Efficacy of the Dutch Vision high-low electrical head-only poultry stunner

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LIVESTOCK RESEARCH
WAGENINGEN UR

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Summary UK The head-only high-low electrical stunner appears to be an effective stunning method for poultry. Well stunned birds remain unconscious for at least 60seconds and therefore it is recommended that the stun-stick interval should not exceed 30 seconds.

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Foreword

Stunning poultry before slaughter using a multi-bird water bath stunning system is under scrutiny because of the conflict between good stunning performance and product quality. Due to changes in requirements documented in EU regulation 1099/2009, the poultry industry is investigating the potentials for stunning interventions that are capable of safeguarding animal welfare while maintaining high product quality standards. As a result more and more slaughter plants are converting from use of the electrical water bath techniqueto gas stunning. However, for various reasons including costs, environment and religious beliefs (halal) there remains a need for alternatives to gas stunning. Head only electrical stunning applying a constant current to individual birds is seen as an acceptable alternative for current practice. The development of a commercial system that can meet animal welfare standards, while maintaining good product quality and can operate at high line speed will be valuable to the poultry industry as well as animal welfare at slaughter.

Summary

Current legislation demands that all birds should be rendered unconscious at stunning and that they remain insensible until death ensues. For many years the multi-bird water bath has been considered the most appropriate method for the electrical stunning of poultry. However, in practice, the presence of several birds at the same time in the water bath creates a parallel pathway of resistance. It has been claimed, that under slaughterhouse conditions only about one third of birds are effectively stunned, one third are inadequately stunned and the remaining third undergo cardiac arrest (Woolley et al., 1986a,b). Based on EU regulation requirements (EU 1099/2009) and on the need for novel stunning methods, Dutch Vision Solutions (DVS) have developed a head-only electrical stunner that operates at a line speed of 13.500 birds per hour delivering a high current of 270mA per bird for 1 second followed by a low current of 60mA for 3 seconds.
The objective of the present study was to confirm that broilers exposed to the DVS head-only electrical stunner are rendered unconscious immediately and remain in an unconscious state long enough to ensure death by exsanguination. Furthermore, this study was conducted to provide information in accordance with EFSA Guideline standards for the evaluation of the effectiveness of stunning interventions (AHAW. EFSA,2013).
In order to assess stunning quality (proof of concept) the effect of the stunning intervention was judged based on EEG analyses (WLR report 304, summarized in Chapter 4). In this experiment 38 broilers were hung in shackles and a current was applied after placing 2 electrodes on both sides of the head. An electrical constant current set at 275mA was administered for 1 second followed immediately by a current of 60mA set for 3 seconds. From this experiment it was concluded that broilers are effectively stunned with a controlled current of 271 ± 32 mA for 1 s followed by a current of 64 ± 16 mA for 3 s using the DVS head-only stunner.

To assess the stunning quality under slaughterhouse conditions (ground truthing) an experiment was conducted at a commercial line speed of 13.500 broilers per hour (Chapter 5). The quality of the stunning intervention i.e., the duration of unconsciousness and absence of pain was assessed for a total of 200 birds divided over 2 successive days taken from 7 different flocks. Quality of the stunning intervention was judged based on behavioural observations and reaction to stimuli i.e., Reaction to threat, eyelid reflex, reaction to pain stimuli, righting reflex, rhythmic breathing and righting activity. Good stunning performance is defined as the percentage of successful stunning interventions. Thus indicating that a stunning unit has produced at least the minimum required 240mA, in compliance with EU regulation 1099/2009. During the tests with the DVS High-Low system performed under commercial conditions (13,500 birds/hour) good stunning performance was realized in > 95% of the birds. However, a considerable variation was observed between the 32 stunning units and between flocks. Effective stunning intervention is defined as resulting in a state of unconsciousness. However, at 30 seconds after stunning approximately 4.5% of the broilers reacted to a stimuli and were therefore judged as not properly stunned. This percentage is in line with ‘good performance’ quality assessment levels allowing for a 95% success rate. The average weight of the broilers was 2.47±0.35 kg (min 1.44kg; max 3.44kg). The significant difference in pre slaughter body weight had no effect on stunning efficacy between broilers or between flocks.

Based on the results it is advised that the stun to stick interval should not exceed 30 seconds to prevent broilers from regaining consciousness during neck cutting and bleeding procedure.

In addition to the outcomes of the presented research an in line back up stunning system is advised. Therefore, a splitter and parallel water bath stunner have been installed leading in-correctly stunned birds into the standard water bath stunner. Test results indicate that the back-up procedure does work but additional performance testing of the splitter unit should be performed under practical conditions and the results added to this dossier.

1 Introduction

Stunning and killing of poultry, as for all animals, is regulated in international legislature (EU Council Regulation (EC) no 1099/2009). Current legislation demands that all birds should be rendered unconscious at stunning and that they remain insensible until death ensues. For many years the multi-bird water bath has been considered the most appropriate method for the electrical stunning of poultry. However, in practice, the presence of several birds at the same time in the water bath creates a parallel pathway of resistance. It has been claimed, that under slaughterhouse conditions only about one third of birds are effectively stunned, one third are inadequately stunned and the remaining third undergo cardiac arrest (Woolley et al., 1986[a,b]). The shackles and framework of the water bath together with the bird itself provide a conductive resistance to the current and thus are potential sources of loss of electrical capacity. According to previous work (Woolley et al, 1986a, b), these sources of resistance vary according to bird resistivity (skull bone structure and thickness), and shackle condition (degree of fouling, contact area with bird). These variations in resistance can influence the quality of the stun to such a degree that some birds receive too much while others receive insufficient current. Ultimately, this can lead to problems with either bird welfare (failure to lose consciousness or rapid recovery) or product quality (haemorrhaging, bone fractures) (Hindle et al, 2010). Because of the inability to guarantee that each bird receives sufficient current to provide an effective stun, use of the conventional electrical water bath in its present form is to be strongly discouraged. Consequently, a number of slaughter plants have changed from traditional water bath stunning to gas (CO_2) stunning methods. However, gas stunning methods , for different reasons (i.e. costs, marketing) do not provide an acceptable alternative for all slaughter plants.

