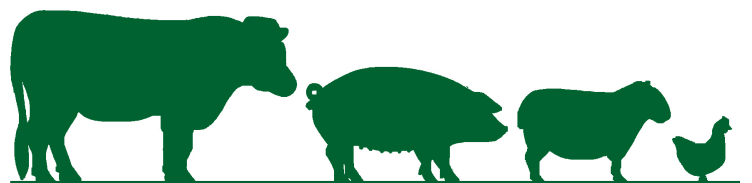




Recent Advances II

HSA International Symposium 2015
16th-17th July
Zagreb, Croatia



Humane Slaughter Association

Welcome to the HSA International Symposium 2015

Welcome to Zagreb, the capital city of Croatia, for the second HSA International Symposium.

Around the world, over 100 billion animals are transported, marketed and slaughtered annually in order to provide food. Growing meat consumption and an increasingly globalised food supply chain add to the need to develop improvements in animal welfare during transport, marketing and slaughter. These challenges, combined with increased consumer concern, are stimulating new developments and the adoption of higher welfare standards in many parts of the world.

The aim of this Symposium is to present and discuss recent scientific and technological advances towards improving animal welfare during transport, marketing and slaughter and the application and uptake of these advances around the world. The event will be an opportunity to identify future priorities and to provide a forum for sharing information and experiences.

We would like to thank all those who are contributing to the meeting, as speakers, poster presenters and chairs, and the delegates from the 25 countries who are attending. We look forward to what will be a stimulating and constructive meeting.

Robert Hubrecht and Mario Ostović

HSA and Faculty of Veterinary Medicine, University of Zagreb



Humane Slaughter Association



Organisers:

The Humane Slaughter Association

The Humane Slaughter Association (HSA) works to improve standards of welfare for food animals during transport, marketing, slaughter, and killing for disease control and welfare reasons. It works through research, education, training and technical advances to bring practical and lasting improvements in food animal welfare around the world.

The HSA has gained an international reputation for being a knowledgeable and practical organisation, with a sound understanding of livestock and livestock handling. The HSA is respected for its focus on science-based solutions and the support it has given to scientific and technical development in its field.

Practical, constructive, proven

Over the last 100 years, the HSA's work has resulted in many significant improvements for food animals around the world and many of the reforms it has promoted are now taken for granted. Significant improvements continue to be achieved through working constructively alongside agricultural, meat industry, veterinary and other welfare and professional organisations.

The HSA provides:

- up-to-date technical information and advice on all aspects of animal handling, transport, slaughter and killing;
- training in humane methods of handling and slaughter of livestock for farmers, vets, abattoir staff and students;
- technical and educational publications in a range of formats;
- independent advice to governments, other welfare organisations and the food industry;
- visits to markets and slaughterhouses recommending and advising on improvements where necessary;
- funding for essential research and other projects through grants and awards;
- development and application of scientific advances into the working practices of the meat industry.

An independent charity, the HSA relies on donations, membership subscriptions and legacies to continue its vitally important work.

Dr Mario Ostović of the Faculty of Veterinary Medicine, University of Zagreb

Assisting in the organisation of the Symposium is Dr Mario Ostović of the Faculty of Veterinary Medicine, University of Zagreb. The Faculty of Veterinary Medicine was established in 1919 and is part of the oldest and biggest university in South-Eastern Europe, the University of Zagreb which was founded in 1669.

Information about the Symposium venue:

The Symposium is being held in the Hotel Dubrovnik on Ban Jelačić Square in the centre of Zagreb. Talks will take place in the Ban Jelačić conference room.

Delegates are kindly requested to take their seats in plenty of time before the start of each session. These will start promptly at the time indicated and each speaker has been allocated five minutes for questions from delegates. The first session, on the 16th July, will begin at 08.55am.

Delegates with any questions or queries should address these to the staff at the Symposium registration desk in the conference foyer. Storage for luggage and cloakroom facilities are available on request.

Catering

Tea, coffee and other refreshments will be served in the conference foyer and in the Ban Zrinski room, where the posters are displayed. Lunch will be served in the Centrum room.

Safety

In the event of a fire or other emergency, please leave via the nearest emergency exit. Delegates should then go to the collection point, which you will be directed to when exiting the building. A check that everyone attending the Symposium is present will then be made.

Access to the wireless network

Search available networks and select either:

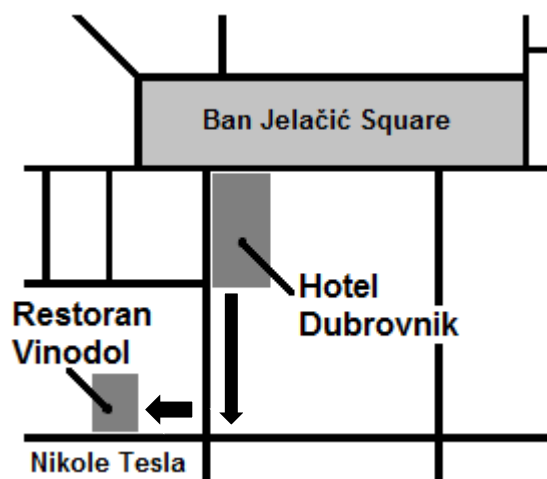
Wifi Hd Guest Password: **dubrovnik1929**

or **Wifi HD Kongres** Password: **HDUzg1929**

Drinks reception:

A drinks reception is being held from 7.30pm on the evening of the 16th July in central Zagreb at Restoran Vinodol. The restaurant is a short walk from the Hotel Dubrovnik at 10 Nikole Tesla. Drinks and canapés will be available at the event. Afterwards delegates are free to explore Zagreb.

There will be people around to act as guides to the venue if need be.



Information on Presentations:

Speakers

We request that all speakers ensure that they have loaded a copy of their presentation, which should be carried on a memory stick and formatted for use on Microsoft PowerPoint for PC, well in advance of the session in which they are to talk. As a guide, we would expect anyone talking in a session scheduled before lunch to have loaded their talk and checked it either the day before or as early as possible on the day of their talk.

Speakers should come to the front of the Ban Jelačić conference room where they can load copies of their talk and check that they are complete. Speakers should also inform staff at the Symposium registration desk once they have loaded their talk.

Access to the Ban Jelačić conference room is from 8.00am on the 16th July.

Posters

Posters will be displayed in the Ban Zrinski room, accessed from the conference foyer. We request that all posters should be in place before the start of the first session at 08.55am on the 16th July. They should be taken down no later than the end of the afternoon refreshment break on the 17th July.

Poster sessions

There will be two poster sessions, when authors will be available to answer questions about their posters. These will take place during the lunch breaks, and will start at 13.10 on both days of the Symposium. Delegates contributing posters are asked to be available by their poster during their allocated session, which can be found in the poster sessions programme.

Badges

Delegates with a special role to play in the Symposium have been allocated a coloured badge, as follows:

Blue:	Organisers and Assistants
Yellow:	Speakers and Session Chairs
Pink:	Poster presenters

Acknowledgements:

We wish to thank **Jarvis Products** for their generous support towards the costs of holding this Symposium.

Timetable: Day one: 16th July 2015

08:00-08:55 Registration and poster set-up

08:55	Dr Robert Hubrecht Humane Slaughter Association, UK	Welcome and Introduction
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09:05-10:45 Session 1 Chair: Peter Jinman, FAWC, UK

09:05	HRH Princess Alia Al Hussein Princess Alia Foundation, Jordan	Islam and animal welfare – a pathway to more humane slaughter practices
09:45	Malcolm Mitchell SRUC, UK	The effects of journey time upon the welfare of pigs in transit: A study under commercial transport conditions
10:05	Karen von Holleben bsi Schwarzenbek, Germany	Evaluation of cattle head fixation for captive bolt stunning under practical conditions – How tight and how fast?
10:25	Suzanne Millman Iowa State University, USA	Assessment of aversion to CO ₂ by weaned pigs and neonatal goats

10:45-11:10 Break

11:10-12:40 Session 2 Chair: Dr Antonio Verlarde, IRTA, Spain

11:10	Dr Denis Simonin Animal Welfare Unit, European Commission	The European Commission's work to improve food animal welfare at slaughter
11:40	Steve Wotton University of Bristol, UK	EC Regulation 1099/2009: Stunning current on cardiac arrest in Halal sheep
12:00	Pia Brandt Danish Meat Research Institute, Denmark	Documentation of welfare of finishing pigs on the day of slaughter
12:20	Rebeca Garcia DEFRA, United Kingdom	Evidence-based policy on welfare at slaughter – Latest regulatory changes, gaps and advances

12:40-14:00 Lunch, including poster session from 13:10

14:00-15:30 Session 3 Chair: Prof Yvonne Vizzier Thaxton, University of Arkansas, USA

14:00	Dr Mara Miele Cardiff University, UK	Making slaughter of livestock acceptable to the consumer: How science, technology and religion affect the public debate about slaughtering practices
14:30	Georgina Limon Royal Veterinary College, UK	Pathophysiology of captive-bolt stunning in alpacas (<i>Vicugna pacos</i>)
14:50	Charlotte Berg Swedish University of Agricultural Sciences, Sweden	Animal welfare at slaughter – A social learning process
15:10	Simon Parotat bsi Schwarzenbek, Germany	Pig slaughter: Detecting signs of life prior to scalding by means of optical flow

15:30-16:10 Break

16:10-17:30 Session 4 Chair: Dr Mario Ostović, University of Zagreb, Croatia

16:10	Antoni Dalmau IRTA, Spain	Use of carbon dioxide to stun rabbits
16:30	Vasco Antunes European Commission Food and Veterinary Office, Ireland	Outcome of audits of EU Member States on animal welfare controls at slaughter
16:50	Phil Hadley EBLEX AHDB, UK	A comparison of handling methods relevant to the religious slaughter of sheep
17:10	Miroslav Radeski Ss. Cyril and Methodius University of Skopje, Macedonia	Absence of stress in sheep while witnessing the slaughtering process

19:00-21:00 Drinks Reception at Restoran Vinodol

Timetable: Day two: 17th July 2015

09:00-10:20 Session 5 Chair: Prof Charlotte Berg, Swedish University of Agricultural Sciences, Sweden		
09:00	Antonio Velarde IRTA, Spain	Electrical stunning effectiveness with current levels lower than 1A in lambs and kid goats
09:20	Claudia Meier bsi Schwarzenbek, Germany	Evaluation of the Meyn multistage CO2 stunning system for chicken with regard to animal welfare under practical conditions
09:40	Hans van de Vis IMARES, The Netherlands	An approach to implement stunning and killing of fish
10:00	Käthe Kittelsen Norwegian Meat and Poultry Research Centre, Norway	Wing fractures in broilers, observed at two Norwegian abattoirs

10:20-11:00 Break

11:00-12:30 Session 6 Chair: Dr Martin von Wenzlawowicz, bsi Schwarzenbek, Germany		
11:00	Tozie Zokufa Program Manager for Africa, Humane Society International and Chairman, PAAWA, South Africa	Humane slaughter: Is Africa there yet? Challenges and opportunities
11:30	Mhairi Sutherland Ruakara Research Centre, New Zealand	Evaluation of a non-penetrating captive bolt to euthanase neonatal goat kids
11:50	Anthony Akunzule Veterinary Services Directorate, Ghana	Review of the transportation system affecting animal welfare during transport of live animal to slaughterhouses in Ghana
12:10	Sophie Atkinson Swedish University of Agricultural Sciences, Sweden	A study of aversion and stun quality in pigs stunned in a gas mixture of 80% N2 and 20% CO2 compared to 90% CO2 during commercial slaughter

12:30-12:40 Presentation of the HSA Award 2015

12:30-14:00 Lunch, including poster session from 13:10

14:00-15:30 Session 7 Chair: Dr Hans van de Vis, IMARES, The Netherlands		
14:00	Prof Yvonne Vizier Thaxton University of Arkansas, USA	From idea to reality: The development of the Low Atmosphere Stunning System
14:30	Eloy Gonzales-Gustavson IVITA, Peru	An evaluation of the humanness of stunning and slaughter methods used in Guinea pigs (<i>Cavia porcellus</i>) for the Andean region
14:50	Alison Small CSIRO, Australia	DTS: Diathermic syncope for cattle stunning
15:10	Georgina Limon Royal Veterinary College, UK	Effect of neck cut position on time to collapse in Halal slaughtered cattle

15:30-16:10 Break

16:10-17:10 Session 8 Chair: Prof Malcolm Mitchell, SRUC, UK		
16:10	Jessica Martin SRUC, UK	Evaluation of electroencephalogram responses of chickens killed using three mechanical devices
16:30	Martin von Wenzlawowicz bsi Schwarzenbek, Germany	Risk factors for the use of a rifle for stunning/killing of cattle
16:50	Merel Verhoeven Wageningen University, The Netherlands	Validation of indicators used to assess unconsciousness in cattle at slaughter

17:10 End

Poster Session: Day one: 16th July 2015

13:10-13:50 Poster Session

Marc Cooper (RSPCA, UK) *Automated assessment of key welfare parameters at the time of killing to better understand on-farm conditions for broilers* (Page 45)

Maurizio Ferri (Italian Veterinary Service, Italy) *Monitoring of animal welfare at slaughter – study results of indicators' use at a bovine slaughterhouse* (Page 49)

Katrine Fogsgaard (University of Aarhus, Denmark) *Are sows sent for slaughter fit for transport?* (Page 68)

Marlene Kirchner (University of Copenhagen, Denmark) *How to assess fitness for transport of Danish broiler chickens* (Page 52)

John Lever (University of Huddersfield, UK) *Farm animal welfare and corporate social responsibility: Making slaughter visible?* (Page 55)

Nikki Mackie (University of Bristol, UK) *Behavioural responses of broiler chickens during Low Atmospheric Pressure Stunning* (Page 56)

Suzanne Millman (Iowa State University, USA) *An animal welfare assessment of swine marketed through buying stations in the United States* (Page 67)

Suzanne Millman (Iowa State University, USA) *Assessment of aversion to different concentrations of CO₂ gas by weaned pigs using an approach-avoidance paradigm* (Page 51)

Suzanne Millman (Iowa State University, USA) *Tolerance of carbon dioxide gas by neonatal goats* (Page 72)

Carla Molento (Federal University of Parana, Brazil) *Perceptions of fish welfare issues by Latin American citizens* (Page 65)

Simone Pauling (Marel Stork Poultry Processing, The Netherlands) *20 years of experience in carbon dioxide stunning of poultry: Proven scientific knowledge and additional insights* (Page 59)

Avraham Pinkas (Hai-Meshek – Israeli Society for the Prevention of Cruelty to Farm Animals, Israel) *Killing spent laying hens on farm, in 1 second* (Page 59)

Kristin Pufpaff (Islamic Food and Nutrition Council of America, USA) *Target areas for animal welfare improvement within a religious context* (Page 62)

Jessica Walsh (University of Guelph, Canada) *Evaluation of producer attitudes regarding on-farm euthanasia methods for commercial meat rabbits* (Page 69)

Hannah Westen (World Horse Welfare, UK) *Transport of equine animals for slaughter: New guidelines on watering and fitness for transport* (Page 71)

Poster Session: Day two: 17th July 2015

13:10-13:50 Poster Session

Hamid Ahmad (Formerly Pakistan Society of Food Scientists and Technologists, Pakistan) *Religious Halal slaughter of animals for food, Animal welfare, Meat science – Knowledge gaps* (Page 43)

Johannes Bergsma (Meyn Food Processing Technology, The Netherlands) *Improving animal welfare: Automated monitoring of foot pad lesions* (Page 44)

John Cranley (AWSELVA, UK) *Risks of sensibility type behaviour during slaughter with and without stunning in Britain* (Page 47)

Kirstin Dahl-Pedersen (Aarhus University, Denmark) *Study design and selection of relevant measures for assessment of fitness for transport of dairy cows* (Page 48)

Leonie Jacobs (ILVO, Belgium) *Effect of transport duration and broiler breeding age on day-old chick welfare and performance* (Page 50)

Helle Daugaard Larsen (DMRI, Denmark) *Video surveillance of CO₂-stunning of finishing pigs in groups* (Page 53)

Renata Leuschner (EFSA, Italy) *The EFSA approach to assessing proposals for new stunning methods* (Page 54)

Gustavo María (University of Zaragoza, Spain) *Effect of long term transportation on sheep productive traits, behaviour and welfare* (Page 58)

Gustavo María (University of Zaragoza, Spain) *Social perception of animal welfare in Argentina* (Page 46)

Luc Mirabito (Institut de l'Elevage, France) *Promoting and implementing high standards of animal welfare: An example in French cattle slaughterhouses* (Page 57)

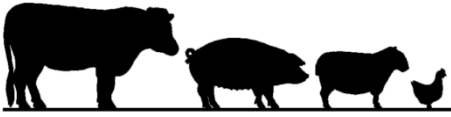
Johanna Probst (Research Institute of Organic Agriculture, Switzerland) *Relationship between stress-related physiological exsanguination blood variables, vocalisation, and stressors at a conventional abattoir* (Page 61)

Jon Ratcliffe (Moulton College, UK) *Causes of livestock vehicle accidents in the UK and the consequences for the animals involved* (Page 63)

Fiona Roberts (Integra Food Secure, UK) *Observations on the understanding and implementation of EC Regulation 1099/2009: Analysis from farm, factory and hatchery audit of the global poultry supply chain for a major UK retailer* (Page 64)

Janet Talling (Animal and Plant Health Agency, UK) *Extended journey lengths (11 days) in high specification lorries does not further compromise pig welfare* (Page 66)

Wouter Veerkamp (Meyn Food Processing Technology, The Netherlands) *Improving animal welfare: CAS stunning before tilting* (Page 70)



Humane Slaughter Association

Scientific Programme: Keynote Speakers

HRH Princess Alia al Hussein

Princess Alia Foundation, Jordan

ISLAM AND ANIMAL WELFARE – A PATHWAY TO MORE HUMANE SLAUGHTER PRACTICES

We are honoured that HRH Princess Alia Al Hussein will speak at the symposium, presenting the work of the Princess Alia Foundation to improve animal welfare at slaughter in Jordan, including promotion of pre-slaughter stunning. HRH will be available to take questions during the lunchtime poster session and evening reception on the 16th July, in addition to taking questions after her presentation.



