the onset of unconsciousness and there has been little evidence of convulsive behaviour (e.g. birds lying on their backs, gross fractures) or panic (e.g. fleeing/crowding/piling of birds).

Clearly further work, directed at reducing potential physical and thermal stress, is required. It would be helpful to characterise more clearly (as has been done for CASK) the responses of birds to inhaling carbon dioxide during WHG. Data on heart and respiratory rates, body temperature and electroencephalogram would shed light on the timepoints of unconsciousness and death, and the welfare impact on the bird prior to unconsciousness. Finally, the technical challenges associated with use of the anoxic gases need resolving, and the use and applicability of these gases investigated fully.

4. Fire-Fighting Foam

Expanding foams have been used for some years now to fight fires in confined spaces where access is limited. The principle is relatively simple. Foam is created by the addition of varying quantities of water to commercially available surfactant in a fan-operated mixing device that sucks in air from the environment. Gas or gas mixtures can be used instead of air to create foam comprising bubbles, the composition of which reflect the gas added. The physical properties of the foam can be varied (to make it wetter, more or less viscous, more or less expandable, and the bubbles to vary in size or in resistance to breakdown/longevity) by varying the concentrations of water and surfactant mixed, and type of surfactant that is used.

Several independent groups have started looking at the potential of using foam to deliver modified gaseous environments inside poultry houses that will be lethal to birds. Initial trials have examined the effects on poultry of foam made with air, or foam constructed with carbon dioxide or anoxic gases.

Further studies are required before the technique finds general applicability for the humane culling of birds. In order for the modified gaseous environment to be effectively delivered to and released at the level of the birds' heads so that the bird can inhale and succumb to the effects of the gas, a number of conditions must be fulfilled:

- Foam must expand into all areas where birds are kept, and maintain the gaseous composition of the bubbles
- Where birds are housed in tiered cages, the foam must be able to penetrate the cages, and be of sufficient strength to support itself as the vertical height of the foam rises within the house
- The approach of the bank of foam, and being surrounded by foam, should not be aversive to birds
- The bubbles should be sufficiently weak so that local movements produced by the birds' heads cause the bubbles to break down to form a 'pocket' of gas that the bird is able to inhale freely
- The foam should not contain any toxic or irritant chemicals that could irritate the skin or the mucous linings of the respiratory tract
- The foam must not form a physical 'plug' in the upper respiratory tract that blocks the tract, causing asphyxiation
- Gas pockets formed must be of sufficient volume for the bird to inhale an adequate quantity of gas to induce unconsciousness and death
- Sufficient gas pockets must be released for all birds in the shed to be exposed to adequate quantities and concentrations of gas
- Once the cull has been completed, it must be possible to breakdown the foam relatively easily and to effectively contain the contaminated waste products that result

However, foam offers many potential advantages: gas at acceptable temperature and pressure can be delivered to birds in a controlled manner; the gas can be effectively targeted at birds and contained, relieving many health and safety concerns; it may be possible to apply minimally aversive gases with this technology; delivery of the gas (i.e. foam) can be observed; its use may be applicable to a wider range of poultry houses than WHG; being immersed or surrounded by foam appears to provoke minimal behavioural responses in broilers; because gas is contained and foam can be targeted, there is little wastage of gas, reducing the costs and environmental impact (c.f. WHG with carbon dioxide). Although much development work is needed, this technique holds promise for the future and has the potential to address many of the practical and welfare concerns associated with other techniques.

Conclusions

The requirement for mass killing as a disease control strategy is unlikely to change in the foreseeable future. The killing of large numbers of animals – although undertaken to protect animal health and welfare, and in the case of AI, public health also - is distasteful, distressing to many, and arouses strong feelings. The competing demands of protecting public health and stamping out disease rapidly impose significant constraints on the range and application of methods that can be used to kill birds effectively and humanely. Despite this, techniques are available that can deliver humane deaths to large numbers of birds in challenging on-farm situations.

Considerable progress in the application of gas for on farm killing has been driven by the threat of AI infection. The use of gas affords many practical advantages in terms of throughput, automation, and reducing the requirement to handle potentially infected birds. WHG is an attractive concept because no live bird handling is required and large numbers of birds can be culled simultaneously with a single effective exposure. However, current technical constraints mean that only application of carbon dioxide is effective, and concerns remain over the welfare impact of exposure of birds to lethal concentrations of this gas. Containerised gassing methods afford flexibility, medium throughput, and the CGU system utilises a gas mixture that is less aversive to birds than carbon dioxide. However, the major disadvantage is that live bird handling is required. The assessment of fire fighting foam as a vehicle for delivery of modified gaseous atmospheres (both carbon dioxide and inert gases) is in its infancy but this technology offers many potential advantages over current WHG and containerised gassing methodologies.

Further work is however required to develop superior systems that negate any requirement to handle live birds, minimise the impact of physical exposure of the gas the bird, and that induce a more rapid onset of unconsciousness and death with minimal aversion.

Session 4: Presentation 10

Inspection and auditing of automated controlled atmosphere methods for slaughter for poultry

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Introduction

Handling and restraining of live birds before electrical stunning in a waterbath can be potentially painful and stressful. Stunning of poultry in automated controlled atmosphere systems can be beneficial for animal welfare if it is done properly.

Other reasons for introduction of this stunning method are easier handling of the stunned birds in comparison to awake birds, improvement of worker safety, especially for shackling of heavy toms with 18-25 kg live weight, a reduction of blood spots in the muscles and possibility of higher line speed.

Regarding animal welfare the effectiveness and impact of the used gases and gas concentrations on poultry should be based on sound science.

The necessary welfare inspections and audits must be done according to the operating mode of the system. Besides a general license of a system, the complex situation of every single installation requires a plant specific approval of welfare including the necessary training of competent authority and personnel. In order of the specific approval, helpful technical specifications should be required in advance of the inspection, to prepare efficient checks. In line with these preparations easy access to the birds at different stages of the stunning process or access points for external measurements of atmospheres, possibilities for verification of alarm devices and settings, time intervals of monitoring and recording process times and gas concentrations can be asked for.

If the necessary devices and access points are not available a longer preparation of an inspection and assistance by the company is necessary. Knowledge of technical descriptions and instruction of the auditors are mandatory before an inspection is carried out.

The inspection and auditing of automated CAS systems encloses the following issues:

Good welfare during bird supply to the system

The aim of good pre-slaughter handling is to reduce excitement and warrant a gentle induction of the stunning process.

Concerning the birds supply, compared to reactions to human contact and the process of shackling before electrical stunning, birds appear to be standing or sitting calm before entering the gas atmosphere. However some main factors compromising welfare during stunning have been identified and in most cases can be eliminated by process optimisation.

Overloading of containers may lead to irregular supply and piling up of broilers on the conveyor belts. The same effect occurs, if belt speed is not adjusted properly. By consequence the risk of unnecessary excitement or insufficient stunning effectiveness (chicken might be hiding their heads under other animals) and bruising increases. This refers also to systems in which the birds stay within the transport crates while being exposed to the gas.

Excitement of the birds before stunning increases in systems where containers are tilted for emptying. In a good system birds show some wing flapping and vocalisation at this time but

only during the first minute after having slipped out of the container until each animal has found its position. Here it is important to give enough space for the animals not to be forced to sit on each other or to fall over each other and to provide a soft surface for them to land on. In practice it can take 45 to 60 seconds until every bird has found its place on the conveyor belt and the group has completely calmed down. If birds fall upon other birds being previously put on the conveyor belt, or if it takes longer than 60 seconds for the birds to find enough space, loading density is too high or the speed of the conveying system is not adjusted properly.

Short wing flapping and vocalisation can be also observed when broilers have to change from one conveyor belt to another. Conveyor belts should be checked for slipperiness from time to time, as some materials may wear out by use and birds will straddle.

Poultry can also be stunned within the transport crates. Here it is important that no parts of the birds body stick out of the crates and loading density is not too high. Crates should be regularly checked for damages. Loading density should be checked periodically before entering the stunner or when crates are being emptied. It should be evaluated according to weight and size of poultry batches.

Compliance with scientifically based induction conditions and corresponding clinical appearance

So far controlled atmosphere systems with composition of gases like
- 40%CO_2/30%O_2/30%N_2 followed by 80%CO_2 in N_2 (Stork PMT, NL)
- 30%CO_2/60%Ar10%N_2 (Anglia Autoflow, UK)
- CO_2 in air in paternoster-like systems (Linco, DK) are used to stun chicken and turkeys.

For the first two atmospheres scientific data are available, which reflect the behaviour and the onset of unconsciousness after exposure. The behaviour patterns of broilers within 30 to 60% CO_2 do not seem to be very different (Lambooij et al. 1999). Higher concentrations should be avoided because scientific data is not available.

The reactions during the induction phase should be in compliance with findings of relevant scientific studies. Birds should sit down or stand calm before loss of neck tension and subsequently loss of posture sets in. Short head shaking and breathing with an open beak up to gasping in some cases can occur. These are typical signs for the impact of CO_2. Flight reactions like wing flapping or jumping should not occur.

After loss of posture birds can show higher physical activity until their muscles become more and more relaxed and movements of the skeletal muscles decrease. It is important to mention, that the patterns of behaviour during induction into the gas may occur at different times in individual birds, e.g. heavier birds may show a behaviour later than light ones. If strong physical activity appears in already unconscious birds while a neighbour bird is still conscious, this might be a welfare concern.

<u>Effectiveness of stunning</u>
After leaving the stunning system birds should be completely relaxed and no movements should be detectable.

Sufficient depth of stunning must assure that in combination with a given stun-stick interval and quality of neck-cutting no animal regains consciousness before dying.

To verify effectiveness of stunning a representative sample of birds should be checked before and after neck cutting until scalding. The first signs of beginning resumption of consciousness are beak opening, rhythmic breathing, spontaneous blinking, wing flapping,

rightening movements and vocalisation. The frequency of broilers showing only isolated eye reflexes (no repeated or rhythmic reactions) normally is very low, e.g. zero, or one or two broilers within ten minutes (/1.670 birds). Up to now not many reported experiences exist. In an own investigation (von Wenzlawowicz et al. 2005) in a CAS system built by Stork PMT (NL), the number of broilers classified as completely awake due to the presence of rhythmic breathing, rightening movements and in some cases vocalisation, was 0.003% (1 out of 36.072). The systems of other suppliers of stunning systems should be able to reach at least the same effectiveness.

It should be kept in mind that birds, which already show signs of rhythmic breathing will awake very quickly afterwards.

Short waiting periods (e.g. <1,5h) after transport may decrease stunning effectiveness in some systems. The influence of climatic changes has not been investigated sufficiently so far, but it is possible that temperature and humidity can have an impact on stunning effectiveness.

When evaluating movements of the birds after neck cutting it must be kept in mind, that some mechanical cutters not only severe the vessels but also cut through the spinal cord so that movements might be due to a broken neck and not coordinated movements. It may be difficult to distinguish between the two if the neck has not been palpated manually.

Process control and monitoring

Suitable process control and monitoring of welfare relevant parameters should include possibilities for easy checks by the competent authority or quality assurance.

The visual inspection of the behaviour and reactions of the birds should be done during supply, induction of anaesthesia (until loss of posture), after leaving the system, before and during bleeding.

Therefore access to the relevant control points (e.g. visible access during induction phase, possibility for clinical checks of stunning effectiveness) must be possible.

The necessary features for proper use, such as exposure time, gas concentration and stun to stick interval should be measured. To check the time intervals it is advisable to take the beginning of slaughter or the first animals of a new flock. Otherwise single birds or crates have to be marked to identify them at the certain check points.

To measure the gas concentrations it is necessary to measure close to the birds head except in those systems where the gas atmosphere is circulated quickly between the supplying source and the chamber of exposure. In such systems measuring within the afferent pipes can be sufficient.

The equipment used for external measurements should be adapted and calibrated for the gases, which should be measured. It should be noted, that the results between measuring devices can differ within +/- 2% for gas concentrations. The collected data should be compared with the companies own data and in relation to the alarm settings.

The personnel responsible for the stunning area should be trained and licensed and of cause capable of managing the system properly. It should be assessed if the personnel recognizes deficiencies and takes the necessary actions. An action plan for the case of an emergency should be available (e.g. many birds wake up, gas supply problems, line stops).

Possible future developments

It can be assumed that the advantages of stunning systems for poultry in automated controlled atmosphere systems will further increase the number of installations. One of the next steps into further mechanisation might be automated shackling, which especially requires relaxed carcasses. Stunning in controlled atmosphere systems will be a pre-requisite for this step.

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Session 4: Presentation 11

Inspection and auditing of automated electrical methods for slaughter

Part 1 White meat - Natalie Smith
Humane Slaughter Association

Poor maintenance, adjustment and calibration of electrical waterbath stunners for poultry can cause a number of problems in relation to animal welfare and product quality. Along with a number of other issues, these include:

- Different designs of electrical waterbath stunners deliver different waveforms which need different settings and can cause confusion as to what are the suitable voltage, frequency and current levels
- Birds may receive pre-stun shocks, due to poor design of the bath entry
- Birds can receive too low a current due to poor electrical contact with the shackle

Different electrical waterbath designs

Variations in manufacturer design and set-up in individual processing plants means that no two electrical waterbaths are exactly the same. Differences in waveform, frequency, water conductivity, bird resistance etc makes it very difficult to provide a standard for plants to work from. Currently, there is also no accurate way to assess how much current each bird has received as it passes through the waterbath.

However, systems have been developed to try and control the amount of variation seen. One particular stunner-monitoring system works by measuring the current passing through individual birds. The system passes through the stunner with the bird, and records the voltage applied to the bird and the current passing through it, as well as variations in current strength (Berry et al, 2002). The unit can store data for about 25 minutes and provides time histories of the current recorded for each bird tested. Since the logger provides continuous time history, of current it is possible to relate variations on the graph to particular points along the waterbath stunner. This is particularly useful for determining causes of pre-stun shocks and current spikes. In general the monitor is used with about 15 birds to give a good indication of the mean value of the current and the range of variation (Berry et al, 2002).

It is important to remember that while this stun monitor will help to ensure the waterbath is set up correctly, there will still be variations in water conductivity, bird resistance etc throughout the day. The only way to continually ensure that birds have been stunned properly is a visual assessment once they exit the bath.

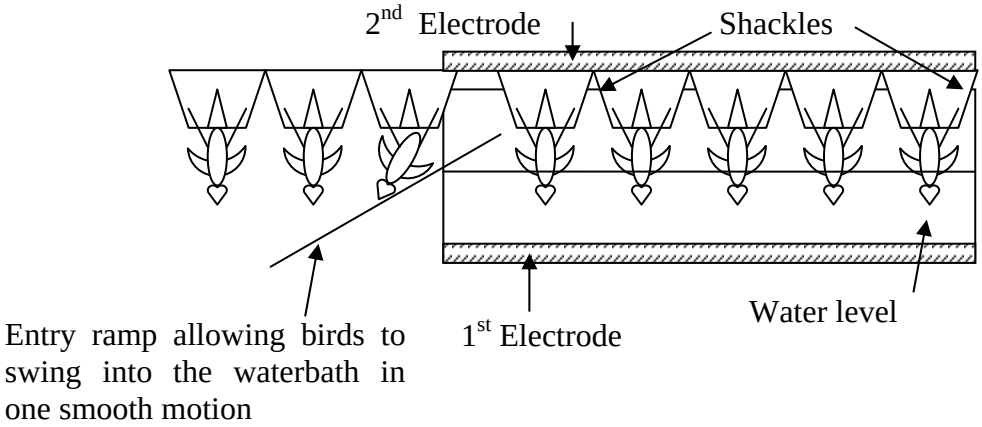
Pre-stun shocks

Pre-stun shocks can happen when the birds' wings make contact with the waterbath before the head, or with the side of the waterbath as the bird enters. Pre-stun shocks can also occur when electrically live water flows out of the waterbath and onto the entry ramp. Wing flapping on entry of the waterbath makes pre-stun shocks more likely and, in turn, if birds receive a pre-stun shock this may start wing flapping and affected birds may then ‘overfly’ the electrical waterbath and not be stunned at all.