Recently, head-only electrical stunning has been developed as an alternative to multi-bird water bath and gas stunning methods. Different studies have shown that head -only electrical stunning can provide an effective stun for broilers using different currents. It was reported by Gregory and Wotton (1990) that for broilers 50 Hz, 117 V, corresponding to 336 mA per bird, appeared to be effective. A later study, (Lambooij et. al., 2010) concluded that, broilers may be insensible and unconscious after head-only electrical stunning with pinned electrodes using an average current of 190 ± 30 mA (sinusoidal AC) applied for 0.5 s. In EU regulation 1099/2009 the specific requirements for head-only electrical stunning of chicken are that a minimum current of 240mA is applied and that the electrodes must span the brain.

Based on EU regulation requirements and on the need for novel stunning methods, Dutch Vision Solutions (DVS) have developed a head-only electrical stunner (HOES). The HOES operates at a line speed of 13.500 birds per hour delivering a high current of 270mA per bird for 1 second followed by a low current of 60mA for 3 seconds.

The objective of the present study was to confirm that broilers exposed to the DVS head-only electrical stunner are rendered unconscious immediately and remain in an unconscious state long enough to ensure death by exsanguination. Furthermore, this study was conducted to provide information that meets the standards of EFSA Guidance for the evaluation of the effectiveness of stunning interventions (AHAW. EFSA,2013).

2 Research elements

Requirements for different stunning methods and thus also for head-only electrical stunning of poultry are defined in EU regulations (EU Council Regulation (EC) no 1099/2009). Specific requirements for head-only stunning of poultry are;

1. Electrodes must span the brain of the animal allowing for size.
2. A minimum current of 240 mA is required for chickens.

Recently, the EFSA panel on Animal Health and Welfare (AHAW. EFSA,2013) provided an assessment guide for the evaluation of the effectiveness of stunning interventions. This guide established two main research stages (Figure 1)

Type	Conditions	Elements of research recommended
I. Proof of concept	Study under controlled laboratory conditions	A. Comprehensive record of stunning intervention and key parameters B. Assessment of onset and duration of unconsciousness by EEG or ECoG C. Assessment of absence of pain, distress and suffering using behavioural **and** either physiological **or** neurological animal-based measures D. Comprehensive record of outcome assessment E. Stunning without sticking to establish duration of unconsciousness achievable with simple stunning intervention
II. Ground truthing	Study under slaughterhouse conditons	F. Comprehensive record of stunning intervention and key parameters G. Assessment of onset and duration of unconsciousness using animal-based measures H. Assessment of absence of pain, distress and suffering using behavioural **and** either physiological **or** neurological animal-based measures I. Comprehensive record of outcome assessment J. Assessment of absence of pain, distress and sufferring during restraint/pre-stunning if it deviates from conventional methods and/or is potentially painful

Figure 1: *elements of research EFSA Journal 2013; 11(12): 3486*

A description of the stunning method and key parameters (chapter 3) has been provided by the manufacturer, Dutch Vision Solutions.
Stage 1, proof of concept, has already been performed and reported (Lambooij and Reimert, 2011). During the stage 1 research the onset and duration of unconsciousness was assessed using EEG measurements. The results from this earlier research are summarized in chapter 4.
In a study under slaughterhouse conditions (chapter 5), stage 2 (ground truthing), key parameters of the stunning intervention, i.e. actual current received per bird and success rate, were measured. In this study the duration of unconsciousness was assessed based on animal behavioural parameters.

3 Description of the stunning method

3.1 General description of the stunning method

The basic principal of the High-low head-only electrical stunning method is that all birds are individually exposed to a constant current administered through the head. It is well known that head only electrical stunning will lead to a tonic and clonic seizures that can result in more or less severe wing flapping. Fundamentally, the DVS high-low electrical stunning method administers an initial high constant or controlled current to the brain of the bird that induces immediate loss of consciousness followed by a low constant current intended to reduce wing flapping and prolong the period of unconsciousness.

The birds are shackled in a similar manner to what has become common practice for water bath stunning. Thereafter, they are transported to the stunning carrousel where the head of each individual bird is grasped between two multi-pinned plate electrodes. The electrodes span the head completely on the right and left side. An adjustable electrical potential (voltage) runs through the head generating a constant current of 270mA for 1 second followed without delay by a constant current of 60mA, both currents are delivered at a frequency of 50Hz.

3.2 Controlling correct intervention

During the period that the head of a bird is between the 2 head electrodes the current is measured and if required the voltage is (automatically) adjusted. Exiting currents are measured and recorded 10 times per second for each bird. This provides an overview of the stunning parameters for inspection. Birds that have received the correct stunning intervention then have their neck cut.