Denis Simonin

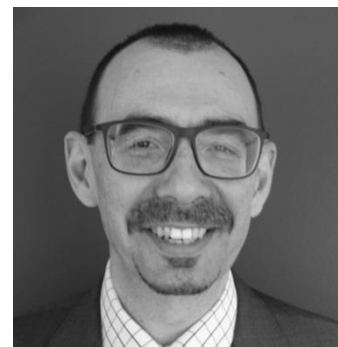
Animal Welfare Unit, European Commission

THE EUROPEAN COMMISSION'S WORK TO IMPROVE FOOD ANIMAL WELFARE AT SLAUGHTER

Since 1999, Dr 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 Consumers. His main responsibilities are the implementation of the EU animal welfare strategy 2012-2015 as well as the EU legislation on the protection of animals at the time of killing (Regulation 1099/2009). He worked for the adoption of both texts as well as, in 2005, the EU legislation on the protection of animals during transport (Regulation 1/2005).

Prior to his current position, since 1985, he worked for the state veterinary services in the French Ministry of Agriculture, occupying different positions related to food safety and international veterinary issues at the central administration. He was also Director of the veterinary services in Rungis, near Paris, where the biggest wholesale market for food in France is located. He also worked on food safety in Québec, Canada, and in South Africa.

Born in 1959, he grew up near Paris, France, graduated as a veterinary surgeon at the National Veterinary School of Nantes (1983) and obtained an MBA from Laval University in Québec City (Canada). He now lives in Brussels, Belgium.



Dr. Mara Miele

Cardiff University, UK

MAKING SLAUGHTER OF LIVESTOCK ACCEPTABLE TO THE CONSUMER: HOW SCIENCE, TECHNOLOGY AND RELIGION AFFECT THE PUBLIC DEBATE ABOUT SLAUGHTERING PRACTICES

Dr Miele's research addresses the geographies of ethical foods consumption and the role of animal welfare science and technology in challenging the role of farmed animals in current agricultural practices and policies. In recent years she has worked with a large interdisciplinary network of social and animal welfare scientists for developing innovative forms of critical public engagement with science that produced the EU animal welfare standard (Welfare Quality). She was also the coordinator of the EU funded project Dialrel (2006/10) that proposed recommendations for addressing the welfare of animals at time of killing, with particular attention to practices of religious slaughter.

In 2012, Dr Miele received the Ashby prize for the paper Miele, M. (2011) 'The taste of happiness: free range chicken', *Environment and Planning A*. Other recent publications include 'Between food and flesh: how animals are made to matter (and not to matter) within food consumption practices' *Society and Space*, 2012, with Adrian Evans, and 'Civilizing the Market for Welfare Friendly Products? The Techno-Ethic of the Welfare Quality© Assessment', *Geoforum*, with John Lever.



Tozie Zokufa

Humane Society International and PAAWA, South Africa

HUMANE SLAUGHTER: IS AFRICA THERE YET? CHALLENGES AND OPPORTUNITIES

Tozie Zokufa is currently the chairman of the Pan African Animal Welfare Alliance, he is the project manager in Africa for the Humane Society International and he serves on the boards of Cape Town-based Soil for Life and the Kenya-based Africa Network for Animal Welfare. He was previously the country representative for Compassion in World Farming in South Africa, the manager for the Humane Education Trust and deputy editor for the *Animal Voice*.

Mr Zokufa worked for over a decade in both the private and public sector as a Meat Hygienist and veterinary public health practitioner. In 2010 he spear-headed the 'One meat-free day a week' campaign, which was endorsed by the city of Cape Town. He has presented papers at the University of Fort Hare, University of Cape Town and Rhodes University, and at conferences in Kenya, Morocco and Brussels. He is author of a chapter in 'Sustainable Food Security in the era of Local and Global Environmental Change' published by Springer, 2013.



Prof. Yvonne Vizzier Thaxton

University of Arkansas, USA

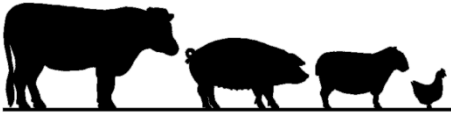
FROM IDEA TO REALITY: THE DEVELOPMENT OF THE LOW ATMOSPHERE STUNNING SYSTEM

Dr Yvonne Vizzier Thaxton is Professor and Director of the Center for Food Animal Wellbeing at the University of Arkansas. The goal of the Center for Food Animal Wellbeing is to improve animal health, animal handling, food safety and productivity. The work to develop and define objective measurements of wellbeing is essential to the Center's goal and includes measures of behaviour, stress physiology, neurophysiology, immunology, and microbiology and production efficiency. In addition, the Center disseminates animal wellbeing practices and legal policy to public and stakeholder clientele. The Center is associated with the National Agricultural Law Center and the Departments of Poultry and Animals Sciences and provides information and research outcomes on animal wellbeing at national and international levels.

Dr Thaxton has spent more than 30 years working in the poultry industry, including as Vice President of Science and Technology at Marshall Durbin Companies and as Professor of Poultry Science at Mississippi State University. She gained her PhD from Auburn University, 1990, and, in 2011, completed a lawyer course in Animals in Agricultural Production at University of Oklahoma Law School.

Dr Thaxton sits on a number of advisory committees including the American Humane Association Scientific Advisory Committee; YUM! Foods Inc. Animal Welfare Advisory Council; Butterball LLC Animal Care and Well-Being Advisory Council; McDonald's Animal Health and Welfare Committee; Safeway Inc. Animal Wellbeing Council, and the American Association of Avian Pathologists Animal Welfare Committee.





Humane Slaughter Association

Scientific Programme: Speaker Abstracts

ISLAM AND ANIMAL WELFARE – A PATHWAY TO MORE HUMANE SLAUGHTER PRACTICES

HRH Princess Alia al Hussein

Princess Alia Foundation, Jordan

The Princess Alia Foundation (PAF) was founded by H.R.H. Princess Alia Al Hussein in 2008 and is a registered NGO in the Hashemite Kingdom of Jordan. Its aim is to promote compassion and respect for all Creation.

The treatment of animals in Jordan's slaughter houses was identified as a key area of concern. As part of seeking a pathway to reform it was necessary to identify the factors that underpinned current inhumane practices in Jordan's slaughterhouses – practices that clearly contradicted, rather than conformed with Islamic teachings.

In association, an in depth study was undertaken by H.R.H. of the directives in the Quran and Ahadith relating to the handling and slaughter of animals. These directives emphatically confirmed the full import given in Islam to reducing the suffering of animals during slaughter and in no way precluded the rendering unconscious of an animal through appropriate means, if this ensured a more humane death.

Whilst the reform process continues to be one of constant learnings and challenges, Jordan's two largest abattoirs now practice pre-slaughter stunning. The support of religious authorities and the growing volume of scientific research in this area has been critical, as has increased acceptance amongst managers, veterinarians and workers that current practices, in fact, fail to confirm to halal requirements.

During H.R.H.'s presentation she will speak to the challenges faced and the issues that underpin current practices of concern. In association she will present the facts, information and arguments that if fully understood and appropriately advocated, can drive acceptance of change.

THE EFFECTS OF JOURNEY TIME UPON THE WELFARE OF PIGS IN TRANSIT: A STUDY UNDER COMMERCIAL TRANSPORT CONDITIONS

MA Mitchell¹, PJ Kettlewell¹, M Farish¹, J. Talling² and M Villarroell³

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There is much debate concerning the maximum permitted journey times for livestock, however, there is little commercially based research that can be directly applied to the determination of acceptable limits for journey times. The current study examined commercial pig transportation to a single UK slaughterhouse on journeys of durations ranging from less than two hours to over 10 hours. The effects of the journeys upon the pigs in terms welfare status and production were assessed by measurements of behaviour and post-mortem carcass indices. 84 journeys were examined across the range of journey times during different seasons of the year and on a variety of vehicles. Post-transport measures including mortality, injury, lesions, casualty slaughter rates, lameness, behaviours in lairage (during a one hour, post-journey observation period) and meat quality parameters including pH_i, pH_u and colour were employed to assess the possible welfare status of the pigs upon arrival and to estimate the degree of pre-slaughter stress imposed. Data were analysed and the effects of all factors in the models were determined by GLMM (logit link function), Logistic regression models and REML. The objectives were to determine if journey time had any direct effects upon stress and animal welfare and to identify if any specific upper limit of journey time for safe transportation could be identified. There were no statistically significant indications that journey time had a detrimental effect of the pigs transported under commercial conditions in the range of travel times sampled this study. It was demonstrated, however, that factors other than travel time per se may have important impacts in determining the responses of pigs to transport stress and therefore the welfare of pigs in transit. These factors include the thermal conditions on the vehicle, the nature of the system in which the pigs were produced prior to transport and interruptions to the journey i.e. stationary periods the most important of which may be the “standing time” at the abattoir. Whilst the effects of all these factors may be exacerbated by excessive journey times the journey time per se in the range of durations examined in this study may not be the most important issue when attempting to optimise welfare in transit.

EVALUATION OF CATTLE HEAD FIXATION FOR CAPTIVE BOLT STUNNING UNDER PRACTICAL CONDITIONS – HOW TIGHT AND HOW FAST?

K von Holleben¹, S Parotat¹, A Hiller² and M Moje³

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²VION GmbH, Hilsen, GER

³MRI, Federal Research Institute of Nutrition and Food, Department for Safety and Quality of Meat, Kulmbach, GER

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New cattle fixation systems enable exact shooting at high slaughter speeds (>60/h). Nevertheless tight fixation not only increases stunning effectiveness but can be stressful for cattle. This study evaluates the new pneumatic MPS cattle stunbox type 2-800 with regard to animal welfare and line speed.

The study was performed during routine slaughter in a German plant (preset line speed 72/h), monitoring fixation and stunning of 194 cattle (68 young bulls =m, 126 cows/heifers =f), black holstein and mixed breeds (horned and polled) using a pneumatic captive bolt (Jarvis SSS). After closing the hind-gate of the box the initial ample length is reduced by moving the unclosed head fixation from the front towards the animals. Fixation consists of a concave head-support-table, complemented by a neck-yoke and linked back-grit, which are first positioned and then closed tightly before the animal is shot and ejected.

To evaluate driving-in we recorded frequency of using electric goads, of dropping the hind-gate on the animals back and how often the next animal entered its head before hind-gate-closure (twin-entering). As welfare indicators at fixation we took time in the box, time from start of fixation-movement to shooting, time in close fixation, frequency of struggling, position of the fixed head, shooting position, stun-stick time, stunning effectiveness and how often cattle were captured twice.

Results for driving-in showed 14% electric-goad-use (m:15%, f:13%). The hind-gate was dropped on the back for 3% (m:4%, f:2%) and frequency of twin-entering was 14% (m:9%, f:17%). Except for twin-entering, which had to be reduced by further measures, these results were judged acceptable.

Average time in the box was 20s, with 12s between start of fixation-movement and stun (m:13s, f:10s). With skilled use the critical time of tight fixation was av. 4.4s (m:4.8s, f:3.9s; max.:6.0s). Meanwhile 16%/6% of bulls/females showed struggling. Although for some cattle, especially females, the forehead was not completely level, shooting position was exact and stunning-effectiveness was 100% with one bull receiving a second, so called security-back-up shot after showing doubtful signs on the landing rust. All animals were bled within 60s. Capturing twice only happened if bulls were too excited to be shot at first try (n=2).

It was concluded that under the conditions investigated head fixation for stunning using the MPS stunbox type 2-800 was according to animal welfare and possible for different types of cattle, including nervous animals, at a preset line speed of 72/h.

ASSESSMENT OF AVERSION TO CARBON DIOXIDE BY WEANED PIGS AND NEONATAL GOATS

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Our research team is exploring animal welfare implications of inhalant euthanasia methods for neonatal ruminants and swine. Gradual fill and two-step protocols are recommended for carbon dioxide (CO₂) for humane induction of unconsciousness prior to death, but few details are provided for implementation. Furthermore, these recommendations are primarily based on forced exposure experiments that present challenges for interpreting outcomes associated with both distress and the dying process. We applied avoidance approach and conditioned place preference tests to “ask” neonatal goats and newly weaned swine about the aversiveness of different concentrations of CO₂. A preference-testing device was custom designed with two connected chambers maintained at static gas concentrations. The control chamber maintained ambient air conditions (1% CO₂); the treatment chamber maintained predetermined CO₂ concentrations. Animals were individually trained to enter the treatment chamber to access a food reward after a period of feed deprivation, followed by the same procedures using different concentrations of CO₂ (10%, 20% and 30%) in the treatment chamber. Tests concluded when loss of posture occurred or after a set test duration (goats: 10 min; pigs: 6 min). Animals experienced each of the CO₂ treatments followed by 2 wash-out days with ambient air conditions. Behavioral outcomes were collected using live observations and video recordings. All goats (n=12) entered the treatment chamber during all CO₂ treatments. During 20% and 30% CO₂ tests, all goats consumed milk prior to and during ataxia. Loss of posture occurred within 83s to 271s of exposure. None of the goats displayed conditioned place avoidance on wash out days. Conversely, only 10 of 12 pigs entered the treatment chamber during CO₂ treatments. Half of the animals exposed to CO₂ exited the treatment chamber prior to loss of posture. However, pigs frequently moved between compartments on both training and test days, posing challenges for interpretation. For pigs that remained in the chamber during 20% and 30% CO₂ tests, violent neuromuscular excitation was observed and resulted in tests terminated for ethical reasons. Surprisingly, no pigs displayed conditioned place avoidance of the treatment chamber on any of the wash out days. Our results suggest loss of consciousness using 30% CO₂ is not aversive to neonatal goats. This experimental paradigm produced inconclusive results for newly weaned pigs, perhaps due to individual differences in sensory perception and foraging motivation.

THE EUROPEAN COMMISSION'S WORK TO IMPROVE FOOD ANIMAL WELFARE AT SLAUGHTER

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In 2009, the European Union adopted a new legislation *on the protection of animals at the time of killing* which applies from January 2013. These new rules increase the responsibility of slaughterhouse operators on animal welfare: they have to appoint an animal welfare officer, they shall establish standard operating procedures and they shall entrust the handling of animals only to staff properly trained. The legislation also requires each national competent authorities to establish a network to provide scientific and technical expertise on animal welfare at slaughter. In 2012, the Commission organised an international conference to raise awareness on the new legislation and published a multi-language booklet on the role of the animal welfare officer in slaughterhouses. In 2014, the Commission made available the first e-learning tool for officials on animal welfare at slaughter, in addition to the traditional training programmes "*Better Training for Safer Food*". In parallel, in 2013 and 2014, Commission's experts from the *Food and Veterinary Office* of the *Directorate General for Health and Food Safety* performed a series of audits in the Member States to check how authorities were implementing the new legislation. The *European Food Safety Authority*, under the request of the Commission, adopted a series of scientific opinions on monitoring procedures at stunning which propose toolboxes of welfare indicators. Finally, the Commission adopted a report on poultry stunning and mandated two studies (one on information to consumers on the stunning of animals and another one on restraining bovine animals by inversion).

EC REGULATION 1099/2009: STUNNING CURRENT ON CARDIAC ARREST IN HALAL SHEEP

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There are two types of slaughter of animals for food production, slaughter with stunning and slaughter without stunning. The derogation from stunning within current legislation, (1099/2009) permits religious groups to perform slaughter without stunning where their beliefs dictate. However, the requirements for Halal slaughter can be interpreted to permit the use of a stunning method provided that method doesn't result in the death of the animal. Head-only electrical stunning is therefore accepted by some Muslim groups but any change in the applied electrical parameters (1099/2009) must be verified in terms of there being no change in the animal's ability to recover after the stun. This study examined the effect of two different electrical stunners (constant voltage vs. constant current) applied head-only to sheep on heart function measured by electro-cardiogram. The measurements were made at the same abattoir but on separate occasions.

DOCUMENTATION OF WELFARE OF FINISHING PIGS ON THE DAY OF SLAUGHTER

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Documentation of animal welfare from farm to slaughter ensures the possibility of keeping a high level of animal welfare during feedback to producers, transporters and slaughterhouses. Documentation of a certain level of welfare can be used actively in marketing welfare-friendly meat. As handling of finishing pigs on the day of slaughter influences the meat quality, optimization of animal welfare may additionally be used to ensure a high meat quality and a minimum of value decreasing injuries of the carcass. In this way, documentation of animal welfare during loading, transport, unloading, lairage and killing can provide several advantages for the slaughterhouse.