For high-throughput processing plants, where more than one bird is passing through the waterbath at any one time, a steeply-inclined flat ramp bolted on to the entrance of the waterbath can be effective in preventing pre-stun shocks from occurring. The ramp should extend over the water so the birds get drawn up the ramp by the shackle line and then swing down into the water in one smooth movement.

This results in the bird's head and wing entering the water together and the bird is stunned immediately (see Figure 1).

Figure 1. Diagram of entry ramp swinging birds into the waterbath in one motion



Whilst entry ramps will help to reduce the likelihood of birds receiving pre-stun shocks once they enter the waterbath, care must be taken to ensure birds do not receive them from the entry ramp itself. This may occur if the ramp is electrically live because of water flowing from the bath onto the ramp or if it is not isolated from the rest of the stunner.

Research funded by the HSA has led to the development of another way to reduce pre-stun shocks on the entry ramp using PVC rods over the original ramp rather than a solid perspex surface. The idea of this system is that any water that does splash onto the entry ramp will flow down either side of the rods and not come into contact with the birds moving up the ramp (see HSA Technical Note 16. *Prevention of Pre-Stun Shocks in Electrical Waterbaths*).

Poor electrical contact

Most electrical waterbath stunners have about 15 birds passing through at any one time and an equal voltage is applied to each bird as its head passes through. However, as birds have differing resistances, ranging between 1000 to 2500 ohms (Sparrey et al, 1993), a voltage which produces an adequate stun current in a bird of average resistance will produce a lower current in birds with high resistance which may cause an inadequate stun. This problem can be increased by poor stunner maintenance and operation, where birds can receive reduced current due to poor electrical contact with the shackle, low water conductivity or intermittent electrical contact which will cause an intermittent current to flow through the bird (Berry et al, 2002).

Particular care should be taken when cleaning the equipment and this should be done in accordance with the instructions given in the manufacturer's manual. Poor electrical contact between the bird and the shackle can be a particular problem with a build up of dirt and limescale, so this must be regularly checked. Electrical conductivity can also be improved by spraying the empty shackles with water before birds are hung on.

Birds can receive an intermittent stun due to poor contact between the shackles and second electrode or earthing bar. This can be resolved by ensuring the shackle line maintains continuous contact with the earthing bar throughout the period that the birds are within the waterbath.

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Part 2 Red meat – Charles Mason

Humane Slaughter Association

Fully-automatic electrical systems for red meat animals cater for cattle and pigs; as yet there are no fully automatic systems available for sheep. Cattle systems are based on the traditional 'stunning-box', as used in conjunction with captive-bolt equipment, and animals are stunned or stun/killed individually. Cattle are restrained in a purpose-built stunning box with built-in electrodes to both stun and kill the animals.

Electrical stun/kill of cattle is achieved using three cycles sequentially: a three second, head-only cycle to stun the animal; followed by a 15 second cardiac cycle to induce ventricular fibrillation (cardiac arrest); finishing with a four second spinal discharge cycle to reduce post-kill convulsions. Equipment for cattle restrains the animals with a neck yoke, chin lift and rump pusher, in order to position them for accurate electrode placement. An electrode will then contact the nose and current will flow from the nose to the neck yoke, stunning the animal. A second electrode then makes contact with the brisket and a further current flows through the body to stop the heart. A third cycle, nose to rump, is used to disrupt spinal reflexes so that animals lie motionless when released from the restraining pen.

There are two systems for pigs, both delivering individual animals to the stunning point by a conveyor: the Valhalla system uses a V-restrainer and delivers a short, very high voltage (up to 1,000V) stun via a static, hinged electrode which contacts the pigs as they pass through; 90% of pigs are killed in this system. The Midas system uses a monorail conveyor and delivers a stun/kill using two cycles sequentially. Pigs are conveyed to a point close to the end of the conveyor where they stop: an electrode makes contact either side of the head between the eye and ear for three to five seconds; following this a second electrode makes contact over the pig's heart for a minimum of five seconds, causing cardiac arrest. Batches of pigs may differ in size, so it is important that with both of these systems,the equipment is adjusted accordingly. If significantly different sized pigs are present within a batch, welfare problems may arise by incorrect electrode placement.

With automated electrical systems, as with manual electrical stunning, it is important that:

- the animals are restrained in a position which allows accurate placement of the electrodes;
- an adequate current is applied for the correct amount of time;
- in stun/kill systems, that the animals are effectively stunned before the cardiac arrest cycle takes place;
- animals are effectively bled without delay.

Inspection and auditing of these systems involves regular, close scrutiny of the equipment, its application and the animals going through the process.

Equipment

All methods of restraint need to be regularly checked in order to eliminate any impact points or protrusions and minimise distress on animals. Where animals of significantly different sizes are passing through the same system, regular adjustment must be carried out to ensure accurate placement of electrodes. The electrodes should be checked for wear and build-up of grease and dirt; they should be cleaned at regular intervals throughout the shift to minimise contact resistance. The output of the equipment under-load needs to be checked regularly and compared to the output displays on the ammeter/voltmeter. This will ensure animals are receiving adequate current and establish whether the displays are of real value, ie do they reflect the output, under-load, of the stunning equipment? The equipment used to carry out these checks must be regularly calibrated.

Application

The placement of electrodes needs to be checked along with the duration of application of the electrodes. With the Midas system for pigs the correct position is between the eye and ear followed by a second electrode making contact over the heart from the side; with the Valhalla system contact must start either side of the head between the eyes and the ears. With cattle the stun electrode must contact the nose to span the brain with the neck yoke; a second electrode then contacts the brisket between the forelegs. Stun cycles should be for a minimum of three seconds and cardiac arrest cycles at least five seconds, but in practice are often longer.

Animals

Whatever the displays on the equipment may say, the surest way to check that animals are being effectively stunned is to make sure they are displaying the physical symptoms of an effective stun/kill, ie an exaggerated tonic phase, followed by a clonic phase fading to a limp carcase. Examination of the carcases post-dressing for meat quality defects may give indications of poor welfare such as bruising, which may suggest impacts and/or bad handling, and broken bones/blood splash which may arise from problems at stunning.

In a well-run operation, inspections and audits will be carried out at three levels:

1. by independent outside bodies on behalf of customers and quality assurance schemes – these will take place at regular intervals such as monthly or quarterly;
2. by plant management, enforcement officers and internal quality control staff, such as official veterinarians (OVs) and animal welfare officers (AWOs) – these should take place daily, at the start of the shift and at random intervals during the shift;
3. by slaughter personnel who, when working with fully-automatic systems, should continually monitor the stunned animals and look for signs of ineffective stunning and/or recovery and take action if necessary. In addition to this, equipment should be regularly checked and adjusted by the plant engineers, who must keep accurate records of these inspections for scrutiny by the OVs and AWOs.

Mini Sessions: Presentation 12

Biosecurity

Professor Mac Johnston
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Biosecurity has been described as “The protection of an animal population from introduction of infectious agents” As a livestock production objective is the “.... humane, efficient production of appropriate quantities of safe, high quality animal products” biosecurity is an important component of such an objective.

Biosecurity in fact describes the process of cumulative steps aimed at controlling critical factors that allow the spread of any agent likely to cause disease. It is usually discussed in relation to infectious diseases but the term in reality is all-encompassing. Many diseases can be spread not only by direct contact between animals/birds, but also by secretions and faeces and also by contaminated boots, wheels of vehicles or equipment. Disease control is based on knowledge of the agent(s) that one is trying to control. Thus it will vary depending on the infectivity of the agent, its pathogenicity, potential for transmission, the ease of recognition of the clinical signs of the disease and ease of defining carrier animals.

Animal disease can be infectious or non-infectious in origin. The infectious agents are viruses, bacteria, fungi and parasites. The disease problems vary according to the infectious agent involved. For example virus can only multiply in host cells but is shed in body fluids with disease presenting as the carrier, subclinical, clinical state. Viruses survive days-months outside host and spread by direct/indirect transmission and do not respond to antibiotics. Bacteria grow in “culture” surviving hours-months outside host. Spread is by direct/indirect transmission and while susceptible to appropriate antibiotics can develop resistance. Non-infectious causes of disease include trauma, hereditary/congenital, nutritional problems, toxic agents and stress.

In the operation of the site it must be policy to avoid at all times the spread of disease between animals and from animals to ‘man’. Equally it is important that ‘man’ is not the inadvertent vector of diseases to animals. As part of the biosecurity a review of necessary animal and human movements has to be carried out to establish how such spread of infective agents might be minimised or avoided. This would result in the rules being drawn up to complement the normal hygiene requirements.

A summary of factors is given in Table 1.

Table 1: Factors contributing to disease control and biosecurity at the level of country, region, area & farm

Key Factor	Major areas of risk
Location	Amount of incomers, airports, sealinks, railway, cars, feet, products, etc.
	Distance from other significant populations, urban and residential areas.
	Distance from major roads; river boundaries, forest plantations
Design	Level of policing for disease risk,
	Design of animal transport facilities
	Location of lairages, handling facilities, etc.
	Perimeter enclosures;
	Segregated accommodation areas;
	Effluent disposal arrangements.
Direct disease control	Limitations on movement of stock (breeding, slaughter, "convenience").
	Limitations on gathering points for the above, regional limits to travel for slaughter
	Selective admission of incoming stock;
	Quarantine & testing of incoming stock;
	Rodent & Insect control;
	Wildlife (bird, deer) control or segregation.
	Surveillance, appropriate health testing, monitoring and specification
	Development of a full Health Control Plan for the farm
	Use of co-ordinated health schemes.
	Vaccination, treatment, culling
Indirect Control	Delivery and collection by road vehicle
	Delivery acceptance criteria and procedure;
	Entry procedures for regular personnel;
	Entry procedures and criteria for visitors; social, low risk & high risk
	On-farm clothing, footwear, and equipment for visitors including vet!
Management	Design of applicable monitoring at all levels from above
	Staff training, compliance and motivation;
	Documentation of on-going biosecurity monitoring and general surveillance;
	Design of outline contingency plans and testing!

At the heart of any herd biosecurity is a system of risk identification and risk management, which will lead to good protection for the herd from infectious disease.

The diseases to target are determined by:

- The financial or practical importance of the disease.
- An assessment of the risk of introducing the disease.
- The availability of low cost and reliable tests.
- Whether or not the disease is already present in the herd.
- The availability of reliable vaccines especially if vaccination status can be differentiated from natural disease.

There needs to be an understanding of how all the factors interact in the field to allow disease to develop in a population of animals. This requires the statistical study of outbreaks, the development of models based on this information and then the testing of these models against real situations to see how well they predict outcomes.

Managing the risk

Control is not a technical challenge but it is a resource management challenge and frequently, when there is a National Disease problem, it can be a public relations challenge. It is however a challenge to emergency preparedness and the key decisions that determine the impact of the disease. In many cases it may be viewed as an endurance challenge

Above all it is essential to ensure that the outbreak is not repeated by prevention of the introduction of disease, the spread of disease and elimination rapidly of any disease present. Critical to this is that any disinfectant used for preventative and decontaminant biosecurity has the biocidal spectrum to cover all possible causative pathogens. In addition to satisfying the requirements of veterinarians, official authorities there must sufficient stocks for immediate use when necessary.

Important considerations for a disinfectant include:

- Practical to use
- Activity in the presence of organic challenge
- Activity at varying temperatures and pH
- Safe to use by the operators, for the animals and consumers
- Environmentally friendly

During times of heightened awareness of the risk of disease, it is appropriate to remind all staff that good biosecurity is essential when working. Indeed failure to follow the rules should be considered most seriously and may be a disciplinary matter. In the meat plant should the slaughter process have commenced and a Notifiable or Reportable Disease be suspected, then appropriate procedures will be implemented The Government service will be informed and the follow up procedures will involve the farm or collection centre of origin and the haulier. A record of all people accessing the Plant and involved at all stages from farm/collection centre must be documented as well as full traceabilty of the animals being available.

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Inevitably with the research and horizon scanning along with modelling of the possible diseases but in managing the Risk one of the key issues is the quality of decision making. This requires the provision of accurate, timely, relevant information to allow for a critical Risk Assessment. The lessons from many disease problems are simple. On-farm surveillance needs to be better and the movement of live animals as "commodities" must be more restricted as well as being better organised, monitored and controlled.

Communicating the risk

While Risk Assessment requires good information managing the risk requires changes in behaviour and both require excellent 2-way communication. This involves Farmers, Agri-Industry, Traders, Transport industry, Tourism, Media, General Public, vets, administrative personnel, army, police etc. Behaviour can be changed through communication and education needs to persuade farmers be more proactive in controlling endemic disease. Government should be prepared to give incentives to encourage this linking it to farm assurance and high health schemes.

Underpinning the risk communication must be a better understanding of the underlying science, better understanding of the process of risk assessment and better understanding of how the risk management measures work.

Counting the cost

Biosecurity is important because infectious agents may reduce performance and product quality. Infectious agents will compromise animal welfare, increase mortality increase medicines usage and increase overheads. Outbreaks of diseases such as foot and mouth disease can be devastating to economies and societies. Government and all relevant Authorities must be ever aware of the possible outbreaks of currently recognised diseases in any country/area but also the possibility of emerging disease.
Effective control and containment must take account of the possible threat of agri- and bio-terrorism.

Conclusion

Biosecurity is the protection of a herd from disease introduction. When developing a biosecurity program, the animal keeper must consider the entry protocol for visitors and livestock and minimise access to non-farm vehicles. Replacements should, whenever possible, should be from a single source of known health status and be subject to quarantine prior to entry. One of the simplest measures would be sensible limits on the number of journeys and distance that an animal makes in its lifetime and it should be slaughtered as near to its final "home" as possible.

The industry must not use the word biosecurity as a panacea when they are not prepared to accept the full consequences of the term! There have been a plethora of articles on the rather loosely used term "Biosecurity" a term that implies a lot more than just control of animal movements. Therefore the concept of biosecurity must go beyond the narrow aspects of cleansing, disinfection and control of animal movements. Veterinarians should play an active role in devising disease prevention strategies and not merely be “fire-fighters” when outbreaks occur. A recognition of effective biosecurity at all stages in the production and slaughter of animals is of critical importance in preventing spread of disease.