It is intended to install a backup stun for any birds that don't receive the correct current or those that are missed by the electrodes. These birds are automatically (within 14 seconds) directed into a standard water bath stunner that is placed in line immediately after the head-only stunner to provide a backup stunning intervention. In this way maximum guarantee for successful stunning is achieved. This improves the rate of successful stunning and reduces the risk to animal welfare.

4 Assessment of stunning quality based on EEG measurements (proof of concept).

Efficacy of stunning is assessed based on measured brain activity or EEG. The results of this assessment have been reported in WLR report 304 (Lambooij and Reimert, 2011). A summary of the results is given below.

4.1 Method

In order to assess stunning quality, 38 broilers were used as they were delivered to the slaughterhouse from a commercial farm. Stunning was applied one bird at a time.
The birds were suspended by their legs in shackles and a current was applied after placing 2 electrodes on both sides of the head. An electrical constant current set at 275mA was administered for 1 second followed immediately by a current of 60mA set for 3 seconds.

Electrical activity of the brain (EEG) and heart (ECG) were recorded from 30 s before and 5 minutes after the stunning intervention for 26 birds. The response of each animal to a noxious stimulus (comb pinching) was observed after stunning. The other 12 birds were stunned immediately followed by a neck cut.

4.2 Results

EEG and ECG recordings with a measured current of 271 ± 32 mA for 1 s followed by a current of 64 ± 16 mA for 3 s were performed on 26 broilers weighing on average 2.4 ± 0.3 kg. Immediately after stunning the birds displayed wing flapping for 4 ± 2 s. A general epileptiform insult with a tonic/clonic and exhaustion phase was observed in all birds. The duration of the general epileptiform insult as visually scored on the EEG was on average 51 ± 12 s excluding 2 birds that died. Five birds responded to the noxious stimulus 30 s after stunning, 19 birds after 60 s, 1 bird after 120 s, 1 bird did not respond at all and 2 birds died. After stunning the ECG revealed fibrillation. The heart rate increased after stunning and recovered afterwards.

The measured current of the 12 birds bled immediately after stunning averaged 269 ± 47 mA for 1 s followed by an average current of 58 ± 0 mA for 3 s. Average bird live weight was 2.4 ± 0.4 kg. Neck cutting was performed 17 ± 2 s after stunning. After stunning spike wave forms were observed for 46 ± 27 s on the EEG followed by quiescent EEGs. None of the birds responded to noxious stimuli. The average heart rate prior to stunning was 353 ± 21 beats/min. After stunning the heart rate increased to 382 ± 83 at 1 min and fell to 158 ± 110 bpm at 5 min.

Within a confidence limit of 95%, taking into account the number of animals with a reliable EEG (n=26), the chance of an effective stun lies between 0.9 and 1.0 for all broilers using set currents of 275mA for 1 s followed by 60 mA for 3 s.

4.3 Conclusions

It can be concluded that broilers are effectively stunned with a controlled current of 271 ± 32 mA for 1 s followed by a current of 64 ± 16 mA for 3 s using the DVS head-only stunner. Because the broilers may recover consciousness they should be neck cut as soon as possible after stunning to ensure that the bird remains unconscious.

5 Assessment of stunning quality under slaughterhouse conditions (ground truthing).

5.1 Animals and Slaughter conditions

The assessment of onset and duration of unconsciousness was conducted under commercial slaughterhouse conditions. At a commercial slaughter plant in The Netherlands at a line speed of 13.500 broilers per hour the quality of the stunning intervention i.e., the duration of unconsciousness and absence of pain was assessed for a total of 200 birds on 2 successive days taken from 7 different flocks (4 on day 1 and 3 on day 2).

The slaughter plant produces poultry meat for the halal market, using a water bath electrical stunner. At this plant all birds are neck cut by hand by 6 slaughter men. The head-only stunner was placed in-line between the carousel where the birds were shackled and the standard water bath stunner. The distance between shackling and entrance to the head only stunner was 23 meters so that the birds were shackled for 41 seconds prior to stunning. The distance between the exit fromf the head only stunning intervention and the maximum sticking location was 14 meters resulting in a maximum stun -stick interval of 25 seconds

5.2 Assessment protocol

During stunning intervention with the head only stunner at a commercial slaughter speed of 13,500 birds per hour 4 broilers were simultaneously selected at random from the slaughter line directly after leaving the stunner. The broilers were placed on their chest on a table. At 30 seconds after stunning and at subsequent 30 second intervals reactions or reflexes were tested in all birds until the broilers regained consciousness. Observation lasted for a maximum period of 5 minutes post stunning. During this period the birds were monitored continuously, particular attention being given to rhythmic breathing or righting attempts.

Reflex or reactions to stimuli were tested in a fixed order and performed by the same person in all tests while a second person observed and registered the results.

Reflexes or induced reactions:

- Reaction to threat: blinking or eye movement as reaction to approaching the eye with a pointed finger without actually touching the eye.
- Eyelid reflex: any reaction to touching the inner corner of the eyelid such as closing or blinking.
- Reaction to pain stimuli: withdrawal or any other movement in reaction to firmly pinching the comb between the nails of thumb and index finger.
- Righting reflex: lifting the head, maintaining an upright head or return of muscle tension in the neck when lifting the head with a finger under the chin.

Spontaneous or continuous observations:

- Rhythmic breathing: breathing movements of the chest in a rhythmic order.
- Righting activity: spontaneous righting of the head or body.

Stunner settings and currents were measured, adjusted and recorded for each individual bird or stunning unit using a custom made data logging system (Ayin). All data was automatically stored on a central computer hard disk.