The systems, which exist today for documentation of animal welfare, are mainly based on auditing. However, a system based on continuous measurements would be advantageous, since it allows producers, transporters and slaughterhouses to respond quickly if changes are observed. Such measurements should be valid, reliable, operational and not least, they should be fast and cheap.

Today there is a general knowledge about the correlation between various post mortem measurements and specific events or handling procedures before slaughter. Potentially, these correlations may form the basis of the use of post mortem measurements expressing ante mortem animal welfare. However, a system combining several measurements to express animal welfare has not yet been described. The present project aims to address this by examination of animal welfare at different points during the day of slaughter and the evaluation of different possibilities to quantify this, such as lactate and skin damage.

Based on the Welfare Quality® Protocol, a welfare assessment was conducted including 480 pigs from 12 commercial pig productions transported by 12 trucks and slaughtered at two Danish commercial slaughterhouses. Behavioural studies (slipping, falling, reluctance to move, turning back, postures and aggression), clinical observations (skin lesions) and physiological measurements (heart rate, exsanguination blood lactate, creatine kinase, temperature) were included.

We combined the biological animal-based measurements with expert opinions in order to aggregate the measurements in a welfare index. Secondly, the welfare index was correlated to post mortem measurements such as the blood temperature and plasma concentration of lactate to pinpoint welfare measurements. The perspective is that these findings by use of technological progress can be implemented at slaughterhouses and used in daily operations to document the level of welfare.

EVIDENCE BASED POLICY ON WELFARE AT SLAUGHTER – LATEST REGULATORY CHANGES, GAPS AND ADVANCES

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Regulation 1099/2009 has been in force in Member States since the 1st of January 2013. This presentation covers a number of advances, which have taken place two years on from the implementation date both at European and Member State level. These include Member States updated domestic legislation, EFSA opinions on electrical waterbath stunners, monitoring indicators and eligibility criteria for research projects on new stunning methods, work in progress related to restraining pens in slaughter without stunning and a forthcoming EU proposal on the welfare of fish at the time of killing.

At Member State level a lot of work has taken place to ensure implementation of the Regulation and that national legislation is updated to ensure it conforms to the new Regulation. The move from the old to new legislation has been subject to several challenges such as:

- Implement new legal definitions of slaughter and stunning (i.e. previously EU Directive 93/117 referred to the term slaughter as causing the death by bleeding whilst under the new Regulation this definition only applies to animals destined for human consumption).
- Review national legislation in order to decide whether to carry forward national rules or not. Review of the wording in the context of 1099/2009 was also required, particularly in relation to the new gas mixtures.
- Update of the slaughterman training system to conform with new Certificates of Competence requirements.
- Train official staff on the new legal requirements and draw up new operational instructions.
- Alert stakeholders and industry to legislative changes and provide support with the development of industry Guides of Good Practice.
- Set up a process to report depopulation welfare information to the COM.
- Identify and progress areas where further research and policy action is necessary (i.e. alternatives to waterbath stunning, alternatives to neck dislocation, blow to the head for piglets/goats, post-mortem welfare indicators, high concentration CO₂ stunning of pigs, stunning of novel species).

**MAKING SLAUGHTER OF LIVESTOCK ACCEPTABLE TO THE CONSUMER:
HOW SCIENCE, TECHNOLOGY AND RELIGION AFFECT THE PUBLIC DEBATE
ABOUT SLAUGHTERING PRACTICES**

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Practices of religious slaughter in Europe have given rise to significant number of public controversies for the risks that these practices pose to animal suffering. Even though the European regulation gives priority to the right of the Jewish and Muslim minorities to practice their own religion and allows the killing of animals without stunning for religious purposes, in the last couple of years a number of countries including Norway, Iceland, Switzerland, Sweden and Poland have banned religious slaughter without stunning for animal welfare reasons. These controversies have been amplified by the expansion of the halal meat market characterized by an unevenness of practices of halal slaughter that might or might not accept the stunning of animals before the cut of the throat and have been strongly affected by the lack of transparency of the meat supply chains in Europe where part of the carcasses of animals slaughtered without stunning are channelled in the 'conventional' market without labelling. While animal welfare considerations seem to be at the heart of both 'religious' and 'scientific' authorities, practices of stunning are considered unacceptable or contested by a significant number of religious authorities.

In this presentation I will address the issues considered important by consumers of halal and kosher animal products for the qualification of meat and animal products as 'halal' or 'kosher'. Furthermore I will examine how the acceptability/non acceptability of certain practices of stunning and how they affect animal suffering is constructed or justified in the context of religious qualification.

PATHOPHYSIOLOGY OF PENETRATING CAPTIVE BOLT STUNNING IN ALPACAS (*VICUGNA PACOS*)

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Alpacas and llamas are increasing in popularity as farmed and exotic pet species in many countries. In these countries camelids are kept predominantly for fibre production and as pets on smallholdings and hobby farms, with small numbers being slaughtered for human consumption. Camelids are an important livestock species in South America where llamas and alpacas are bred for fibre, meat, leather and used as pack animals. Slaughter and dispatch of domestic camelids in the United Kingdom (UK) is normally performed with penetrative captive bolt or free bullet. Meanwhile, in most parts of South America it is performed by puntilla, which involves the insertion of a knife into the back of the neck in an attempt to sever the spinal cord. Currently, there are limited standards or guidelines for the humane dispatch of llamas and alpacas in the UK or overseas. The recommendations that do exist are principally based on anecdotal observations supported by unpublished information or extrapolated from previous research in other livestock species. The aim of this study was to examine the behavioural and cranial/spinal responses of alpacas culled by captive bolt shooting and the resulting pathophysiology of captive bolt injury.

Ninety-six alpacas were shot (103 shots) in a range of locations with a penetrating captive bolt gun (CBG) with 2.5 gr cartridges. Ten (9.8%) alpacas were incompletely concussed following the first shot. No animals required more than two shots. Incorrectly placed shots accounted for all of the animals that displayed signs of sensibility. Damage to the thalamus (OR 0.04; $P < 0.001$), hypothalamus (OR 0.05; $P < 0.001$), midbrain (OR 0.02; $P < 0.001$), medulla (OR 0.06; $P = 0.007$), cerebellum (OR 0.13; $P = 0.006$), parietal (OR 0.13; $P = 0.006$) and occipital lobes (OR 0.05; $P = 0.006$) were significantly associated with decreasing odds of incomplete concussion.

In conclusion, the study found that CBG stunning can be reliably used to induce insensibility in alpacas and that the top of the head or crown position maximises damage to the thalamus and brainstem. Damage to these structures was associated with the induction of insensibility. These results could be used for updating guidelines and practices for the stunning and dispatch of alpacas and other camelids.

ANIMAL WELFARE AT SLAUGHTER - A SOCIAL LEARNING PROCESS

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Animal welfare is of high interest to citizens and consumers. Furthermore, animal welfare at slaughter is an area covered by extensive legislation at the EU level, mainly through EC Regulation 1099/2009 which requires training and certificate of competence for slaughterhouse staff. Dealing with complex issues with ethical concerns, such as animal welfare, requires a process of learning by every member of society. Such learning must also continue throughout life, as an ongoing adaptation to emerging challenges and new scientific findings. This can best be achieved when the learning is based on curiosity, collaboration, and grounded in real-life experience and situations. Such social interactions constitute the basis for social learning. Thus, animal welfare is in need of a social learning process.

The use of Open Educational Resources (OER) is a way to meet the challenge of this new learning approach. The term (OER), meaning digital material released with an intellectual property license that allows for free use, adaptation, and distribution, was adopted at a UNESCO meeting in 2002. OER can be used for both formal and informal learning.

The Swedish University of Agricultural Sciences (SLU) has, with financial support from the national authorities and in collaboration with slaughterhouses and NGO's, developed an OER on Animal Welfare at Slaughter and Killing. It includes 650 webpages, 800 illustrations, 150 video clips, learning objectives, interactivities and take-home messages. Publishing photos and video footage showing slaughter is not uncontroversial as such pictures can be perceived as aversive by some, and the umbrella organisations for slaughter houses feared that such pictures would be used by animal rights groups to discredit abattoirs. Hence, placing the material behind a password barrier was suggested. However, the aim is to provide free access to everybody to the knowledge we have today about animal welfare in relation to handling of animals at slaughter and killing and to support local efforts in improving animal welfare. The material is now available at disa.slu.se and can be accessed and used by anyone, including various course organizers. A translation into English is underway.

With reference to the wisdom of the crowd it can be argued that collectively developed resources are of higher quality than those the individual can develop on their own. OER practices, in its more radical form, can be seen as an integrated, open and formative peer review, conducted in real time in front of the eyes of anybody interested.

PIG SLAUGHTER: DETECTING SIGNS OF LIFE PRIOR TO SCALDING BY MEANS OF OPTICAL FLOW

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Most slaughter pigs are reversibly stunned with either carbon dioxide (CO₂) or electric current (EC). Death is induced by chest sticking and animals are conveyed towards further dressing and scalding. At this point, some pigs may still show signs of life. To date, no method to reliably prevent this scenario is routinely implemented.

We developed a system to ascertain death prior to further dressing and scalding: Pigs are sprayed with 60 °C hot water (HWS) several minutes post sticking. Water is applied for at least 5 s to the head and front legs of the pigs using a purpose built device. Short video sequences are recorded for each pig and analyzed in real time. Custom software based on optical flow, an image processing tool, is used for this purpose. Pigs with movements following HWS can thus be detected and killed before further processing.

The suitability of HWS to determine death was evaluated in 42.544 pigs from 8 German abattoirs with various types of either CO₂ (A-E) or EC (F-H) stunning systems operating at 65-560 pigs/h ($n_{CO_2} = 37.108$, $n_{EC} = 5.436$). Movements during HWS occurred in 0.59 % and huge differences were observed between abattoirs: 0.0 % (A, C, E), 0.25 % (B), 0.02 % (D), 2.8 % (F), 4.9 % (G) and 0.4 % (H). Frequencies of movement types for pigs stunned with CO₂ vs. EC were: 29 % vs. 57 % for front legs, 63 % vs. 38 % for righting reflex and 78 % vs. 53 % for mouth opening ($p < 0.001$). Subsequent manual examinations (corneal reflex, nasal septum pinch) were positive in 44 % of pigs with movements during HWS (CO₂: 71 %, EC: 37 %; $p < 0.001$). Pigs without movements during HWS had negative manual results in all but one of the cases (EC).

So far high intensity movements following HWS are reliably differentiated from passive wobbling/conveying movements of the suspended pigs. However, not all movement types can be automatically detected yet. The real-time analysis software is being further developed and final sensitivity and specificity will be available after the end of the project (03/2015).

Our findings show that signs of life prior to further processing do occur sporadically in pig abattoirs with both CO₂ and electrical stunning regimes. The rarity of cases suggests the use of an automated detection method. The system we developed is promising but not yet able to detect all affected pigs.

USE OF CARBON DIOXIDE TO STUN RABBITS

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An effective stun is not only considered when it induces a state of unconsciousness in the animal, but also when it lasts until death by exsanguination. Nowadays, a reversible electrical stunning is the main system used in the rabbits slaughterhouses to stun. The stunning procedure involves removing the rabbits from their cages, catch them and place them individually the two electrodes in the correct position on the head. The time in applying the electrodes, the intensity of the current and a quick exsanguination are key points to ensure a 100% of success, even in slaughterhouses killing more than 2000 animals per hour. As in other species, such as pigs and poultry, CO₂ stunning has the advantage of avoiding to catch the animals and allows to produce an irreversible stunning, so time for bleeding can be increased. On the other hand, it is unknown how fast the induction of unconsciousness is with different concentrations of CO₂ and the time animals will show the aversion signs observed in other species due to the acidic, spicy and irritating conditions of the gas. The aim of the study was to assess the aversion reaction and the onset and duration of unconsciousness during the exposure to 70%, 80%, 90% (90C) and 98% CO₂ in atmospheric air with a stun to stick interval of 70 s and 120 s. The study was carried out in the experimental slaughterhouse of IRTA, which is equipped with a gas stunning system lift Dip Special XL. A total of 458 rabbits were studied and in 210 of them, electrodes were allocated on the head to assess brain activity by means of EEG. Other measures assessed were activity in the crate, nasal discomfort, heart rate and vocalizations as signs of aversion, loss of posture, rhythmic breathing and corneal reflex as signs of unconsciousness and righting reflex, vocalizations and complete awareness as signs of recovery. The exposure to CO₂ produced in all cases aversion signs in comparison to the exposure to atmospheric air, with few differences between treatments. The loss of posture in rabbits was the most valid indicator of unconsciousness, being associated with an increase of 4Hz waves on the EEG of the rabbits. The loss of posture appeared at 22-25 s after the beginning of the exposure with 90C, and the first signs of aversion at 10 s (nasal discomfort). In the case of a stun-stick interval up to 70 s, 110 s of exposure to 90C ensured a 100% of animals without signs of recovery in any moment before death. In case of increasing the stun-stick interval to 120 s, a exposure to 90C of 150 s was needed. In comparison to other treatments, as lowest the concentration of CO₂, longest times of exposure were need and lowest times in seeing signs of recovery were seen. In fact, with the times assessed in 90C, most of the rabbits (more than 90%) were already death at the exit of the stunning system.

OUTCOME OF AUDITS OF EU MEMBER STATES ON ANIMAL WELFARE CONTROLS AT SLAUGHTER

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The Food and Veterinary Office of the European Commission's Directorate General for Health and food safety carried out audits to EU Member States on animal welfare during slaughterhouse operations to assess implementation of Regulation (EC) No 1099/2009.

Operators have made a great effort to implement the new requirements for standard operation procedures and animal welfare officers and these contributed positively to increase animal welfare at the time of slaughter. Training of slaughterhouse personnel was also in place, and best practice was seen where there was an assessment of the workers practical competence prior to certification.

Guides to good practice have been developed by the industry and approved by the authorities, mainly in the red meat sector, but the poultry sector is lagging behind. The absence of guidelines makes compliance difficult for small slaughterhouses. Scientific support is in place but not yet fully utilised in many of the countries audited.

Official veterinarians, in many countries, have not yet made the change from inspecting animal welfare directly to auditing operator's performance, and they still rely solely on their own inspections, which had generally not been effective in bringing about the necessary changes. These difficulties were overcome particularly where experts from a higher level of the competent authority carried out inspections additional to the official veterinarian's daily checks, and these additional checks were prioritised for slaughterhouses posing the greatest risk for animal welfare.

Generally, animal welfare was respected for mammals. The major problem found for animal welfare was that the electrical parameters used for waterbath stunning of poultry were not set at levels which ensured that birds were effectively stunned. The main reason for this put forward by the Industry was meat quality problems when higher currents were used; however there were a small number of Member States where they had successfully implemented the new parameters.

The Commission services will discuss further with the Member States the conclusions from this series of audits and consider how to spread the good practices which have been identified and to follow up with those Member States where action is still required.

A COMPARISON OF HANDLING METHODS RELEVANT TO THE RELIGIOUS SLAUGHTER OF SHEEP

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Legislation governing non-stun slaughter of sheep in England requires that they are individually and mechanically restrained for slaughter and not moved for at least 20s post neck cut, until unconsciousness or insensibility occurs. Complying with the need for individual handling, in what is a flock animal, has the potential to adversely affect welfare, in turn contravening the general legislative requirement to reduce any avoidable distress at slaughter. This study investigated the effects of individually loading and restraining lambs compared with the normal practice of group loading and restraint of lambs prior to slaughter when using a V-shaped restrainer. Rotating and static design loading pens were also compared to represent the range of conditions and facilities found across English abattoirs. Plasma cortisol and lactate concentrations were significantly lower in group-loaded animals and significant reductions were observed in the time duration of a range of components of handling as well as the average total time to load each lamb. Loading pen type had a less marked impact upon results, however, individual loading and restraint of lambs within a V-shaped restrainer appears particularly stressful for sheep in comparison with group loading. The loading pen type had a mixed effect although the rotating crowding pen is likely to have minimised physical exertion in lambs during loading and restraint. Based on these findings, group loading in a V-shaped restrainer, whilst complying with the 20s standstill, is likely to be preferable in religious, non-stun slaughter of sheep.

ABSENCE OF STRESS IN SHEEP WHILE WITNESSING SLAUGHTERING PROCESS

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The objective of this study was to determine the potential stress response of the sheep while witnessing slaughtering of another animal from the same flock and the level of its welfare disturbance. Eighty female sheep were divided in test and control groups (10 sheep/group), test groups were submitted to witnessing the slaughtering process, while control groups were visually isolated from the slaughtering. Four replicate trials of this experiment in the same conditions, in sheep's natural environment, were performed. PCV, serum cortisol, beta endorphin from blood samples of two sheep/group were monitored 10 min before slaughtering and 10 min, 1, 3 and 6 hours and 1 day after the slaughtering. The level of mobility was continuously monitored during the experiment using accelerometers attached on the left hind leg of three sheep/group. A multilevel model was tested for each parameter. The clustering and repeated measures were modelled as repeated measure on individual, group and inter-group level. The estimate and SE of cortisol, β endorphin and PCV before slaughtering was 0.555 (0.140), 0.249 (0.112) and 0.503 (0.159) and after the treatment was 28.950 (31.465), 10.341 (27.563) and 1.475 (1.125), respectively. The acceleration values were in the acceleration category 0-1, indicating standing, for both groups without any differences during the procedure ($p>0.05$). Results from this study indicate that there was no significant effect of the slaughtering process on the sheep, sheep within group and group within replicate trial for all tested parameters, suggesting no detection of stress and sheep welfare disturbance in tested animals using the described measures and methodology.