Mini Sessions: Presentation 13

Environmental issues

Gordon Hickman
State Veterinary Service

Mini Session: Presentation 14

Welfare and Food Safety

Milorad Radakovic
Food Standards Agency

Introduction

Since its inception in 2000, the Food Standards Agency (FSA), has been the United Kingdom (UK) Central Competent Authority (CCA) for public health issues related to food from farm to fork. The Agency operates independently as a non - ministerial government department run by a chair and 12 publicly appointed board members. The Agency's core values are to put the consumer first, to be open and accessible and to be an independent voice.

The key aims of the Agency Strategic plan 2005 -10 are:

- to continue to reduce foodborne illness;
- to reduce further the risks to consumers from chemical contamination including radiological contamination of food;
- to make it easier for all consumers to choose a healthy diet, and thereby improve quality of life by reducing diet-related disease; and
- to enable consumers to make informed choices.

The FSA is an evidence-based organisation and that principle applies to the ways in which we meet all of our objectives including how we regulate.
(www.food.gov.uk)

The Department for Environment, Food and Rural Affairs (Defra) is, amongst other responsibilities and roles, the CCA for animal health and welfare of animals.
(www.defra.gov.uk)

The FSA's focus and particular responsibilities are different from those of Defra reflecting their different primary roles. However, when there are cross cutting issues to deal with, an effective working relationship has been established at all levels through personal communication between professionals, or more formally through working groups and consultations about particular issues.

The ultimate end of food producing animals is death, either by killing when not intended to be used for human consumption, or slaughtering (bleeding) when intended to be used for human consumption. The exception to this is that small wild game is killed, but not bled while still intended to be used for human consumption.

The public and final consumers are sometimes confused by these two terms, although they are clearly defined in relevant welfare legislation. It is, therefore, important as a starting point to any discussion, to bear this in mind and to use this terminology appropriately.

Food safety legislation

New Food Hygiene Regulations have been in force in the European Union since 1st January 2006. The primary objective of these Regulations is **'the pursuit of a high level of protection of human life and human health'** as stated in Regulation (EC) 178/2002, which lays down the general principles and requirements of food law. Where appropriate, the

Hygiene Regulations provide links with other relevant legislation at EU level such as the Welfare and Zoonosis Directives, etc.

Nowadays the majority of food related legislation is directly applicable in Member States. In UK approved premises this legislation is enforced by the Meat Hygiene Service (MHS) in Great Britain (GB), and in Northern Ireland (NI) by Department of Agriculture and Rural Development (DARD). Local Authorities enforce it in other places.

Welfare legislation

EU Council Directive 93/119/EEC on the protection of animals at the time of slaughter and killing requires that ' **animals shall be spared any avoidable excitement, pain or suffering during movement, lairaging, restraint, stunning, slaughter or killing.**

The EU legislation relevant to welfare of animals at slaughter and killing is transposed into national UK legislation by " The Welfare of Animals (Slaughter or Killing) Regulations 1995", as amended. In the UK it is enforced by different enforcement bodies; by the State Veterinary Service (SVS) and Trading Standards (TS) on farm and during transport (The Welfare of Animals (Transport) Order 1997), and in approved slaughterhouses by the MHS in GB and DARD in NI.

Common themes in welfare legislation may be linked to the 5 basic animal freedoms (from Farm Animal Welfare Council, FAWC- the UK independent advisory body www.fawc.org.uk).

These are:

1. Freedom from hunger and thirst.
2. Freedom from discomfort.
3. Freedom from pain, injury or disease.
4. Freedom to express normal behaviour.
5. Freedom from fear and distress.

Are basic principles of food safety & animal welfare legislation similar?

Although the objectives of animal welfare and food safety legislative framework are different, some parallels can be drawn.

For example the Hygiene Regulations, in the spirit of Hazard Analysis and Critical Control Point (HACCP) principles, aim to prevent, eliminate or to reduce food borne hazards in products of animal origin to an acceptable level. Realistically an absolute prevention or elimination of food borne hazards may not always be achieved, but is no reason why every attempt should not be made to apply practices that would reduce the risk to an acceptable level.

Similar principles may be applied where the Welfare Directive requires that 'animals shall be spared of any avoidable excitement, pain or suffering…' For example, while an absolute prevention of animals' stress cannot always be achieved, but there should be no justifiable reason why it cannot be brought down to a satisfactory level.

Who is responsible, from "farm to fork" for food safety and from "farm to abattoir" for welfare of animals?

The primary responsibility for food safety (hygiene) and welfare of food producing animal species rests with the Food Business Operator (FBO), including farmers who are recognised as FBOs under the Hygiene Regulations. FBOs, as required by the Hygiene Regulations,

must comply with welfare requirements by the careful handling of animals without causing them unnecessary distress during collection and transport.

The Official Veterinarian (OV) in the abattoir is responsible for verifying the FBO's (including farmers') responsibilities, through effective and risk based ante/post mortem inspection procedures and auditing.

The official controls in places where products of animal origin are produced should cover all aspects that are important for protecting public health and, where appropriate, animal health and animal welfare. The nature and intensity of the official controls should be based on an assessment of public health risks, animal health and animal welfare, where appropriate, e.g. in abattoirs.

Regular assessment of welfare aspects in slaughterhouse is therefore an important part of an OV's tasks.

Ante mortem inspection

The purpose of ante mortem inspection is to determine whether welfare has been compromised or if there are any signs of any condition that might adversely affect human or animal health, paying particular attention to the detection of zoonotic and notifiable diseases. The OV is to verify compliance with relevant Community and national rules on animal welfare, such as rules concerning the protection of animals on farm, in transport and at the time of slaughter.

In an emergency situation, whether for public, animal health or for animal welfare reasons, OVs are empowered to take the appropriate action. This action, in the case of welfare non-compliances, may vary from slowing down or stopping the production, ordering emergency killing of animals and/or collecting the evidence for recommendation for prosecution.

Post mortem inspection

During post mortem inspection duties, whether they are done personally by the OV or by an Official Auxiliary (OA), further verification of compliance with animal welfare rules takes place. The common visible abnormalities found at post mortem inspection are mainly related to animal health problems such as pneumonia, liver fluke etc. The evidence of these conditions does not *per se* indicate that welfare rules have been broken or that the welfare of the animal was poor.

Very few conditions found post mortem are of public health significance, e.g. *Cisticercus Bovis, Hydatid cyst* etc.

Visible abnormalities may also indicate animal welfare problems that have occurred either on farm, transport and lairage or during stunning. For example, lesions such as pododermatitis in poultry are readily identifiable as being caused on farm. On the other hand it is not always easy to determine whether some injuries occurred on farm, in transport, in the lairage or during stunning. In some cases one can determine with certainty where the injury occurred e.g. that a high voltage stunning caused broken backs in pigs.

Handling and transportation of live animals 'from the farm to the abattoir', however humane, inevitably causes various degrees of stress. As a consequence the quality of the final product (meat) may be affected with some uncommon conditions such as Pale Soft Exudative meat (PSE) and Dried Firm Beef (DFD). Post mortem inspection may also discover the various degrees of bruises on carcasses. Such lesions will have to be trimmed before meat is sold for human consumption, and as a consequence the FBO will suffer financial loss.

Stressed animals are also more likely to shed pathogens *(E. Coli, Salmonella)* which may be present in the gut flora of clinically health animals. The risk of cross contamination of pathogens between the animals and from animals to meat is increased, and it may have occurred on farm, during loading, transport, unloading, or lairaging.

Ante and post mortem inspections have their limitations in detecting and determining pathogens *(E. Coli, Salmonella, Campylobacter*), and accurately assessing degrees of stressed animals. Therefore, careful handling of animals from farm and in the abattoir is very important.

Collection and Communication of Inspection Results (CCIR)

The Food Hygiene Regulations require the OV to 'Collect and Communicate Inspection Results' (CCIR) that are relevant for public/animal health and welfare. The information recorded should be factual, meaningful, understandable and useful to all concerned. The results of the inspection activities are to be passed to FBOs (including farmers), their veterinary surgeons and kept in relevant databases for surveillance purposes.

The collection and communication of these results should not be seen as being useful only when there are serious problems requiring enforcement action.

The use of this valuable information may be equally, or arguably more important, for monitoring and driving up public/animal health and welfare standards of subsequent batches of animals and at all stages of production – from farm to abattoir.

Some specific 'on farm' issues

It is often mistakenly perceived that welfare of animals and food safety do not pull in the same direction. In some cases this could be argued, for example, it is known that animals that have been reared in a welfare friendly environment (access to outdoors) carry a higher number of food borne pathogens, e.g. *Campylobacter, Salmonella* compared to indoor farming. In any case either argument put forward should be balanced and realistic.

There are many other cases where food safety and welfare are mutually supportive.

Only healthy clean animals may go for slaughter for human consumption. The farmer therefore has an incentive to keep animals healthy, not allowing the development of chronic conditions such as emaciation. However, in an emergency situation the legislation allows that an otherwise healthy animal that has had an accident may, after satisfactory ante mortem inspection, be killed on farm and its body transported to the abattoir for further dressing. *(British Cattle Veterinary Association booklet, September 2005* www.bcva.org.uk*).*

In these cases the animal benefits from the veterinary examination and subsequent decision either of being treated or killed humanely on farm. The farmer, on the other hand, benefits by salvaging some cost through selling the meat for human consumption.

Some red meat species such as even toed farmed game (Cervidae, Suiade and bison in exceptional circumstances) due to their nature and difficulties in handling, may under certain conditions, be slaughtered and killed on farm to avoid any risk for the handler or to protect the welfare of animals.

Traditionally in the UK, small quantities of poultry may be killed on farm to be sold directly to the final consumer on the local market. The Hygiene Regulations continue to allow this practice. Animal welfare benefits include no collection and transport of poultry. Some

concerns have been expressed for the hygiene of some of these farms, although there is a little evidence to support this claim.

Under certain conditions, slaughtering of poultry on farm is allowed on a larger scale. After slaughtering, the animal bodies must be despatched to the slaughterhouse for immediate (within 24 hours) or delayed (up to 15 days) evisceration. This flexibility could again benefit the welfare of poultry (particularly spent hens) because no collection and transport of poultry will take place. There is also some evidence to suggest that chilled evisceration of poultry results in more hygienic dressing because the viscera is less likely to break and cause cross contamination.

Until now no FBO in the UK has applied for the authorisation to undertake this activity on farm and it is unlikely that this flexibility will be taken on by many.

Some specific "abattoir" issues

Structure

Structurally, all red meat slaughterhouses are required to have adequate and hygienic lairage facilities that must be equipped for watering the animals, and if necessary for feeding them. Adequate lockable facilities for the slaughter of sick and suspect animals are also required unless there are suitable arrangements to deal with such situations, for example that such slaughter takes place in other establishments, or at the end of day.

Structural requirements for white meat slaughterhouses that are relevant to welfare of poultry are less prescriptive than for red meat. There must be a room or covered space for the reception of animals and their inspection before slaughter. During collection and transport, animals must be handled carefully without causing unnecessary distress.

Stunning and slaughter

Detailed requirements for stunning and slaughtering of animals are not prescribed in the Food Hygiene Regulations, however this must be done humanely and hygienically. For example it could be argued that chest sticking (where the trachea and oesophagus remain intact) compared to transverse cut is beneficial for the welfare of animals (faster bleeding – faster ultimate death) and for public health (minimal neck contamination).

There are also food safety concerns associated with some stunning methods used for different animal species. In red meat animals potential food safety risks are contamination of edible tissues with pathogenic microorganisms and CNS tissue (TSE concerns in TSE susceptible species) when a penetrating stunning method is used.

In poultry the food safety concern is associated with electrical bath stunning and inhalation of contaminated water and possible spread of pathogens into edible tissues.
More knowledge and research is needed in this area.

Conclusions

- Good welfare and food safety start at farm level.
- The welfare of animals and food safety, considered either separately or together, may be perceived differently by farmers, animal handlers, slaughterhouse operators, consumers and sometimes scientists.
- Economic, political, ethical, religious and other factors may also, in different countries, influence attitudes towards welfare of animals and food safety.

- One needs to be realistic when passing judgements and making decisions with the aim of improving welfare and food safety.
- In food law three interconnected components; risk analysis – risk assessment, risk management, and risk communication – provide a systematic methodology for the determination of effective, proportionate and targeted measures or other actions to protect health. A similar concept could be very effective in driving up welfare standards for food producing animals.

There should not be much argument in saying that healthy animals raised in welfare friendly environments produce safer food. But is this always the case?

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ACMSF Second Report on Campylobacter (July 2005) http://www.food.gov.uk/multimedia/pdfs/acmsfcampylobacter.pdf

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Best practices and procedures for monitoring and enforcement of animal welfare requirements at state level

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Introduction

The outcome of meat production is for 'safe food from animals that are well cared for'. To ensure the outcome is being achieved the Competent Authority has to monitor both food safety and welfare standards. The setting of standards for welfare is the first stage in a process which protects individual animal welfare. The standards have to be publicized and instruction made available. Compliance with the standards has to be measured or monitored and where necessary enforcement action has to be taken to secure the animal's welfare. Monitoring the results of this work enables the Competent Authority to be satisfied that these requirements are being applied.

The EC Directive on Animal Welfare allows Commission experts to make on the spot checks to ensure Competent Authorities from each member state are checking that the establishments are fulfilling the requirements.

Animals should be able to demonstrate the five freedoms throughout their lives and the Competent Authority should arrange for inspections to be carried out at the slaughterhouse

The Food Hygiene Regulations (EU 854/2004) require the Official Veterinarian to carry out audit of Food Business Operator's controls and specified inspection tasks. One of those inspection tasks is to verify compliance with relevant Community and national rules on animal welfare, such as rules concerning the protection of animals at the time of slaughter and during transportation.

Each veterinarian has responsibility for identifying areas on non-compliance with animal welfare rules and for taking any necessary enforcement action to ensure animal welfare is protected.

Recording the welfare standards that are observed during inspections of establishments serves several purposes:

1. To protect the welfare of animals at the time of the inspection,
2. To record objective evidence which may support enforcement proceedings,
3. To record the level of compliance,
4. To record the reasons for any non-compliance,
5. To assess that consistent standard are being applied by both Food Business Operators and officials,
6. To identify new or improved methods of operating which contribute to enhancement of the welfare of animals.

The welfare of animals can be considered at the level of the individual animal, at herd or flock level or area or country level. Assessing and analysing standards of welfare in these different situations requires the collection of various sets of data, each of which should contribute to an outcome at the higher level culminating in changes to policy or legislation that will provide for the better protection of animals. There is a risk from considering best practice in this area in isolation that could lead to fragmented data collection and unnecessary burden on the Food Business Operator or the Competent Authority. It has been

recognised that because the same officials enforce both the welfare regulations and the Food Hygiene Regulations in the slaughterhouse environment the legislators should take due notice of all the relevant legislation and ensure there is read across. The monitoring and enforcement of welfare regulations are referred to as an inspection duty within the EU Food Hygiene Regulations EC 845/2006.