5.3 Results

5.3.1 Stunner settings and performance

The standard settings of the DVS High-low electrical head only stunner are 270mA for (high) for 1 second followed by 3 seconds at 60mA (low) per individual bird. During the tests 3 of the 32 stunning units appeared to malfunction which resulted in a failure rate varying from 20 to 100%. One unit (unit 22) didn't function at all during the tests in 7 different flocks. The failure rate of unit 4 varied between 20 and 62% for the same 7 flocks and for unit 26 the failure rate varied between 53 and 81% for the 7 flocks used in the tests.

For the remaining 29 fully functioning stunning units the failure rate averaged 5%. However, it has to be acknowledged that there was a considerable variation in performance (failure rate) between the stunning units (0.0- 31.5%) and between flocks within each stunning unit. Failure rate is defined here as not producing the minimum required current of 240mA demanded by EU regulation 1099/2009. This leads us to conclude that for the 29 working units in 95% of the broilers the legal minimum requirement (240mA for head only stunning of broilers) was achieved.

During the tests to compare 1 and 2 seconds exposure to the high current period (see chapter 5.3.3) all units were working correctly. During the measurement period of 2 hours and 15 minutes data was measured and stored from in total 4800 broilers. During the test period a total failure rate was realised of 4.4%. The failure rate can be split into 3 categories 1) 0.9% resulted in an electrical current of 0-10mA and appeared to correspond with the number of empty shackles, 2) 1.8% resulted in an electrical current of 10-40mA classified as missed heads, 3) 1.8% resulted in a realised electrical current of 40-<239mA with an unidentified reason. From this second measuring period it was found that the real failure rate, birds that are missed or don't receive the intended minimal electrical current was 3.6% and thus that in >94% of the stunning interventions birds receive the intended legally required minimum current.

5.3.2 Animals

In total 200 birds from 7 different commercial flocks were assessed for stunning quality. The average weight of the broilers was 2.47±0.35 kg (min 1.44kg; max 3.44kg). The significant difference in pre slaughter body weight had no effect on stunning efficacy between broilers or between flocks.

5.3.3 Identification of stunning quality

Assessment of stunning quality is based on the duration of absence of behavioural parameters or absence of reactions to stimuli. On the whole, the broilers displayed tonic seizures, occasionally developing into a clonic seizure for a short period immediately after stunning, often followed by a relaxation of the body within 5-10 seconds after leaving the stunner. All birds, when taken from the slaughter line, within 15 seconds post stunning, were relaxed without muscle tone and with their heads hanging limply.
A small number of broilers, estimated at below 1%, died due to the stunning intervention.

A reaction to a threat (figure 2) or approaching finger pointing towards the eye (without contact) was not observed in 99.3% of the broilers 30 seconds after stunning, in 96.8% at 60 seconds after stunning and in 90.3% at 90 seconds after stunning. Thereafter, bird reaction increased rapidly ,being present in 95% of the broilers at 180 seconds post stunning.

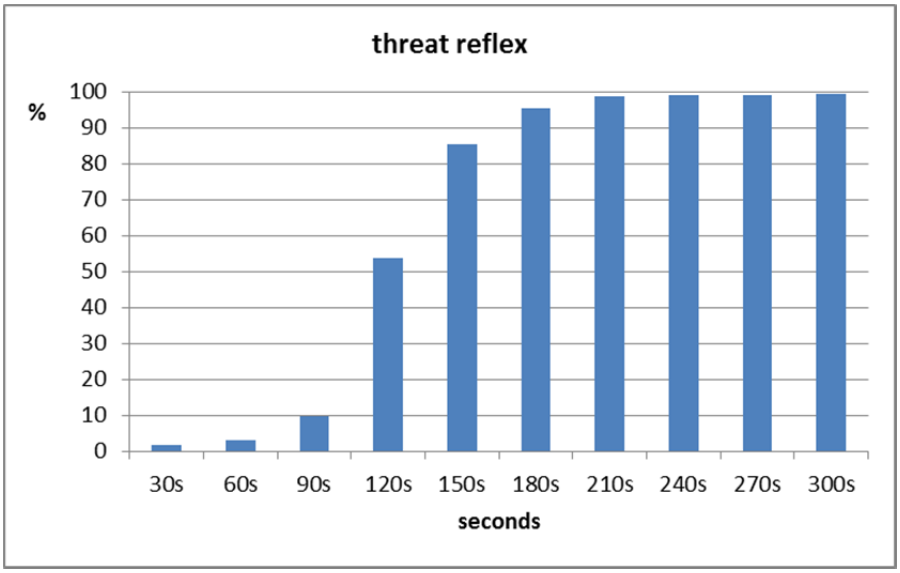

Figure 2: *percentage of birds displaying a reaction to a threat after head-only stunning.*

The response to touching the inner corner of the eyelid (figure 3) was not observed in 97% of the broilers at 30 seconds post stunning, 89.6% at 60 seconds and 45% of the broilers at 90 seconds post stunning. The percentage of birds reactions to contact with the eye lid increased rapidly at 60 seconds post stunning and was observed in 95% of the broilers at 150 seconds post stunning.