ELECTRICAL STUNNING EFFECTIVENESS WITH CURRENT LEVELS LOWER THAN 1A IN LAMBS AND KID GOATS

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An experiment with 360 lambs grouped into three Spanish commercial categories, (Pascual, 13-16kg; Recental, 9-13kg and Lechal <7kg carcass weight) and 120 kid goats (7kg) was performed to assess stunning effectiveness after head-only (HO) and head-to-body (HB) electrical stunning with intensity currents of 0.3, 0.5 and 0.7 Amperes (A) in comparison to 1.0A. Stunning effectiveness was determined by assessing physiological reflexes and electroencephalography (EEG). After stunning, all animals showed tonic-clonic muscular activity and epileptiform EEG pattern, absence of rhythmic breathing, corneal reflex, spontaneous blinking and pain sensibility irrespective of the current intensity or stunning system. The quiescent EEG occurred earlier ($P<0.05$) in HB compared to HO in all categories. More animals recovered corneal reflex and rhythmic breathing before onset of the quiescent activity after stunning with HO (from 15 to 50%) compared to HB (from 0 to 15%) ($P<0.05$). Concluding, HO and HB electrical stunning with 0.3, 0.5 and 0.7A induce effective stunning similar to 1.0A in lambs and kid goats. After electrical stunning and sticking, brain failure occurs earlier in HB compared to HO system.

EVALUATION OF THE MEYN MULTISTAGE CO₂ STUNNING SYSTEM FOR CHICKEN WITH REGARD TO ANIMAL WELFARE UNDER PRACTICAL CONDITIONS

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Though permitted by EU-Reg.1099/2009 German law requires additional scientific evaluation for broiler CO₂-stunning-systems with regard to animal welfare. This study is part of the evaluation of the Meyn®-multistage-system taking into account behaviour during induction and stunning effectiveness.

Broilers of 10 flocks (live weight 1.6-2.8kg) were slaughtered under routine conditions (line speed 9000/h) on 2 days. The CO₂-stunning-system comprised 3 independent stunning cabinets, each processing 470 to 820 chicken in 2 GP poultry-containers at a time. Chicken were exposed to CO₂ in air subsequently increasing in 5 stages (setpoint for CO₂: 18%, 28%, 33%, 38% each for 1 min, followed by 62% for 2 min); the same key parameters are used for all conditions. Then the cabinet was flushed with air, containers went to destacking and tilting and chicken were shackled and decapitated (times between leaving 62% CO₂ and decapitation were between 4.5 min and 19 min yet but should be further reduced).

Behaviour was observed in all cabinets through the window (one bird/tier, n=72). The same 72 tiers (approx. 2800 chicken) were witnessed until all chicken had lost neck tension and no signs of consciousness (heads up, open eyes) were detected. Additionally we took 42 videos for further analysis.

Stunning effectiveness was checked for 44750 birds just before decapitation (pos3), 25 seconds earlier (pos2) and 40 to 80 seconds before decapitation (pos1). Five flocks (n=66700) were monitored completely at pos1.

Results of direct behaviour observation showed that latest at the end of stage₂, two minutes after gassing had started all chicken had lost consciousness. During induction we recognized the typical behavioural pattern: A few seconds after stage₁ started, birds began to swallow (av.8.6s). Afterwards deep breathing and head shaking started (av.15.6s). Some birds got up at this point, if not standing already. Subsequently birds sat down (av.34.7s), their head fell down/ eyes closed (av.75.7s). No jumping or flight intentions occurred.

Stunning effectiveness was 99.97%. Reawakening, if present, happens quickly, so that birds awake were found at pos1 and could be selected and back-up-stunned at shackling (av. 0.03%; 0.00% to 0.07%/ flock).

We conclude that for the Meyn®-multistage-system behaviour during induction is according to animal welfare and corresponds with findings in other systems. All birds have lost consciousness before entering high CO₂%. Stunning effectiveness is very high but occasionally birds are able to regain consciousness. This shows the importance of an effective routine back-up despatch procedure by responsible and trained staff.

AN APPROACH TO IMPLEMENT STUNNING AND KILLING OF FISH

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We present a strategy to put effective stunning and killing of farmed and captured fish into practice. In the first place, in a laboratory setting the conditions need to be established for an effective stun without avoidable stress and discomfort. This requires registration of EEGs and ECGs in fish in combination with behavioural observations and an assessment of product quality to determine whether carcass damage occurs. When stunning or killing does not induce immediate loss of consciousness and loss of sensibility, other supplementary, stress-physiological measurements are needed. During subsequent application of assessed stunning and killing methods in a commercial setting it is likely that stress-physiological and neurophysiological measurements are not practicable. Therefore, only behavioural observations and physical measurements of for instance strength of the electrical current, its waveform and voltage across electrodes and air pressure applied for percussive stunning can be carried out. Caution is needed, however, with respect to the interpretation of data obtained during behavioural observations of fish. Fish that do not respond may still be conscious and conscious fish may not show responses to administered stimuli.

The last step of our strategy is focused on control of effective stunning and killing of fish in practice. To achieve this a process-oriented Quality Assurance system should be implemented. Briefly, the QA system involves: 1) an analysis of hazards that may be detrimental to the welfare of fish; 2), measures to prevent these hazards; 3) establish critical steps at which control can be applied and, as a result, deterioration of fish welfare can be prevented, eliminated, or reduced to an acceptable level and 4) determination of critical limits for each critical step in the process of stunning and killing. It is known that QA systems can be easily adapted, when deemed necessary. With respect to implementation of a QA system to control welfare of fish during the process of stunning and killing, we expect that this is practicable, as in various industries QA systems have been incorporated.

WING FRACTURES IN BROILERS, OBSERVED AT TWO NORWEGIAN ABATTOIRS

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Catching and loading broilers for transport as well as handling prior to shackling at the abattoir (i.e. emptying the transport containers and gas stunning) may cause wing fractures. Fractures occurring in conscious birds are painful and severely compromises broiler welfare.

This study aimed to investigate the attribution of wing fractures to different steps in the pre-slaughter chain, from farm to slaughter line, by examining individual birds before and after pre-slaughter handling at the abattoir. Wing fractures were examined in 11.609 broilers, from 12 different flocks (3 containers from each flock, between 860 and 997 broilers), slaughtered in two different abattoirs; one with CO₂-stunning (GS) and one with electrical stunning (ES).

Individual broilers (all Ross 308, mixed gender) were examined for wing traumas at 2 (3) different control places in both abattoirs: 1) directly out of the containers in the lairage area, 2) after evacuation and shackling (only ES) and 3) post-stunning. Wing fractures were identified by the presence of open fractures, open epiphyseal plate detachments, of visible bleedings around the elbow joints or wings held in a dislocated position. Observed birds with wing fractures in lairage were immediately culled, others were forwarded to the slaughter line for the next observation. The GS abattoir empties the containers directly into the CO₂-tunnel and birds are unconscious during shackling. At the ES abattoir, the crates are evacuated from a higher altitude and birds are shackled while conscious, before stunned in a water-bath with an electric current. Wing examination was conducted by the same two persons at all stages. The prevalence of wing fractures attributed to pre-slaughter handling on farm was an average of 0.8 percent (CAS 0.73 percent, ES 0.88 percent), average prevalence post-stunning was 2.35 percent (CAS 1.80 percent, ES 2.90 percent). Regardless of abattoir, significantly more fractures ($P < 0.01$) occurred during pre-slaughter handling at the abattoirs, than during catching. There was a tendency, though not significant, that more fractures occurred at ES than GS. Slaughter line registration at ES was done in to different places, with identical results; no fractures were caused by electrical stunning. That means that all fractures observed in ES occurred in conscious animals, likely caused by evacuation of containers. It was not possible to examine birds between evacuation and stunning in GS. Fewer fractures occur during catching, than at the abattoirs, but on-farm fractures results in more prolonged suffering than fractures occurring immediately before stunning. Thus, monitoring of wing fractures as an indicator of animal welfare at abattoirs is of utmost importance to enhance animal welfare in broilers last day of life.

HUMANE SLAUGHTER: IS AFRICA THERE YET? CHALLENGES AND OPPORTUNITIES

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Consumers all over the world are starting to ask questions about where their meat comes from, and Africa is no different. Increases in the demand for animal-sourced food are estimated to be high in Africa over the coming years. By 2050, the meat market is projected at 34.8 million tonnes, an increase of 145 percent over 2005/07 levels. Demand for livestock products in sub-Saharan Africa is increasing rapidly. The trend of increasing demand is currently not being matched by similar growth in local production. Several African governments, as well as regional organizations, are now working out how they can best ensure that their farmers can contribute to the better availability of high-quality livestock products, thus reducing the need for dependence on increased imports.

The strategic and societal importance of African agricultural performance is also clearly illustrated by its direct and indirect relationship to and impacts on all eight United Nations Millennium Development Goals (MDGs) (United Nations, 2009). The World Organisation for Animal Health (OIE), on May 27th 2015, updated the OIE Terrestrial Animal Health Code and made it possible for African countries with wild species like buffalo that naturally harbour foot and mouth disease (FMD) viruses to be able to trade beef without necessarily requiring the physical separation of wildlife and livestock, with this comes the responsibility to ensure adequate animal welfare (i.e. humane slaughter). This paper focuses on Africa's position with regards to humane slaughter and discusses the opportunities and challenges that are available.

EVALUATION OF A NON-PENETRATING CAPTIVE BOLT TO EUTHANASE NEONATAL GOAT KIDS

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Manual blunt force trauma (BFT) is a common method of euthanasia for sick or excess kid goats. This practice is not well received by farm operators or industry and may vary in effectiveness, resulting in a call for a more standardised mechanical method. The objective of this study was to evaluate the effectiveness of a compressed gas powered non-penetrating captive bolt (BOCK Industries, Inc., Philipsburg, PA, USA) to euthanize goat kids within 48 hours of kidding. In experiment 1, 10 kids were anaesthetised then euthanized by placement of the device to the back of the head of the goat between the ears, with the kids jaw angled towards its chest. The severity of brain haemorrhage and skull fracture was assessed by gross anatomical examination. In experiment 2, 100 goat kids were euthanized using the same technique and brainstem reflexes and convulsions measured every minute for 15 minutes to assess insensibility, time of brain death and cessation of cardiac activity. A secondary method of euthanasia was used if immediate insensibility or cessation of cardiac activity within 15 minutes was not achieved. In experiment 3, seven goat kids were lightly anaesthetized and the electroencephalogram (EEG) was recorded to assess awareness following application of the non-penetrating captive bolt. In experiment 1, haemorrhages were observed close to the vital centres in the brainstem. In experiment 2, all goat kids were rendered immediately insensible without return to sensibility and cessation of cardiac activity occurred within an average of 8.4 minutes (range: min: 3.2 minutes; max: 16 minutes). One goat kid was euthanized using a secondary method because cardiac activity had not ceased within 15 minutes, but this animal did not return to sensibility within this time period. The non-penetrating captive bolt reliably caused immediate, sustained insensibility followed by death in goat kids. EEG confirmed that the non-penetrating captive bolt resulted in the immediate onset of EEG activity which was not compatible with awareness.

REVIEW OF THE TRANSPORTATION SYSTEM AFFECTING ANIMAL WELFARE DURING TRANSPORT OF LIVE ANIMALS TO SLAUGHTER HOUSES IN GHANA

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Live animals have been transported from the Sahel countries to Ghana over generations. This is because the country is a net importer of live animals for slaughter for local consumption. Apart from live animal imports, the country internally moves live animals from the guinea savannah to the coastal zones for slaughter. Live animals imported from the Sahel countries are transported by vehicles from the guinea savannah zones and travel over 1,000km in transport in vehicles.

Along this route from Paga to Accra, for instance, there are seven official customs checks points and 48 police official and unofficial check points. All these checks points delay the movement of the transport vehicles and therefore, increase the travel time from the entry border post of Paga to destination markets at Kumasi and Tulaku in the coastal zone. Such a delay in travel time, puts heavy stress on the live animals moved, increasing the poor welfare status of the animals in transport.

The main issue is how to improve the welfare of live animals during transport from the Sahel countries to the destination markets in Ghana. Articulated vehicles are not designed for live animal transport, for instance, having no partitions. These vehicles are used to transport goods from Ghana to the Sahel countries and, on their return, ferry live animals as an optional cargo.

This paper reviews the transportation systems with negative animal welfare impacts during transport from the Sahel countries into the country, and within the country. The main animals transported are cattle, sheep and goats. In total 6,000 cattle are transported per month from Burkina Faso to Ghana. Additionally, live birds such as guinea fowl, local fowls, are transported for slaughter.

The purpose of this review of the transportation of live animals over long distances and the effect on animal welfare is to identify some policy implications to reduce negative animal welfare impacts on live animal during transport. The review will make necessary policy recommendations for the member states of the Economy Community of West African States involved in live animal transport.

A STUDY OF AVERSION AND STUN QUALITY IN PIGS STUNNED IN A GAS MIXTURE OF 80% N₂ AND 20% CO₂ COMPARED TO 90% CO₂ DURING COMMERCIAL SLAUGHTER

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Partenoster gas stunning allows group handling of pigs which optimises animal welfare. However the high concentration (>90%) of carbon dioxide (CO₂) used in these systems, causes suffering due to the acidity of the gas and the severe sense of breathlessness it provokes in pigs during induction. Laboratory studies indicate aversion can be reduced by decreasing CO₂ concentration below 30% and adding Nitrogen (N₂). This study aimed to assess during commercial slaughter; aversion and stun quality in pigs stunned in a Butina® 6 box paternoster stunner filled with pre-mixed gas at 80% N₂ and 20% CO₂ (80N/20CO₂), compared to pigs stunned with 91 -93% carbon dioxide (90 CO₂). Gas levels were measured using Dan sensor® MAP check devices at 2.2m and 5.6 m in the 63m³ pit. IP surveillance cameras with 10 hour memory cards and battery powered packs, were installed in 2 boxes, filming 83 groups (3 pigs per group) during stunning with 80N₂/20CO₂; and 115 groups (4 pigs per group) with 90CO₂. Aversion was evaluated by the presence of escape behaviour, loss of balance, conscious gasping and muscle excitation. A total of 802 pigs in the former and 1000 pigs in latter were observed for stun quality during stun to stick (spontaneous blinking, righting reflex, repeated corneal reflex or repeated gasping indicated inadequate stunning). During stunning with 80N₂/20CO₂, Oxygen (O₂) levels fluctuated between 0.45 and 2.7 %, and CO₂ levels between 15.5 and 18.1%. The duration of behaviour indicating conscious aversion varied between 28 and 54s, averaging 38s during the induction phase. Pigs took longer time to fall, showed more aggressive muscle excitations, vocalisation and both conscious and unconscious gasping during 80N₂/20CO₂ stunning. Adequate stunning occurred in 93% of pigs stunned with 80N₂/20CO₂ but levels of O₂ above 2% appeared to negatively affect stun quality. In 90CO₂, aversion periods ranged from 28 to 50s, averaging 34s and all pigs showed adequate stunning. Pigs could be adequately stunned with both gas mixes; however, in both systems pigs showed a high degree of conscious aversive behaviour during the induction phase, reinforcing the need to find alternative more humane gas stun systems.

FROM IDEA TO REALITY: THE DEVELOPMENT OF THE LOW ATMOSPHERE STUNNING SYSTEM

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It started with a conversation on improving poultry slaughter between two men, one of whom is a pilot. He speculated that duplicating the altitude hypoxia experienced in flight could be a more humane way of stunning chickens by controlling the atmosphere without the addition of gas. A team of researchers was selected to test the feasibility. The first experiment, which was observational, demonstrated feasibility. Next, a small-scale test unit was constructed, and a series of experiments were completed combining physiological parameters, e.g. blood gases, with observation of the birds as well as gross necropsy. Electroencephalogram (EEG) with tethered birds was performed to verify that the birds were insensible before behavioral responses such as wing flapping and ataxia occurred. Over a period of 5 years, the timing of the atmospheric pressure reduction was refined to optimize the system. A commercial-sized unit was constructed to verify that upsizing the unit had no affect on performance. Final testing at a large commercial poultry abattoir provided the necessary data to obtain government approval for processing broilers for sale using the method. Finally request to USDA for approval to use was granted. Subsequently additional testing, using EEG and free-moving birds, was done to confirm that loss of posture occurred at the time of loss of sensibility. This method provides an opportunity for humane slaughter in a variety of poultry species as well as varying size abattoirs.

AN EVALUATION OF THE HUMANENESS OF STUNNING AND SLAUGHTER METHODS USED IN GUINEA PIGS (*CAVIA PORCELUS*) FOR THE ANDEAN REGION

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Guinea pigs (*Cavia porcelus*) are an important source of protein in the Andean region in South America. Specific guidelines regarding the welfare of guinea pigs before and during slaughter have yet to be developed. This study critically assessed the humaneness of five different stunning/slaughter methods for guinea pigs: cervical neck dislocation with pre neck cut (NC-CND; n=30), cervical neck dislocation with post neck cut (CND-NC; n=30), electrical head-only stunning (n=83), CO₂ stunning (n=21) and spring-powered captive bolt (n=10).

