CO_2 – STUNNING OF TURKEYS IN A V-SHAPED TUNNEL

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SUMMARY

Stunning with carbon dioxide gas (CO_2) is recently discussed as an alternative to electrical water bath stunning of turkeys. Investigations were carried out in order to assess some welfare aspects in turkeys when stunned with CO_2. The turkeys passed an increasing CO_2 atmosphere in a V-shaped tunnel on a commercial slaughter plant under practical conditions. The behaviour of the animals in the tunnel was observed and some clinical reflexes were checked before shackling. First results indicate significant convulsions immediately after entering the CO_2 atmosphere and deep unconsciousness without any clinical reflexes when leaving the tunnel.

Keywords: stunning, CO_2, turkeys, behaviour, animal welfare

INTRODUCTION

Turkey meat is a popular food not only in the EU but all over the world. About 1,890,000 t of turkey meat are produced in the EU, and even 2,464,000 t in the USA (1). The most common stunning procedure before bleeding is the electric water bath method even if there are some well known disadvantages (2).

In recent years it has been shown that exposition to gases like carbon dioxide (CO_2) can be an alternative eliminating welfare concerns related to some failure associated with the application of electrical current and the stress the animals suffer during shackling (3). The birds can remain sitting in their transport boxes and enter the gas stunning tunnel system without being stressed by human contact in the slaughterhouse. After the stunning procedure they do not realise uncrating and shackling because of being unconscious.

However, there are also disadvantages in relation to stunning with CO_2. Firstly, the birds go through a phase of excitation when entering the CO_2-atmosphere. This time period is not yet well defined but can last at least 10 s. Secondly, analgesia must continue beyond the point of neck cutting to make sure the animals do not gain consciousness again before having bled to death. Therefore it is required to keep the initial period as short as possible and reach unconsciousness as quick as possible. Proposals were made to divide the process of stunning into stages of different gas concentrations and different types of gases and leave the bird sufficiently long in such an atmosphere (4). One option is to work with an increasing CO_2 concentration in air during the stunning process from which a hypercapnic hypoxia results (5). Monitoring the state of consciousness of the animals during the stunning process is crucial. This can be done by testing e.g. the reflexes of the birds during the period of time from coming out of the tunnel until neck cutting.

This paper reports on some first results from stunning turkeys with CO_2 in a V-shaped tunnel observing their behaviour in the CO_2-atmosphere and checking their consciousness by testing

clinical reflexes (eye lid reflex, interphalangeal reflex) when leaving the tunnel and before shackling.

METHODS

The study was carried out in a medium sized typical poultry slaughterhouse in the north-east of Germany which stuns turkeys with CO_2 in a newly designed V-shaped stunning tunnel. Figure 1 shows a drawing of the system. The birds enter the tunnel sitting in their transport boxes (crates) by means of a mechanical conveyor belt directly from the transport lorry. Each box contains either five cocks or eight hens. One crate needs 180 sec to pass the tunnel. The process runs continuously from right to left employing two conveyor belts. The descending conveyor belt of the tunnel (YARA, Dülmen, Germany) is about 6 m long, the ascending belt 3 m.
CO_2 is injected in the tunnel at three points (Figure 1, points 1-3). At the end of the ascending part of the tunnel the anaesthetised birds fall on a conveyor-belt and are shackled upside down manually.

Gas monitoring: The concentrations of CO_2 and oxygen (O_2) were measured continuously for several hours on five different days in the tunnel atmosphere at different sites as indicated in Figure 1. CO_2 was measured at points B, C and D by an integrated device to monitor and correct the CO_2 concentration at the set points of 20%, 45% and 85%. Additionally we installed a second gas analysing system consisting of the gas analyzer unit "EL6010-Uras14" for CO_2 which measures per NDIR (Non-Dispersive Infrared Absorption) technique and the "EL6010-Magnos106" oxygen (O_2) analyzer (Figure 1, points A- E) which measures the specific paramagnetic behaviour of oxygen (ABB Advance Optima System, Zurich, Switzerland). Gas samples were sucked by continuously running pumps through Teflon tubes (4x1mm) from the sampling to the analysers. Five all-day measuring campaigns were completed so far.

