EFFECT OF GROWTH PROMOTING HORMONES AND HIGH VOLTAGE ELECTRICAL STIMULATION ON MEAT QUALITY OF FINISHED STEERS

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Abstract – The impact of growth promotants and high voltage electrical stimulation (HVES) on meat quality of steers was evaluated. Ninety-six steers were assigned to implant (IMP) or non-implanted (NIMP). At 45 min post-stunning, HVES was applied to alternate carcass sides. The use of HVES resulted in improvements in LL colour. For shear force of the LL, a significant two-way interaction between implant and HVES was observed (P<0.05). HVES reduced shear force, but the effect was more pronounced in NIMP (-2.64kg) *versus* IMP (-2.08kg). The tenderizing effect of HVES on LL shear force is, therefore, reduced in IMP steers at 24 h.

Key Words – beef, HVES, growth implant.

I. INTRODUCTION

In North America over 90% of finished slaughter cattle receive some type of growth promotant. Combinations of implants that contain estrogenic and androgenic hormones are a common practice and they produce a greater response than single-hormone implant strategies [1]. However, use of estrogenic growth promotants, especially in combination with trenbolone acetate (TBA), has been reported as detrimental for some meat quality traits. Shear force values have been reported to be higher for meat from TBA implanted animals [2]. Electrical stimulation (ES) is another practice used routinely in the beef industry to improve tenderness and meat quality in beef cattle. Typically one of two forms of ES are used, low voltage (LVES; <100 V) or high voltage (HVES; 470-3600 V). When HVES was compared directly to LVES, the tenderizing effect of HVES was greater, but their combination did not lead to further improvements [3]. Yet, it is not clear if HVES and growth promotants interact in terms of carcass and meat quality. Thus the aim of the present study was to evaluate the impact of using a combination of implants and HVES to examine their interaction on meat quality of finished steers.

II. MATERIALS AND METHODS

A total of 96 crossbred steers were used with 48 implanted (IMP, 120 mg TBA and 24 mg estradiol benzoate) and 48 non-implanted (NIMP). Steers were targeted for slaughter at 8-10 mm backfat. At 45 min post-mortem, pH of the *longissimus lumborum* (LL) was measured. Following this, alternate carcass sides were exposed to HVES (470 V, 60 Hz, 1.5 A for 1 min). At 24 h post-mortem, marbling score was assessed subjectively using beef marbling pictorial standards. Following 20 min exposure to atmospheric oxygen, subjective (Japanese Meat Grading Association, JMGA) and objective (Minolta CR-200) colour were assessed at the grade site (12^{th}-13^{th} rib). The LL muscle was dissected and subsampled for drip loss and proximate analyses. Warner-Bratzler (WB) shear force measurements were performed at 24 h post-mortem on cooked LL steaks using a WB shear cell attached to an Instron 4301 Materials Testing System. Data were analyzed using the MIXED procedure of SAS, with a split plot design including the fixed effects of growth implant group in the whole plot, and ES in the subplot.

III. RESULTS AND DISCUSSION

NIMP steers had higher marbling scores than IMP (P=0.01; Table 1). Consistently, the intramuscular fat content was significantly lower in LL from IMP steers compared to NIMP (P=0.02). Previous studies have reported an increased *longissimus* muscle area and decreased intramuscular fat associated with implanted cattle. Leaner carcasses from implanted cattle might result from an increased quantity of muscle and not a decreased quantity of fat [4]. Colour from meat exposed to HVES was significantly (P<0.01) lighter, more saturated, and redder at 24 h. This resulted in significantly higher (P<0.01) JMGA scores in LL steaks from unstimulated sides. ES results in increased post-mortem

metabolism causing an immediate fall in pH with a subsequent increase in protein denaturation and free water at the cell surface allowing for greater reflectance, partially accounting for the brighter appearance of the meat [5]. A two-way interaction (P<0.05) between implant and HVES was observed for the shear force of the LL. At 24 h unstimulated LL muscles, either NIMP (8.13 kg) or IMP (8.29 kg), had the highest shear force. ES reduced shear force in all treatment groups, but the effects were more pronounced in the NIMP (5.49 kg) than in IMP (6.21 kg).

Table 1 Effect of HVES treatment on grade and quality characteristics of the *longissimus lumborum.*

Characteristic	Non-implanted	Implanted	SEM[b]	Unstimulated	HVES[c]	SEM	I^a	S^a	$I \times S^a$
Marbling score[d]	420	396	7.67	397	419	7.76	0.01	0.11	0.14
Intramuscular fat, $mg \cdot g^{-1}$	33.9	29.6	1.29	31.8	31.7	0.95	0.02	0.83	0.72
Shear force LL, kg	6.81	7.25	0.15	8.21	5.85	0.14	0.02	0.02	0.02
L* (lightness)	37.8	37.7	0.41	36.5	39.0	0.38	0.67	<0.001	0.60
Chroma, %	20.9	20.9	0.20	19.8	21.9	0.17	0.94	<0.001	0.14
Hue angle, ^{o}	21.9	21.9	0.15	21.2	22.5	0.13	0.98	<0.001	0.33
JMGA[e] colour score	6.33	6.42	0.16	6.91	5.85	0.14	0.61	<0.001	0.31

[a]*P* - values: *I*: Implant effect, *S*: stimulation effect and *I*×*S*: Implant×Stimulation interaction. [b]SEM, standard error of the mean. [c]HVES, High voltage electrical stimulation. [d]USDA marbling photographs. [e]JMGA: Japanese Meat Grading Association.

IV. CONCLUSION

The use of HVES resulted in improvements in LL colour. Improvements in shear force were observed at 24 h post-mortem in the LL when HVES was applied to both IMP and NIMP beef, being more pronounced in the latter. This study confirmed results from previous studies on effects of implant and ES strategies in isolation but also provides insight on the use and optimization of combined use of growth promotants and HVES practices. In this sense, the tenderizing effect of HVES on LL shear force was reduced in IMP steers at 24 h. Further studies on ES should be conducted in order to better understand the overall impact of ES on meat quality and its interaction with other practices such as growth promotants or ageing.

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