Twenty-seven (90%) and twenty-nine (97%) animals in the NC-CND and CND-NC groups respectively had at least one behavioural or cranial/spinal response after cervical neck dislocation. All animals had a partially severed spinal cord. Following head-only electrical stunning 5 (6%) animals were classified as mis-stunned. The duration of induced insensibility was between 30 and 69 (mean 43 ± 11)s. Live weight was the main factor associated with the duration of insensibility after head-only electrical stunning, with heavier animals having a longer period of insensibility. One (1%) animal was classified as mis-stunned after captive bolt stunning. Post mortem examination revealed that the bolt only superficially damaged the left occipital lobe, suggesting that the cause of incomplete concussion was due to misplacement of the shot. Increased respiratory effort was observed during CO₂ stunning. However, there were no other behavioural responses that could be associated with suffering.

The results of this study suggest that spring-powered captive bolt and electrical stunning were humane methods for the dispatch of guinea pigs. Carbon dioxide stunning was deemed as relatively more humane than cervical neck dislocation. Nonetheless, if this method was to be adopted a more automated and cost effective system would need to be implemented. This study is the first detailed assessment of the humaneness of different stunning/slaughter methods for guinea pigs for human consumption. Of the methods assessed, captive bolt was deemed the most humane, effective and practical method of stunning guinea pigs. Cervical neck dislocation should not be recommended as a slaughter method for guinea pigs. These results have direct relevance to all countries where guinea pigs are used as a source of protein and for the dispatch of laboratory guinea pigs.

DTS®: DIATHERMIC SYNCOPE FOR CATTLE STUNNING

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Preliminary research has shown that electromagnetic energy technology is likely to induce recoverable insensibility in animals and could result in an effective reversible stunning method that is suitable for religious slaughter. The mechanism of action is essentially selectively increasing the temperature in the brain, by only 7 or 8° C, to the point that hyperthermic syncope (fainting) occurs, but below the point at which irreversible brain damage and death occurs. Wagstaff Food Services Pty Ltd and Advanced Microwave technologies have designed a system for delivery of electromagnetic energy to sheep, goats, cattle, buffalo and camel (DTS®), and application to anaesthetised cattle resulted in EEG traces that indicated unconsciousness (seizure-like activity, similar to that seen when electrical stunning is used). In the current study, nine conscious cattle received DTS, and nine control animals were stunned using a captive bolt.

The animals were observed closely by video capture and live observations, and all behavioural responses during and after stunning were recorded. Semihemiperic percutaneous EEG was recorded prior to application of the stun and then following stun, after the animal was released from the restraint unit. Blood samples were taken prior to stunning and from the free-flowing exsanguinate post stunning; and analysed for cortisol, β -endorphin, ACTH, noradrenaline and adrenaline.

From the live observation of the animals, eight of the nine DTS animals were considered to be fully stunned. One animal was considered only partially stunned, so was re-stunned using captive bolt prior to exsanguination. The process of release from the head capture unit and collection of EEG data was slow, taking between 3 and 6 minutes, so although the remaining animals were considered stunned by the DTS treatment, by the time all data were collected, 4 were beginning to convulse, and 2 began to demonstrate the return of reflexes. These were re-stunned using captive bolt prior to thoracic stick, for personnel safety reasons. Two animals remained stunned, i.e. demonstrating loss of corneal and withdrawal reflexes, beyond data collection, so were exsanguinated by thoracic stick without re-stun. The clearest indicators of effective stun were: loss of corneal responses; loss of withdrawal reflex; eye staring, not following movement. This paper will also include data from blood sample analysis.

EFFECT OF NECK CUT POSITION ON TIME TO COLLAPSE IN HALAL SLAUGHTERED CATTLE

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When cattle are slaughtered without stunning, any delay between the cut to the neck and the onset of unconsciousness could result in suffering. Previous research has shown that when upright restrained or cast cattle are slaughtered, the ends of the severed carotid arteries (cephalic and cardiac ends) can develop false aneurysms, which can impede or stop blood loss. It has been shown that cutting the neck at a position corresponding to the first cervical vertebra (C1) compared to the conventional C2+ will almost eliminate false aneurysm development, thereby minimising the risk of arrested exsanguination

This study examined the effect of neck cut position on the time to physical collapse in upright restrained halal slaughtered cattle (n=644). Time to collapse was used as an indirect indicator of the early stages of onset of unconsciousness. Cattle were slaughtered with either a conventional low (LNC) (n=561) or a high neck cut (HNC) (n=83). The cuts were categorised as either LNC with ≥ 2.5 trachea rings (TR), or HNC with ≤ 2 TR left on the cephalic segment of the severed trachea.

Time to final collapse for 81% of all cattle was within 20 seconds (s) of the cut, with 4% taking longer than 60s. Mean time to final collapse was higher in the LNC compared to HNC (18.85 ± 1.06 s and 13.53 ± 1.34 s respectively ($P < 0.01$)). False aneurysm size was assessed in the cardiac ends of the severed carotids. The mean false aneurysm scores were higher in the LNC cattle (0.84 ± 0.03) compared to the HNC (0.60 ± 0.08) ($P < 0.01$). There was a significant association between the position of the cut and false aneurysm scores ($P < 0.01$). Animals that took > 20 s to final collapse had larger false aneurysms. In summary, the HNC reduced the mean time to final collapse and the frequency of animals that took longer than 20s to collapse. Based on these findings, adopting a HNC could reduce the welfare compromise associated with the delayed time to loss of consciousness during slaughter without stunning.

EVALUATION OF ELECTROENCEPHALOGRAM RESPONSES OF CHICKENS KILLED USING THREE MECHANICAL DEVICES

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Evaluation of brain function is key to defining conscious states of an animal, as well as determining whether brain death has occurred and a killing method has been successful. A total of 230 birds of two bird types and ages (broilers/layers + juveniles/full grown) were tested on *three novel mechanical poultry killing devices, plus* a control (manual cervical dislocation – MCD). *The novel methods were* Modified Armadillo (MARM), Modified Rabbit Zinger (MZIN), and a novel mechanical cervical dislocation device (NMCD). All of the mechanical devices were tested in a previous experiment on cadavers and had demonstrated their ability to kill birds. All birds were anaesthetised prior to testing via gas inhalation of 8% Sevoflurane and oxygen at 2 L per min for roughly 20 s (“fast knockdown”), so not to compromise welfare. Efficacy of killing was determined in two ways: 1) duration and characteristics of electrical brain activity (via interpretation of electroencephalography (EEG) recordings), and 2) post mortem analysis (device success – desired anatomical affect on bird was observed and resulted in death; and kill success – adequate anatomical damage achieved to kill bird). Due to the EEG implant interfering with MZIN application, birds in this treatment group were not implanted and no EEG data recorded. Failed kill attempts were immediately emergency euthanised (33/230 birds), majority of which were MARM (20) and MZIN (10) treated birds. Kill success ($F_{3,229} = 24.46$, $P < 0.001$) was significantly affected by killing treatment (MCD = 100.0 ± 0.0 %; NMCD = 96.0 ± 0.0 %; MZIN = 75.0 ± 0.0 %; MARM = 48.7 ± 0.0 %). Device success ($F_{3,229} = 4.38$, $P = 0.004$) was also affected by killing treatment (MZIN = 75.0 ± 0.0 %; NMCD = 44.0 ± 0.0 %; MCD = 41.0 ± 0.0 %; MARM = 39.5 ± 0.0 %). EEG data showed that the killing treatment had an effect on duration to unconsciousness ($F_{2,47} = 4.24$, $P = 0.022$), with NMCD having the shortest duration post-killing (NMCD = 3.1 ± 0.3 s; MCD = 3.2 ± 0.3 s; MARM = 3.5 ± 0.3 s). Duration to isoelectric (brain death) was also affected by killing treatment ($F_{2,47} = 4.24$, $P = 0.022$) with MCD having the shortest duration (MCD = 41.8 ± 6.3 s; NMCD = 46.3 ± 6.0 s; MARM = 72.0 ± 16.1 s). This study provides evidence that the NMCD is a promising novel mechanical device for killing poultry on-farm.

RISK FACTORS FOR THE USE OF A RIFLE FOR STUNNING/KILLING OF CATTLE

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On-farm slaughter has become more popular in Germany since hygienic rules for slaughtering cattle, raised outdoor, were changed in October 2011. In order to gather information about the best practice to avoid welfare infringements, 44 cattle (German Angus, Galloway and Highland Cattle) were shot and assessment of effectiveness was carried out. In 9 cases cattle were not shot properly and required a second shot or back-up stunning by captive bolt. The reasons for failures were analysed and led to identify the following risk factors and resulting recommendations:

Pre-slaughter handling: Shooting nervous and moving cattle lead to a high failure rate. Therefore cattle should be adapted to the surrounding of the shooting area and the personnel before being shot. The best results were found when one animal out of a group of at least three cattle was shot. The shooting pen should be connected to a stable or neighbor paddock, which could be used as an escape area after the shot. The best results were achieved if cattle were shot after their feeding during resting time.

Distance between gun and cattle/ limitations of shooting area: Failures happened if cattle were shot while too far away. A huge shooting area also resulted in difficulties to place a second shot if necessary. In order to shoot precisely and to reach the animal quickly after the shot it is recommended to use a pen with a maximum distance of 20 m between marksman and animals head.

Precision of the shot was identified as the most welfare relevant factor. This includes the following aspects:

Capability of the marksman: fail shots happened if the marksman was not well trained. If regular training was proven and a trial shot was performed at the day of slaughter this was beneficial.

Aiming support technique: iron sights turned out to be less appropriate because this prevents a complete view on the head of the cattle. A telescopic sight or a red dot sighter instead were helpful.

Caliber of ammunition: Suitable ammunition for rifles was proven to be effective when small caliber e.g. 22 (Magnum) was used on a distance up to 20m. Bigger caliber and stronger cartridges e.g. 30-06, 8x57 showed no benefits with regard to a higher precision. Smaller caliber seemed to be more convenient for the marksman.

In conclusion skills of the marksman had the most important impact on animal welfare during stunning and killing cattle by rifle.

VALIDATION OF INDICATORS USED TO ASSESS UNCONSCIOUSNESS IN CATTLE AT SLAUGHTER

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The validity of indicators to assess unconsciousness under different stunning and slaughter conditions is under (inter)national debate. The aim of this study was to validate absence of threat-, withdrawal-, eyelid-, and cornea reflex as indicators to assess unconsciousness in calves subjected to different stunning and slaughter methods. Each calf was equipped with non-invasive EEG electrodes to record brain activity (presented in an electroencephalogram or EEG) as a standard to verify unconsciousness in calves. Calves with an average warm slaughter weight of 200 ± 22 kg were randomly assigned to one of the following four groups: 1. Captive bolt stunning followed by neck cutting (n=25); 2. Neck cutting followed by captive bolt stunning at 30 s post neck cutting (n=25); 3. Neck cutting in an upright position (n=7); 4. Neck cutting in a dorsal position (180° rotation; n=25). All reflexes were verified once in a controlled conscious state. After start of the procedure (T=0 s) reflexes were assessed on T=5 s in group 1 and 2 and on T=15 s and every following 20 s in all groups until all reflexes showed a negative response three times in a row. Timing of loss of reflexes (mean \pm sd) per group after start of the procedure (T=0 s) are presented in Table 1. Visual assessment of EEG traces and spectral analyses will provide information on loss of consciousness in each calf. The analyses will also provide detailed information on when reflexes are lost in relation to loss of consciousness in the different groups. These results will be presented at the conference.

Table 1. Loss of different reflexes (mean \pm sd) in calves subjected to 4 different stunning and slaughter methods.

	Group 1 Captive bolt stunning followed by neck cutting	Group 2 Neck cutting followed by captive bolt stunning at 30 s	Group 3 Neck cutting (upright position)	Group 4 Neck cutting (dorsal position)
Loss of:				
Threat reflex (s)	Immediate	17 \pm 12	52 \pm 27	27 \pm 15
Withdrawal reflex (s)	Immediate	11 \pm 9	41 \pm 38	26 \pm 19
Eyelid reflex (s)	Immediate	34 \pm 5	238 \pm 107	113 \pm 30
Cornea reflex (s)	Immediate	33 \pm 8	255 \pm 118	126 \pm 39



Humane Slaughter Association

Scientific Programme: Poster Abstracts

RELIGIOUS HALAL SLAUGHTER OF ANIMALS FOR FOOD, ANIMAL WELFARE, MEAT SCIENCE – KNOWLEDGE GAPS

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The presentation is based on a two years study conducted in some Muslim countries and the discussions held with some leading religious scholars of the world to understand rituals of Halal slaughter better and to identify scientific and technological opportunities to improve the procedures in the light of the practicing religious beliefs and the existing scientific developments. The outcome of the study is likely to assist the international livestock industry involved in the Halal production, trade, import/export of live animals and meat for adopting strategies to cope with the current and the emerging future scenarios in this sector. There is said to be international trade of about US\$750 billions in Halal food and non-food products and a substantial part is livestock related products. Islamic code of animal welfare provides care, mercy and kindness towards animals at all times and more so at slaughter. However, it is not being followed in letter and spirit in most Muslim countries. Important religious basics of Halal slaughter comprise of cutting neck of a healthy live animal, from the front with a long sharp knife while making the religious invocation. Consumption of blood (in any form) is forbidden. Irrespective of science it is a firm belief held by most Muslims that only Halal slaughter causes no or less pain & leads to maximum bleed out at slaughter to give safe and healthy meat. Intervention of pre-slaughter stunning in Halal slaughter and issues like stress and pain, concept of pre-slaughter injury to animal, comparative bleed-outs and ensured reversible stunning require pertinent and focused future research attention. Relationships between stunning, meat quality, blood splash and bleed out needs serious consideration. It is desirable that the research aspects should emphasize concern for religious respect, objectivity and ritual credibility. It is not the Islamic code rather the ignoring of it by Muslim societies is the cause of undue sufferings to animals and giving rise to the controversies in the non-Muslim world. There is need to implicate simple science and technology procedures in Halal slaughter, like proper mechanical restraint, improved neck cutting techniques and training etc. as it is affecting meat quality, workers safety and adding to the ongoing animal miseries. Important and explicit spirit of the religious code is that any modification in Halal slaughter procedure must override commercial considerations compared to animal and human values.

Poster Session: 17th July

IMPROVING ANIMALWELFARE: AUTOMATED MONITORING OF FOOT PAD LESIONS

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Introduction

Conditions in the poultry house e.g. leaking water cups, watery feces and poor ventilation may cause wet litter. Wet litter may stick to the feet, initially leading to discolorations, which may gradually increase to severe foot pad lesions. Van Harn et al (2014) reported that wet litter not only induces foot pad lesions, but also affects overall animal welfare, the ability to walk, quality and yield. To get grip on this issue, the first step is to monitor foot pad lesions post mortem in the slaughter plant.

Results

Dir 2007/43/CE Annex III prescribes that possible indicators of poor welfare conditions, like contact dermatitis are monitored during post mortem inspection; these data shall be communicated with the farmer and the competent authority, to enforce appropriate action. Foot pad lesions are an important form of contact dermatitis and therefore a point of attention (Ask 2010). Litter conditions may vary considerably within a poultry house, so birds at a certain spot may be much more affected than birds at another spot.

This means that a reliable view of the extent of foot pad lesions requires that birds are monitored during the entire time a flock is processed. This would require continuous manual monitoring, which is labor intensive, expensive and tiring. In practice however, feet are collected from the slaughter line, during only one or two short periods during the slaughter of a flock. Furthermore, manual scoring of foot pad lesions is subjective, and not constant in time, due to fatigue, and loss of concentration.

To overcome these issues, an automated foot pad lesion monitoring system has been developed and validated, based on a score card, a definition how to use the score card, and an imaging system to grade the sessions. During the validation, the results of the camera grading system proved to be consistent, and comparable to the judgment of trained judges (de Jong et al 2011, de Jong 2013).

The system has been approved by the Dutch authorities, and is used on a daily basis in two major Dutch poultry slaughterhouses.

Conclusions

This automated system allows a more thorough monitoring of foot pad lesions, thereby creating a basis for addressing the causes of foot pad lesions, thereby improving animal welfare.

Poster Session: 17th July

AUTOMATED ASSESSMENT OF KEY WELFARE PARAMETERS AT THE TIME OF KILLING TO BETTER UNDERSTAND ON-FARM CONDITIONS FOR BROILERS

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Assessing the welfare of a sample of animals on a farm can help provide information regarding the level of welfare being achieved on that farm. However, for some species, particularly broilers, it can be challenging to make adequate and accurate assessments at this time, especially for some key welfare parameters, such as foot and hock burn. For example, it can be impracticable to assess a sufficient number of birds to provide a good indication of flock-level prevalence; individual birds have to be caught, handled and inverted for assessment, which can cause stress; and, the birds feet and hocks are often dirty thus hindering or preventing assessment. Therefore, it is preferable to make such assessments at the time of killing when the animals are dead, cleaner and presented in a way that makes assessment quicker and easier.