Annex 1 section 1 chapter II C Welfare of animals states:

The official veterinarian is to verify compliance with relevant Community and national rules on animal welfare such as rules concerning the protection of animals at the time of slaughter and during transport

In GB separate legislation made under the Animal Welfare Act provides the detailed legislative requirements and sets out enforcement powers. The same enforcement powers do not apply across both the disciplines of hygiene and welfare

An Official Veterinarian has many and various duties to perform during a working day and is not able to monitor the welfare of each animal throughout the slaughter process. At State level officials have to be aware that the role of the veterinarian is to verify compliance with the requirements of the relevant legislation through a series of checks and audits, they are not able to ensure, or provide a guarantee, that the welfare of each animal has not been compromised. To obtain this level of assurance would require full time supervision of the lairage and slaughter process which would likely be disproportionate to the risks in GB premises. Monitoring and assessment should be on a risk assessed basis related to the confidence the officials have in the ability and willingness of the management to maintain compliance and good practice. Establishing the level of confidence in management has to be based on objective evidence and is best demonstrated through the application of HACCP based procedures.

The Food business Operator has responsibility for the welfare of the animals in his care. This can be demonstrated through the use of HACCP based principles to minimise the risk of adverse effect on welfare and to ensure suitable corrective action is taken.

At the level of individual premises the use of HACCP based principles should reflect the following:

- Identify a team or person (dependant on size of business) to take responsibility for welfare,
- Identify the hazards to the welfare of the animals,
- Identify the points at which these hazards can be controlled,
- Set the monitoring requirements and frequency at those control points,
- Set out the actions to be taken if the controls are found to be out of tolerance,
- Keep records of the actions taken and their effectiveness on correcting the situation,
- Review the system regularly so that changes in production, e.g. size of sheep, introducing goats or checks on animals' identification, are taken into account and managed.

By implementing this type of system the Food Business Operator is able to demonstrate to the official that welfare risks are monitored and managed. The degree of risk to animals at the point of slaughter can be assessed by collating evidence of HACCP based principles.

Monitoring and Measuring welfare compliance

Identifying the critical sites for monitoring and the tools for measuring welfare standards is the key to achieving a successful outcome. The legislation requires certain welfare standards some of which if not applied would have a direct and rapid negative effect on the welfare of the animals. Failing to render animals immediately unconscious by the stunning process would have an immediate effect on the welfare of the animal, is unacceptable and requires immediate action. Other requirements in the legislation are designed to avoid the risk of the animal's welfare becoming compromised. For example the design of the lairage including non-slip flooring or curved walkways.

Instruction to officials at the slaughterhouses are:

1. To monitor the level of compliance with relevant welfare legislation,
2. To assess welfare and report when animals have suffered actual harm,
3. To take action to protect the animal and sanction the perpetrator.

By assessing information on these three areas at state level it is possible to assess whether the legislation as set out is sufficient to protect the animals.

Time and resource for such inspections is limited and should be focussed on the key areas of transport, lairage design, lairage operation, handling prior to slaughter, stunning or killing and bleeding.

Welfare assessment system

GB has developed the Welfare Assessment System. The information is recorded by the OVs at the different establishments but allows collection of evidence on a monthly basis and creates a report to the Competent Authority. Guidance is provided for the completion of the initial document.

The use of the welfare assessment system provides a framework for a consistent approach to reporting and enforcing. This structured system allows for easy collation of data and monitoring of trends.

A score of 1 is awarded when high welfare standards have been delivered throughout the month. A score of 4 is awarded when animals are judged to have suffered actual harm. The awarding of a score in any of these categories is linked to the enforcement strategy. When a veterinarian records a score of 4 it is accompanied by a submission for a recommendation to prosecute. Veterinarians are required to make the appropriate judgements following the hierarchy of enforcement, which provides for reasonable, fair and proportionate enforcement.

Guidance to OVs for awarding scores under the welfare assessment system.

Score	Definition	THE OV should apply the score if…
0	Does not apply at this establishment.	Does not apply at this establishment.
1	Best practice principles were observed deployed by the plant operator.	The establishment fulfils all 'best practice' criteria for that section.
2	Standards of animal welfare were observed as complying with the requirements of WASK. No concerns relating to transport.	There have been no NCs (3 or 4) recorded over the month for that section, but one or more of best practice criteria are not fulfilled.
3	Welfare practices were observed as failing to comply with the requirements of WASK, but there was no evidence of avoidable excitement, pain or suffering. Welfare of animals during transportation was suspected to be compromised.	Any technical NCs have been recorded on the daily reports (see WEL 3/3 guidance notes) during the period.
4	Welfare practices were observed as failing to comply with requirements of WASK, and there was evidence of avoidable excitement, pain or suffering being caused to an animal. Welfare of animals during transportation was suspected to be seriously compromised.	There have been NCs causing actual harm to animals (whether prosecutable or non-prosecutable) recorded on the daily reports (see WEL 3/3 guidance notes) during the period.

An example of the guidance provided to the OV to ensure consistent reporting of incidents.

5. Stunning / Killing (All under WASK)				
	Compliance		**Non compliance**	
	1	2	3	4
5.1 Appropriate number of licensed slaughterers for all species (Sch.1 Para.2 & 7)	Sufficient number of slaughterers to provide cover for all eventualities.	Adequate number of slaughterers for each species and method of slaughter. Provisional licence holders operate in the presence of full licence holder or veterinary surgeon.	Premises operating without a licensed slaughterer available, or provisional licence holder operates unsupervised.	As for 3, but avoidable excitement, pain or suffering caused.
5.2 Access to back-up stunner (Sch. 2, Part 1 (1) (f))	Well maintained back-up system instantly available.	Back-up stunner available.	No back-up stunner, or back-up not available, or not maintained.	As for 3, but avoidable excitement, pain or suffering caused.

5. Stunning / Killing (All under WASK)				
	Compliance		**Non compliance**	
	1	2	3	4
5.3 Gas CO_2 Killing (PIGS ONLY) (Sch. 7, Part II)	The chamber is constructed, maintained and operated in compliance with statutory requirements, and checks are made and recorded to show CO_2 concentration (minimum 70%) in the gas mixture, and all pigs are killed by the system. If back-up stunning equipment is used, such animals are bled without delay, and do not enter the scald tank or undergo electrical stimulation for at least 30 seconds.	The chamber complies with all statutory requirements, and all pigs are killed by the system. If back-up equipment is used to stun in emergency, regulations are complied with. Gas concentrations are monitored.	The chamber does not comply, or animals recover consciousness, and post-stunning procedures not followed to ensure adequate stun-stick or stick-dressing times.	As for 3, but avoidable excitement, pain or suffering caused.

Recording all the information on the individual WAS forms enables the Competent Authority to note the level of compliance across the country. This can be done for any time period and an example of the possible outcome is demonstrated below.

July 2006		Transport					Lairage Design					Operation					Handling					Stunning/Killing					Bleeding				
Region	No of Returns	1	2	3	4	n/a	1	2	3	4	n/a	1	2	3	4	n/a	1	2	3	4	n/a	1	2	3	4	n/a	1	2	3	4	n/a	Inv
North	59	3	48	6	2	0	7	47	3	0	2	8	48	2	0	1	7	48	3	0	1	6	51	0	0	2	8	50	0	0	1	0
Central	81	14	60	6	1	0	11	65	4	0	1	16	58	4	2	1	14	65	2	0	0	14	66	1	0	0	24	57	0	0	0	3
South & West	45	9	34	2	0	0	4	37	3	0	1	7	36	2	0	0	5	39	1	0	0	13	32	0	0	0	16	28	1	0	0	0
Wales	26	3	20	3	0	0	3	19	4	0	0	5	20	1	0	0	4	22	0	0	0	5	19	2	0	0	8	16	2	0	0	0
Scotland	32	9	20	2	1	0	5	24	2	1	0	9	21	1	0	1	7	21	2	1	1	9	20	2	1	0	10	21	0	1	0	4
	243	**38**	**182**	**19**	**4**	**0**	**30**	**192**	**16**	**1**	**4**	**45**	**183**	**10**	**2**	**3**	**37**	**195**	**8**	**1**	**2**	**47**	**188**	**5**	**1**	**2**	**66**	**172**	**3**	**1**	**1**	**7**

Infringements of animal welfare may take place along the chain from the farm to the point of slaughter. In some cases this may involve a number of different enforcement bodies but effective enforcement is only delivered when the responsibilities of each is clearly defined and all are working to the same priorities.

Monitoring trends

Data collection allows for the identification of new and innovative ideas that can be assessed and shared.

The stunning method of choice at individual premises is relatively stable but alters slowly over a period of time following scientific advances. Operators are influenced by systems that

introduce the ability to improve rate of throughput or improve meat quality. However the welfare of the animals is not dependent only on the construction and effective usage of the equipment.

Recording the chosen method of stunning has highlighted three recent trends in the choice of stunning methods.

In 2000 electrical stunning for cattle was only used by one Operator in GB. By 2006 six premises had introduced in this method of stunning. Data gathering demonstrates that only larger premises are using the electrically stun box as a result of installation and running costs. The cost of installing the system is prohibitive to the smaller business and this has to be taken into consideration when considering promotion of best practice or changes to legal obligation. Legislators have to balance the benefits of new systems, which in this case include a increase in effective stunning and improved health and safely of those carrying out the bleeding operation, with cost per unit of production. The Competent Authority should always consider the impact of any regulatory change on all sectors of the industry and should monitor the effects of those changes to ensure the intended outcome has been achieved.

A similar trend has been seen in the poultry industry with the larger operators introducing the gas killing of poultry. Again the cost of conversion and maintenance is restrictive. However, the perceived benefits to the welfare of the birds and the meat quality are considerable.

There has been a small increase in the number of animals slaughtered by the religious method and consideration has been given to the use of modern handling equipment for this type of slaughter.

It is important for policy makers and legislators to make balanced judgements so that business can continue to function and produce safe food from animals that are well cared for. Over burdening industry can result in demand driving product to be imported from countries where welfare systems may not be closely monitored and enforced. Such actions could impact on the overall world status of animal welfare. Data collection contributes to an accurate assessment of the likely impact on industry of policy decisions or legislative change.

Register of licensed slaughterers

The register of licensed slaughterers provides a system for the sourcing of manpower necessary for controlling an outbreak of notifiable disease. The register enables those qualified to humanely kill animals to be traced and registers the type of equipment that they are licensed to operate.

Maintenance of the register forms a part of contingency planning enabling the Competent Authority to be satisfied that there is sufficient trained workforce to mobilise to control a disease outbreak.

Enforcement

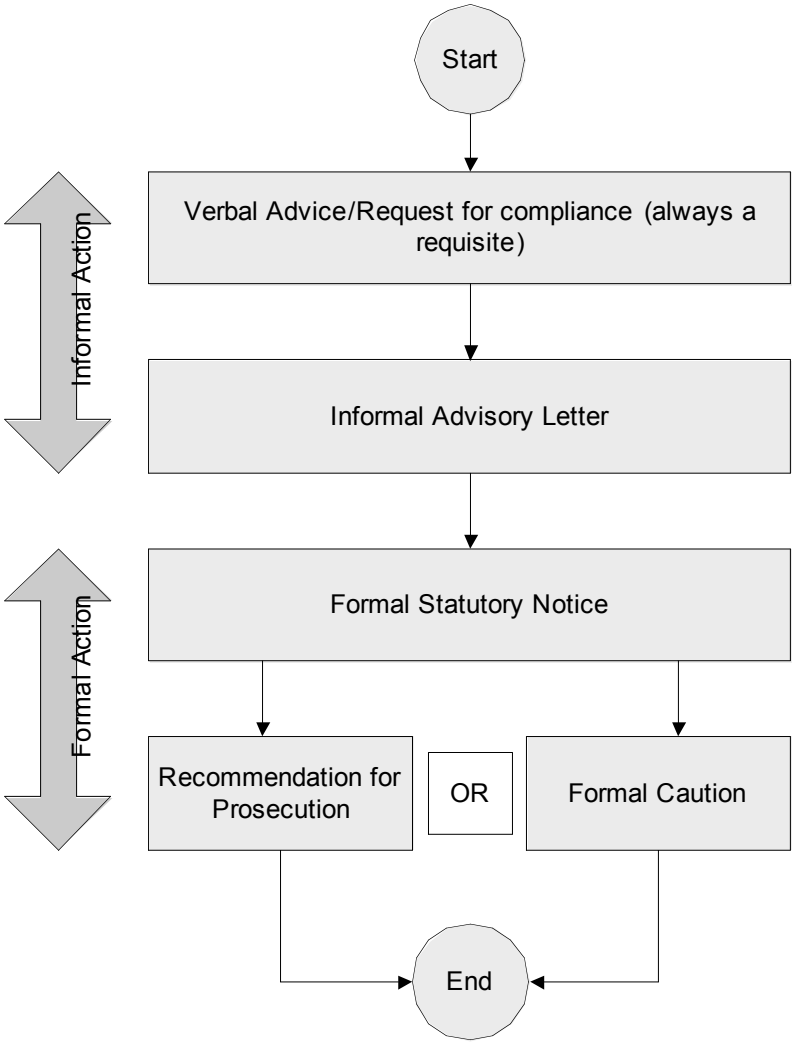
Animal welfare is a high priority area of work and it is important to be able to demonstrate that sufficient action has been taken to protect animals from harm. Inspecting and identifying welfare issues does not itself protect welfare. It is the actions taken following those inspections that protects for the future. Enforcement is often thought of as a final solution with redress for non-compliance through the courts, but enforcement should have a wider remit ranging from education and advice through to formal action. The Competent Authority should ensure there is simple clarification of what can be complex legal terminology in legislation that sets out the legal obligations of FBOs. A code of practice which cross refers to the legislation and which is easily available to Food Business Operators will minimise the

risk of welfare issues arising due to ignorance, misunderstanding or incorrect interpretation. Such proactive education reduces the need for more formal enforcement action. It also provides the enforcers with a simple guide to compliance resulting in a consistent approach to the enforcement of the key areas.

An example is the Code of Practice on the Welfare of Poultry at Slaughter drafted by Defra and currently in consultation. The code has been enlarged from its previous draft to reflect technical, industry and research developments in welfare over the past four years.

However cases do arise where enforcement has to be taken and this may result in formal court proceedings. Best practice for enforcers is to follow a hierarchy of enforcement to ensure the process is fair and proportionate to the non-compliance. When an animal is subject to actual harm the welfare status of the animal should be addressed immediately. Objective evidence should be secured and formal enforcement initiated.

Hierarchy of enforcement and collection of evidence



Evidence of work is presented in the following format:

Category	Score (1,2,3, 4,0)	Brief summary of deficiency details	Species affected	Action taken	Date referred for investigation	Investigation ref no.
5 Stunning/ Killing	3	On (date(s)), no visible functioning voltmeter observed on pig stunner	Young pigs	Advisory letter sent on (date)		
6 Bleeding	4	On (date(s)) 20 broiler birds observed entering scald tank while still conscious	Broilers	Recommended FBO and slaughterer for investigation. Slaughter licence recommended for suspension	01/12/04	XXXX (Number supplied by Operations Support Unit)

Monitoring of persons alleged or proven to have caused pain or suffering to animals at premises across the county can indicate a major problem being caused by a single individual. In such a case there has to be central co-ordination of the witnesses and a higher degree of enforcement may be appropriate. For example a producer may send cattle to a number of slaughterhouses where the problems are identified. By monitoring across the country this individual would be identified and targeted action could be taken. In this type of example the result could be a total ban on the keeping of animals and/or a substantial fine.

