Report of an HSA Workshop Meeting on Low Atmospheric Pressure Stunning (LAPS) 10th September 2013, London

Introduction

1.1 The Humane Slaughter Association (HSA) held a workshop in London on 10th September 2013 to discuss the use of Low Atmospheric Pressure Stunning (LAPS) for food animals at slaughter. The HSA's purpose for organising the meeting was to learn of the development and use of this new system, discuss scientific findings relating to humaneness, and consider its potential for wider use and what further research might be needed relevant to this.

1.2 The meeting was attended by participants with an interest in the topic from scientific, technical, animal welfare and legislative perspectives. Presentations were given by Dr Karen Christensen from OK Foods, Arkansas, USA, and Dr Dorothy McKeegan from the University of Glasgow, UK.

The LAPS method and research relevant to assessment of its humaneness

2.1 Dr Christensen spoke about her experiences of using LAPS equipment at OK Foods, a high-throughput commercial broiler processing plant in the USA. The development of the technology and the motivation behind its development were explained. The LAPS process and the use of the technology in practice were then described, followed by a comparison of LAPS to alternative commercial methods of slaughter. Video footage of the LAPS equipment in use was shown, including footage of the birds in the chamber during a cycle.

2.2 Dr McKeegan presented the results of research into the method that has been conducted, both in a laboratory setting and in the commercial operation at OK Foods. Dr McKeegan's research has focused on evaluating the humaneness of the method using EEG and ECG data from birds undergoing the process. This work has recently been published (McKeegan, DEF., Sandercock, DA & Gerritzen, MA (2013) Poultry Science 92(4): 858-68).

2.3 Dr Christensen explained that the initial motivation for the development of LAPS equipment was to develop a humane stunning system which avoided the need for live shackling of birds, was 100% effective (i.e. killed all the birds) and was free from any possible operator interference. The equipment at OK Foods has been developed over three years in co-operation with the University of Arkansas and the manufacturer, Technocatch. The equipment has gained USDA and CFIA 'no objection' status and has been in full commercial use at OK Foods since spring 2011.

2.4 At OK Foods, the LAPS equipment consists of a chamber capable of holding two standard poultry transport modules (each containing 200-250 birds). Air is gradually removed from the chamber, such that pressure declines with time to follow a specific curve, and is 20% of ambient pressure by the end of the cycle. The system is powered by electricity only (there is no requirement for gas or other supplies) and is computer-controlled, including mechanical redundancy and fail safe protocols, preventing operator interference (so that the rate of decline of pressure follows a set trajectory with time that has been found to be optimal for welfare and efficacy). The chamber contains an infra-red camera to allow monitoring of the birds.

2.5 The birds are held in the chamber for a 280 second cycle. The cycle length has been designed to incorporate a significant safety margin to ensure 100% effectiveness. The LAPS process is irreversible, i.e. it is a stun and kill method. No birds have failed to be effectively stunned/killed by the process at OK Foods. Four chambers are used in parallel at OK Foods to achieve a processing throughput of 21,600 birds an hour.

2.6 Dr McKeegan discussed results from two studies into the method. The first involved a laboratory study of 14 birds using a single-bird capacity LAPS chamber. In the second study data were collected from 28 birds in the commercial system at OK Foods (one bird was monitored in each of 28 batches undergoing a LAPS cycle).

2.7 The results and conclusions are summarised below:

- ECG recordings showed no increase in heart rate during LAPS. This has been interpreted as indicative of an absence of stress response during the process.
- ECG shows a significant fall in heart rate from 40 seconds in to the cycle.
- ECG artefacts were used as a crude indicator of bird movement; specifically ataxia and wing flapping. The mean time to first ECG artefact, thought to reflect ataxia, was 39 seconds (range 20-69 seconds). Intense ECG artefacts thought to reflect wing flapping after loss of consciousness were seen at a mean time of 128 seconds (range 96-159 seconds).
- EEG results showed increasing slow wave activity (consistent with reduced brain activity) from 10 seconds (thought to be induced by darkness at this early stage of the process, and then by the declining oxygen pressure), peaking at 30 seconds into the process. Similarly, Delta wave activity (consistent with deep sleep/unconsciousness) increased to a peak at 30 seconds.
- It was suggested that the EEG results support a conservative estimate for time to unconsciousness of 40 seconds into the LAPS process. This coincides with observations of loss of posture in the birds at around this time.
- There was individual variation in timing but, otherwise, ECG and EEG results were highly consistent between individual birds.

2.8 Post-mortem examination of birds that had undergone LAPS (in a separate study to the above) found no pathology in lung, liver or muscle tissue. Additionally, no ear damage was found on post-mortem examination. These results have not been published.

