MEDIUM VOLTAGE ELECTRICAL STIMULATION AS A TOOL TO IMPROVE NELORE BEEF QUALITY

Daniela A. Vasco[1], Mariane Beline[1,2], Camylla P. Monteiro[1], Alessandra F. Rosa[3], Luiza B. Andrade[1], Ana J. A. Hayashida[1], Enzo M. Ribeiro[1], Patricia M. Ramos[1], David E. Gerrard[2] and Saulo L. Silva[1*]

[1]College of Animal Science and Food Engineering, University of Sao Paulo, Pirassununga, SP 13635-900, Brazil.

[2] School of Animal Sciences, Virginia Tech, Blacksburg, VA 24061, USA.

[3]Smart Meat Projects and Consulting Ltda, Pirassununga, 13635-900, Brazil

*Corresponding author email: sauloluz@usp.br

I. INTRODUCTION

Bos indicus cattle and their crosses have been extensively used for meat production in hot climates/regions because of their heat tolerance. However, their meat has been often recognized as lower quality than that of Bos Taurus breeds, due primarily to lower tenderness scores. Beef tenderness can be improved through various pre- and post-slaughter practices, including electric stimulation of carcasses, which accelerates pH declines post-slaughter and improves beef tenderness and colour scores [1, 2]. More recently, medium voltage systems have been used by industry with important benefits for the quality of the final product [2]. Therefore, the aim of this study was to evaluate the effect of medium voltage electrical stimulation on carcass and meat quality traits of feedlot finished Nellore cattle.

II. MATERIALS AND METHODS

Seventy-two Nellore cattle (intact [n=24], immunocastrated males [n=24], surgically castrated males [n=12], and intact heifers [n=12]) were randomized assigned to one of two treatments consisting of either electrically stimulated (ES) and non-stimulated (NS) carcasses. Thirty-min after exsanguination, carcasses were split, and the left side of each carcass was assigned to ES and the other side was used as a control (NS). Electrical stimulation was performed using a medium voltage of 300V, frequency of 15 Hz, for 60 sec. Temperature and pH were obtained immediately before and 1, 3, 6, 9, 12, and 24h after the stimulation. After chilling (24h), three 2.5 cm thick samples of the *Longissimus thoracis* muscle were collected, vacuum packaged, and aged for 1, 7, or 14 d for color, cooking loss, and Warner-Bratzler shear force (WBSF) analyses. Samples were classified by tenderness class based on thresholds described by Destefanis et al. [3] as follows: tender (WBSF < 42.87 N); intermediate (42.87 ≤ FC ≤ 52.68); and tough (WBSF > 52.68). Results were analysed using the Mixed procedure of SAS, with treatments (ES and NS), time of measurement (1, 7, 14 d) and time X treatment interaction as fixed effects. Gender and harvest day added as random effects.

III. RESULTS AND DISCUSSION

There was a treatment X time interaction for the carcass pH ($P < 0.001$) and temperature ($P = 0.028$). Muscle from ES carcasses had lower pH values for all times (Figure 1) and higher temperatures from 1h to 9h postmortem (Figure 2). Differences in pH were greater immediately after slaughter and decreased with time. WBSF values were lower for steaks collected from ES compared to those from NS carcasses at all ageing times investigated ($P < 0.001$; Figure 3). Samples from ES carcasses at 1 d were equivalent to those from NS at 7 d of ageing (64.3 vs 66.4N, respectively), and those from ES carcasses collected at 7 d were equivalent to those of NS at 14 d (51.1 versus 51.4), respectively. All steaks from NS carcasses were classified as tough, while those from ES carcasses were classified as 93% tough and 7% intermediate (Figure 4). After 7 d of aging, 3% of the steaks from NS carcasses were classified as tender compared to 26% from ES carcasses. After 14 d, 56% of

steaks from ES carcass were considered tender and 6% tough, while 26% of those steaks from NS carcasses were classified as tender and 36% as tough. Steaks from ES carcasses had greater (P = 0.018) cooking loss than those from NS carcasses. A luminosity (L*) X ageing approached significance (P=0.064), with steaks from ES carcasses having lower L* than those from NS at 1 and 7 d (42.3 vs 43.9N, and 44.8 vs 45.6N), respectively, though no differences were detected at 14 d (46.3 vs 46.6N).