Conclusion

Monitoring of welfare standards and enforcement is only effective when a consistent, structured reporting is utilised. Staff carrying out the inspections and enforcement should be competent in their field, have received training in this area of work and have access to guidance on decision making. The outcome of monitoring provides the Competent Authority with information necessary to fulfil its obligations in relation to Community legislation and to monitor trends in aspects that affect the welfare of animals at slaughter. In identifying and disseminating information on innovation and changes in best practices the Competent Authority is able to secure improvement to animal welfare. Enforcement action ensures that those who transgress the law and fail to care for their animals are suitably punished.

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Best practices and procedures for monitoring and enforcement of animal welfare requirements at individual organisation (slaughterhouse) level

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Introduction

Animal welfare in the slaughterhouse depends on the animals, the personnel and the existing technical and constructional prerequisites. Quality of handling and technical lay out is not depending on the size of the enterprise.

Animal welfare is best in those slaughterhouses where the attitude towards humane methods of slaughtering is incorporated, whereas if this attitude is not apparent, a lot of offences against enforcement of animal welfare rules and regulations and resulting expenditures can be found.

Procedures for monitoring welfare requirements at individual organisation level

Procedures for monitoring and enforcement of animal welfare in the slaughterhouse should be focussed on all possible kinds of impact leading to stress, unnecessary suffering or pain before or during slaughter.

Monitoring animal welfare is similar to monitoring meat hygiene: in must be done constantly and consequent in order to get good results.

Monitoring must be performed in the three areas:

- delivery and driveway to lairage,
- lairage and driving to stunning (for poultry: unloading and shackling)
- stunning and debleeding.

In these areas all the technical and constructional devices must be checked if they allow proper handling, stunning and slaughter. These checks should be done during slaughter as well as after slaughter without animals.

Clinical findings during carcass inspection (e.g. bruising) should also be a part of welfare monitoring.

In each area animal related aspects (fitness), constructional premises, technical devices as well as characteristics of personnel and management have to be evaluated. All of the latter are closely related to each other.

For each species and stunning system certain key points exist, where regular monitoring is mandatory. However there are different rankings concerning the importance of these key points (from general to detail). One of the very general key points is stunning effectiveness, a parameter which summarizes the quality of several factors like stress level of driving system, properties of stunning devices and alarm systems, skills of stunning and sticking personnel. Each of these factors has to be checked more carefully if stunning effectiveness is not satisfying.

Special checks, which require sophisticated measuring instruments, like measuring of electrical currents or gas atmospheres, can be necessary. Therefore independent institutions

(private or official) must be available, to perform periodical checks and provide assistance to the local authorities.

The validation / ranking of the different checkpoints should lead from a general impression to more detailed checks if necessary. This classification helps to perform checks with different intensities, which can accommodate animal welfare checks within routine meat hygiene inspections.

- "Outcome checks" (e.g. calm animals, good stunning effectiveness) give general summarizing parameters and a first impression or a hint to possible areas of concern.
- "Key checks" (e.g. risks of injury or stress, stun-stick-intervals) should be checked in any case even if the outcome checks do not raise suspicion.
- "Detail checks" are necessary in case problems were determined. They should give references to deficiencies, which lead to the insufficient outcome.

Concerning the frequency of the checks it is advisable to change the habit (time and intensity) of monitoring from time to time.

Looking at the staff involved the following questions may be helpful:
• Are they trained and skilled?
• Are they working calmly or loudly?
• Do they handle animals calmly or roughly?
• How do they handle weak, sick or injured animals?
• What is the course of action in special situations?
• Referring to their skills: Psychological and physical fitness appropriate to their position?

Checkpoints at the delivery

The following list gives an overview on the checkpoints at the delivery:

Outcome checks:
• Calm dry animals, no exhaustion, no injury or downers
• Minimum excitement and use of driving aids at driving to the lairage
• No/ minimum balking slipping and falling
• Low noise level

Key checks:
• Waiting time before unloading
• Shelter against adverse climatic conditions
• Handling and supervising (responsibilities)
• Facility layout (floor, light, sides, risk of injury)
• Devices for casualty treatment

Detail checks:
• Vehicles: space, separation of groups, risk of injury
• Animals: fitness for transport and driving, exhaustion
• Transport and unloading staff: handling, group size and separation, "processing" of casualties
• Ramp: space on the ramp, lay out of driveway (walls, width), light, shadows, drains, impediments, sources of noise

A positive first impression is given, if animals and people are calm and there is a minimum of balking, slipping and falling. In case slipping and falling is detected, it may either be a result of a slippery floor or a result of too much excitement of the animals. Staff may be too nervous or maybe has failed to provide clean driveways, which became slippery by excrements by the time.

Casualty treatment often is a very good indicator of existing rules and patterns. Are these animals killed on the spot without unnecessary delay? Who takes the decision? Are the necessary devices in place and in good condition?

Checkpoints in the lairage

The following list gives an overview on the checkpoints at lairage:

Outcome checks:
• Calm animals (dry cattle, pigs lie down, no exhaustion, no injury, no fighting, no mounting)
• Low noise level (people can talk without raising their voice excessively, 70-85 db)

Key checks:
• Shelter against adverse climatic conditions, showers (pig)
• Handling, control and supervising (responsibilities) space, separation of groups
• General facility layout, size, possibilities for separation, access, floor, light, walls, risk of injury
• Special facilities: drinking devices, tying devices
• Lairage time (in relation to transport time and climate)

Detail checks:
• Animals: do they rest (ruminate)? How quickly do they show resting behaviour?
• Staff: adequate measures (separation, showering, casualties)
• Layout: walls, flooring (slipperiness, wet areas, puddles), separation of animals, mounting prevention (cattle), dangerous parts, sources and prevention of noise

In the lairage a low noise level and calmly resting animals give a good overall impression. However where poultry are concerned calm animals may also indicate exhausted animals, in case of hypoglycaemia. Thus transport and fasting times have to be taken into account when judging the animals.

Shelter against adverse climatic conditions, separation of groups and supply of real resting conditions are the main requirements. The behaviour of the animals gives helpful hints. How quickly do pigs lie down after transport? In case they don't lie down it may be because of a cold or wet floor, too high a noise level, insufficient shelter (lay out of walls), frequent moving from one lairage area to another or mixing of strange animals.

Checkpoints at driving to stunning

Outcome checks:
• Constant driving flow in relation to speed of stunning, prevention of stop-start movement
• Calm animals and calm people
• Low noise level

Key checks:
• Frequency of balking, slipping, falling, excitement, exhaustion, no tunnelling (pigs), no mounting (cattle)
• Handling and supervising (responsibilities)
• Use of driving aids (frequency, quality, necessity)
• General facility layout, adequate for line speed, floor (!), light, impediments, risk of injury, access, pressure limitations of automatic driving gates

Detail checks:
• Reasons for excitement balking / use of driving aids: impediments, high pinching noise, irritant (moving) objects, time in single file, floor (!), light, reflections, separations/ gates, lay out details, measurements (width, height, narrowing)
• Staff: skills, driving group size, differences between different handlers
• Special cases: e.g. too small, too big, too wild, too weak animals
• Special cases: line stops (how do the personnel react and what course of action exists for these cases)

Driving to stunning depends very much on line speed, choice and design of the system and skills of people. Subjective assessment of noise level gives a useful impression of the overall situation.

The overall time an animal spends between lairage and stunning area should be preferably short, because stressful driving to stunning may destroy the positive effect of resting at lairage.

Impediments which are often found. as well with the consequence of frequent use of driving aids are funnel shaped entrances into single file races (pigs), frequent stop and go, badly constructed back up devices and slippery floors. As well noise or draughts coming from the slaughter-line may be a reason for balking.

The use of driving aids should be limited to necessary cases. Are they used reasonably or on every animal? Will animals, which are not able to walk, be stunned separately? When mechanical driving systems are used it is important to look how excessive forces on the animals are prevented.

In the case of poultry it is of importance to see how long it takes from shackling to stunning. Too short (>20 seconds) as well as too long (> 60 seconds) hanging times must be avoided. When poultry is deloaded out of crates the manner of handling should be checked. When an electrical water bath is used, pre-stun shocks must be avoided as well as any fearful influences, which can cause potentially painful wing flapping.

Checkpoints at stunning

For the effectiveness of stunning it is important how technical devices, characteristics of animals and skills of the personnel are interacting. Every stunning method has its own characteristics. Therefore checking a method requires taking these specifications into account. For example at head-only electrical stunning the clinical picture/ behaviour of pigs can look very different depending on the position and activity of the animals before stunning, the placement of the electrodes, the size and character of the current and the duration of current flow. The Scientific Report from the EFSA (2004) provides the scientific background, minimum requirements and monitoring points for the various stunning and killing methods used for the most common species slaughtered for human consumption.

Outcome checks:
• Animals are “suitable” for the system, adequately restrained and calm
• Stunning is effective

Key checks:
• Technical devices must be checked as accurately as possible. The chosen device must be in good condition and adequate for the species and intended slaughter speed.

• Restraining devices should allow the proper use of the stunning method without causing unnecessary distress or pain for the animal.

- *Captive bolt:* The characteristics of the chosen type of captive bolt gun and its cartridges must be appropriate for the animals, which have to be stunned. Depending on the type of gun it is possible to disassemble, check the interior (rubber buffers, cleanliness of the interior, movement of the bolt) and assemble during a break or after slaughter. Captive bolts should have a concave tip, which is sharp. When the bolt often gets stuck in the cranium or the bullet hole is irregular, it can be a symptom for worn rubber buffers or a bolt that is blunt or bent. The proper placement of the bolt should be checked in relation to stunning effectiveness.

- *Electrical stunning systems:* Electrodes must be suitable for the skin (hair) and size of the animals to allow an instantaneous onset of current flow through the brain. The electrical parameters must be appropriate to stun the chosen animals immediately and for a sufficient length of time. The necessary parameters should be displayed and monitored for the user. Failures in size and duration of current flow should be indicated by a visual or audible signal to the slaughter personnel at the place of stunning. In bigger plants failures should be documented and held ready for inspection. If possible the devices used should be checked with species relevant resistances (e.g. 125-250 Ohms for pigs of different sizes). Then waveform and frequency of the current can be checked as well, as they have an important impact on stunning effectiveness and duration of unconsciousness. The proper placement of the electrodes should be checked in relation to stunning effectiveness.

- *Gas stunning systems:* must allow the animals to be exposed without unnecessary stress. They should be able to see each other and their surrounding and have enough space for each animal to stand in an upright position until posture is lost and loss of consciousness sets in. Gas concentrations must be measured and monitored continuously. In the case of too low gas concentrations signals must be activated to warn the personnel. The personnel must be aware of the necessary exposure times in a certain atmosphere. The gas atmospheres should be checked by external measurements and the results compared to those of the slaughterhouse. For an external control a flexible tube, a gas pump and a gas analyser are necessary. After slaughter the gas supply can be shut off to verify if and when the alarm sets in.

- To perform a check on the proper use of a stunning method an appropriate *sample size* must be chosen as stunning failures often happens punctually. Guidelines for sample sizes of red meat animals are given in the following table:

Animals to be slaughtered per day	Percentage to be checked for stunning effectiveness (%)
up to 50	75-100
50-100	50-75
100-250	50
250-500	25
500-1000	20
1000 and more	10 and less

At certain critical times during a slaughter day the effectiveness can be crucial (beginning / end of slaughter/ before breaks). Therefore not only number of animals but also distribution of sampling periods over the day should be considered.

- Effectiveness of stunning can be checked during and after application taking the typical physiological reactions into account. Each method has different signs of proper stunning depending on the animals, the method (e.g. electrical head only, electrical with heart, poultry in water bath, gas atmospheres) and its application. To avoid misinterpretations the signs of an effective stun as well as monitoring of relevant parameters should be carefully considered

(see EFSA 2004). For example the long application of very low currents can simulate proper stunning while just immobilizing the animals, which is against animal welfare.

- The interval between end of the application of the stunning method and sticking (*stun-stick-interval*) must be adequate to the respective duration of unconsciousness. The time allowed for bleeding until further slaughter steps continue should be sufficiently long. A representative sample of animals must checked on any signs of movements before further potentially painful treatments continue.

- Concerning the *personnel* the following requirements should be checked:
  - capability of correct use of stunning equipment including use of fixation device
  - correct position of devices (electrode, bolt, level of water bath)
  - reaction to signals of failure, alarm, time settings
  - communication between stunning and sticking-position
  - capability of correct sticking (always as soon as possible, sufficient blood flow)
  - ability to judge signs of recovery or failure of stunning
  - ability to perform proper back up stunning.

Detail checks:
In the case of problems before, during and after stunning special investigations or longer observations might be necessary to find the reason for these deficiencies. For example in the case of regular appearance of vocalisation of chicken during or after passing an electrical water bath, it will be necessary to look more deeply into depth of immersion, electrical contact of the shackle and especially current parameters.

In terms of bleeding sticking knives should be pointed, sharp and sufficiently long to achieve a good blood-flow. The personnel should be able to sever the relevant blood vessels and provide a sufficient loss of blood in a short time. In doubt a stopwatch bucket and a measuring cup (or balance) can be helpful to quantify the amount of blood lost in relation to a certain time frame.

Estimated blood loss (litre) within the first 30 seconds after the cut in pigs cattle and sheep:

Pigs (120 kg)	3-4
Cattle (500 kg)	10
Sheep (35 kg)	1

The slaughter personnel must be trained and skilled but these requirements do not exclude appropriate supervision by the management. Therefore it must be checked if and how monitoring of personnel is done and what kind of action is taken in the case of malpractice. This leads to the last but important question about the attitude of the management towards animal welfare: Does the management put emphasis on animal welfare?

After the investigations a preliminary report to the responsible manager, highlighting severe deficiencies and good solutions, should be given.

Enforcement of welfare requirements at individual organisation level
A sustainable enforcement of animal welfare is only possible if there is a certain pressure for the companies to take care. The motivation for careful handling of slaughter animals ideally comes from both sides: the management of a slaughterhouse as well as from the local authority. If this is not the case it is mandatory to support the local authority by the help of the supervising public authority.

In general the company is responsible for working in compliance with animal welfare requirements. The local authority has to check if these requirements are met (beside other also verify the companies own monitoring and recording).

When starting to enforce animal welfare the current status must be established. Therefore the different steps, which the live animals pass, must be included (see point 2.). Within the first series of checks the authority and company should get a profound view of the situation and possible deficiencies. Subsequently the choice of checkpoints will be adapted to the specific situation and the frequency of control checks will be determined. In case of major deficiencies (e.g. stunning effectiveness) necessary actions may be required at once (stop of the slaughter line, change of personnel, increase of parameters). If company management does not accept the authorities view, the help of an independent expert may be necessary.

If not already existent, a job specification for staff members and the procedure for every step must be determined (e.g. use of driving aids, group size etc.) in together with the company. Training courses, providing background and explaining procedures are helpful to communicate the necessary rules and regulations. Depending on the acceptance it can be helpful to mention the sanctions, which will be taken by the authorities in the case of offences. For the supervising veterinarians it is necessary to have a contact person to the staff, especially when there are communication problems due to different languages. In some countries there already exist – defined by regulations - “animal welfare officers” at company level, acting as partner to authorities providing mediation or troubleshooting. Veterinarians and meat hygiene inspectors must speak equivocally and act consequently to avoid a loss of trustfulness. Lacking knowledge must be completed.