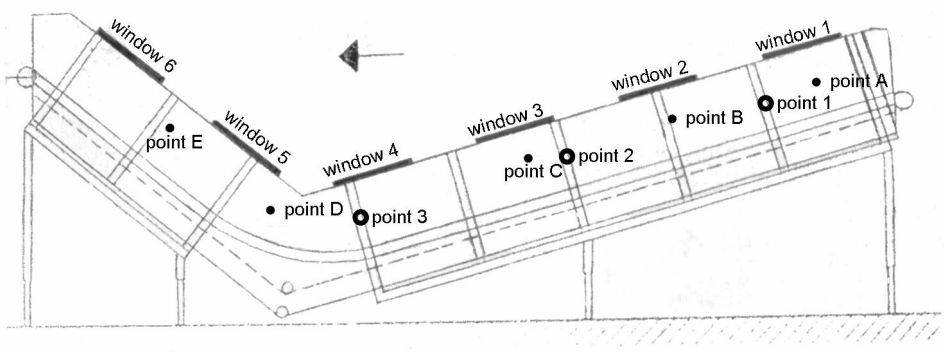

Figure 1. Outline of the V-shaped CO_2-tunnel for stunning turkeys. The gas measuring points from A to E, the gas inlet points 1 to 3 and the windows for observations from 1 to 6 are indicated

The animals: The study included 2830 (1717♀/ 1113♂) turkeys of the strain BUT Big 6. The behaviour was observed of 2600 turkeys (n_1) and 230 turkeys were tested for their reflexes (n_2). The average age of the males was 20 to 21 weeks and their weight about 20 kilos. The hens were slaughtered at an age of 16 weeks weighing seven to nine kg.

Behaviour: The animals` behaviour (n_1=2600) was studied by direct observations through the first four transparent glass windows (80 x 60 cm) in the ceiling of the tunnel (Figure 1). Each window section in the descending part was directly observed for about 100 minutes, divided into 50 min observation of hens ($n_{1.1}$=1600) and 50 min observation of cocks ($n_{1.2}$=1000). Following behavioural patterns were monitored: wing flapping, divided into light (only light single flaps), intense (flaps were more often and powerful) and excitative (excitations shown as long running flaps with a high frequency) flapping, deep breaths, head shaking, head´ s changeover into opisthotonus, lost posture of the head and preserved posture of the head respectively in high CO_2 concentrations (in window 4). It was not possible to watch every single animal in one box because the viewer´ s perspective was limited by the size of the windows, the moving crates and the sufficient but reduced light and by the fact that some birds were sitting one upon the other. Thus, the direct observation could not monitor every single animal but gives a good impression of the animals` behaviour in the areas with different gas concentrations.

Reflexes: Having passed the tunnel all indiscriminately chosen animals (n_2=230), 117 hens ($n_{2.1}$) and 113 cocks ($n_{2.2}$), were taken off the conveyor-belt short-time before the point of shackling. Painful stimuli were placed with surgical tweezers in the Telae interdigitales of both feet (Interphalangeal reflex) and the eyelid closure was controlled. The reactions to the painful stimuli were divided into negative (no reaction) and positive (reaction) results. Eyelid closure was discriminated from no closure (open eyes), full closure (closed eyes) and half opened eyes. After this procedure the birds were shackled to continue the normal slaughtering process.

RESULTS

Gas monitoring: Table 1 summarises the CO_2 and O_2 concentrations measured at the five sampling points A to E on five days by the ABB-gas analyser. Each figure represents the arithmetic mean of five measurements.

The lowest CO_2 and the highest O_2 concentrations are found at point A. At point C a concentration of 70 % CO_2 is observed. This is about 75 sec after the animals have entered the gas atmosphere in the tunnel. The highest CO_2 levels are reached at point D. Usually at this point the birds did not show any movement anymore. The O_2 level stayed at around 6 to 8 % from point C to D.