Both foot and hock burn are a type of contact dermatitis, whereby the affected skin turns dark and deep lesions can result. Both can be painful, provide a potential route for chronic infection and can lead to lameness. Further, they can affect bird performance by reducing growth rate and increasing culling and rejection rates. Therefore, accurate monitoring and controlling of these diseases is important.

Some slaughter plants manually assess these conditions when the birds are dead on the shackle line. However, despite it being more practical to assess the birds at the plant, other factors, such as a line speed, availability of labour, time and inter-observer variability can inhibit accurate, reliable assessment.

However, automated assessments, such as the camera inspection systems developed by Meyn, provide a significant advancement in the assessment of both foot and hock burn – providing more reliable, accurate and consistent flock-level assessments. Positioned on the slaughter line, these systems use digital imaging to automatically detect and score lesion severity for each bird. For each flock, the proportion of birds with each score is calculated, stored and reported. Images can also be saved for historic viewing. Lesion detection and grading settings can be altered to cater for various sensitivity requirements.

In conclusion, assessing important welfare conditions at the time of killing has the potential to provide a better understanding of on-farm welfare as the handling and processing of animals at this time aids assessment. Automated methods, e.g. the Meyn inspection systems, can significantly improve assessment accuracy and thus provide more meaningful information to help inform welfare improvement decisions on-farm.

Poster Session: 16th July

SOCIAL PERCEPTION OF ANIMAL WELFARE IN ARGENTINA

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The aim of this paper was to know the perception that people has related to the treatment production animals receive, interest and knowledge people has about animal welfare and habits and consumption attitude of animal products. The study was held in the city of Río Cuarto (Argentina) and took 692 cases. The samples were selected randomly with gender quotas (April-June 2013) by interviews with a form of closed questions with choices of answers in Likert's scale in five levels. The survey was divided in three parts: perception about animal welfare, information about animal products consumption habits; and knowledge about animal welfare and its importance to society. The data was analyzed with SPAD. More than one third of surveyed believe consumption animals are very well or well treated; a 40% believe that they have regular treatment and 17, 2% believe that are mistreated or very badly treated. The 98% of surveyed state consuming animal products, from highest to lower: bovine meat, dairy, chicken meat, eggs, pork meat, fish, honey and lamb meat. The 72, 4% of people were aware of the concept of animal welfare and the 66% could make an association with the five freedoms. The 45, 4% of people claim to be concerned about this subject. The community has a positive perception about the treatment that animals in extensive production have, but the perception related to intensive systems as it is in chickens or pigs was negative. Related to horse treatment, people have a negative perception on treatment of carriage horses. Most of surveyed consume animal products, they preferred "farm animals" by the belief that are better quality, and they would be willing to pay more for products that assure being produced respecting animal welfare and more than half associate it with the five freedoms. They notice that animal welfare benefit both animals and people. Most of them agree that school should educate on this subject.

Poster Session: 17th July

RISKS OF SENSIBILITY TYPE BEHAVIOUR DURING SLAUGHTER WITH AND WITHOUT STUNNING IN BRITAIN

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The slaughter in the UK for many decades was preceded by stunning. Small numbers of cattle, sheep and birds were slaughtered by specialists, without stunning, for the supply of religiously approved meat for specific communities. Two recent surveys of slaughter in the UK by the FSA in 2011 and 2013, have reported an increase in non-stunned slaughter of cattle from 16% to 25%, in sheep and goats from 19% to 37% and in poultry from 12% to 16%, as abattoirs which stunned all animals have now moved to non-stunned slaughter. Economic, administrative and religious pressure for non-stunning has increased as labelled and un-labelled meat produced from the same animal may be sold into diverse markets, furthermore Food Business Operators (FBO) may avoid the expense of stunning equipment necessary to comply with EC Regulation 1099/2009 on the protection of animals at time of killing.

The EFSA Toolbox clinical methods are essential for the assessment of each animal's insensibility at Key Stage 1 to test the stunning of animals prior to the incision, also at Key Stage 2 to establish death before further processing, using the absence of corneal and pupillary reflexes and a limp body. In non-stunned slaughter death was confirmed at Key Stage 1. However, the testing of these brain stem reflexes, risks triggering resurgence of sensibility, consciousness with aversion, fear type or anger like behaviour.

Whilst reflexes indicate signs of life, they are not proof of sensibility. However, non-stunned chickens bleeding in cone restraint 15 seconds post incision responded to attempts at touching, with aversive movements. If confronted at 25 seconds post incision, a pecking behaviour was induced also bird kicking was seen. 121/788 birds were alive at 90 seconds, 29/788 at 120 seconds, and 10/788 at 150 seconds, showing truncated unsolicited resurgent episodes of anger type behaviour. Behaviours observed in calves (3/100) e.g. righting behaviour or standing for 5 minutes may indicate hypothalamic processing post incision, with a risk of sensibility or consciousness. There is also a risk of resurgence of reflexes even consciousness and sensibility, when non-stunned and stunned animals were hoisted by the hind leg, either after the cut or in the latter case before incision and subsequently. This resurgence may be related to increased blood supply to the circulus arteriosus in sheep illustrated by Willis (1668).

Poster Session: 17th July

STUDY DESIGN AND SELECTION OF RELEVANT MEASURES FOR ASSESSMENT OF FITNESS FOR TRANSPORTATION OF DAIRY COWS

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EU legislation on the protection of animals during transport states that before a dairy cow, or any other animal, can be transported its fitness for transport must be assessed. In order to avoid unnecessary stress, pain, exhaustion and potential violations of animal welfare regulations it is therefore important to be able to assess fitness correctly. However, farmers, drivers and even veterinarians find this challenging, as not only must the current health state of the animal be assessed, but also if and how the transportation is likely to affect the animal. So far little research has dealt with this challenge.

The purpose of the study is to gain knowledge of how short distance transportation by road (< 8h) as well as other risk factors related to the cow and transportation affect the welfare of dairy cows during and after transportation, and to identify clinical and behavioural manifestations prior to transportation likely to increase the risk of a cow being judged unfit for transport when reassessed after transportation.

The project (2014 through 2016) is an observational study of approximately 500 Danish dairy cows transported to slaughter by road. It is designed as a cross-sectional study with follow-up where each cow is examined before and after transportation to the abattoir. Examinations will include behavioural and clinical observations, e.g. grinding of teeth and locomotion score. In addition, production data such as gestational age and factors relating to the vehicles used for transport and the transportation itself e.g. use of partitions between animals and duration will be recorded. Data analysis will include a comparison of the examinations made before and after transportation. Potential risk factors for cows unfit for transport will be identified by multivariable analysis.

Based on the findings, we aim to develop a reliable and easy manageable tool in the form of a scoring system for assessing fitness for transport of dairy cows. In the future, such a scoring system may be used by farmers, drivers or veterinarians to identify cows which are fit for transport and cows which are not. This could successively lead to improved welfare for cows transported to slaughter.

The project is one of three subprojects in a large Danish project on transportation. The other two projects deals with broiler chickens and sows, respectively.

Data collection will start in 2015 and continue throughout the year. We wish to present preliminary results in a poster presentation, July 2015 in Zagreb.

Poster Session: 17th July

MONITORING OF ANIMAL WELFARE AT SLAUGHTER - STUDY RESULTS OF INDICATORS' USE AT A BOVINE SLAUGHTERHOUSE

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Animal welfare is an issue of growing concern for the general public and regulators due to ethical, public health and economical aspects. Regulation (EC) 1099/2009 lays down requirements for monitoring animal welfare at slaughter. More specifically, the requirements related to the stunning process are scientifically supported by recent EFSA scientific opinions for bovine, sheep, goats, pigs and poultry.

The new European approach promotes the use of measurable animal-based welfare outcome indicators. The aim is to provide a more objective assessment of animal welfare at the time of killing and an harmonised implementation of animal welfare legal provisions among EU Members States. For proper and effective stunning and killing operations, the animal welfare indicators for unconsciousness and consciousness are to be defined and included in the monitoring procedure. The animal welfare officer according to EU legislation is the key person responsible for designing and supervising the monitoring procedure and for adopting corrective actions in case of non-compliance.

This study was carried out to describe the practical implementation of animal welfare monitoring procedures in an industrial bovine slaughterhouse in Northern Italy. To monitor the effectiveness of stunning in 800 bovines during routine slaughtering, indicators of unconsciousness and consciousness as defined in the EFSA Scientific Opinion were used. The checks were carried out on a sufficiently representative sample of animals by defining a uniform criteria and a specific frequency.

Main results demonstrated that in order to improve the significance, relevance and feasibility of the monitoring procedure, some of the unconsciousness indicators need to be correlated to a specific time after the stunning. Moreover it clearly emerged that the overall performance of the monitoring activity is depending on animal welfare awareness among plant personnel and a clear commitment of the Food Business Operator. To address these aspects and to make the system more reliable and effective in terms of protection of animal welfare, ad hoc training for plant staff tasked with animal welfare duty should be delivered periodically. Furthermore, training should be based on results of previous checks and any factor that may influence the effectiveness of the stunning process, such as changes in the type of animal or in the organisation of the staff's work.

Poster Session: 16th July

EFFECT OF TRANSPORT DURATION AND BROILER BREEDER AGE ON DAY-OLD CHICK WELFARE AND PERFORMANCE

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Broilers are the most numerous of all farm animals, ca. 5 billion are being produced in the EU every year. Most of these broiler chicks are transported to production sites within 1-2 days post-hatch. This process may cause stress, compromising the chicks' welfare and productivity. The impact of transport conditions is still poorly understood and likely depends on the chicks' quality and fitness. Chick quality is known to be affected by the age of the breeder flock amongst others. The aim of this study was therefore to investigate the combined effect of transport duration and breeder age on chick welfare and productivity.

Chicks from either young (28.9wk) or old (59.7wk) Ross 308 breeders (both males and females) were bred under commercial standards. After hatch, 3240 chicks were transported in 36 crates of 0.24 m², with 90 chicks per crate, from either young or old breeders. An equal number of randomly selected crates were subjected to a short (1.5h) or long (11h) road transport, resulting in a 2x2 factorial set-up. After transport, 2800 chicks were placed in 100 pens (2m²) at the ILVO site. Each pen was stocked with 28 chicks from a single crate (stocking density ca. 35kg/m² at 42 days). Five to seven chicks were randomly selected per crate (n=228) and were assessed for chick quality, weighed and then culled to weigh yolk sac reserves.

Mortality of the penned chicks was recorded daily until slaughter (42d). Number of chicks with stunted growth was recorded per pen once every fortnight. Feed conversion ratio was calculated for 40 pens, per feed type (starter, grower, finisher).

Chicks subjected to long transport were lighter (42.3g vs 43.7g; P=0.002) and had lower yolk sac weights than those subjected to short transport (3.9g vs 5.2g; P<0.001). Breeder flock age positively affected chick weight (38.4g for 28wk and 47.6g for 59wk; P<0.001) and yolk sac weight (3.4g for 28wk and 5.7g for 59wk; P<0.001), but negatively affected chick quality score (92.7% for 28wk vs. 89.1% for 59wk; P=0.001). Data on feed conversion ratio, mortality and the number of chicks with stunted growth will be presented at the conference. These results show that transport duration affected weight and yolk sac weight, whilst breeder age also affected chick quality.

Poster Session: 17th July

**ASSESSMENT OF AVERSION TO DIFFERENT CONCENTRATIONS OF CO₂ GAS
BY WEANED PIGS USING AN APPROACH-AVOIDANCE PARADIGM**

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The objective of this study was to examine the aversiveness of carbon dioxide (CO₂) to weaned pigs using approach-avoidance and condition place avoidance paradigms. A preference-testing device was custom designed with two connected chambers maintained at static gas concentrations. The control chamber maintained ambient air conditions (1% CO₂); the treatment chamber maintained predetermined CO₂ concentrations. Twelve crossbred healthy weaned pigs were individually trained for 5 consecutive days to enter the treatment chamber to access a food reward, with ambient air in both chambers. Pigs were feed deprived for 5-6 hours prior to testing to stimulate foraging motivation. After 2 minutes in the control chamber, a sliding door was opened to provide access to the treatment chamber. Pigs could move freely between chambers for 6 minutes after initial entry to the treatment chamber, after which they were removed and returned to the home pen. During the testing phase, the same procedures were used with the treatment chamber maintained at one of three CO₂ levels: 10%, 20% or 30%. Tests concluded when loss of posture occurred or after 6 minutes. Pigs experienced each of the CO₂ treatments, followed by one wash out day with ambient air conditions. Behavior collected using live observations and video recordings. During testing with CO₂, 2 pigs failed to enter the treatment chamber. Of the 10 pigs that entered at 10% CO₂, none displayed avoidance responses or loss of posture. Of the 10 pigs that entered at 20% CO₂, all displayed ataxia and open mouth breathing. Five pigs remained in the treatment chamber until loss of posture occurred (mean ± SEM = 192 ± 23 s). Ten of the pigs tested at 30% CO₂ entered the treatment chamber within 6 minutes, and 4 remained in the treatment chamber until loss of posture occurred (mean ± SEM = 78 ± 6 s). Pigs that failed to remain in the treatment compartment until loss of posture occurred frequently moved between the control and treatment chambers. During 20% and 30% CO₂ tests, pigs displayed violent neuromuscular excitation, at which time the test was terminated for ethical reasons (mean ± SEM = 212 ± 24 s at 20% CO₂ and 81 ± 6 s at 30% CO₂). No pigs displayed conditioned place avoidance of the treatment chamber on any of the wash out days. Exploratory behavior of pigs posed challenges for interpretation in this approach-avoidance experimental design.

Poster Session: 16th July

HOW TO ASSESS FITNESS FOR TRANSPORT OF DANISH BROILER CHICKENS

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According to the Council Regulation EC 1/2005 on the protection of animals during transport, the suitability for transportation should be evaluated before translocation of animals. This evaluation is a necessity to ensure animal welfare but at the same time the evaluation present a challenge for the veterinary authorities in that transport fitness is not very well defined. The aim of this project (2013-2016) is therefore to establish knowledge about useful indicators to assess broilers suitability for transport. The objective is to develop a practical protocol which can be applied to assess the transport fitness of a flock on-farm within 24 hours prior to harvesting.

During 2015, a number of Danish broiler flocks will be visited within the last 24h before the birds are mechanically harvested and transported to slaughter at approx. 36-37 days of age. Each flock will be assessed at 3 different stages of transport: i) on-farm before harvesting, ii) after harvesting before transport, iii) after transport during lairage at the abattoir. Some post-mortem data will also be included.

On each farm, a transect walk, fear assessment and a Qualitative Behaviour Assessment (QBA) will be performed and a random sample of focal animals will be assessed clinically. Resource- and management data will be included, such as litter quality, house and flock characteristics as well as personnel background and empathy. During the mechanical harvesting, data on e.g. the speed and height of the harvester, light and noise levels, as well as the harvesting team experience and empathy will be collected. During the transport itself, the birds cannot be accessed, so resource based measures such as variations in temperature; driving and road characteristics as well as time travelled will be included. At lairage, a sample of birds will be clinically assessed prior to shackling. In addition, meat inspection data as rejections, dead on arrival (DOA) and pathology will be included. Data will be analysed for confounding and further modelled to identify risk factors for DOA and rejections. The project will conclude with recommendations for indicators that should be included in an assessment protocol performed prior to transport in order to perform an evaluation of the fitness for transport on broilers farms.

Poster Session: 16th July

VIDEO SURVEILLANCE OF CO₂-STUNNING OF FINISHING PIGS IN GROUPS

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CO₂-stunning of finishing pigs in groups is the most widespread stunning method in large abattoirs in Europe. The method of lairage and driving of the finishing pigs in smaller groups, with no usage of electric goad in the drive way leading to the stunning facility, is generally recognized for taking the natural behaviour of finishing pigs in to account, and thereby providing improvement of the animal welfare, compared to earlier systems, where electric goading could be frequent. Furthermore, it is possible to obtain a very stable and reliable stunning quality, leaving sufficient time for shackling, hoisting and sticking.

Gas stunning under experimental conditions can provide valuable and detailed measurements. However, usually only a limited number of individuals can be included in such studies, and furthermore, it is well known that the induction and course of the gas-stunning process can be influenced by differences in stress-levels and physiology of the individual animals.

In order to be able to optimize both the stunning conditions and handling of the animals before stunning, it is therefore desirable to be able to systematically survey the stunning process of a representative number of animals under commercial conditions.

The objective of the study was to demonstrate and describe a method for video surveillance of the entire stunning process of finishing pigs during commercial conditions, combined with surveillance of handling and behaviour before stunning.

Video surveillance of the offloading of vehicles, direct observation during lairage, and video surveillance of the drive way and push-hoist gates, combined with video surveillance of the stunning progress will provide an effective tool for the investigation of the correlation between handling immediately before stunning and the induction and progress of the stunning procedure.

The method of surveillance of the stunning process will be demonstrated, and preliminary results presented.

Poster Session: 17th July

THE EFSA APPROACH TO ASSESSING PROPOSALS FOR NEW STUNNING METHODS

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Council Regulation (EC) No 1099/2009 lays down rules for the killing of animals bred or kept for the production of food, wool, skin, fur or other products as well as the killing of animals for the purpose of depopulation and for related operations. A lawful application of modified or new stunning methods in the European Union must ensure a level of welfare at least equivalent to that associated with the methods already described in this Council Regulation on the protection of animals at the time of killing.