Discussion

3.1 The discussion following the two presentations focussed on three main areas:

- Animal welfare
- Operational and technical considerations
- Further processing and meat quality

Animal welfare

3.2 Although birds occasionally displayed headshaking (2 of 14 in the laboratory study; individual observation was not possible in the commercial system study), this was not thought to be the same as aversive head-shaking seen in gas systems, and it was suggested that it might indicate arousal. It was agreed that further behavioural studies would be helpful for determining variation between birds in time taken to lose posture, and to develop standard monitoring criteria. There are difficulties (both ethical and practical) in performing some of the behavioural tests that can be informative about welfare aspects (e.g. aversion, conditioned place aversion, and cognitive function tests). Conditioned place aversion tests would require birds to undergo recompression following LAPS, making it difficult to evaluate the aversiveness of decompression alone. It was mentioned that recompression can be painful in humans.

3.3 The lack of an increase in ECG readings during the process was interpreted as indicating that birds did not experience additional stress during LAPS. However, the average heart rate upon entering the chamber was high (up to 400bpm) and it was questioned whether this may have constrained further increments. It was reported that ECG recordings over 450 beats per minute had been recorded in other studies, so it was thought that further increase could have been possible. The potential to measure stress hormone levels in birds during LAPS was discussed. However, this might not be possible in view of the short cycle times.

3.4 The effect of bird density in the chamber was discussed. It is not thought that this has a significant effect on the process.

3.5 The Technocatch LAPS equipment has been tested on turkeys and laying hens, with good results. It was discussed that the method could have significant potential for pig processing.

3.6 The acceptability of the method for religious slaughter was raised. LAPS is a stun and kill method and may therefore not be acceptable for religious slaughter. However, there is some residual heart activity recorded by ECG when birds exit the process and this may allow the method to be deemed acceptable by some religious communities.

Operational and technical considerations

3.7 Operational advantages of LAPS equipment compared to other commercial methods include: low capital costs, low running costs (OK Foods estimated a saving of $750,000 per annum on gas costs), and low carbon emissions. The working environment for staff at the hanging-on point is improved. Staffing requirements at OK Foods have not changed, but staff turnover has reduced.

3.8 The system is capable of operating with different module sizes (e.g. Anglia Autoflow systems commonly used in Europe) and can be manufactured with different chamber sizes.

3.9 The LAPS equipment automatically adjusts to changes in environmental temperature (lengthening the duration of the initial pressure reduction phase in cooler temperatures).

3.10 Concerns were expressed over the identification of dead-on-arrival birds (DOAs). This was a significant concern for OK Foods, but it was found that staff did not experience any difficulty in identifying DOAs (using toe rigor and temperature as indicators). This has been confirmed with infrared temperature recording of core-body temperature of birds on the processing line.

3.11 Periods of intense wing flapping are seen during the LAPS process, which are also observed in other stunning methods. OK Foods have recorded an increase in wing damage on carcases of <2%. However, this is offset by the elimination of damage which previously occurred at dumping and live-shackling.

3.12 Faecal voiding occurs during convulsions in the LAPS chamber, this is reported to have resulted in a decrease in visual faecal contamination within the processing plant. Previously, when using an electric waterbath system, OK Foods reported significantly higher levels of faecal contamination in the scalding tank. It was suggested that scientific evaluation of carcase contamination might be helpful towards making the case for the uptake of LAPS in Europe. A benefit of reduced faecal voiding within the plant is that it has been possible to reduce feed withdrawal before processing, from 10-12 hours to 4 hours. This results in a greater bodyweight yield and an emptier gall bladder, which results in cleaner processing. Additionally, reduction of feed withdrawal provides a welfare benefit to birds that are accustomed to having food present at all times.

Further Processing and Meat Quality

3.13 Bleeding out is reported to be comparable to that when using electrical waterbath systems. USDA has required that bleeding occurs within 10-15 minutes of death. With LAPS, exsanguination is usually completed within 2 minutes after exiting the chamber under normal

operational conditions. Time to exsanguination may exceed 15 minutes in the event of conveyor breakdown after exiting the LAPS chamber. Any carcasses showing signs of rigor will not be placed on the processing line. OK Foods report that the time to bleeding could be further reduced with improved plant design.

3.14 The change to LAPS from electric waterbath stunning has had no impact on defeathering.

3.15 Apart from a reduction (compared with electrical stunning) in blood spotting, the change to LAPS has not had any impact on meat quality or further processing in terms of moisture pickup or marination.

3.16 Perception of the method has been positive in OK Foods' supply chain and customers have started to specifically request the method.

Conclusions

4.1 In conclusion, LAPS appears to offer significant advantages over other commercial methods of slaughter currently in use for broilers, from animal welfare, operational and economical perspectives.

4.2 Further work is required:

- To publish results of post-mortem examinations undertaken to detect signs of injury or pathology associated with decompression.
- On behaviour during decompression to observe variation in time to loss of posture and apparent loss of consciousness, to observe interactions between birds, and to develop standard monitoring criteria for the method based on behavioural studies.
- To consider the potential value of stress hormone studies.
- To present microbiological data on carcase contamination rates (to make clear the reported difference in faecal soiling between electrical waterbath stunning and LAPS systems).
- To evaluate the potential use of LAPS for other species.

Participants

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