Impact of a novel amperage-based electrical stimulation system on meat quality and palatability of finished steers

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Objectives: In North America, commercial carcass weights continue to increase and the efficacy of high constant voltage electrical stimulation has been questioned. This study evaluated the effect of an amperage-based electrical stimulation (AES) system with constant current, where the voltage of the source varies depending on the impedance of the carcass, on meat quality and palatability of finished steers.

Materials and Methods: A total of 101 crossbred steers (n=50 implanted with 120 mg trenbolone acetate and 24 mg estradiol benzo- ate, n=51 non-implanted) within a wide range of hot-carcass weight (353-557 kg) and fatness (3-38 mm) were used. At 2 week intervals, steers were shipped to the federally inspected Lacombe Research and Development Centre research abattoir, stunned, ex- sanguinated and dressed in a simulated commercial manner. Following carcass splitting, the pH of the *longissimus* musclewas measured at 45 min post-mortem. Subsequently, one carcass side was exposed to an AES (2.04 A for 1 min with 2 s ON/2 s OFF pulses) whereas the other side was not treated (non-AES, Control). Carcasses were then chilled conventionally at 2°C. At 3 h post- mortem, pH was measured again on the *longissimus*. After a 72 h chilling period, carcass sides were knife-ribbed between the 12^{th} and 13^{th} ribs and pH and objective colour (CIE $L^*a^*b^*$, hue and chroma) were recorded across the ribeye surface(Barragán et al., 2021). After removing the *longissimus* from each carcass side, one steak (2.54-cm thick) was collected and cooking loss and War- ner Bratzler shear force (WBSF) were measured (Barragán-Hernández et al., 2022). The remainder of the *longissimus* was vacuum- packaged and wet-aged at 2°C for 3 more days. At 6 d post-mortem, *longissimus* samples were removed from the vacuum packag- es, purge losses and pH were recorded, and four steaks (2.54-cm thick) were removed. Cooking losses and WBSF were measured on the first (6 d post-mortem) and second (re-vacuum packaged and wet-aged for a total of 12 d) steaks. The third steak was pack- aged in a retail display package with an absorbent pad and overwrapped with oxygenpermeable film, held at 4°C for 4 d in a retail display case, and objective colour and drip loss were measured (López-Campos et al., 2018). The fourth steak was vacuum-pack- aged and frozen at −25°C for further descriptive sensory analysis performed by a 10-member expert meat evaluation panel (Barragán-Hernández et al., 2022). A split-plot design in a mixed model (SAS, 2009) was used to evaluate the effects of implant treat- ment (whole plot) and AES (subplot) on meat quality and palatability. The AES, implant and their interaction were considered fixed effects. Slaughter date, panel session and panelists were included as random effects and freezing time as a covariate.

Results and Discussion: Regardless of implant treatment, AES decreased the pH at 3 h (5.84 *vs.* 6.17) and 72 h post-mortem (5.45 *vs.* 5.54) (P<0.001), although increased purge losses (11.40 *vs.* 10.10 mg/g) and drip losses (43.65 *vs.* 41.02 mg/g) (P<0.01), prob- ably due to the faster pH drop. This faster pH reduction could prevent cold shortening in AES carcasses by ensuring earlier rigor onset and less rigor contraction. In addition, AES resulted in meat with a lighter (higher L^*: 41.73 *vs.* 39.62), redder (higher a^*:23.11 *vs.* 21.98, higher hue: 34.64 *vs.* 33.98), yellower (higher b^*: 15.98 *vs.* 14.82) and more intense colour (higher chroma: 28.11 *vs.* 26.53) than non-AES meat (P<0.001). These improvements in colour persisted through 6 d post-mortem for all colour values (P<0.01), except for luminosity (L^*) that was similar (P>0.1), and after 4 d in retail display for b^* and hue (P<0.01). Additionally, regardless of implant treatment, AES increased cooking losses (231.84 *vs.* 203.47 mg/g) and time (4.36 *vs.* 3.80 s/g) (P<0.0001) and tended to decrease WBSF values (6.81 *vs.* 7.01 kg, P=0.071) at 3 d post-mortem, although no differences in cooking losses and time (P>0.1) and a tendency to increase WBSF (6.42 *vs.* 6.28 kg and 5.66 *vs.* 5.44 kg, P=0.071) were observed at 6 and 12 d post- mortem, respectively. A more evident effect was observed on palatability (P<0.01), as AES meat presented higher initial (6.40 *vs.* 6.23) and overall tenderness (6.85 *vs.* 6.70) and lower amounts of perceived connective tissue (7.34 *vs.* 7.16) than non-AES meat. An AES × implant interaction affected overall tenderness and palatability, as AES increased meat overall tenderness to a greater extent on implanted (6.74 *vs.* 6.50) than non-implanted (6.95 *vs.* 6.91) steers (P=0.069) and increased overall palatability in meat from implanted steers (6.74 *vs.* 6.58, P<0.05).

Conclusion: These results suggest potential benefits of this novel approach of electrical stimulation to enhance meat quality and palatability attributes from both implanted and non-implanted steers, which could be of value to the beef industry.

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