The European Commission (EC) has recently received several studies in support of requests from Member States for modified and new stunning methods (e.g. for waterbath stunning of poultry, low atmosphere pressure systems (LAPS) for stunning poultry, electrical stunning of small ruminants and modified atmosphere stunning of rabbits). The EC asked the European Food Safety Authority (EFSA) to provide scientific assessments of these studies.

EFSA's Animal Health and Welfare Panel (AHAW) developed a guidance document that defines the assessment process and criteria by which it assesses these studies. The first level is an eligibility assessment of the study. If this is fulfilled, the study is subjected to an assessment of reporting and methodological quality. The eligibility criteria are based upon the legislation and previously published scientific results. They focus on the intervention and the outcomes of interest, i.e. immediate onset of unconsciousness and insensibility or absence of avoidable pain, distress and suffering until the loss of consciousness and sensibility, and duration of the unconsciousness and insensibility (until death). As a final step in this first assessment phase, the methodological quality of the submitted study is evaluated. If the criteria regarding eligibility, reporting quality and methodological quality are fulfilled, a full assessment of the animal welfare implications of the proposed alternative stunning intervention, including both pre-stunning and stunning phases, and an evaluation of the quality, strength and external validity of the evidence presented is carried out.

When generating supporting data for modified or new stunning interventions, the use of live animals should be minimised as stated in Directive 2010/63/EU on the protection of animals used for scientific purposes. Potential pain, distress and suffering of animals subjected to experimental investigations must be avoided and the principles of replacement, reduction and refinement (the 3Rs) when using animals for scientific purposes should be applied.

Poster Session: 17th July

FARM ANIMAL WELFARE AND CORPORATE SOCIAL RESPONSIBILITY: MAKING SLAUGHTER VISIBLE?

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Until relatively recently, the slaughter of animals for human consumption was almost invisible: many of us consumed meat but chose to remain ignorant of its origins. From the late 20th century onwards a series of crises raised concerns about farm animal welfare (FAW) within industrial food production systems, but the slaughter of animals was rarely discussed. A series of complex global processes have since pushed the underlying issues back into public consciousness and political debate, with animal slaughter now being discussed more openly than at any time over the last two centuries. However, while corporate retailers and large supermarkets are making FAW a central feature of corporate social responsibility strategies, slaughter still remains a largely invisible issue.

The Business Benchmark for Farm Animal Welfare (BBFAW) epitomizes this situation. Lunched in line with the increasing recognition of the business case for improving FAW at the global level, BBFAW was designed to improve corporate reporting on FAW management and performance in order to stimulate good practice by corporate retailers and supermarkets. One of the BBFAW assessment criteria relates to the position of companies on the avoidance of meat from animals not subjected to pre-slaughter stunning. While most developed countries have legislation that requires animals to be stunned prior to slaughter, there are often exceptions that allow slaughter to be practiced without pre-stunning under certain conditions. However, despite the emergence of halal and kosher meat markets and their associated controversies in a number of EU countries, the BBFAW found that almost 75% of the companies assessed do not provide any information on animal slaughter in their corporate reports and policies.

This paper assesses the reasons for this omission and the continuing invisibility of animal slaughter in corporate food policy discourse.

Poster Session: 16th July

BEHAVIOURAL RESPONSES OF BROILER CHICKENS DURING LOW ATMOSPHERIC PRESSURE STUNNING

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Low atmospheric pressure stunning (LAPS) is a new stunning method for broiler chickens (*Gallus gallus domesticus*), which has the potential to be more humane than current methods. LAPS consists of a hypobaric chamber that allows oxygen to be gradually removed from the environment by the controlled removal of air; the process takes 280s. In this study, the behaviour of 50 individuals and 50 groups of 20 broilers was observed during LAPS. Latencies, total durations, single bout durations and number of bouts were recorded for all behaviours. Three different decompression curves were applied during the process (settings related to ambient temperature which affects air density) and their effects on behaviour were investigated. Not all birds displayed all behaviours, but a subset of behaviours (ataxia, loss of posture, clonic and tonic convulsions) occurred in a consistent sequence. Mandibulation, headshaking and open bill breathing occurred earliest at 44.5s (range 4.4s-137.5s), 50.8s (range 3.3s-167.3s) and 57.4s (range 4.3s-187.9s) respectively after LAPS commencement. Ataxia was observed on average at 57.3s (range 17.8s-77.2s), with birds at colder temperatures taking longer to succumb to ataxia than those at warmer temperatures. Loss of posture (LOP) is viewed as a behavioural marker for loss of consciousness and it occurred on average at 83.7s (range 58.8s-232.7s). Clonic and tonic convulsions were displayed after LOP at 110.5s (range 63.3s-208.2s) and 117.4s (range 73.9s-185.3s) respectively. Mean time to motionless was 199.4s (range 158.2s-245.6s) and was not affected by temperature setting. Based on LOP, the data suggest that birds are in a conscious state for longer during LAPS than in controlled atmosphere stunning (CAS), but the induction to unconsciousness is more gradual and there were no escape responses during LAPS. Although behaviours potentially indicating negative welfare were seen (e.g. headshaking), they did not occur in all birds. The results suggest that LAPS could improve bird welfare at the time of slaughter.

Poster Session: 16th July

PROMOTING AND IMPLEMENTING HIGH STANDARD OF ANIMAL WELFARE: AN EXAMPLE IN FRENCH CATTLE SLAUGHTERHOUSES

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The new regulation on the protection of animals at the time of killing, adopted in 2009, by the European Union provides the industry with a new template for the development of high standard of animal care at the abattoirs.

The French organizations of cattle slaughterhouses by collaborating with research institutes initiated a working program to promote and implement best practices available. A guide to good practices, which intends to be the basis for standard operating procedure (SOP), was finalized in 2010.

This includes four main tools:

- A hazard analysis realized step by step from the unloading of the animals till the death. As an output of this analysis, recommendations about design and management have been proposed in two separate sections.
- A specific guide dedicated to the layout of slaughterhouses.
- Flowcharts and instructions: For each step of the process, the standard operating procedures are described and conditional/decision points are identified in relation with the main risks for animal welfare. Corrective actions and/or alternative procedure are proposed.
- Self-monitoring procedure to be used by the Animal Welfare Officers (AWO) to check the efficiency of the different procedures at the different step of the process. This procedure lists animal-based measures (e.g., slips, falls, handling, signs of consciousness...) which should be monitored in parallel with the control of SOP.

Following the first release, the guide, officially recognized in 2014, was updated by taking into account new results available from research studies and by being submitted to a reviewing process carried out by the competent authorities, including consultation of the NGO and the French food safety authority.

In parallel, since 2012, slaughterhouses operators and AWO have been specifically trained for the use of the guide. Specific programs of 2 to 3 days training have been developed for each category of operators. A national database of questions was produced by a network of scientists and is currently used by the competent authority for an online independent evaluation for the certificate of competence.

Poster Session: 17th July

EFFECT OF LONG TERM TRANSPORTATION ON SHEEP PRODUCTIVE TRAITS, BEHAVIOUR AND WELFARE

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Transport imposes a stress on livestock, which may be aggravated by age. Little is known about how cull animals (typically older and weaker) recover after transport and how much it compromises their welfare. In this study, 22 cull ewes of the *Chamarita* native breed were transported by road for 4 hours (200 km) and physiological stress indicators were measured one day before transport and at four time points post-transport (0, 4 and 24 h), and compared to 22 similar ewes that were not transported (i.e., remained on the source experimental unit). Live body weight the day before and immediately after transportation was recorded using a portable digital weighing scale and the weight loss during transportation was calculated. Blood samples were taken from all ewes (both transported and no transported) the day before and immediately after the road transportation and 4 h and 24 h post-transport to evaluate physiological responses to stress and body temperature of ewes was measured by temperature registered buttons inside intra-vaginal sponges without hormones. Direct observations, with a combination of scan and behaviour sampling, were carried out to collect information on individual behaviour and the time it took the ewes to drink water, eat and rest after returning to their pen, respectively. Transported ewes lost approximately 1 kg live weight compared to controls, and had higher body temperatures until 12 h post-transport. Cortisol, glucose, NEFA concentrations as well as the N/L ratio and other physiological indicators were higher immediately after unloading in transported ewes but mostly returned to normal after 4 hours, with complete recovery after 24 hours. Behavioural analysis post-transport demonstrated that transported ewes chose to eat before drinking and spent less time resting than controls in the first three hours after unloading. Although there is evidence to suggest that stress responses may be more severe and prolonged in aged animals, we found that cull ewes had levels of physiological stress parameters that fell within ranges for adult sheep and recovery 24 hours after transport.

Poster Session: 17th July

20 YEARS OF EXPERIENCE IN CARBON DIOXIDE STUNNING OF POULTRY: PROVEN SCIENTIFIC KNOWLEDGE AND ADDITIONAL INSIGHTS

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Controlled Atmosphere Stunning (CAS) has been adopted in a high proportion of modern poultry processing plants within and outside of the EU. The main driver for adopting CAS, which was first introduced for poultry in the mid-90s, are considerations of animal welfare and meat quality. To achieve high welfare standards, producers in Europe are required to apply high electrical currents during electrical waterbath stunning. This often leads to haemorrhages in the fillet and tenderloin, due to the simultaneous contraction of all muscles when the electricity runs through the complete body of the birds. When applying CAS, these muscle contractions are eliminated, thus preventing the occurrence of haemorrhages in the valuable fillet and tenderloin.

To ensure high animal welfare standards with CAS, many scientists have investigated different atmospheres and evaluated their effect on poultry. Based on this extensive research, mixtures using the anesthetic effect of carbon dioxide are accepted for stunning of poultry in the EU, as well as mixtures using inert gases for anoxic stunning. In practice, mixtures using carbon dioxide are preferred, to avoid the risk of meat quality damage during heavy convulsions and vigorous wing flapping that can often be observed during anoxic stunning. The possibility of an aversive reaction of chickens to carbon dioxide was initially discussed and scientifically evaluated, with the conclusion that conscious birds are administered to a maximum of 40% carbon dioxide. After loss of consciousness they are then transferred to higher carbon dioxide concentrations for a deeper, irreversible stun. Moreover, the addition of oxygen to the mixture during the induction of unconsciousness has been recommended by several scientists for a smooth induction.

Today, carbon dioxide stunning is the method of choice in European poultry processing. Mixtures are administered in pits, tunnels or compartments, where the animals are either introduced into a chamber with a pre-defined atmosphere, or the gas is inserted into an enclosed compartment with birds. In all cases a good control of the gas atmospheres is mandatory to maintain high animal welfare standards. During 20 years of implementing Multiphase CAS under practical conditions, with different local circumstances, observing birds from different breeds, flocks and management systems, knowledge from initial scientific assessments could be substantiated and further extended through continuous assessment and evaluation. To ensure high animal welfare standards in daily practice, validated behavioural parameters are needed to link scientific assessments under laboratory conditions to observations in the field.

Poster Session: 16th July

KILLING SPENT LAYING HENS ON FARM, IN 1 SECOND

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Transportation of spent laying hens causes them severe suffering. They are roughly handled when taken out of the cages, and with broken legs and chests pressed into small boxes for transportation to the slaughter house.

From the moment the first hen is removed from the cage until it is killed it could take 8-10 hours. Removing all hens from the cages, transportation, waiting in the slaughter house and slaughtering all hens is a long and hard-suffering time.

Hai-Meshek conducted a research aimed at finding more humane methods of transportation. E.g. more gentle taking out from the cages, small number of hens in the boxes, covered truck against sun, wind and rain and so on. Such solutions would increase the time spent on farms and decrease the number of hens on the truck, which means an increase in costs. The only way to force such solutions is by legislation, but even then it would not work. It is difficult to detect truck drivers violating the rules and the fine is negligible, compared to savings by the abovementioned cruel method.

The only humane solution is by preventing the transportation and slaughtering on farm. Spent laying hens are not edible, so they need not be slaughtered in the slaughter house. The solution of slaughtering on farm was rejected because of the problem of blood and the hen's vocalisations.

Hai-Meshek initiated and participated in the development and the building of a facility for the Humane Killing of Spent Laying Hens on Farms. The hens are electrified and die in 1- 1.5 seconds.

Now the facility is brought to every farm in Israel and is used also for killing sick flocks. No more transportation of spent laying hens is allowed!

Poster Session: 16th July

RELATIONSHIP BETWEEN STRESS-RELATED PHYSIOLOGICAL EXSANGUINATION BLOOD VARIABLES, VOCALISATION, AND STRESSORS AT A CONVENTIONAL ABATTOIR

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The objective of the current study was to determine relationships between stress-related physiological and behavioural variables and a series of individual animal data. Stress-related blood parameters (exsanguination serum samples were obtained for cortisol, glucose, and lactate analysis) and animals' vocalisations (as a verbalism of stress response) were set in relation to sex, breed type, and carcass weight as well as electrical prodding actions and duration of the animals' stay in the stunning box. A total of 192 cattle (45 bulls, 61 steers, and 86 heifers) from different breeds (30 dairy breed, 70 beef breed, and 92 crossbreeds) were observed from lairage to the stunning box when the animals were slaughtered routinely, within 1 day at a commercial abattoir. The frequency of electrical prodding actions by slaughterhouse staff (three categories: zero prods, 1 to 3 prods, and 4 to 9 prods per animal), sex (bulls, steers, and heifers), breed (crossbreeds, beef cattle, and dairy cattle), the length of the stay inside the stunning box, and carcass weights were recorded.

The average carcass weight was 231 kg (SE = 46.2). The average ages were 393 days (SE = 87.6) in bulls, 401 days (SE = 192.6) in heifers, and 310 days (SE = 27.4) in steers. Vocalisation occurred in thirteen percent of all observed animals. By trend, male cattle vocalised less than females ($P = 0.07$). Mean exsanguination blood values were: 77.2 ng cortisol/ml (SE = 68.8), 5.7 μ mol glucose/ml (SE = 1.3), and 6.7 μ mol lactate/ml (SE = 3.3). Steers and heifers had higher concentrations of serum cortisol than bulls ($P < 0.01$). None of the stress-indicating variables were affected by breed type. More than hundred animals (117) were prodded for one to three times, 24 animals obtained between 4 and 9 prods, and 49 animals were never prodded. Proddings were not related with the blood serum variables and the occurrence of vocalisation. With increasing time spent inside of the stunning box measured cortisol concentrations increased ($P < 0.05$). No influence of time in the stunning box was found on serum lactate and glucose values or on the percentage of vocalising cattle. The stress levels measured in the present study were considerably high, but it was not possible to connect the stress indicators distinctly to individual factors. Future research should take into account the influence of farming conditions as well.

Poster Session: 17th July

TARGET AREAS FOR ANIMAL WELFARE IMPROVEMENT WITHIN A RELIGIOUS CONTEXT

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There is a need to focus on training within the context of religious slaughter to ensure maximal animal welfare in a way that is respectful of religious beliefs. Animal welfare research that has been done in the arena of religious slaughter has focused on the moment of the animal's death. The quality of an animal's death is greatly influenced by the restraint and procedure that leads to the moment of loss of sensibility. Animal welfare scientist and proponents of humane slaughter should begin by focusing on training endeavors that enhance the final minutes to days of an animal's life without questioning tenants of religion.

The areas of religious slaughter in need of improvement are similar to conventional slaughter. A focus should be placed on safe transport, calm handling, and gentle, yet effective, restraint. In addition, Islamic slaughter practice should ensure that sharp, appropriate knives are used if un-stunned slaughter is being preformed. These areas have direct support in a number of religious teachings and thus could be taught as religiously encouraged, if not a required, responsibility.

Training materials, such as those published by Temple Grandin, need to be made available in relevant languages and the economic value of good end of life welfare should be taught to invested groups. Investments made in animal handling equipment would allow for un-stunned slaughter without painful practices such as intentional tripping or live hoisting of ruminants. Comfortable, safe transport should be ensured for all animals heading for slaughter regardless of how or in which country they are to be slaughtered. Research to help determine the ideal restraint mechanism for each type of stunning and/or slaughter should be conducted by scientists with relevant training.

The greatest improvements in animal welfare are accomplished through collaborative efforts involving multiple interest groups. It is imperative that a way is found to incorporate those practicing religious slaughter in this collaboration in a way that does not exclude them due to a fundamental belief.

Poster Session: 16th July

CAUSES OF LIVESTOCK VEHICLE ACCIDENTS IN THE UK AND THE CONSEQUENCES FOR THE ANIMALS INVOLVED

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Livestock vehicle accidents can have devastating consequences for the welfare of animals being transported yet little is known about the characteristics of these accidents in the UK. This study obtained details of 207 livestock vehicle accidents that occurred in the UK between 2003-2013 from internet media reports and archive newspaper records. A significant difference ($P < 0.005$) was found in the frequency of accidents at different times of the day with 43% occurring between 7am and 11am. A significant difference ($P < 0.005$) was also found in the distribution of accidents throughout the year with notable increases in October and November. Cattle were involved in the most accidents (41%), followed by sheep (26%), pigs (15%) and chickens (15%). Accurate livestock casualty numbers could not be obtained, but the results indicated the vast majority of animals killed were chickens. The majority of accidents only involved the livestock vehicle (78%), with large transporters being involved in most incidents (72%). There was a highly significant difference ($P < 0.001$) in the causes of accidents with overturning being the main reason; caused by a sudden and substantial shift in livestock position. All livestock are at risk in large transporters; whilst cattle face additional risks when towed in trailers behind 4x4 vehicles. Two factors contribute to overturning accidents; poor driving style and commercial livestock vehicle design. Driving style can be improved through training and reduced pressure on drivers, whilst better vehicle design can be achieved by adopting new technologies and changing some industry practice.