Monitoring welfare requirements either through human spot checks or using technical support like video surveillance or measuring, protocol and alarm devices can be very effective, if people are skilled and measurements are done correctly and reasonable. The use of checklists and control samples can help to standardise the procedure. However many data are collected without leading to detect and avoid deficiencies. If results are not analysed, and clear responsibilities are missing, any enforcement of animal welfare will lack from the beginning.

In terms of welfare enforcement a good cooperation between animal welfare officers and competent official veterinarians is beneficial. Possible dependency between companies and competent authorities can be antagonised by superior independent inspections. Auditors and inspectors must be competent and apply the same standards to everyone. Requisitions and reliable audits by the retail industry support the efforts by the company and official surveillance.

<u>Common difficulties</u>
Business competition from the retail market has lead to a situation in Europe where small plants are no longer competitive and many of them have to close. Bigger companies associate but the pressure for low cost slaughter is still apparent. Therefore many companies still have to find ways for working as cheap as possible. A subsequent loss of quality and decreasing welfare standards are common.

The personnel is not always trained and licensed. Especially workers from the new European member states, which are employed by subcontractors, work for a small salary and have little or no experience in handling animals. Due to the hard work and the small salary they often do not work longer than 6 month and have to be replaced. Bad handling of animals caused by low-cost workers - often not able to understand the language - is a recent problem. These workers have to be properly trained and licensed if they work with living animals - a challenge for the industry as well as for the official supervision.

People work too long or without necessary breaks. Animal welfare officers are not in charge or people who are already overstrained with other jobs are responsible for the monitoring of animal welfare. The level of knowledge of the personnel and also the responsible veterinarians is not always as good as it should be. Further education can prevent this insufficiency.

Investment in new facilities and necessary equipment or service and maintenance are often delayed even if a detrimental effect against animal welfare is apparent (e.g. slippery floor where animals fall).

Often the speed of the slaughter line is raised without adaptation of the driving- and the stunning-system. Shortcomings like this are often made by both sides management of the slaughterhouse but also competent authority. A maximum line speed for a life animal system must be determined and also service and maintenance intervals must be fixed. Some solution to this can be a general licence for a driving or stunning system by a superior authority including maximum line speed, service intervals etc.. However due to the variation of systems a company specific approval of a facility or system in most cases has to be endorsed.

Problems can also appear, if veterinarians are not interested in the enforcement of animal welfare. The reason for this phenomena can result from a lack of support by their supervisor when avenging offences, the pressure from the transport or slaughter personnel or and misapprehension of animal welfare (animal welfare is not relevant because animals are dying within a short time). Working at the slaughterhouse is not the favourite job of veterinarians and especially live animal inspection and monitoring of animal welfare can be unpleasant and troublesome. Difficulties in punishing badly working staff leads to frustration. Often vets see apparent failures and promise a punishment but after a lot of paperwork is done nothing happens. Improvement is certainly provided by further education and change of minds.

Measuring and monitoring techniques may be complicated and require some extra learning and practice. Again further education and training is required, may be establishment of task forces assisted by technicians and engineers.

A common problem is that bad animal welfare (e.g. driving systems and races) often is based on mistakes during planning and construction of slaughter plants. Careful planning and good consulting service can avoid these mistakes, which often later on can only be solved by spending huge sums of money.

Delivery of sick or injured animals – unfit to transport - is still an important matter within several EU member states. This problem is in most cases based on a lack of veterinary supervision and too mild punishment of infringements. But also a lack of respective attitude and lack of formation of farmers and keepers should be considered. Change of attitude and effect of formation only shows up slowly.

Inspection in small slaughterhouses is a special case. In most establishments live animal inspection is done before slaughter and then the responsible vet or meat hygiene officer only comes back later in the day for meat inspection. Stunning and slaughter happen without permanent presence of a veterinarian. Monitoring of animal welfare during the procedures of stunning and slaughter in these plants only takes place when special checks are performed by the supervising authority. These checks may an be only once or twice a year depending on the capacity and commitment of the local authority. A way out of this dilemma is not very clear. Automatic protocol units (and data transfer) or web cams may be expensive and require again time an competence of the controlling vet. In most cases technical data e.g. on stunning parameters alone do not provide enough information without having a look on the

animal itself while being stunned. However they might be helpful to decide whether the frequency of controls has to be increased.

Animals can suffer during the performance of religious slaughter. Still no common rules exist within the EU. Instead painful procedures like turning cattle onto their back before cutting, inadequate restraining methods or neck cutting by people without the necessary skills can be observed. These different treatments concerning religious slaughter within different countries lead to transfer of live animals and meat between (EU-member) states. Consumers are not informed if they buy meat, which comes from animals killed by bleeding in full consciousness.

Possible future developments

Until now legislation has not been enforced by all member states of the EU to ensure proper handling and effective stunning of every animal slaughtered. The diversity or even errors in interpretation of the present EU directive makes it difficult for the official vets to realise and avenge offences. Future regulations will hopefully provide clear guidelines to the industry about what is expected to safeguard animal welfare as well as to facilitate enforcement.

New technical equipment (video surveillance, alarm devices for fail stunning procedures) often is necessary to monitor the function of complex stunning systems. These technical devices will be incorporated in modern monitoring systems for animal welfare.

Diversification within formation of veterinarians and constant increase of knowledge and technical development often makes it impossible for the competent authorities to perform a reliable control on their own. It must be possible for them to get assistance. Regular comprehensive checks by specialised institutions should be mandatory.

Specific training throughout all responsibility levels (staff, animal welfare officer, veterinarians, technicians) is an important key to enforce and safeguard animal welfare. The need for training has been recognized. Enforcement still develops in this area.

In future more and more ethical aspects about treatment of slaughter animals will be taken into consideration. Animal welfare lessons will be established in school and the retail markets like to display good conditions for the farm animals. The reason for this development might be the increasing distance between consumers and the field of production.

References:

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Session 6: Presentation 17

Experience gained from dealing with Newcastle Disease

Professor Pam Hullinger
Lawrence Livermore National Laboratory

Euthanasia is a humane death that occurs with a minimum of pain, fear, and distress

In any poultry production system, it is inevitable that some birds will become ill, debilitated, or injured. If the bird is unlikely to respond favorably to treatment, or if treatment is not feasible because of economic or public health considerations, euthanasia may be the best option to prevent the bird from suffering. In addition, healthy spent hens may be killed on-farm for subsequent rendering because their low market value makes it impractical to send them to a processing facility. This pamphlet is designed to aid producers, transporters, and veterinarians in making appropriate decisions regarding euthanasia and on-farm killing of poultry.

Decision Making

Questions to be considered in deciding whether a sick, debilitated or injured bird should be euthanized include:

- Is the bird experiencing pain or distress?
- Is recovery likely?
- Is the bird likely to transmit disease to other birds?
- Is the bird able to access the feed and water?
- Can the bird be treated?
- Is the bird or its eggs suitable for human consumption, or will they be suitable for consumption after recovery or treatment?

General economic considerations may also play a role in deciding whether or not to euthanize a bird.

Considerations for Euthanasia Methods

• **Poultry Welfare:** The method chosen should minimize the pain and distress experienced by the bird. However, the choice of techniques may be limited in certain environments. In all cases, proper restraint can help to decrease the bird's fear and distress. When possible, poultry should be held gently in an upright position with their wings closed to prevent flapping, not carried upside down by the legs. Covering the eyes with a hand or a piece of cloth exerts a calming effect, as does holding the bird in contact with the handler's body.

• **Human Safety:** The method chosen should not pose undue risks to the individual performing the euthanasia. Some methods are more dangerous than others, and should only be used under controlled conditions with proper equipment or protection.

• **Skill:** Appropriate training of personnel is important to ensure that poultry are euthanized appropriately. Untrained personnel in an emergency situation can use some methods, while others, like cervical dislocation, require skill and training to carry out correctly.

• **Aesthetics:** Some methods may be objectionable to the person performing the procedure because of blood loss or involuntary reflex movements by the bird. Personnel that may euthanize birds should be trained to understand how birds respond to particular euthanasia methods.

• **Cost:** Some methods are more costly than others are. Some have initial costs associated with the purchase of equipment, but are thereafter inexpensive.

• **Limitations:** Some methods may be suitable for only certain ages or types of poultry. In addition, some methods involve administration of controlled drugs by a veterinarian.

Euthanasia Methods for Poultry

• **Cervical Dislocation** – If carried out near the head area, dislocation of the neck vertebrae from the cranium damages the lower brain region, causing rapid unconsciousness. In order to be humane, dislocation must cause severance of the brain from the spinal cord and carotid arteries. This is best achieved using a stretching motion rather than by crushing the vertebrae. Training of personnel is critical. Small birds can be dislocated by applying a rotational movement to the neck. Adult poultry should be held by the shanks with one hand, and the head grasped immediately behind the skull with the other hand. The neck is then extended and dislocated using a sharp downward and backward thrust. The necks of larger or heavily muscled birds like broiler breeders, turkeys, geese, ratites, and waterfowl are extremely difficult to dislocate. It is therefore recommended that other methods like captive bolt or gas euthanasia be used for birds weighing more than 6.5 pounds. Flapping and other body movements may persist for several minutes after cervical dislocation, although if the vertebrae have been properly dislocated these are reflex reactions. Securing the bird's wings prior to performing the dislocation can prevent involuntary flapping. To ensure death, the bird's throat should be cut after cervical dislocation. If large numbers of birds are to be euthanized cervical dislocation is not an appropriate method because personnel performing the procedure rapidly become fatigued due to the physical effort required.

• **Argon** – Argon gas is an acceptable method for killing all poultry species except waterfowl, and is not an irritant like CO_2. Exposure to argon causes hypoxia. A concentration of 90% argon in air, or a mixture of argon and CO_2 (see below), should be used to for euthanasia of newly hatched fowl chicks, ratites, and poults. Older birds should be euthanized using argon with less than 2% residual oxygen.

• **Carbon Dioxide (CO_2)**– Carbon dioxide causes rapid onset of anesthesia with subsequent death due to respiratory arrest. Death occurs in 2-5 minutes depending on the species and concentration of CO_2 used. Poultry can be euthanized using carbon dioxide gas by being placed in containers that are sufficiently airtight to maintain CO_2 at desired level. Depending on how many birds are being euthanized, a circulation system may be necessary to ensure that the gas does not become stratified. Birds should be added to the chamber gradually so that proper CO_2 levels are maintained. CO_2 should always be delivered from vapor delivery cylinders or, if from a liquid delivery cylinder, vaporized first to prevent it from turning into dry ice. To meet the criteria for humane euthanasia, birds already in the chamber must be unconscious before being overlain by other birds loaded after them, and unconsciousness must be maintained until death occurs.

Domestic fowl chicks should be euthanized using a concentration of CO_2 of at least 80% in air; higher concentrations (at least 90%) are required for newly hatched turkey poults and ratite chicks. However, such high concentrations of CO_2 are aversive to adult birds. Adult chickens should be killed using approximately 50% CO_2 in air. A mixture of 30% CO_2 and 60% argon or 90% argon (with less than 5% residual oxygen) is effective and less aversive to adult chickens than CO_2 alone. CO_2 is not an acceptable method for killing waterfowl.

It is especially important to confirm death when birds are euthanized using gas, since they can appear dead but then regain consciousness. Containers in which birds are euthanized should be clear or have a window through which the birds can be observed.

When large numbers of poultry are to be killed, as during the depopulation of spent hen flocks, it is important that CO_2 be injected frequently into the chamber to maintain these levels. A Modified Atmosphere Killing (MAK) System can easily be constructed for CO_2 killing of spent hens (Egg Industry, April 1998, pages 10-16). The MAK container holds about 200 hens when full.

• **Carbon Monoxide (CO)** – Carbon monoxide is a relatively rapid and effective method of euthanasia for birds. Carbon monoxide combines with the hemoglobin in the red blood cells in preference to oxygen, causing hypoxia. Only a pure, commercially compressed source of CO should be used. Vehicle exhaust is not an acceptable source of CO for euthanasia because it is hot and contains contaminants. High levels of CO are deadly to humans, and chronic exposure of pregnant women to even low levels of CO can cause birth defects. Only well-trained personnel should therefore use carbon monoxide and then only under properly controlled circumstances. The gas should be delivered into tightly sealed containers and the area around the containers monitored for leakage. Depending on how many birds are being euthanized, a circulation system may be necessary to ensure that the gas does not become stratified.

• **Gunshot** – Larger birds like ratites can be euthanized by gunshot directly to the head, causing extensive damage to the brain. The gun must be correctly positioned to ensure that the brain is destroyed. Care must be taken to ensure human safety when using firearms.
It is recommended that the carotid arteries and jugular veins be severed immediately afterwards to ensure death**.**

• **Captive Bolt** – Captive bolt pistols designed for livestock can be used to euthanize larger poultry species like waterfowl and ratites. The pistol should be applied correctly. Because there is motion after use of the captive bolt, it is advisable to restrain the bird to prevent injury to personnel. It is recommended that the carotid arteries and jugular veins of the bird be severed immediately afterwards to ensure death**.**

• **Electrocution** – Electrocution is a rapid and acceptable method of euthanasia provided that a sufficient current passes first through the brain to ensure unconsciousness, and then through the heart to induce cardiac arrest. Specialized equipment is required to ensure humaneness and personnel safety.

• **Exsanguination/Decapitation** – Birds can be killed by severing the jugular veins, carotid arteries, and trachea. Full decapitation also results in a rapid decrease in blood pressure and brain stem trauma. However the blood vessels may seal after being severed, delaying the onset of unconsciousness, and brain responses do persist for a brief period of time after decapitation. For this reason, exsanguination or decapitation should only be used as sole methods of euthanasia in extreme emergencies involving animal suffering where alternative methods are not feasible because of lack of equipment or trained personnel.

Exsanguination and decapitation are acceptable methods of euthanasia when the bird is first stunned or anesthetized. Hand-held electrical stunning knives are available for stunning and exsanguinating chickens and turkeys, although these do pose personnel dangers if used in an area where there are wet surfaces. Birds can also be stunned first by administering a blow to the head.

• **Maceration** – Maceration in a high-speed grinder results in rapid death, and is considered a humane method for disposing of young chicks and embryonated eggs. Only grinders specifically designed for disposal of poultry, which have blades that turn at 5000 or more revolutions per minute, should be used for this purpose. The grinder should be properly maintained and must not be overloaded, since birds may be incompletely macerated under these circumstances.

• **Anesthetic Overdose** - When properly administered by the intraperitoneal route, barbiturate overdose produces rapid unconsciousness and anesthesia followed by respiratory depression and cardiac arrest. Federal regulations require these drugs to be purchased, stored, and used under the supervision of an individual registered with the US Drug Enforcement Agency (DEA). Poultry euthanized using barbiturates must be properly disposed of in accordance with state regulations.

