

EFFECT OF CARBON DIOXIDE STUNNING METHOD ON THE STRESS LEVELS OF TURKEYS DURING THE SLAUGHTER

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Abstract – The present study aimed to compare the effect of different combinations of carbon dioxide concentrations and times of exposure on turkey during the slaughter. To understand the behavior of the animal during the slaughter, two experiments were developed with different stunning parameters. In the first case, the objective was to stun the animal in several stages increasing gradually the concentration of CO₂. Three completely different phases were performed: a first stage of animal adaptation to CO₂, a second stage in which the animal relaxation occurred. A final third stage where the highest concentration of CO₂, took place and the animal was stunned.

In the second assay of the study, we carried out a more drastic stunning in the shortest time possible. In this case, the turkeys were subjected to a rapid increase in CO₂ concentration to reach 80% by direct injection into the chamber. Measurements on stress animal were carried out by evaluating glucose, cortisol and lactate during bleeding phase. It is evident that the different combinations gas concentration/time of exposure induce more or less stress of turkeys. According to the results, the stress parameter values were lower in Experiment 1.

Key words – Consciousness, cortisol, gas stunning, lactate.

I. INTRODUCTION

The stunning method using CO₂ as anesthetic gas developed in the poultry sector to slaughter the animals has taken the place of electrical stunning as a way to produce the loss of consciousness and sensibility of the bird before the slaughter.

Up to now, the electrical stunning was by far the most common stunning method used in poultry species. However, this system produces too many injuries in the animal [1] such as broken bones, damaged viscera, bruised wing joints, red wing tips or hemorrhages on the breast meat, [2, 3, 4] reflected in the final quality of the carcass.

There are many studies showing the advantages regarding animal welfare of the gas stunning against the electrical water-bath or direct neck-cutting ones [5].

This system reduces the stress produced during live-hang process before the birds are moved toward the electrified water bath.

With the gas stunning method, the animals are introduced in a gas-filled chamber in cages or directly in crates during the transport previously to shackling and neck-cutting.

There is an improvement in animal welfare when the anesthesia induction is quickly produced. The anesthetic effect of CO₂, that causes fast unconsciousness when is inhaled in high concentration, is well-known [6, 7].

The main problem is the fast consciousness recovery when the stun has not been completed. For this reason, the benefits of this method in animal welfare has been also described when the bird dies directly during the stunning [8].

The animal exposed to a CO₂ atmosphere shows aversive reactions such as pungency and breathlessness which is translated in gasping, vocalizations and head shaking [9, 10]. This stage continues until the loss of consciousness of the animals [9] and is linked to the CO₂ concentration.

Glucose, lactate and cortisol blood concentrations are stress indicators [10, 11]. The stress can cause a depletion in muscle glycogen resulting in higher postmortem muscle pH because of the prevention of glycolysis by elimination of its substrate [12]. Ante mortem stress factors can also affect meat quality in poultry [13].

The stress and postmortem lactic acid production, together with the protein denaturation with high muscle temperature, cause meat quality defects such as soft texture, water holding capacity decrease, juiciness diminishing and increase of PSE meat rate [14, 15, 16]. The objective of the present work was to compare the effect of different combination of carbon dioxide concentrations and times of exposure on turkey stress levels during the slaughter.

II. MATERIALS AND METHODS

One hundred one turkeys (54 males and 47 females) were used to carry out the experiment. All the animals came from the same farm and

were subjected to the same loading system, and transport and feedlot period of time.

The animals were distributed into two groups. Each group was stunned at different exposure time period and CO₂ concentration.

In the Experiment 1, 26 male and 21 female turkeys were exposed to a gradual increase of CO₂ until an 80% was achieved during 120 seconds with a previous adaptation period. Twenty eight male and 26 female turkeys were stunned in the Experiment 2 reaching the same CO₂ concentration of the first experiment but faster (100 seconds) and without the adaptation period.

The stun was carried out in a hermetic chamber with a controlled CO₂ injection and a constant gas analyzer. Neck cutting was performed immediately after stunning.

Blood for stress parameters determination (glucose, lactate and cortisol levels) was collected in after the neck cutting. Glucose level in mmol/L was determined with a One Touch® Ultra Soft® device (Johnson & Johnson Medical Devices & Diagnostics Group). This instrument presented a display where the glycaemia value was directly read. The Lactate Scout+® device (EKF diagnostics, Alemania) was used to quantify the lactate blood concentration in mmol/L.

The cortisol concentration was measured through an ELISA reaction performed with the kit MAGLUMI Cortisol (CLIA) © (Shenzhen New Industries Biomedical Engineering Co., China).

The data obtained were subjected to a two way ANOVA analysis with two factors (the experiment and the sex) using the general linear model procedure of STATISTICA data analysis software system, version 10.

III. RESULTS AND DISCUSSION

Glucose, lactate and cortisol serum levels are presented in Table 1.

No significant differences were observed between different CO₂ concentrations and time of exposure in serum glucose levels for neither male nor female turkeys. However a tendency towards significance (P<0.10) was observed in both genders and glucose level was higher in animals of the Experiment 2 than in those of the Experiment 1. These results were in accordance with those obtained by Bórnez [17] with light lambs who reported that individuals exposed less time to the gas presented higher values of serum glucose (5.58 vs 3.83 mmol/l).

There were significant differences between different CO₂ concentrations and times of exposure in serum lactate levels for both male and female turkeys. In both cases, animals of Experiment 1 showed lower values of serum lactate than those of Experiment 2. So the slower the increase of CO₂ concentration, the lower the serum lactate level was.

These results are in agreement with those of Nowak [18] in pigs, who reported that the lower exposure time for an 80% of CO₂ concentration, the higher serum lactate level was detected. However, these results did not match with the data published by Bornez [18] in light lambs who found higher serum lactate values when the time of exposure was higher.

Regarding the serum cortisol, the effect of the treatment was not significant.

These results are in accordance to those reported by Bornez [19] in suckling lambs, however they do not fit with those in light lambs [17] where significant differences were observed in serum cortisol depending on the time of exposure to the gas.

It would be necessary to quantify the serum cortisol level in a higher number of turkeys to confirm the lack of effect of the difference of exposure time in our population [20].

Table 1. Glucose, lactate and cortisol serum level of the population stunned by two different stunning methods.

<i>Biochemical parameters</i>	Experiment 1 Male turkey	Experiment 2 Male turkey	p-value	Experiment 1 Female turkey	Experiment 2 Female turkey	p-value
N	26	28		21	26	
Glucose (mmol/l)	2.88 ± 0.109	3.29 ± 0.180	0.060	2.54 ± 0.072	2.85 ± 0.143	0.081
Lactate (mmol/l)	5.37 ± 0.184	7.23 ± 0.235	<0.001	5.03 ± 0.275	6.55 ± 0.179	<0.001
Cortisol (ng/ml)	0.54 ± 0.097	0.42 ± 0.056	0.149	0.31 ± 0.060	0.54 ± 0.064	0.112

IV. CONCLUSION

There are not significant differences in serum glucose and cortisol levels of turkeys stunned with two different exposure times and CO₂ concentrations. However the serum lactate value varied significantly with the difference in the stunning conditions. The stress parameter values were lower in Experiment 1, when the increase of the CO₂ concentration was slower.

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