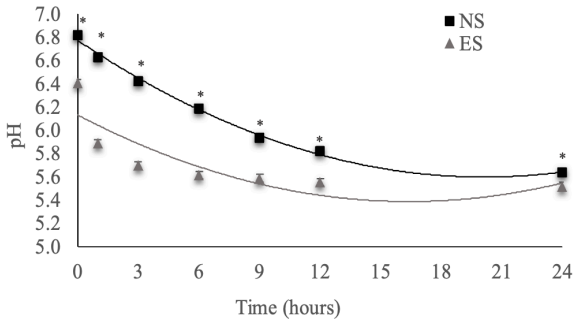

Figure 1 – Carcass pH according to post-mortem time and treatments (ES: electrically stimulated; NS: non stimulated carcasses. *Treatments differ (P<0.05)

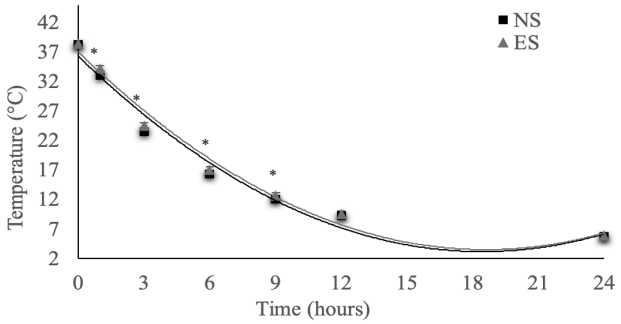

Figure 2 – Carcass temperature according to post-mortem time and treatments (ES: electrically stimulated; NS: non stimulated carcasses. *Treatments differ (P<0.05)

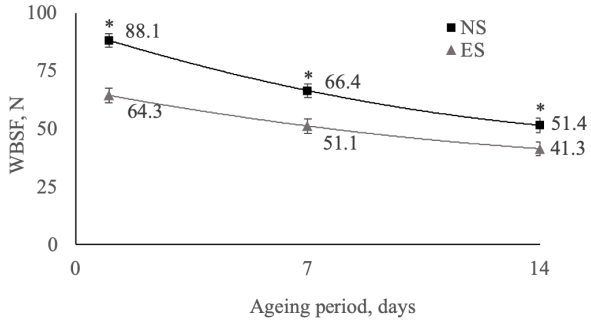

Figure 3 – Warner-Bratzler shear force values according to post-mortem time and treatments (ES: electrically stimulated; NS: non stimulated carcasses. *Treatments differ (P<0.05)

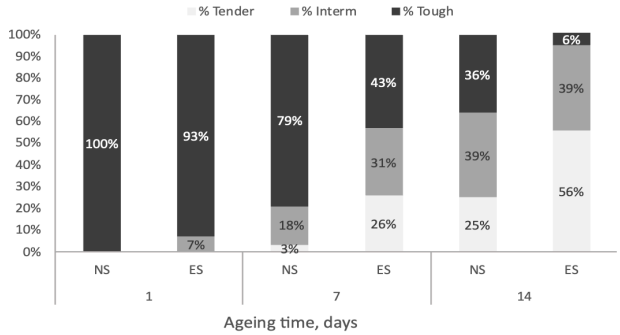

Figure 4 – Tenderness classes according to post-mortem time and treatments (ES: electrically stimulated; NS: non stimulated carcasses.

IV. CONCLUSION

Addition of medium voltage ES to Nellore beef carcasses accelerates pH decline and improves meat tenderness without compromising meat color. Application of this technology positively impacts beef quality without increasing costs associated with increased ageing times. Implementation of this technology should contribute positively to the sustainability of beef supply chain.

ACKNOWLEDGEMENTS

To the Fluxo Equipamentos Eletrônicos LTDA by providing the electric stimulation equipment and to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

REFERENCES

1. Adeyeml K.D.; Sazili A.Q. (2014). Efficacy of carcass electrical stimulation in meat quality enhancement: a review. Asian-Australas Journal Animal Sciences 27: 447-456.
2. Ji, X.; Luo, X., Zhu, L.;,Mao, Y., Lu, X., Chen, X., Hopkins, D.L., Zhang, Y. (2021). Effect of medium voltage electrical stimulation and prior ageing on beef shear force during superchilled storage. Meat Science 172: 108320.
3. Destefanis, G., Brugiapaglia, A., Barge, M. T., Dal Molin. (2008). Relationship between beef consumer tenderness perception and Warner–Bratzler shear force. Meat science 78: 153-156.