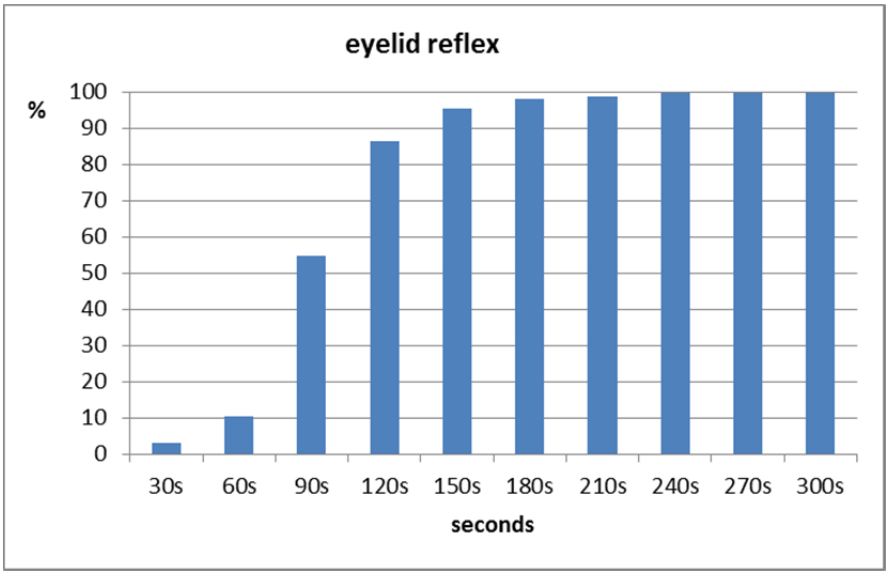

Figure 3: *percentage of birds displaying a response to eyelid contact.*

Reaction to a pain stimuli or firmly pinching the comb was not observed in 95.1% of broilers tested at 30 seconds post stunning (figure 4). At 60 seconds post stunning, a reaction to a comb pinch was not observed in 60.8% of the birds tested . At 150 seconds post stunning more than 90% of the broilers reacted to a comb pinch.

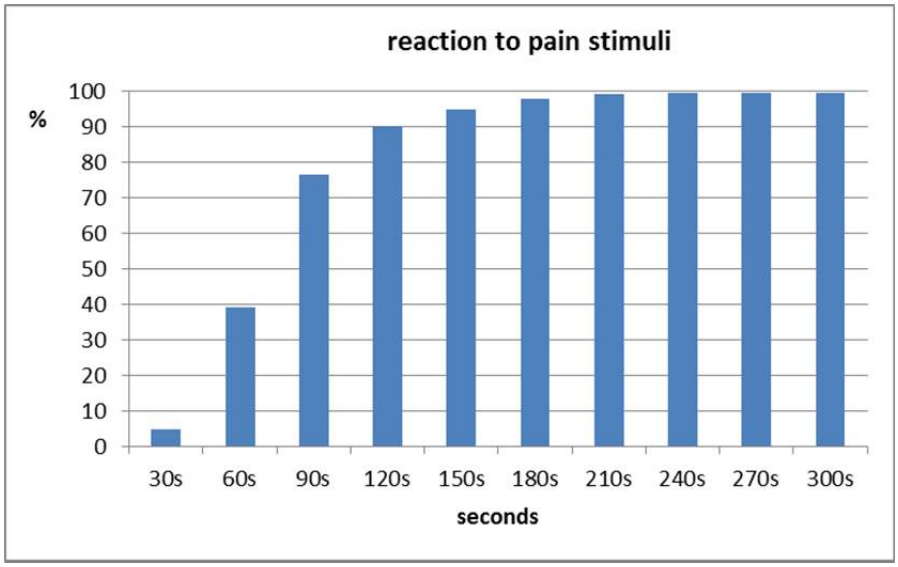

Figure 4: *percentage of birds displaying a response to a comb pinch.*

The righting reflex (figure 5), displayed as the birds attempting to raise their head off the observation table was absent in 97% of the broilers at 30 seconds post stunning. At 60 seconds post stunning, the righting reflex was not observed in 87.5% of the broilers tested. Thereafter, neck tension returned gradually and the incidences of righting reflex increased considerably. The righting reflex was observed in 57% of the birds at 90 seconds and increased to more than 95% at 150 seconds post stunning.

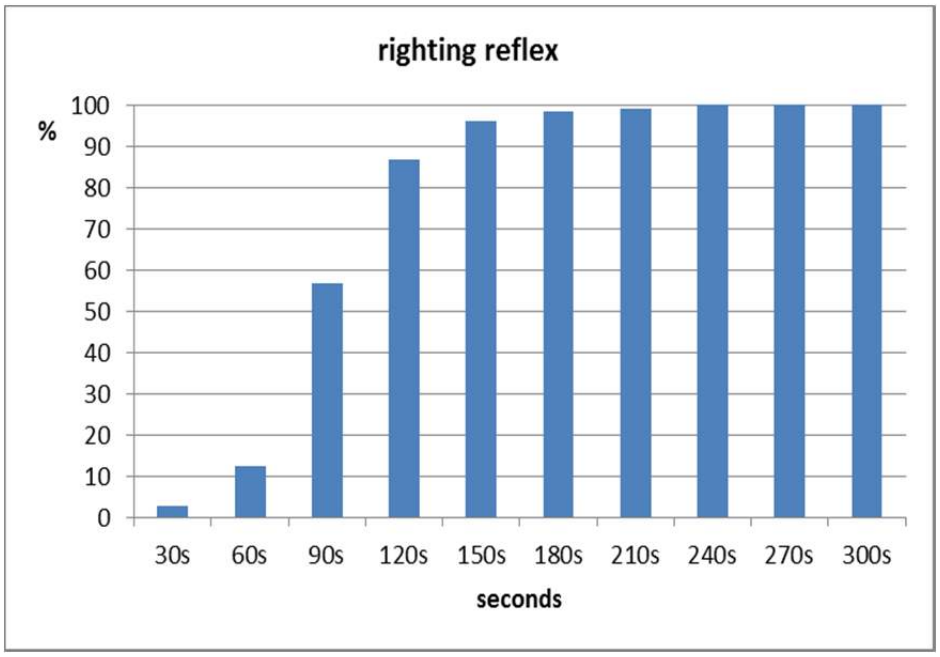

Figure 5: *percentage of birds that raised their head or attempted to change body position or regain muscular tension in the neck.*

Rhythmic breathing was observed after stunning in almost 99% of all broilers tested and fluctuated between 99% and 100%. This indicates that all birds were breathing but breathing was not always classified as rhythmic or normal.