Table 1. Arithmetic mean (x) gas concentrations (CO_2, O_2) with standard deviation (s) at the five measuring points (A to E) in a stunning tunnel for turkeys in a commercial slaughter house

Gas	Point A	Point B	Point C	Point D	Point E
	x s	x s	x s	x s	x s
CO_2 %	27 ± 6,3	35 ± 5,5	70 ± 10,3	77 ± 11,2	72 ± 7,8
O_2 %	16 ± 1,4	14 ± 1,7	8 ± 2,0	6 ± 2,2	7 ± 2,0

Behaviour: Most of the turkeys are sitting in the crates while being carried to the tunnel's entrance, only a few are standing. Many birds show panting and breathing through the opened beaks. Because of the incline of the V-shaped tunnel the cages cant forward when entering the tunnel. Many turkeys stand up, patter and flap lightly with their wings as to keep balance. Figure 1 gives the percentages of observed head postures and reactions of turkeys during stunning with CO_2 at different positions in the gas tunnel. At the position of window 1 all birds were completely

conscious. More than 20 % started head shaking. 30 seconds later at window 2 about 7 % of the birds showed the head posture of opisthotonus. An increasing number of birds loose head posture completely but some preserve the posture of the head (5 % at window 4). In Figure 3 the frequency and intensity of wing flapping is illustrated at the different observation points. Light wing flapping can be seen at all windows with the highest incidence at window 1 (28 %) followed by window 4 (18 %) and lowest at window 2 (3 %). Observations of breathing showed that at window 1 about 2.2 % of the birds did a deep breath with an opened beak. This number increased in window 2 up to 11%, decreased in window 3 (1.5 %) and window 4 (1 %). No animal showed any reactions while coming out of the tunnel. All turkeys lay down with lost posture and predominant closed eyes. There were never any moves monitored during the process of shackling and before the point of neck cutting.

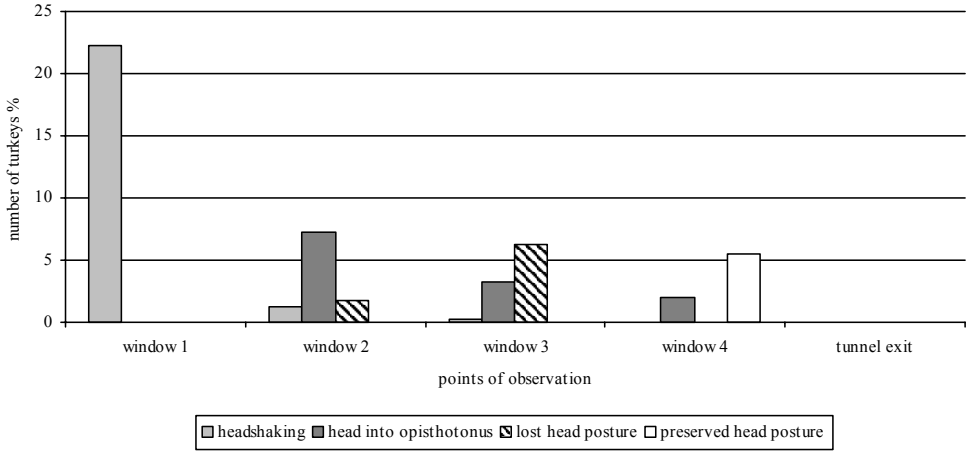

Figure 2. Head posture and reactions of turkeys during stunning with CO_2 at different positions in a gas tunnel in %. (n_1=2600)