Confirmation of loss of consciousness and death

Confirmation of death is critical regardless of the method chosen. The cessation of reflexes in the head area can be used to confirm loss of consciousness:

- Lack of response to a hard pinch delivered to the comb, wattles, or snood
- Lack of blink reflex when the eye is touched

The following signs can be used to confirm death:

- Cessation of respiration
- Cessation of heartbeat

Euthanasia Action Plan

All personnel that work with the birds, including transporters, should be trained in appropriate euthanasia methods and be provided with any equipment that might be necessary for euthanizing sick or injured birds or for on-farm depopulation. A written action plan for routine and emergency euthanasia should be developed and followed wherever birds are handled. Since improved euthanasia methods for poultry, and particularly for on-farm depopulation, are currently under development, the action plan should be reviewed and updated regularly to incorporate these new methods as appropriate.

Below is an example action plan for poultry euthanasia.

EUTHANASIA ACTION PLAN

Farm Name: XYZ Farms
Date: Month/Day/Year
Drafted by: J. Smith, Producer

Phase	Euthanasia method of choice	Alternative Method
Hatchery	Selected method	Alternative method
Adults	Selected method	Alternative method
During Transport	Selected method	Alternative method

Post this plan in a centralized area as a guideline for humane euthanasia of poultry on your farm. Remember to review the plan with any new employees, and also review the plan annually as a reminder to all personnel.

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Session 6: Presentation 18

Experience gained from dealing with killing for control of foot and mouth disease

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State Veterinary Services

Funeral pyres were a common sight in parts of Cumbria during March and early April in 2001. They were the result of the culling of large numbers of livestock for disease control, the Foot & Mouth Epidemic of 2001. In the United Kingdom that year there were 2026 Infected Premises, along with 4762 premises defined as Dangerous Contacts and a further 3369 premises were culled as Contiguous Premises. At the peak of the epidemic, during the third week in March 2001, almost 300 cases were confirmed, the scale of culling can only be described as 'enormous'.

I worked as a Temporary Veterinary Inspector for the Ministry of Agriculture, Fisheries and Food (now Defra), from the 10 March 2001 based at the Carlisle Animal Health Office (Disease Control Centre). That centre alone dealt with 891 confirmed cases, the first case in Cumbria on 28 February 2001, the last case on 30 September 2001. During 2001 I spent time on over 70 premises where culling of livestock took place

In 2001 few of the veterinary surgeons who were carrying out the field work had seen foot and mouth disease as a clinical entity, so not only did we have to be able to diagnose we also had to deal with the consequences of that diagnosis. Today I would like to share with you some of the experience I gained in working throughout the epidemic in 2001, and specifically relate that experience to the culling of large numbers of livestock under field conditions for disease control.

Prior to 2001 I had experience working in abattoirs and had assessed slaughtermen prior to providing them with certificates of competence (to enable them to be fully licensed), so was at least aware of the welfare standards required for the stunning and killing of animals. Under field conditions, however, life was not quite so straightforward. Once a diagnosis and confirmation of disease had been reached the veterinary surgeon on the farm had set in motion a sequence of events that would culminate in the disposal, by whatever method, of the livestock on that farm.

After diagnosis the veterinary surgeon had potentially very little time before livestock would be culled, although in the early days of the epidemic, March and April, the procedures for valuation and culling were inevitably delayed. As the senior government official on site the veterinary surgeon was the 'responsible person', so they had to have, or develop, skills they may not have used before, the learning curve was very steep. Organisational skills, man management skills and communication skills were vital, and at the heart of it all we had to remember that for the farmer and his/her family it was a stressful time. Not only were 'strangers' arriving on their premises and removing animals that were infected, the farmers had to face up to the future with their livelihoods, at least in the short term, destroyed. The situation called for a sensitive approach, with calmness and rational thinking to be used.

During the time between diagnosis and the commencing of the cull we had time, sometimes albeit a short time, to consider a location or locations on the farm where animals could be humanely culled. Not only did we have to consider a suitable site, and arrange for suitable facilities to be available, for the restraint of the animals we also had to consider a site that would be suitable for the 'holding' of carcases in the event of disposal being delayed. We also had to consider access to the site for vehicles and disposal lorries. The veterinary surgeon on the farm had to relay back to the Disease Control Centre what would be required for the particular circumstances on the farm, number of animals to be culled, facilities already

available on site, were mobile sheep or cattle pens required, access issues and the number of staff required for managing the handling of the livestock in safe manner. In some cases the farmer, along with farm staff, would be able to assist, but in other cases those people could not face being present when their stock were culled and we had to respect their wishes.

The priorities as I saw them in 2001 were for the welfare of the farm animals, including their safety and security, the safety of all personnel on site and the welfare of the farmer and his family. It was vital to communicate with the farmer to advise them and let them know what was happening on their farm and with their property. Biosecurity was important and it was sometimes necessary to restrict the movements of personnel to be able to ensure biosecurity. I was faced in May on an infected premise with a farmers wife who was pregnant and whose baby was overdue, could she go to the hospital and return to the farm afterwards?

A slaughter team was allocated to the Infected Premises, depending on the number of animals to be culled the team could be just two persons. On other farms, where for example the culling of cattle and sheep was to take place simultaneously at different locations two slaughter teams would be allocated. In such cases a second, or even a third veterinary surgeon would be available to monitor each part of the cull.

On farms where I was in charge I set out to identify the leader of the slaughter team and set the ‘ground rules. I would check that the hardware being used by the them was adequate, ensure that backups were available in the event of breakdown and check that, when captive bolts were being used, the correct strength or charge of ammunition was available for the species being culled. Slaughter teams were not used to working in disease control / field situations. It became clear to me very early on in the epidemic that some killing teams were not correctly prepared or equipped with spare parts for repairs. Captive bolt guns were liable to break down due to overheating (remember that in most slaughterhouses the common method of stunning for sheep is by use of electric tongs). It was said that in March 2001 captive bolt pistols were fetching premium prices because of their ‘earning potential’. Slaughter teams were paid on piece rates, paid for the number of animals they culled, so the veterinary surgeon had to ensure that tasks were not rushed at the expense of welfare considerations.

In April 2001 I was appointed leader of the slaughter advisory team at Carlisle and I was able to provide training for veterinary surgeons prior to them being faced with the challenges of field culls. Experience I had gained by that time, along with discussions held in hotel bars in the evenings with colleagues gave the opportunity for ‘problem solving’. At the end of each on-farm cull a certificate had to be completed by the veterinary surgeon in charge. This certificate logged the number of animals slaughtered by a named slaughter team, but also commented on the way in which the slaughter was conducted with consideration for animal welfare. As leader of the team I was able to audit the slaughter teams with feedback from my colleagues.

On-farm killing reduced the killing methods available for use. Additionally for reasons of avoiding disease transmission it was not feasible to bleed animals once they had been stunned to ensure their death. “Stunning and pithing” was the preferred choice for most cattle and sheep, plastic (disposable) pithing rods were available for cattle and metal rods were manufactured and used to ensure that sheep were killed efficiently.

There were cases where we had to use ‘alternative’ methods to cull livestock to ensure their welfare at slaughter. Guidance was given to veterinary surgeons in the field that animals identified as being heavily infected when the disease was diagnosed should be culled without delay. In practical terms this meant that we had to carry adequate sedative and barbiturate

injection to enable us to carry out this procedure. Sometimes I had to call the Disease Control Centre to ask for such injections to be brought to a farm, the largest number of cattle I had to cull by this method on one farm, late one Sunday evening, was ten.

Once into March the lambing season in Cumbria was in progress and arrangements had to be made to ensure the welfare of these young animals, the use of the captive bolt was not appropriate. Lambs were injected with barbiturate, intra-cardiac, it appeared to be a humane way of carrying out a procedure that was distressing for many people. Where large numbers of lambs were to be culled in this manner we were able to use veterinary students to give the injections, under the direct supervision of a (qualified) veterinary surgeon.

I have kept the subject of the use of 'free bullets' as the last method that I observed used in 2001. Whilst slaughtermen with experience in the use of captive bolts were more readily available, there were circumstances where the use of trained marksmen with rifles / pistols and free bullets were necessary. I had to deal with situations where bulls, reared for beef and kept indoors, had to be killed with free bullets. There were obviously health and safety issues in these cases, I had to rely on the experience and skill of the marksmen. Once cattle were let out to grass in May 2001 there was more call for free bullets to be used to kill suckler cattle. Marksmen would use a vehicle as their 'base' and, accompanied by a veterinary surgeon, would carry out the task. 'Fallen' animals were checked as soon as possible after being shot, I was fortunate in that the marksmen I worked with were highly skilled.

Finally, the use of a 'field abattoir, Great Orton (now renamed as Watchtree) , established at the end of March and used through to the end of April 2001, to 'resolve' the burial backlog of cattle and sheep carcases and to provide facilities for the mass cull of sheep held within 3 kms of confirmed cases of Foot & Mouth Disease. Great Orton was a Second World War airfield, last used by the Royal Air Force in 1965. The Army defined it as a suitable site for the burial site at the end of March 2001. I did not actually work at that site, but had the opportunity one day in April 2001 to visit and see for myself the way in which the welfare of sheep was handled.

The day to day logistics at Great Orton were managed by the Army and the culling of sheep at the site was supervised by the Royal Army Veterinary Corps. Veterinary surgeons, and veterinary students, from the Carlisle Disease Control Centre, were seconded each day to provide veterinary supervision for the handling at transport and culling of sheep and lambs. On arrival at Great Orton lambs were shed from the older sheep, very young lambs were carried off the lorries to safeguard their welfare. The arrival, shedding and movement of animals were audited by veterinary surgeons. Slaughtermen stunned and pithed older sheep in specially constructed slaughter bays (under cover) whilst the lambs were injected with intra-cardiac barbiturate. Disposal of the carcases was in pits excavated on either side of an old runway.

The slaughter of over 200,000 sheep at Great Orton was audited by the RSPCA and by the Humane Slaughter Association. The Chief Veterinary Officer for the RSPCA, Mr Laurence, in a letter written after his visit to Great Orton on 1 April 2001, wrote : *" I saw no incident that caused me any concern with regard to animal welfare. Sheep and lambs were unloaded efficiently and quietly and killed humanely and with compassion"*

Mr Mason, Technical Director of the Humane Slaughter Association, visited Great Orton on 3 April 2001 and in a subsequent letter wrote: *"Given the numbers of animals involved and the consequent numbers of operatives on site, this operation was conducted in an efficient and professional manner, with animal welfare clearly of paramount importance"*

So, in summary, the key points gained from my experience, for planning and implementation of the culling of animals 'in the field' for disease control :

- Allow as much time as possible for the organisation prior to commencement of the cull to ensure that appropriate handling facilities are in place to ensure the safety and welfare of animals (and personnel).

- Optimum location of site for culling on farm to be established considering methods to be used to remove carcases for disposal

- Method of cull to be established to fit in with conditions that prevail on site and species being culled, eg options to use sedation prior to injection or stunning, use of injection alone for young animals, use of free bullet to be considered.

- Overall supervision of the cull, wherever possible, should be by a person with experience of having worked in an abattoir. This enables closer supervision of slaughtermen to ensure that culling is carried out in a humane manner and in accordance with welfare at slaughter legislation.

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Session 7: Presentation 19

Auditing and reporting animal welfare in slaughterhouses – An independent auditor's perspective

Mandy Lucas
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Objectives

- Understand how independent auditors work
- Review the role of independent auditors in welfare assessment
- Review the role of retailers' quality assurance schemes in setting welfare standards
- Areas of common interest, and differences, with state monitoring/inspection authorities

Let's start by agreeing what an audit is and who carries it out. Is there a difference between an inspection, assessment and an audit? Let us look at the dictionary definitions.

Inspect: come and see in an official or professional capacity. There is nothing too scary in this description, except perhaps the word "official".

Assessment: the classification of someone or something with respect to its worth. I am not sure this helps too much.

Audit: Systematic and independent examination to determine whether activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Now this does sound daunting, but if we break it down. *Planned arrangements* – this is the standard being adhered to and your own working procedures. *Implemented effectively* – do we do what we say we are going to do? *Achieve objectives* does it improve animal welfare? Who carries it out? Someone who listens attentively, who observes carefully and assesses. However, whatever we call it and whoever does it, to most, it means adding stress to an already fraught process.

How can we ensure that an independent audit adds value to our business rather than cost?

Typical Audit Flow

- Appointment
- Opening Meeting
- Inspect the process
- Inspect and verify records
- Inspector's "quiet" time
- Closing Meeting

An appointment will not always be made, for some this is a positive as it prevents the sleepless nights beforehand. But it does rely on all key staff understanding their roles and being able to demonstrate compliance, even if the designated person is missing.

An Opening Meeting is used to set the scene so that everyone involved has a clear understanding of what is about to happen and why. Typically an inspection will start with the physical process and then look at verifying what has been seen by inspecting records.

Every inspection should have a declared outcome. Before the closing meeting the inspector will probably need to collect their thoughts and draw up a report. At the closing meeting findings will be confirmed and outcomes discussed. Make sure you understand what has been found, why it is non- conforming and have a clear idea as to what is needed to conform. By this stage you may just be glad to see the back of us and get us out through the door. But take the time to learn and understand. Also challenge interpretation and ask for explanations; the inspector will not always be right. We are human too?

Everyone who is being audited has the right to understand the process, preferably before it starts. This is why the opening meeting is crucial. They have the right to question and understand what is being observed and the conclusions or issues it raises. Ask what is being observed, why, is it good or bad. If the environment is too noisy for a full discussion, move to a quiet area and then return. Most importantly they also have the right to be respected, ensuring that their views are being listened to and acknowledged. Very rarely is a business non compliant because they want to do the job badly. Mostly it is the interpretation of what is needed that is wrong. Usually there will be a sound reason why something is designed and carried out in a particular way. Occasionally it will be “because we’ve always done it that way”. An inspector should listen to why and discuss the implications of change.

During an audit we are working with you to demonstrate compliance against a known standard, we are not looking to catch you out. Non conformances are most often raised because the requirement was misunderstood, rather than because a business is not willing to comply. Use an audit to understand the interpretation of the standard and the reasoning behind it. A competent auditor must be able to explain both what they are looking for and why. Hiding behind the phrase “because it says so” is a sign of a weak auditor.

Retailer standards aim at providing a level playing field, across their supply base. Commonly based on the law of the land and production methods employed in the country in which their consumers reside. Ensuring that customer expectations are met, despite the fact that product may be sourced globally. Retailers have the power to influence at all levels; this can be used positively to improve animal welfare standards worldwide.

Basing standards on UK law will often create conflict with local customs and laws, putting independent auditors at odds with state enforcement agencies. Within Europe, often the difference is interpretation of EU Directives by different member states or different implementation strategy. Outside the European Union it is rare for a local law to prevent compliance with UK welfare law; it perhaps just doesn’t encourage it. However, conflicts between Health & Safety or Food Safety laws and Animal Welfare law is more likely to work against improving welfare standards, particularly in countries which have yet to address the legislative rights of animals at slaughter.

We will now look at the Top 10 frequently occurring non conformances which have an impact on animal welfare. Why do they occur and how can they be avoided?

“Personnel carrying out any of the following tasks must be licensed (under UK law or the equivalent) and have received a certificate of competence from a veterinary surgeon; restraint, stunning, slaughter, killing, assessment of effective stunning or killing, shackling of any stunned animal, bleeding of an animal which is not dead.”