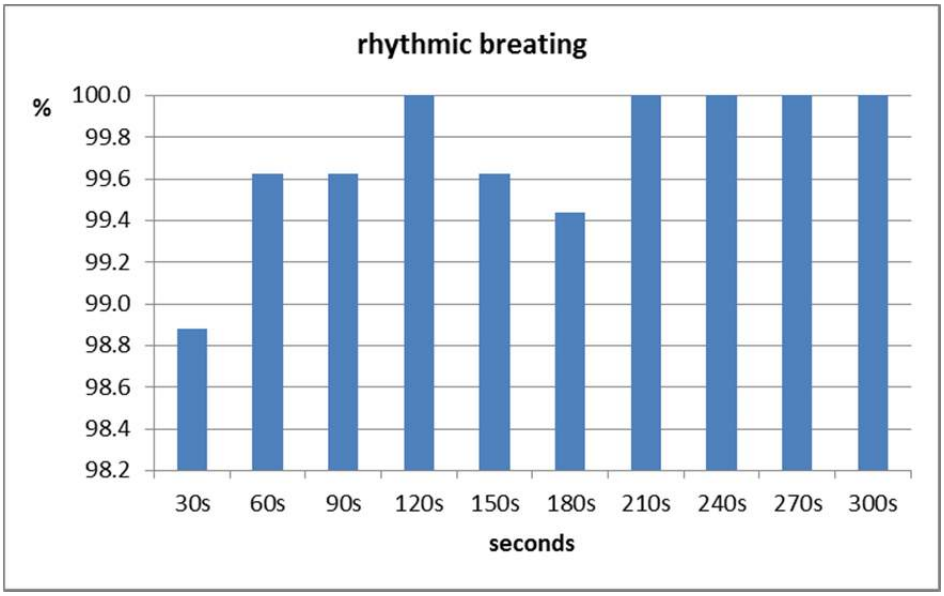

***Figure 6**: percentage of birds displaying normal breathing.*

Because head-only stunning results in a limited duration of unconsciousness the stun-stick interval is also limited. Extension of the period of unconsciousness is assumed to occur after prolongation of the period of high current. Therefore, on the first slaughter day in 2 flocks, 50 broilers were exposed to the standard 1 second high followed by 3 seconds low current and 50 other broilers to an adjusted stunner intervention. For this second group the 1 second period of high current (275mA) was extended to a second period resulting in a stunning intervention of 2 seconds 275mA followed by 2 seconds 60mA. Broiler response was observed according to standard protocol immediately after stunning.

5.3.4 Effect of extending the high current period

Because head-only stunning results in a limited duration of unconsciousness the stun-stick interval is also limited. Extension of the period of unconsciousness is assumed to occur after prolongation of the period of high current. Therefore, on the first slaughter day in 2 flocks, 50 broilers were exposed to the standard 1 second high followed by 3 seconds low current and 50 other broilers to an adjusted stunner intervention. For this second group the 1 second period of high current (275mA) was extended to a second period resulting in a stunning intervention of 2 seconds 275mA followed by 2 seconds 60mA. Broiler response was observed according to standard protocol immediately after stunning.

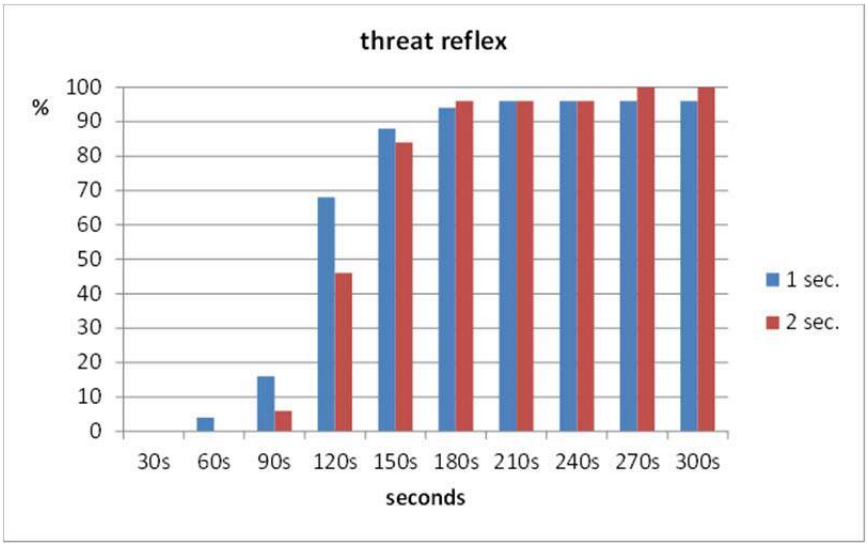

Figure 7: *percentage of birds displaying a response to a threat after 1 or 2 seconds high current head-only stunning.*

The reaction to a threat (figure 7) occurred later after the prolonged stunning intervention compared to the standard stunning protocol. Although the differences in reaction to touching the eye lid were not as clear (figure 8). For both parameters no positive reactions were observed at 30 seconds post stunning in the extended high current intervention. After the 2 second high current stunning intervention the first reactions to a threat were observed at 90seconds post stunning. Furthermore, at 60 and 90 seconds post stunning a smaller number of broilers reacted to threat and touching the eye lid.