Poster Session: 17th July

OBSERVATIONS ON THE UNDERSTANDING AND IMPLEMENTATION OF EC REGULATION 1099/2009: ANALYSIS FROM FARM, FACTORY AND HATCHERY AUDIT OF THE GLOBAL POULTRY SUPPLY CHAIN FOR A MAJOR UK RETAILER.

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The introduction of EC regulation 1099/2009 represents a significant advancement in and harmonisation of existing legislation at a community level relating to the welfare of specified animal species at the time of killing; with the additional requirement that 3rd party countries should demonstrate equivalent levels of compliance when exporting product to the EU.

Tesco Stores (UK) Ltd required inspection of their global agricultural supply base against 1099/2009 from point of commencement (January 2013). This was in order to understand existing levels of compliance, timeframe for change and barriers to implementation (be they National or sector specific). There was additionally concern that prior to regulatory commencement it was apparent that there were areas where the detail of implementation was unclear, particularly surrounding manual culling restrictions on farm.

The supply base as a whole is inspected by Integra Food Secure Ltd, an independent, ISO 17020 accredited, inspection body.

A total of 703 inspections were carried out in the period from January 2013 to October 2014 across a range of poultry establishments. The breakdown by species and sector is summarised as anonymised data in Table 1.

	Hatchery*^	Farm**	Factory**^	Total
Chicken (UK)	37	183	34	254
Chicken (EU)	28	160	27	215
Chicken (Non-EU)	27	60	17	104
Total	92	403	78	573
Turkey (UK)	10	81	4	95
Turkey (EU)	12	20	6	38
Turkey (non-EU)	-	-	-	-
Total	22	101	10	133
<p align="center">* All Hatchery cull methods (IMD and CA) are represented in Hatchery data ** bird weights from day old to >>5kg are represented within farm data. ***All current poultry stunning methods (CA single; CA biphasic; high and low frequency electrical stun and sites with Halal accreditation) are represented within the slaughter data ^ Hatchery and factory data include repeat visits to the same site to provide time frame comparisons</p>				

Table 1: Summary of Inspections

A summary of non-conformance findings will be presented by timeframe, country and supply sector indicating where continued barriers to implementation, or problems of understanding persist and highlighting demonstrable improvement and good practice where noted.

Poster Session: 17th July

PERCEPTION ON FISH WELFARE ISSUES BY LATIN AMERICAN CITIZENS

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Recent studies on cognition, emotional states and nociception have suggested that fish are sentient beings. However, surveys about public perceptions on fish sentience and welfare are scarce. Additionally, humane slaughter regulations in most countries do not include fish, as is the case in Brazil and Colombia. This study aimed to assess the perception of Brazilian and Colombian citizens in relation to sentience, welfare and humane slaughter in fish. An online survey was distributed to the population of Bogotá, Bogotá D.C., Colombia, and Curitiba, Paraná, Southern Brazil. We received responses of 782 respondents, 395 from Bogotá and 387 from Curitiba. The survey consisted of questions on demographics and people perception regarding sentience, slaughter methods and different practices involving fish. Comparisons were made using Mann-Whitney and chi-square tests; the calculated error was 5%. Results showed that 75.8% (593/782) of respondents believe fish are sentient animals. The participants were asked about the level of sentience in eleven different species, on a 5 point-scale. The descending order in perception of sentience was human baby (87.6%), dog (78.5%), wolf (65.7%), cattle (58.6%) sheep (56.5%), mouse (45.4%), hen (43.7%), pigeon (40.1%), fish (33.5%), butterfly (17.6%) and cockroach (14.9%). Results seem related to the level of human affinity to each species. Furthermore, a higher perception of sentience regarding mammals may be associated with phylogenetic proximity. In general, women's perception on sentience was higher for all species ($p < 0.01$). A high level of fish suffering was perceived in some practices and killing methods. Amongst all participants, 18.4% (144/782) found catch-and-release recreational angling acceptable; being 29.4% (87/296) amongst men and 13.8% (67/486) amongst women ($p < 0.01$). Likewise, 74% (579/782) of respondents perceived high level of suffering in the catch-and-release angling. Slaughter methods cited as most commonly observed were asphyxia (84.6%) (662/782), decapitation (49.2%) (385/782), percussion (35.3%) (276/782), gutting (33.6%) (263/782) and transportation of live fish in dry plastic bags, characterizing slow death by asphyxiation (11.0%) (86/782). Most respondents (92.3%) (722/782) pointed out that these methods of slaughter cause suffering in fish. Forty-three percent (344/782) of respondents have heard the term humane slaughter, with varying percentages according to different levels of education ($p < 0.01$). Even then, 75.3% (589/782) of respondents considered that fish should be included in humane slaughter regulations. In conclusion, the perception of fish sentience and welfare issues in citizens from two Latin American cities supports changes in the way these animals are treated, including proactive steps to improve legislation.

Poster Session: 16th July

EXTENDED JOURNEY LENGTHS (11 DAYS) IN HIGH SPECIFICATION LORRIES DOES NOT FURTHER COMPROMISE PIG WELFARE

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Long distance transport of pigs may be detrimental to welfare, especially when the journeys consist of ferry crossings, temperatures over 35°C, and journey durations of over 24 hours. To evaluate the magnitude of the welfare impacts we monitored breeding pigs during commercial journeys, lasting between 24 hours and 11 days. Working with 4 different gilt breeding and export companies, data was collected during 11 journeys that occurred during all seasons of the year; due to disease precautions pigs were not unloaded during statutory rest stops, and food and water were provided on the lorry at each stop. Data collected was behaviour, mortality and poor breeding performance. No behaviours identified by EFSA as indicating adverse welfare were observed. Mortality for all journeys was 0%. No poor breeding performance was reported. Pigs showed patterns of lying behaviour similar to pigs of the same weight in a home straw pen. Lesion scores, caused by fighting, increased over the first 24 hours of the journey but then did not change. Behaviour was not influenced by high temperatures or a ferry crossing; maximum environmental temperatures of 37°C were measured and two ferry crossings of x hours were included in the journeys monitored. This study indicated that the welfare of pigs when transported in appropriate stocking densities, and in high specification lorries is not further compromised by extended journeys.

Poster Session: 17th July

AN ANIMAL WELFARE ASSESSMENT OF SWINE MARKETED THROUGH BUYING STATIONS IN THE UNITED STATES

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Culled breeding animals represent 3% of swine slaughtered in the United States. Pigs are culled for multiple reasons including size, body condition, injury and poor performance. There are concerns that culled animals face higher risks of becoming fatigued or non-ambulatory during marketing and transport. The objective of this study was to explore the welfare of culled swine marketed through buying stations across the United States. Specifically, we sought to characterize the prevalence of different types of compromised swine as well as identify potential risk factors associated with fatigued and non-ambulatory animals. An observational survey was conducted at integrated and independent buying stations from March to October 2014. A total of 16 individual buying stations were enrolled, representing four marketing companies with locations in the Midwestern and Eastern U.S. The number of trailers per day ranged from one to twelve incoming loads. Animals per load ranged from 9 to 160, and included culled sows, breeding gilts, boars, and market pigs. Detailed animal assessments were conducted at the time of unloading on all incoming trailer loads with every animal on each load assessed. Animals were scored for condition on arrival (non-ambulatory, fatigued, dead), as well as body condition, injuries, hernias, skin lesions, vulva lesions, tail bites, lameness, abscesses, and prolapses. Animals that were classified as non-ambulatory, injured and/or severely emaciated by buying station employees and segregated from their cohorts were further evaluated based on the final outcome (rested and recovered, euthanized or died). Descriptive summary statistics have been completed for 6,714 pigs and 116 trailer loads. Five animals were dead on arrival (0.07% total prevalence), with a further 23 euthanized during the unloading process (0.34% total prevalence). Follow-up assessments were conducted on 74 animals segregated from their cohort, of which 55 were euthanized (74%). Sows and boars comprised 84% of the fatigued animals (16% total prevalence), 77% of the lame pigs (5% total prevalence) and 87% of the animals with body condition score 1 (3% total prevalence). Market pigs comprised 11% of abscesses (6% total prevalence), 78% of hernias (3% total prevalence) and 55% of tail bitten pigs (1% total prevalence). Opportunity to identify at risk animals that fail to cope with transport and handling stressors can assist decision-making about fitness for transport, with implications for humane endpoints and mitigating production losses.

Poster Session: 16th July

ARE SOWS SENT FOR SLAUGHTER FIT FOR TRANSPORT?

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Each year more than 400.000 Danish sows are sent for slaughter and transported by road to abattoirs. To date, only very limited knowledge about the fitness for transport of these animals are available, as most research on pig welfare on the day of slaughter have focused on finishing pigs. However, for each individual sow, the fitness for transport must be assessed pre-transport in order to avoid transportation of unfit sows, leading to unnecessary suffering and potential violation of the animal protection legislation.

This poster presents an on-going project aimed to gain knowledge about fitness for transport of sows sent for slaughter in Denmark. Via recordings of behaviour and clinical condition of the animals on-farm and upon arrival at an abattoir, as well as conditions during transport (duration 0-8h), this project seeks to provide knowledge about risk factors and relations between the baseline condition of the sows and their condition upon arrival at the abattoir. This information will form basis of the development of a scoring system, which will facilitate the pre-transport assessment of fitness for transport in sows.

The project involves an observational study of approximately 600 Danish sows destined for slaughter. We will record data during several of the phases characterising the day of slaughter: on-farm (baseline), during a stay in a pick-up facility before transport, during loading onto the vehicle, during transport, during unloading and at the entrance to the abattoir as well as during lairage.

This project is part of a larger Danish initiative focussing on farm animal fitness for transport. The two other sub-projects involve dairy cows and broilers.

Poster Session: 16th July

EVALUATION OF PRODUCER ATTITUDES REGARDING ON-FARM EUTHANASIA METHODS FOR COMMERCIAL MEAT RABBITS

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The development and validation of efficient, humane, and safe methods for on-farm euthanasia of all livestock species, including meat rabbits, is a high priority for both provincial and federal governments and is important for meeting Canada's international animal welfare commitments to the OIE. There are no readily available reference guidelines or training tools for commercial rabbit producers or their veterinarians in Canada that cover decision-making for early identification of cull animals and acceptable methods of on-farm euthanasia. A lack of available information has resulted in inconsistent decision-making regarding animal culling, neglect of animals requiring euthanasia on-farm, and inappropriate techniques being used for euthanizing rabbits on-farm. A 32-question survey tool was developed that addressed issues such as methods used for culling adult and juvenile rabbits, satisfaction with techniques and estimated skill level, reasons for culling, evaluation of animals for insensibility and death, how they were trained to kill rabbits on-farm, euthanasia success rate, disposal practices, and amount of money that the producer would be willing to spend on equipment geared to rabbit euthanasia. In addition, producers were asked to read a short explanation about the use of non-penetrating captive bolt tools for euthanasia and carbon monoxide gas inhalation for depopulation, and answer several questions related to these scenarios. The survey tool was reviewed and approved in advance by the University of Guelph Research Ethics Board. Commercial meat rabbit producers in Ontario and Quebec were contacted to participate in the survey, since these two Canadian provinces account for over 80% of the rabbit meat produced in Canada. A low value incentive card was offered to encourage their participation; however, all answers were anonymous. Responses to questions were highly variable and it was clear that inappropriate methods were often used for culling and disposing of rabbits on-farm, that culling was considered a highly unpleasant task, that many individuals were uncertain about their skill level for culling, and that producers strongly believed that there was a need for training material development in this area. This poster will present the findings from this survey in full. These results will be used to develop future training tools for Canadian meat rabbit producers about appropriate techniques for euthanizing meat rabbits of different ages as well as recognizing signs of pain and distress in their animals.

Poster Session: 16th July

IMPROVING ANIMAL WELFARE: CAS STUNNING BEFORE TILTING

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Introduction

In Europe, live birds are mainly transported in either drawer systems or in transport containers. Until recently, such containers were emptied by tilting, so live birds slipped from their floor onto a conveyor belt. From there, the birds were either hung by their feet, and stunned in an electrical water bath, or stunned by CAS (avoiding live hanging). However, the drawback of unloading live birds remained.

Mohan Raj (1990): “The main benefit of gaseous stunning methods in comparison to electrical stunning is that the birds can be stunned in their transport crates and this would eliminate the pre slaughter stress associated with uncrating and hanging live birds.” The next step to improve animal welfare was to stun the birds *in* their transport container (so before live tilting).

Results

During their life, birds are protected by Dir. 2007/43/CE; at the day of slaughter, birds are also protected by a.o. Reg (CE)1099/2009. Both standards demand that avoidable stress must be avoided. Tilting live birds is thought to be stressful to the birds, and this stress is avoided by CAS stunning *before* unloading.

Recently, a new CO₂ CAS system has been developed, validated (Gerritzen 2012) and introduced to the market (Gerritzen 2013).

Birds become unconscious in the first phase and become irreversibly stunned in the second phase, compliant to Reg (CE)1099/2009 Annex I, Chapter I, table 3, no 2.

In both phases the CO₂ concentration is increased stepwise, to further improve animal welfare and the depth of stunning.

Conclusions

In this new approach, avoidable stress from live tilting can be avoided, thereby answering to public concern regarding animal welfare and further complying to current legislation.

Poster Session: 17th July

TRANSPORT OF EQUINE ANIMALS FOR SLAUGHTER: NEW GUIDELINES ON WATERING AND FITNESS FOR TRANSPORT

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Welfare problems amongst equine animals transported long distances across Europe for slaughter have been well documented in the literature and by NGOs. There is a concerted effort to tackle these problems through various means, most notably legislative changes to achieve a reduction in journey times. However, the process is lengthy and often faces resistance from those involved in the trade. Industry-accepted measures to address poor welfare in the short- to medium-term are required. As such, European Commission-endorsed guideline documents have been produced that focus on two key areas: watering and fitness for transport.

Inadequate water provision leading to signs of dehydration and its sequelae are consistent findings in the field. Anecdotal evidence suggests that widespread misinformation is a significant contributory factor. The 'Practical Guidelines on the Watering of Equine Animals Transported by Road' provide clear and simple guidance on water requirements, the effect of transportation on water requirements, how and when to provide water, signs of possible dehydration and how to deal with a dehydrated animal. The guidelines include a one-sheet summary of the crucial points.

Legislation concerning fitness for transport is ambiguous and subject to interpretative differences, making fitness a complex and often contentious issue. Following on from the publication of well-received bovine guidelines, 'Practical Guidelines to Assess Fitness for Transport of Equidae' have been produced. The guidelines provide examples of various conditions that either deem an animal unfit for transport or that require further assessment prior to transport, along with guidance on the appropriate course of action in each case.

Both guideline documents were produced by a stakeholder group consisting of experts from various fields (including veterinary medicine, equine welfare, transport, the equine industry and the meat trade) and are available in several European languages. The specific objectives of the guidelines are to increase understanding of watering and fitness for transport and to assist with interpretation of relevant legislation, in particular Council Regulation (EC) No. 1/2005, without imposing further regulation. It is hoped that the guidelines will be widely accepted and utilised by all those involved in the transport of equine animals, thus generating important welfare improvements and associated benefits.

Poster Session: 16th July

TOLERANCE OF CARBON DIOXIDE GAS BY NEONATAL GOATS

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Euthanasia methods for compromised or unwanted neonatal goats (kids) have received little scientific scrutiny, and inhalant agents have not been evaluated for ruminants. The objective of this study was to examine the aversiveness of carbon dioxide (CO₂) to kids using approach-avoidance and condition place avoidance paradigms. A preference-testing device was custom designed with two connected chambers maintained at static gas concentrations. The control chamber maintained ambient air conditions (1% CO₂); the treatment chamber maintained predetermined CO₂ concentrations. Twelve kids were individually trained for 6 consecutive days to enter the treatment chamber to access the milk ration, with ambient air in both chambers. After 5 minutes in the control chamber, a sliding door was opened to provide access to the treatment chamber. Kids received 10 minutes access to the treatment chamber, after which they were removed and returned to the home pen. During the testing phase, the same procedures were used with the treatment chamber maintained at one of three CO₂ levels: 10%, 20% or 30%. Tests concluded when loss of posture occurred or after 10 minutes. Kids experienced each of the CO₂ treatments, followed by 2 wash-out days with ambient air conditions. Behavior collected using live observations and video recordings. All 12 kids learned to enter the treatment chamber to consume the milk ration. All kids entered the treatment chamber during all CO₂ treatments. Ten kids tolerated 10% CO₂ for 10 minutes without loss of posture; one left the treatment chamber at 8.5 min after consuming his full ration and one lost posture at 289s. During 20% and 30% CO₂ tests, all kids consumed milk prior to and during ataxia. Loss of posture occurred within 83s to 271s of exposure. None of the kids displayed conditioned place avoidance on wash out days. These results suggest CO₂ may be an acceptable method for euthanasia of goat kids.

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The HSA is a charity recognised internationally for promoting scientific, technical and educational advances towards improving the welfare of food animals worldwide at slaughter, killing, marketing and transport.