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# EFFECTS OF ELECTRICAL STIMULATION ON HOT BONED CHICKEN BREAST (P.MAJOR) TENDERNESS

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## INTRODUCTION

The production of boned breast meat has increased dramatically in Brazil in the last years. In this situation processing techniques that could shorten processing time, like hot boning, are of interest. However, it is reported that hot boning has an adverse effect on meat tenderness, increasing meat shear values (Lyon *et al.*, 1985). One possible way of minimizing this problem is to combine hot boning with electrical stimulation. Most of the research on this subject has been carried out with red meats (Pearson and Dutson, 1985). The purpose of the electrical stimulation is to accelerate post-mortem biochemical changes increasing the tenderization of meat during cold storage by preventing cold shortening. The tenderizing mechanism is not clear yet although some theories, founded on experiments, suggest that electrical stimulation causes physical rupture of muscle fibres and increases in the proteolytic activity of endogenous enzymes (Thompson *et al.*, 1987).

Poultry differ from other meat species because their muscle enters rigor rapidly. Chicken breast muscles enter rigor within 60 minutes post-mortem while leg muscles take 30 minutes (Kijowski *et al.*, 1982).

Research on electrical stimulation of poultry meat is less volumous. Some work compares high and low voltage stimulation (Thompson *et al.*, 1987) or the effects on meat tenderness of hot boning and time of stimulation (Hamm, 1981; 1982). Maki and Froning(1987) used high voltage (880V, 340mA) over a period of 36s and observed improved tenderness of turkey meat. Jenson *et al.* (1979) used high voltage (800V) and could not observe a clear improvement of meat tenderness. Thompson *et al.*(1987) evaluated the effects of low voltage (45V) and high voltage (240, 530 and 820V) over different times of stimuli on chicken breast meat tenderness. Low voltage decreased shear values of hot boned breast meat but high voltage (820V) only significantly decreased shear values of conventionally deboned breast meat. Using electrical stimulation of 100V, Froning and Uijttenboogaart(1988) observed increased tenderness of breast muscle deboned at 120 and 240 minutes after stimulation.

The objective of this work was to determine the effects of low voltage electrical stimulation using different voltages on tenderness of hot boned and conventionally boned chicken breast meat.

## MATERIALS AND METHODS

Ten chickens, with weights in the range of 2.2 to 2.5kg were selected at random from a population of 45 day old Cobb strain and used for each stimulation voltage. All chickens were stunned with a voltage of 40V for 11s (30-50mA). After a 90s bleeding period, which was normally finished after five minutes, the carcasses were subjected to pulsed electrical stimulation (2s on; 1s off) at the voltages of 45, 80 and 100V using an EEBVA low voltage electrical stimulator from Jarvis do Brasil. The pulses were completed after 30s for both treatments of deboning (hot and conventionally).

After scalding and picking, five carcasses were suspended from a shackle by the neck and the breast fillet (*pectoralis superficialis*) was removed by severing the humeral scapular joints and stripping the meat from the carcass by pulling downward on the wings. The fillets with the wings attached were chilled first at 21°C for 15 minutes and then at 3°C for 30 minutes.

The other five stimulated carcasses followed the normal line of the abattoir and were deboned after chilling and dripping. As a control, for both types of deboning five non-stimulated were used carcasses. Five trials were conducted in different periods.

Data were analyzed according to the factorial model using analysis of variance and Duncan's multiple range test available in the Statistical Analysis System (*SAS Institute Inc.*, 1990)

Thawed fillets(24 hours, 2 to 3°C) with the wings removed were placed on roasting racks in aluminum foil and cooked to an internal temperature of 85°C according to the *working group* (1987). After chilling to room temperature the fillets were maintained at 2°C for 24 hours. Samples of 2cmx1.13cm$^2$ were cut according to Froning and Uijttenboogaart(1988).

Samples from the right side were sheared in a direction perpendicular to the muscle fibres in an INSTRON equipment model TM-2318 using a Warner-Bratzler device. The left side of the breast was used for the sensory analysis. Sensory analysis was conducted using a trained panel of 14 judges who scored firmness, juiciness and overall quality on a descriptive scale with 10 points. The statistical model used was an incomplete block design. The sensory panel was conducted using the Computerized Sensory Analysis developed by Comusense, Inc. The mean values of the evaluated parameters were statistically analyzed using analysis of variance and Duncan's multiple range test according to SAS (1990).