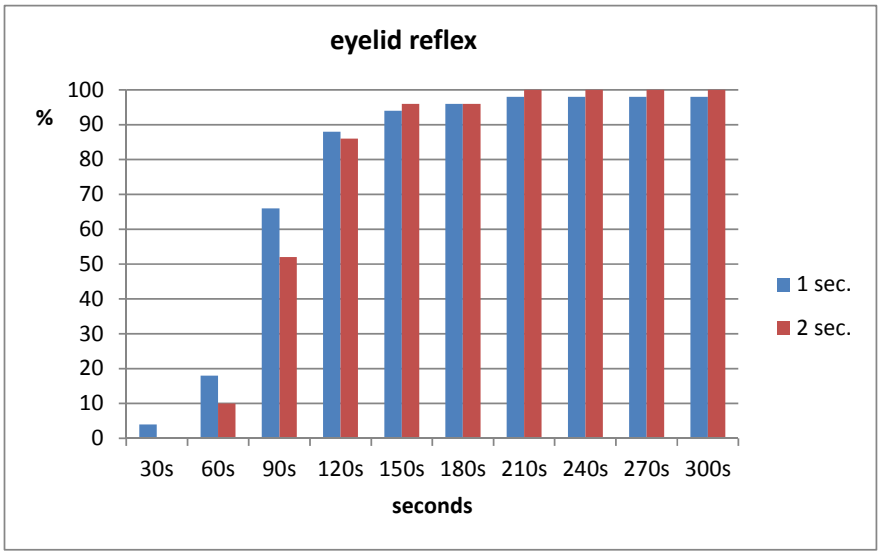

Figure 8*: percentage of birds displaying a response to eye lid contact after 1 or 2 seconds high current head-only stunning.*

The reaction to a pain stimulus (figure 9) was absent in all birds after the extended stunning intervention. Furthermore, substantially fewer birds reacted at 60 and 90 seconds post stunning in the extended stunning intervention compared to the standard stunning interval.

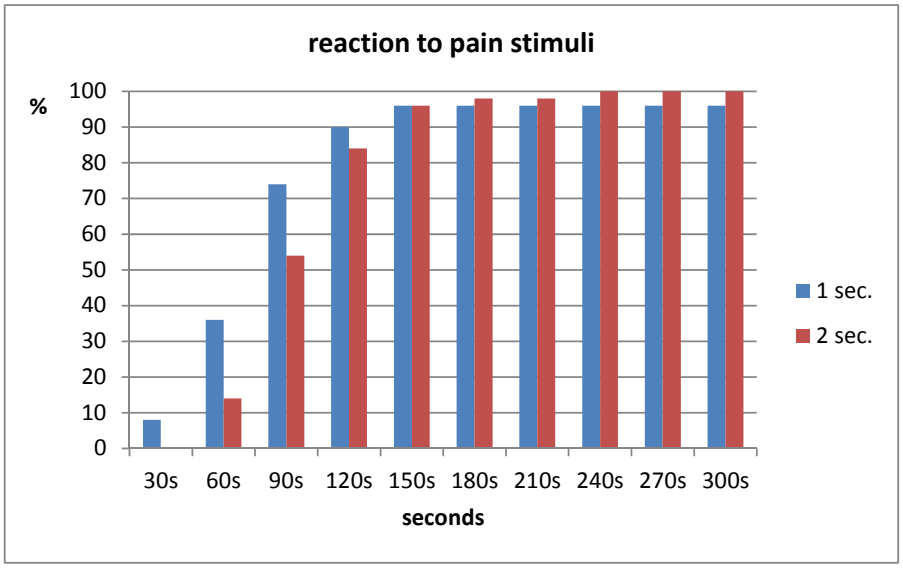

Figure 9: *percentage of birds displaying a response to a comb pinch after 1 or 2 seconds high current head only stunning.*

In broilers exposed to the extended high current stunning intervention the righting reflex was also absent in all 50 birds at 30 seconds post stunning. At 60 seconds post stunning the righting reflex occurred in 8 percent of the broilers in the extended stunning intervention whereas it occurred in 21 percent of the standard stunning intervention group.