In the UK this is covered by the MHS Slaughterman license, which is essentially a certificate of competence issued by the OVS. However, this non conformance is not confined to overseas slaughterhouses. Common failings will be that a provisional license has expired or that the plant has changed from electrical stun to gas killing and the licenses have not been updated. Also there appears to be confusion and debate in the poultry world as to whether there is a need for a license in a poultry plant using a gas killing method. Some OVS believe

it is unnecessary, but to comply with this clause, someone needs to be able to assess effective killing and needs a certificate of competency at least.

Overseas, there is sometimes reluctance by state veterinarians to put their name to an individual's competence. Conversely in many countries, wherever you look, there is a vet. Gaining certificates of competence should not be that difficult.

"Any animal which is sick or injured (casualty animal) must be transported and lairaged separately and be provided with clean dry bedding"

The easiest solution is not to transport casualty animals, failing that (and to take account for casualties en route) dealing with all casualties at the point of detection, will eliminate the need for animals to be lairaged separately and to provide bedding.

This is often where food safety considerations conflict with welfare. The factory deems the casualty is still fit for human consumption, but to abide by food safety requirements they will be killed at the end of the day, where the line can be slowed down and cross contamination can be avoided. The result is too many animals to pen separately. Flexible penning will help and perhaps a compromise of end of shift (rather than end of day) would elevate the problems.

There is also a conflict with some environmental requirements, with restrictions on the waste outputs from a factory, straw and shavings may not be considered an option. Cow cubicle mats can be considered, but make sure they do provide comfort and cover the whole of the lying area.

"All equipment must be clean, in good working order and maintained under a planned programme."

Many factories will say that the animals will tell you when things are not working correctly. This is true, but surely we don't want to wait for pain and suffering to occur before we take action? How do we know that the lamb is receiving 1 Amp, is the amp meter calibrated? How often do we change the blade on the autoknife? Which captive bolt did we use yesterday and was it cleaned?

"A daily check sheet must be completed which ensures that the lairage complies with the requirements of this COP."

What is essential for the health and wellbeing of animals in your care and what could fail you? Is there water to drink and if there is a cooling spray does it work? Will the fans work when you want them? Have we got clean, dry bedding where appropriate? Is there any damage on the internal structures? Is the light intensity adequate?

"There must be a breast rubbing strip from the point of hang on until the point of stun in electrical stunning systems."

On the face of it quite easy to understand, but don't forget the subtext; …and the birds must maintain contact with it. The easiest way to check this is to place your hand between the comforter and the birds. Are the birds in contact with your hand? Make sure any overlaps and joins run in the direction of the birds. Check for worn and torn materials, bent bars and that the maintenance or cleaning team has put them back!

"Materials used for the construction of accommodation, and in particular for the construction of pens, cages, stalls, equipment and vehicles with which the animals may come into contact, must not be harmful. They must be well maintained and capable of being thoroughly

cleaned and disinfected. All internal surfaces and fittings must be free of sharp edges or projections and must be arranged such that injury is avoided."

This covers nearly everything in the factory from transport crates in poultry factories to the metal gates, bars and troughs in red meat. Can canvas and wood be cleaned and disinfected? Are inverted birds positioned so that they don't hit the birds in crates below? At some point, in most factories, animals pass through holes in the wall. This is better if it can be designed to happen to a stunned, dying or dead animal. But inevitably, live animals pass through gaps which need to be big enough for easy passage.

"Where animals have been in the lairage for more than 12 hours they must be provided with feed (of a type which is ideally familiar)."

They have straw bedding, what more do they want? Straw is acceptable, providing it is in a hayrack or hay net and therefore accessible at anytime. Bedding will become soiled and therefore not truly available as a feedstuff.

Here again we may conflict with starve out requirements under Food Law. Certainly when we first went to South America we were advised that it was illegal to feed within 24 hours of slaughter. All factories lairaged animals overnight and therefore all required feeding under UK Law. Interestingly, we now have established suppliers who feed (demonstrated by unannounced inspections) and others who still state it would be illegal to do so.

"When transporting cattle and sheep, bedding e.g. straw or wood shavings, must be used to absorb urine and faeces and provide some thermal comfort. Straw must be used for calves."

Since this clause was first written, we have superior vehicles with drainage systems and holding tanks. Straw would only serve to clog these up and prevent free drainage. So an outcome based approach is perhaps more suitable. Is there slurry seeping from the tailgate? Are the animals dry and clean?

"All animals in held in lairage must have access to clean water at all times. The drinking facilities must be sufficient for the type and number of animals, be constructed so that they are accessible to all the animals and cannot readily be fouled."

Water must be available at all times. However, in a prestun raceway, if there is a short breakdown it is probably more stressful to return animals to the lairage area than to leave them without water. But for pre-planned breaks, for lunch, etc. there is no such excuse.

Water should be sited where is least likely to be fouled but still accessible to animals. Floor level for pigs will often result in fouling and pigs being denied access due to other pigs laying across them. If killing sheep and cattle, make sure both have access.

"Electric goads must not be continually held by stockmen to prevent habitual use, they must be kept near handling areas, only picked up when necessary and must be replaced after use. The minimum of force must be used when moving animals round the lairage and to the point of stun/slaughter. Goads may only be used (on adult animals) when all passive methods of persuasion have failed. Where goads are deemed necessary the design of handling facilities (e.g. flooring, layout, lighting) must be investigated to see where improvements can be made."

Always use passive persuasion first. If a goad is to be used, make sure all know the requirements of what part of the body and for how long. And make sure the animal has somewhere to go.

It is also important to review why the goad is being used, what we can do to re-design facilities to reduce its use. It won't always need capital investment.

One thing to remember throughout the process is that inspectors will not be put off by lack of access. However hard you try. It is critical that stunning, slaughter and bleeding can be observed. Health and safety cages around the stun bath, low light levels, animals being immobilized, facilities being too high, too close to the wall, all these conditions mean that you cannot assess the animals in your care either and therefore cannot demonstrate compliance.

At the end of an audit you should have a clear understanding of your strengths and weaknesses, as well as understanding what is required to improve. An auditor will not provide solutions, this is your job. Our role is to ensure you understand why what you are doing does not comply and why compliance is important. Your management team is then the right group to decide how sustainable compliance will best be achieved for your circumstances.

Session 7: Presentation 20

Reporting and evaluating animal welfare under disease control situations

Professor Pam Hullinger
Lawrence Livermore National Laboratory

Session 7: Presentation 21

Evaluating welfare aspects of animal handling in slaughterhouses and at killing for slaughter.

Professor Neville Gregory and Tess Benson
Royal Veterinary College, *Humane Slaughter Association*

The purpose of this paper is to give some examples of sections taken from an auditing system for preslaughter handling, stunning and slaughter in New Zealand abattoirs. The parts that have been selected are those that are most relevant to European conditions. They are offered as examples of how auditing *can* be done.

The primary aim with this audit is to check for compliance with the Code of Practice in NZ. The audit is modified to suit individual abattoirs, and it is intended for use by the abattoir companies when inspecting their own facilities. The company auditors are trained on how to conduct the audit. The audit has also been used by an independent auditor in place of the company auditors, and individual abattoirs have been awarded a certificate if they passed a predetermined acceptability rating. Not all abattoirs passed. Failures were due to inconsiderate management of stock that were unfit for slaughter (for example in holding paddocks near the abattoir), inappropriate supervision of stock washing procedures, and inappropriate handling of casualty animals.

The feature that caused most difficulty when training company auditors was inspection of the neck for severance of both carotid arteries. At some abattoirs the staff delegated to do the auditing were yard staff and they were unfamiliar with butchery or dissection procedures. They got there in the end, but it took time to acquire the technique.

The auditors are given a list of the main points in the Code of Practice. This helps them recognise the outcome that should be achieved, as well as the process they should use in reaching that outcome. The points in the Code of Practice have not been reproduced in this paper, and they are referred to as “AWAC requirements”.

Some of the observations rely on estimating the prevalence of a situation. The number of animals that should be examined when assessing the prevalence is given.

Other features worth noting about New Zealand conditions are as follows.

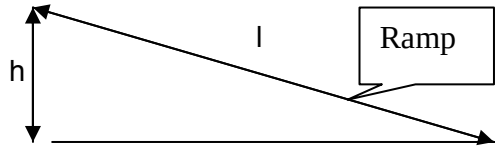
1. livestock trucks have a sliding rear door instead of a tailboard door that acts as a ramp.
2. dogs are used for moving sheep in abattoirs
3. “pugging” refers to boggy conditions in the paddocks
4. most sheep pass through a swimwasher at least once at the abattoir before slaughter
5. a “chain” is a slaughterline. Some sheep abattoirs have as many as four chains working simultaneously.

Areas to be audited include:

- Unloading stock at the Processing Plant
- Holding and Handling at the Processing Plant
- Restraint at Stunning
- Captive Bolt Stunning
- Electrical Stunning
- Electrical stunning in sheep, pigs and bobby calves
- Sticking

Appendix 1 – Measuring the angle of the Ramp

Measure the height of the ramp above the horizontal (h) and the length of the ramp (l), using a tape measure.



Divide h by l. Determine the angle of the ramp from the table below:

Angle of the ramp (degrees)	h / l
1	0.017
2	0.035
3	0.052
4	0.070
5	0.087
6	0.105
7	0.122
8	0.139
9	0.156
10	0.174
11	0.191
12	0.208
13	0.225
14	0.242
15	0.259
16	0.276
17	0.292
18	0.309
19	0.326
20	0.342
21	0.358
22	0.375
23	0.391
24	0.407
25	0.423
26	0.438
27	0.454
28	0.470
29	0.485
30	0.500

Auditing welfare standards in red meat abattoirs – part 2

Tess Benson, Humane Slaughter Association

The second part of the presentation will focus on post mortem inspection and critical points that should be considered when reviewing the design and operation of facilities.

Post mortem inspection

Post mortem inspection of carcasses can provide a great deal of information about what has happened to the animal prior to slaughter. Assuming that an animal is in good physiological condition when it arrives at the plant, most downgrades in meat quality can be put down to inadequacies in either transport, handling or stunning, or a combination of all of these factors.

The most obvious factors to be investigated are: Bruises, broken bones, PSE or DFD meat and blood splash.

Bruising

The causes of bruising can be variable and also can happen in a number of different situations. The more common factors are:

Rough handling: over use of handling aids, or pulling of wool

Inappropriate facilities: raceways and pens not designed for the particular species, protruding metal in raceways or pens – even badly designed feeding and watering facilities can bruise animals.

Transport quality: the quality of the driver is of paramount importance, if they break too suddenly, turn corners tightly or, accelerate quickly the animals will be thrown around in the vehicle and be bruised. The stocking of the vehicle is vital: too little space to move and the animals may crush each other, too much space and they have a higher risk of falling or slipping.

Vehicle design: All the decks should be high enough for the animals to be transported. They shouldn't have protruding parts and the ramps should be designed so animals load and unload easily and without the need for routine use of handling aids. A non-slip surface is also essential.

Presence of horns: in the UK the presence of horns seems to be increasing as farm staff numbers reduce. This can cause problems when the animals are stocked too tightly and also if they are mixed.

Stun box design: the design on the stunning pen or box should be simple and not allow animals to knock themselves on anything within the box. They should also be easy to load so that the use of handling aids or wool pulling is avoided.

Mixing of animals: any animals not used to others will fight to establish a pecking order in the new group. This should be avoided at all times, not only does it cause bruising but it will also raise stress levels overall.

PSE meat

This condition, pale soft and exudative, meat is commonly found in pigs and is caused by short-term stress prior to slaughter. The more obvious causes are lairage and handling conditions, although transport may also play a role if animals are not held for long prior to killing.

PSE meat occurs because the pH level drops very quickly (in one hour as opposed to 4-5 hours in well rested pigs). This causes the meat to have a high water loss and look very pale.

Certain breeds have a higher susceptibility to the condition and no matter how good the facilities some pigs will get stressed and produce PSE meat. However, by reducing the levels of mixing (to zero preferably) keeping the temperature level suitable and using gentle and considerate handling, the levels of PSE will be minimal to non existent.

Fighting is very common in pigs in a new environment (especially if they have been mixed) this will not only increase the chances of PSE meat but will also result in skin damage and bruising.

DFD meat

DFD meat is again related to levels of stress prior to slaughter, but this time it is long term stressors and can often be more related to transport conditions than the abattoir. It more commonly occurs in cattle, and young males of any species tend to be more at risk then females or older animals.

With DFD the pH falls by a very small amount post mortem and this causes the meat to be dry firm and dark.

As mentioned in the bruising section, poor transport conditions and vehicle design which cause stress in the animals may lead to the DFD condition and should be monitored carefully, ie which lorry is used, which driver, length of journey etc.

Broken bones

The introduction of high-voltage equipment is often blamed for broken bones in animals and can be more prevalent in situations where pigs are stunned on the floor.

The use of two-stage electrical stunning equipment has alleviated this problem to an extent. However, stunning position and accuracy do play a part in this problem. If the tongs are not applied correctly or they slip during the current flow and are then reapplied, this second surge of electricity can cause broken bones. If there is a high prevalence of broken bones, one of the first steps is to establish if the equipment if functioning correctly and which staff are stunning when the problem occurs. Sometimes refresher training and highlighting the problem to staff can reduce this problem immediately. Other causes can be when the tongs are held on an animal as they are shackled and the entire weight of the animal is taken by one leg. This can also increase the chance of blood splash.

If all areas are covered and there doesn't seem to be a problem in the stunning area, it is also worth investigating the feed on farm, it has been known for diets to be changed or incorrectly formulated which result in pigs having weak bones.

Blood splash

Blood splash occurs when the blood vessels in the body break and blood leaks into the surrounding area. It can be seen with both electrical and captive bolt stunning.

This can be associated with broken bones, so many of the observations above are also true for blood splash eg hoisting animals whilst tongs are still intact, the use of high-voltage stunning.

Blood splash can also be a hidden problem when only primal cuts are sold and the meat is not cut open, or a different product is being butchered and different parts of the muscle are revealed.

A delayed or long stun-to-stick time, can increase the prevalence of blood splash as the pressure inside the blood vessels immediately after stunning is very high, if this pressure is not reduced, by bleeding the animal then there is an increased chance of damage to the vessels and the resultant blood splash.

Key points on design and operation

No matter what facility is being assessed there will always be three different requirements: throughput, stunning system and species handled

These three factors can lead to a vast range of options and therefore it is important to assess each plant as an individual. However, there are always two key points that should never be forgotten when reviewing and designing systems: keep it simple and design it from the animals' point of view.

Reviewing design and operation

The following eight points provide a comprehensive starting point to review a system already in place, or one that is to be installed.

- Conformity
- Flexibility
- Usability/reliability
- Environmental factors
- Human factors
- Animal factors
- Cost
- Future implications

These points are discussed in the presentation, but can also be found in detail in the leaflet: *Technical Note 13. Design Specifications: Handling Facilities for Abattoirs and Farms.* Which can be found in your delegate packs.

Although aimed at abattoirs and farms, the points to be considered can be adapted to transport systems also.

Session 8: Presentation 22

Collection of specific information to contribute to the development of internet learning facilities relating to humane slaughter and killing.

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Participants

Key Publications