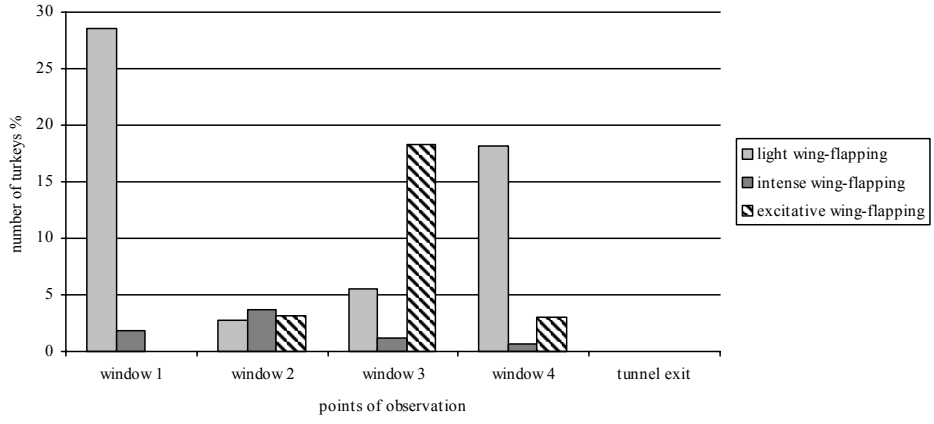

Figure 3. Wing-flapping of different intensity of turkeys during stunning with CO_2 at different positions in a gas tunnel in %. (n_1=2600)

Reflexes: Table 2 describes the results of the examined reflexes. Nearly 80 % of the birds had their eyes shut. The painful interphalangeal reflex could not be observed in any case. This indicates that the animals were obviously dead when leaving the stunning tunnel. This assumption was also supported by the fact that none of the animals which were kept aside for 3 to 4 minutes showed any sign of regaining consciousness again.

Table 2. Reflexes observed in turkeys (n_2=230) after CO_2-stunning

Reflex	Eyes open	Half-opened eyes	eyes closed
Eyelid closure	1 (0,4 %)	46 (20 %)	183 (79,6 %)
	No reaction		Positive reaction
Interphalangeal reflex	230 (100 %)	----------	0

DISCUSSION

This preliminary study shows that stunning of turkeys in the described V-shaped CO_2-tunnel results in an adequate anaesthesia at the end which allows an easy shackling of unconscious birds which also do not recover consciousness while bleeding to death. This is to be welcomed under aspects of animal welfare and occupational safety because it eliminates a lot of disadvantages of the electrical water bath method.

However, there are also some observations which give cause for concern. When entering the gas atmosphere many animals show signs of discomfort. They shake their heads, breath with opened beak and move their tongue. Nevertheless in general they stayed relatively calm which may be also due to the transport stress they suffered before and the narrowness in the crates. The light wing flapping and moves of their feet while entering the descending tunnel were probably for keeping balance.

The observation of window 1 presented all birds being conscious and registering the CO_2. They showed headshaking and wing flapping as defence moves because the gas irritated the mucosal membranes of their respiratory tract. This respiratory distress was rising in window 2. The birds felt breathless and showed intense wing flapping. By these gas concentrations unconsciousness started, heads moved into opisthotonus and finally lost their posture. Excitations in form of wing flapping started at the lower verge of the second window and mainly happened at window 3. Here many animals had already lost their head posture, only a few still showed opisthotonus and a few isolated birds showing headshaking or breathing deeply. It may not be excluded that some turkeys experienced this state of CO_2 concentration (ca. 70%) still being conscious. In window 4 the majority of turkeys reached the state of unconsciousness. The light and a few intense wing flaps can be interpreted as the end of the excitations. At the exit of the tunnel all birds lay down in the crates with lost posture and predominant closed eyes. The investigation of the reflexes seems to support this conclusion.

CONCLUSIONS

CO_2-stunning in this V-shaped gas tunnel seems to have a good potential to effectively stun turkeys at the end which allows a simplified shackling of unconscious birds which also do not recover consciousness while bleeding to death.

However, in the initial stunning phase the negative effects of CO_2 are observed such as breathlessness, head shaking and wing flapping indicating a high degree of discomfort, possibly the birds may even experience pain and anxiety. This time span comprises about 60 sec.

Alternative methods should be introduced for this initial stunning phase which may eliminate these disadvantages for the birds, e.g. using a gas like argon in a multi-phase system which causes anoxia instead of hypoxia.

Future work will include examination of stab blood for catecholamines (short term stress indicators) as well as for lactate and glucose as meat quality parameters, including carcase temperature, pH, water holding capacity and conductivity after one and after 24 hours.

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