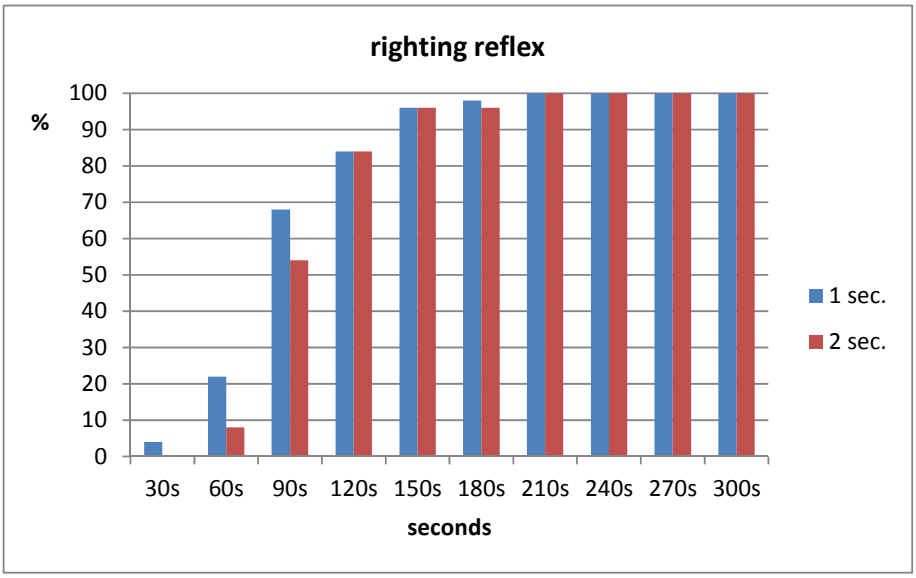

Figure 10: *percentage of birds that raised their head or attempted to change body position or regain muscular tension in the neck after 1 or 2 seconds high current head only stunning.*

No differences were observed in rhythmic breathing due to extending the high current period (figure 11). All birds in both groups maintained a normal breathing rhythm.

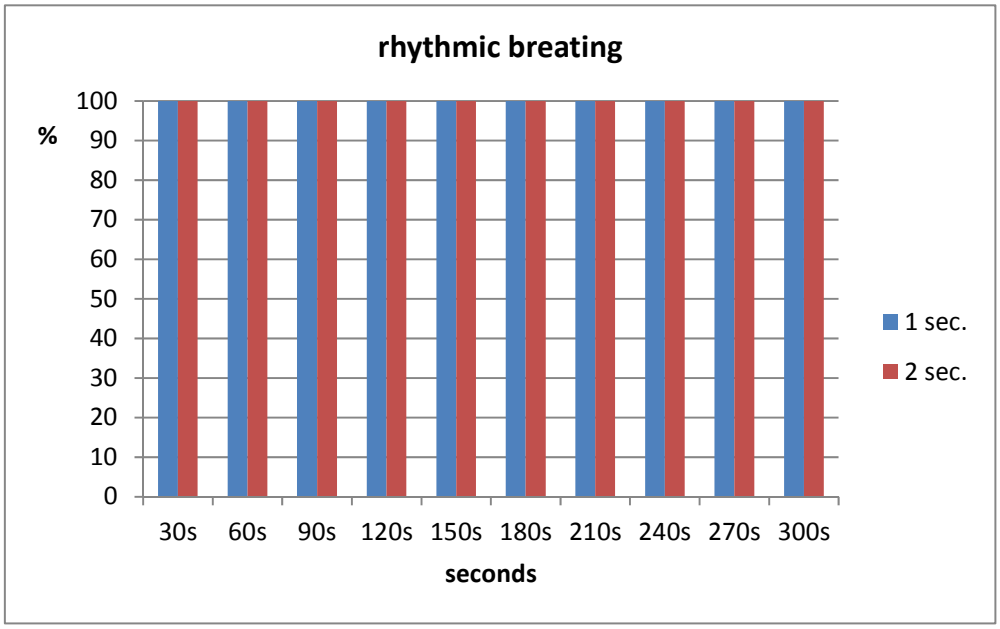

Figure 11: *percentage of birds displaying normal breathing after 1 or 2 seconds high current head only stunning.*

5.4 Conclusions

Good stunning performance is defined as the percentage of successful stunning interventions. Thus indicating that a stunning unit has produced at least the minimum required 240mA, in compliance with EU regulation 1099/2009.
During the tests with the DVS High-Low system performed under commercial conditions (13,500 birds/hour) good stunning performance was realized in > 95% of the birds. However, a considerable variation was observed between the 32 stunning units and between flocks.

Effective stunning intervention is defined as resulting in a state of unconsciousness. However, at 30 seconds after stunning approximately 5% of the broilers reacted to a stimuli and were therefore judged as not properly stunned. This percentage is in line with 'good performance' quality assessment levels allowing for a 95% success rate.

Sixty seconds after stunning, 10% of the broilers reacted to eyelid contact and 12% displayed a righting reflex when the head was supported (finger under head). A reaction to a comb pinch was observed in 40% of the broilers at 60 seconds post stunning. These results compare favourably with the results of the EEG trial from the previous study, summarized in chapter 4. From the earlier study, it was concluded that the stunning intervention resulted in a tonic/clonic seizure lasting approximately 51 seconds and a response to noxious stimuli at 60 seconds in almost all birds.
For those birds not properly stunned i.e., reacting to stimuli at 30 seconds, it is assumed that they did not receive the required current of 240mA.

Therefore, it can be concluded that head-only stunning with a 1 second high current followed by a 3 second low current results in effective stunning with a duration of unconsciousness lasting 60 seconds in most birds.

Based on the results it is clear that the stun to stick interval should not exceed 30 seconds to prevent broilers from regaining consciousness during neck cutting and bleeding procedure.

Extending the high current period from 1 to 2 seconds has a marginal but positive effect on the duration of unconsciousness. However, the effects of extending the period of high current on product quality were not part of the study and need to be determined.

Based on the DVS stunner performance and the effectivity of the stunning intervention it is recommended to install automatic back up stunning.
Based on the results a splitter and parallel line have been installed leading in-correctly stunned birds into the standard water bath stunner. Test results indicate that the back-up procedure is working. Performance of the splitter unit should be tested under practical conditions and the results added to this dossier.

6 References

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