

INFLUENCE OF CARBON DIOXIDE STUNNING METHOD ON pH, COLOUR AND TEXTURE OF TURKEY MEAT.

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Abstract – The objective of this study was to investigate the effects of gas stunning on the turkey quality meat. Specifically, in this study stunned parameters were changed, such as the CO₂ concentration and stages of it. Two different experiments were performed.

The experiment 1 consisted on stunning 25 turkeys in three different stages; the first one to immobilize animals where it was reached 25% of CO₂ for 20 seconds. The second step, which aim was to achieve animal relaxation, it was reached a concentration of 55% of CO₂ for 40 seconds. The last stage was the desensitization of the animal where it was reached 65% of CO₂ for 55 seconds. The total time was 110 seconds.

In the second experiment, 25 turkeys were stunned in only one step where the CO₂ concentration gradually increased until 80 % CO₂ was achieved. The total time was 100 seconds.

Later, pH, color and texture were analyzed at 20 minutes and 24 hours post-mortem in turkey breasts from turkeys of the experiment 1 and 2.

CO₂ concentration during stunning only affected color of breast. As for pH and texture there were no differences in both experiments.

Key Words – Poultry, pre-slaughter management, meat quality.

I. INTRODUCTION

Electrical stunning (ES) has been a common method to immobilize poultry prior to slaughter in poultry processing plants [1]. Electricity is convenient, economical, and requires little room [2]. However, some methods of electrical stunning (particularly those required by European regulations) have been reported to increase the incidence of carcass damage such as red wings tips, broken bones, and muscle hemorrhages [3]. Because electrical stunning affects muscle quality, there has been considerable interest in developing alternate methods of immobilization [2].

Fletcher [2] suggested that, of the alternative stunning methods, gaseous stunning seems to be

the only practical substitution for electrical stunning. The anesthetic properties of CO₂ have been known for a century and attempts have been made to use it as a general anesthetic agent [4, 5]. This property of the gas would make it useful in preslaughter stunning by quickly rendering the birds unconscious. The actual stunning of birds with CO₂ was not studied until the middle of the 1950s [6]. Subsequent research on the effect of CO₂ stunning suggest that CO₂ stunning of birds resulted in improved bleedout [6] and better meat quality [7].

Hirschler [8] reported that CO₂ stunning reduced the incidence of carcass defects, such as broken clavicles and breast, thigh, and shoulder hemorrhages, compared to ES. Kang [9] reported that the lower incidence of damage to the carcasses stunned by CO₂ was due to the calmer nature of birds during a gaseous stun.

The purpose of this study was to investigate the effect of stunning with different concentrations of CO₂ in the quality of turkey breast analyzing pH, texture and color.

II. MATERIALS AND METHODS

Turkeys

In this work we studied a population of 50 female turkeys, with the same weight and age, to study some quality parameters of breast meat. In fact, we analyzed pH, color and texture of turkey meat depending on CO₂ concentration during the stunning.

Table 1. Stunning parameters: CO₂ Concentration and times in experiment 1.

	[CO ₂] %	Time (Seconds)
Stage 1	25	20
Stage 2	55	40
Stage 3	65	55

Experiment 1

The first experiment was based on studying the pH, color and texture of 25 female turkeys. These turkeys were stunned in the three different stages described in table 1.

To sum up, turkeys were stunned for 115 seconds and a concentration of 65% CO₂ was reached.

After stunning, turkeys were slaughtered manually cutting both carotid and jugular. Then turkeys continued through the phases of bleeding, scalding, plucking and manual evisceration, obtaining finally the carcass.

From the turkeys were stunned to carcasses were obtained, it spent around 20 minutes. At this point (20 minutes post-mortem) the color and pH were measured in the breast of the 25 female carcasses. Then, the carcasses were cooled stored between 0 - 4° C until the next day.

Finally, the turkey breasts were cut up from turkeys for analyzing pH, color and texture at 24 h post-mortem.