## RESULTS AND DISCUSSION

The Warner-Bratzler shear values and the sensory scores for tenderness of the chicken breast meat for all treatments. For muscles boned conventionally after chilling there was no statistically significant influence of stimulation voltage on tenderness or shear values. Warner-Bratzler shear values for these conventionally deboned muscles were in the range of 5.5 to 5.8Kgf/g. Sensory scores for tenderness ranged from 6.3 to 7.6. Shear values were significantly higher for the breast muscles of non stimulated birds with values around 7.6Kgf/g. However, the sensory evaluation showed that only the muscles stimulated at 45V had a tenderness score of 7.6, significantly more tender than the non stimulated control samples that had a score of 5.4.

For the hot boned breast muscles there was also no significant influence of stimulation voltage on tenderness as evaluated by sensory and shear values. Non-stimulated muscles had significantly higher shear values, around 11.3Kgf/g. However sensory scores for tenderness were not significantly different for all treatments, ranging from 4.0 to 4.9.

Comparing hot boning to conventional boning (Table 1), it can be observed that the shear values of hot boned muscles stimulated at 80 and 100V did not statistically differ from conventional non-stimulated muscles.

The sensory data did not show a clear picture. For the same stimulation treatment scores were always lower for hot boned muscles than the conventionally boned ones; but only hot boned muscles stimulated at 80V were significantly tougher. The sensory tenderness of non stimulated muscles was not significantly affected by the boning method although shear values were significantly higher for hot boned muscles.

The statistical evaluation of the overall effects of deboning method and electrical stimulation on shear values are shown in Table 2. Hot boned muscles had significantly higher shear values, an average of 9.3Kgf/g, than conventionally boned muscles (6.2Kgf/g). Electrically stimulated muscles had significantly lower shear values, in the range of 7.0 to 7.2Kgf/g, than the non-stimulated muscles (9.5Kgf/g).

The sensory analysis for juiciness and overall quality of the breast meat for the hot and conventionally boning are shown in Table 3. There was a statistically significant difference between the method of deboning for juiciness and overall quality. Muscles conventionally deboned showed juiciness around 5.1-5.9. Hot deboned muscles had juiciness in the range of 3.5-4.3. Conventionally deboned meat did not show differences between treatments for overall quality. Hot boned muscle at 100V, with a score of 5.9, was considered statistically better than the non-stimulated muscle, with a score of 4.3. Between the types of deboning, only the hot boning at 100V did not statistically differ from the conventional treatments.

## CONCLUSIONS

Electrical stimulation had a tenderizing effect on both hot boned and conventionally boned breast meat. Electrical stimulation may allow production of hot boned breast meat as tender as non-stimulated conventionally deboned breast meat.

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Table 1. Shear values and subjective tenderness of breast meat.

| Treatment | Shear value[1] (Kgf/g) | Tenderness[2] (sensory analysis) |
|---|---|---|
| Conventionally | | |
| 45V | $5.5^{d}$ | $7.6^{a}$ |
| 80V | $5.8^{d}$ | $7.0^{ab}$ |
| 100V | $5.8^{d}$ | $6.3^{abc}$ |
| Non-stimulated | $7.6^{c}$ | $5.4^{bcd}$ |
| Hot boning | | |
| 45V | $9.1^{b}$ | $4.7^{cd}$ |
| 80V | $8.3^{bc}$ | $4.0^{d}$ |
| 100V | $8.6^{bc}$ | $4.9^{bcd}$ |
| Non-stimulated | $11.3^{a}$ | $3.3^{d}$ |

[1] 5 trials (5 measures for each trial)
[2] mean of 3 trials (7 measures for each trial)

Table 2. Effects of the type of boning and voltage of stimulation on the shear value of breast meat.

| Boning[1] | Voltage[2] (V) | Shear value (Kgf/g) |
|---|---|---|
| Hot boning | | $9.3^{a}$ |
| Conventionally | | $6.2^{b}$ |
| | 45 | $7.3^{b}$ |
| | 80 | $7.0^{b}$ |
| | 100 | $7.2^{b}$ |
| | Non-stimulated | $9.5^{a}$ |

[1] means of 100 measurements
[2] mean of 50 measurements

Table 3. Juiciness and overall quality measured by sensory analysis.

| Treatments | Juiciness[1] | Overall Quality[1] |
|---|---|---|
| Conventional | | |
| 45V | $5.9^{a}$ | $7.1^{ab}$ |
| 80V | $5.1_{ab}$ | $6.5^{ab}$ |
| 100 | $5.7_{a}$ | $7.2^{a}$ |
| Non-stimulated | $5.2_{ab}$ | $6.1^{abc}$ |
| Hot boning | | |
| 45V | $3.5^{c}$ | $5.2^{cd}$ |
| 80V | $3.8_{bc}$ | $5.1^{cd}$ |
| 100V | $4.3_{bc}$ | $5.9^{bc}$ |
| Non-stimulated | $4.2_{bc}$ | $4.3^{d}$ |