EFFECT OF ELECTRICAL STIMULATION ON THE DROP OF pH AND TENDERNESS OF MEAT FROM ZEBU CATTLE

Marina Avena Tarsitano[1], Ana Maria Bridi[2], Eder Paulo Fagan[3], Franciele Caroline Bolfe[4], Ana Beatriz Messas Rodrigues Pinto[4], Thales de Almeida Bitencourt Cardoso [4], Nayara Andreo[4], Louise Manha Peres[4], Mariany Gavioli Antunes[5], Diogo Sendi Toshimitsu Kawagoe[6]

[1]DSc student of the Graduate Program in Animal Science, Universidade Estadual de Londrina, Londrina, Paraná, Brazil, [2]Animal Science Department, Universidade Estadual de Londrina, Londrina, Paraná, Brazil, [3]Animal Science Department of Veterinary Medicine, Universidade Estadual do Norte do Paraná, Bandeirantes, Paraná, Brazil, [4]MSc student of the Graduate Program in Animal Science, Universidade Estadual de Londrina, Londrina, Paraná, Brazil, [5]Graduating in Veterinary Medicine, Universidade Estadual do Norte do Paraná, Bandeirantes, Paraná, Brazil, [6]Graduating in Animal Science, Universidade Estadual de Londrina, Londrina, Paraná, Brazil

Abstract – The objective of this paper was to evaluate the drop in pH and the tenderness of the meat from carcasses of Zebu cattle electrically stimulated. Experimental treatments were T1: 32 electrically stimulated (EE) carcasses and T2: 32 carcasses which were not electrically stimulated (SE). The pH was measured in the *longissimus dorsi* muscle with a portable potentiometer, in left ½ carcasses, in times of 45 minutes, four, eight, 16, 20 and 24 hours after slaughtering. Shearing strength was measured perpendicularly to the muscle fibers, with a Warner-Bratzler blade adapted to texture meter Stable Mycro Systems TA-XT2i. There was a quadratic effect for pH values in relation to the measuring time. Shearing strength lowered when electrical stimulation was used. Both pH and tenderness were positively influenced with the use of high voltage electrical stimulation.

Key words – shear force, *rigor mortis*.

I. INTRODUCTION

Post-slaughtering handling has direct impact on the end quality of meat. When the ATP reserves are finished, there is an irreversible link of actin and myosin molecules, characterizing *rigor mortis*, as well as the loss of elasticity and increase of muscular tension, and the meat reaches its maximum stiffness value [1].

The main consequence of the cadaverous rigidity is the maximum shortening of sarcomeres. And one of the factors greatly affecting the final size reached by the sarcomere is the temperature in which the carcass is kept during the period prior to the onset of cadaverous rigidity.

Usually, cattle carcasses are refrigerated at 2°C. If the carcass cools down too fast, it might suffer the phenomenon "cold shortening". Carcasses from Zebu cattle are usually more susceptible to the shortening of sarcomeres due to the low degree of finishing, that is, due to the low deposits of subcutaneous fat. Electrical stimulation of carcasses helps in preventing the shortening of sarcomeres by accelerating the onset of *rigor mortis*, before the carcass cools down. An electrical current runs through the carcass during slaughter, causing intense contractions and accelerating anaerobic glycolysis and the drop of pH, reducing the period for establishing rigor [2].

Electrical stimulation also activates the proteolytic enzymes by acidification of the medium and also causes the physical rupture of myofibrils due to the intense muscular contraction it provokes [3].

The objective of this paper was to evaluate the drop in pH of electrically stimulated carcasses and the tenderness of their meat.

II. MATERIALS AND METHODS

The experiment was performed in a commercial slaughterhouse in São Paulo state, Brazil. A total of 64 carcasses from Zebu animals from Nelore breed with less than 24 months of age (up to two

permanent teeth) were used. Experimental treatments were T1: 32 electrically stimulated carcasses (EE) and T2: 32 carcasses that were not electrically stimulated (SE). The high-voltage electrical stimulation consisted of the passing of an 800V electrical current through the carcass after slaughtering, before the carcass entered the cold chamber.

The pH was checked in the cold chamber, with a Testo 205 potentiometer, in the left ½ carcasses, at 45 minutes, four, eight, 16, 20 and 24 hours after slaughtering in the *longissimus dorsi* muscle.

The samples went through cooking in a pre-heated electrical oven at 180°C until reaching internal temperature of 72°C. After this, they were stored for 24 hours at 4 ± 2°C. From each sample, six cylindrical sub-samples measuring 2.5 cm long and 1.27 cm in diameter were collected, using a cylindrical steel sampler. Shear force was measured perpendicular to the muscle fibers, with a Warner-Bratzler blade adapted to a CT3 Texture Analyzer [4].

Data were submitted to F test and variance analysis with polynomial derivation, the 5% significance level (Genetic and Statistical Analysis System.Version 9.1, 2007).

III. RESULTS AND DISCUSSION

According to what can be observed in Table 1, pH values both for non-stimulated and electrically stimulated carcasses had a quadratic behavior in relation to the pH measuring time. However, this quadratic behavior could have happened due to the slight increase in pH in the measuring at 24 hours.

However, electrically stimulated carcasses had a lower pH in all times when compared to the non-stimulated ones. At 45 minutes after slaughtering, pH of stimulated carcasses was already below six while those carcasses that were not stimulated were still with pH above this value.

Table 1. pH values of not stimulated carcass (SE) and stimulated carcass (EE) over time.

Time	pH (SE)	pH (EE)
45 min	6.38 ± 0,18 *	5.87 ± 0,19 *
4 h	6.19 ± 0,15 *	5.73 ± 0,15 *
8 h	6.09 ± 0,23 *	5.71 ± 0,12 *
12 h	6.00 ± 0,23 *	5.73 ± 0,16 *
16 h	5.87 ± 0,23 *	5.69 ± 0,14 *
20	5.82 ± 0,23 *	5.70 ± 0,13 *
24 h	5.92 ± 0,18 *	5.73 ± 0,15 *
CV%	3.425	2.64
P%	0.0009[1]	0.0112[2]

[1]$y= 6.38208-0.0494475x+0.0011965x^2$;
[2]$y= 5.84266-0.0204185x+0.000666388x^2$
*Same line: Significant difference in the 5% probability according to the F test.

This decrease in pH in the first minutes after slaughtering helps to prevent the shortening of sarcomeres by cold, and this is one of the factors leading to improvement in the tenderness of meat from electrically stimulated carcasses.

In Table 2, values found for shear force are described. It can be noticed that the tenderness in samples belonging to the electrically stimulated treatment was 13.8% higher when compared to the samples from the treatment without electrical stimulation.

Table 2. Shear force values of not stimulated carcass (SE) and stimulated carcass (EE) according to electrical stimulation usage.

Treatment	FC kgf
SE	5.29 ± 0.77*
EE	4.56 ± 0.86*
CV %	16.531
P%	0.0255

*Significant difference in the 5% probability according to the F test.

Stimulation releases high electrical energy, being much greater than what the muscular structure can tolerate, thus causing damages to

the cell membrane with fragmentation of contractible fibers and connective tissue [5].

IV. CONCLUSION

High voltage electrical stimulation efficiently acted in the drop of pH, thus improving the tenderness of Zebu cattle meat.

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