Experiment 2

This experiment consisted of analyzing the pH, color and texture of 25 female turkeys. In this case, the stunning involves a higher concentration of CO₂ in less time. Specifically, in this experiment was reached 80% CO₂ in a time of 100 seconds. Moreover, this stunning was based on increasing gradually CO₂ concentration until achieved 80%.

Then, it was analyzed the same meat quality parameters than in experiment 1 (pH, color and texture) at 20 minutes post-mortem and 24 hours post-mortem. The following equipments were used to measure the parameters of meat quality:

- pH: pH-meter penetration Crison PH25 +.
- Color: Spectrophotometer: CN Minolta 2600-D.
- Texture: texture analyzer TA-XTplus. To analyze the texture, a piece of each breast was introduced in a bag and cooked until the internal temperature reached 70 ° C in a water bath. Subsequently, we proceed to measure the shear force (amount of force necessary to completely cut the core) expressed in kg/cm².

For the statistical analysis it was used the Statistica program.

III. RESULTS AND DISCUSSION

In this section it is focus on analyzing whether the different stunning have influence on the quality turkey meat.

pH

In the experiment 1 the average pH was 6.21, while in the experiment 2 the average pH was 6.24. The p-value was 0.654. Therefore, it was concluded that there was no significant difference in pH depending on CO₂ concentration during stunning.

Texture

In this quality parameter the average texture in experiment 1 was 3.66 kg / cm², while the average texture in the experiment 2 was 3.31 kg / cm². The p-value was 0.151; therefore, there was no significant difference in texture depending on CO₂ concentration during stunning.

Color

The axis L * (lightness), a * (red-green) and b * (yellow-blue) were analyzed.

In the experiment 1 the average value of L * was 37.85, whereas in the experiment 2 the average value of L * was 38.36. The p-value was 0.641 so there were no significant differences in lightness.

For the axis a* the average value in experiment 1 was -2.38 and in the experiment 2 the average value of a* was 1.79. The p-value was 0.003, so in this plane of light there were significant differences depending on CO₂ concentration during stunning.

In the case of the axis b *, in the experiment 1 the average value b* was 5.639, while in the experiment 2 the average value b* was 0.862. The p-value was 0,001; so that, in this parameter, there were also significant differences depending on stunning.

IV. CONCLUSION

According to our results the different combinations of gas concentrations and time of exposure affected color of the turkey breast. Specifically, the axis a* (red-green) and the axis b* (yellow-blue) changed depending on the CO₂ concentrations. However, there were not

differences in pH, texture and the axis L* (lightness) of turkey breast, depending on CO₂ concentration during stunning.

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REFERENCES

1. Mountney, G. J. (1976). Poultry Products Technology. AVI Publishing Co., Inc., Westport, CT
2. Fletcher, D.L. (1993). Stunning of broilers. *Broiler Ind* 56:40-46.
3. Gregory, N. G, & Wilkins, L. J. (1989). Effect of stunning current on carcass quality in chickens. *Vet Rec* 124:530-532.
4. Hickman, H. H. (1912) A forgotten pioneer of anaesthesia. *Br Med J* 1:843.
5. Sieker, H.O, & Hickman, J. B. (1956). Carbon dioxide intoxication: The clinical syndrome, its ethology and management with particular reference to the use of mechanical respirators. *Medicine* 35:389-423.
6. Kotula, A. M, Drewniak, E. E, & Davis, L. L. (1957). The effect of carbon dioxide immobilization on the bleeding of chickens. *Poultry Sci* 36:585-589.
7. Zeller, W, Mettler, D & Scatzmann, U. (1988). Studies into the stunning of slaughter poultry with carbon dioxide. *Fleisch-wirtschaft* 68:1308-1312.
8. Hirschler, E,M, & Sams, A,R. (1993). Comparison of carbon dioxide and electricity for the preslaughterr stunning of broilers. *Poultry Sci* 72 1:143.
9. Kang, I. S, & A. R. Sams, (1999). Bleedout efficiency, carcass damage, and rigor mortis development following electrical stunning or carbon dioxide stunning on a shackle line. *Poultry Sci.*, 78: 139 - 143.