THE EFFECT OF TENDERSTRETCHING AND ELECTRICAL STIMULATION ON ALPACA (*Vicugna pacos*) MEAT TENDERNESS

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Abstract –Tenderstretching (TS) and electrical stimulation (ES) were applied to 36 split alpaca carcases in a 2 x 2 factorial arrangement. At 24 hours, the *m. semitendinosus (ST), m. psoas major (TL) and m. adductor femoris (AF)* were removed. A 5 g sample was frozen prior to sarcomere length (SL) measurement and 80 g aged for 10 days prior to shear force (SF) and ultimate pH testing. Two SF blocks were prepared from the AF of each carcase half for intramuscular comparison. The ST was unaffected by treatment. Tenderstretching improved tenderness and reduced variability within the AF, without negatively affecting the TL. Electrical stimulation improved tenderness of the TL. Results indicate that when applied in combination, ES and TS will maximize the tenderness and consistency of alpaca carcases on a whole carcase basis.

Key Words – processing treatments, meat quality, exotic species

I. INTRODUCTION

The Australian alpaca meat industry is growing. To date, the literature has reported inconsistencies in alpaca meat quality, namely due to carcase leanness and processing limitations [1]. Current literature has explored the effects of processing techniques such as electrical stimulation (ES) and tenderstretching (TS) on alpaca as a means to overcome this, reporting improvements within different areas of the carcase [1, 2]. However, these effects have mainly been observed in the *m. longissimus* and *m. semimembranosus*, with the intramuscular effects of these treatments on alpaca hindquarter muscles having not yet been reported. The aim of this study was to explore the effect of combining TS with ES on the tenderness of various alpaca muscles, and to observe the intramuscular impact of treatment application on the alpaca hind quarter, in order to determine any additive effects on alpaca muscle tenderness and consistency.

II. MATERIALS AND METHODS

Thirty-six 23 month old castrated male huacaya alpacas were slaughtered across 2 days, two months apart (n = 18 animals/processing). All carcases were split down the vertebral column, before each carcase side (n = 72) was assigned to a treatment in a 2 x 2 factorial arrangement. Treatments included 1) Achilles hung (AH) and no ES (AH + No ES; CON); 2) AH and ES (AH + ES); 3) TS and no ES (TS + No ES); and 4) TS and ES (TS + ES). Carcase halves were suspended by the Achilles tendon, for AH treatment, or the pelvic bone, for TS treatment, prior to stimulation. Stimulation was applied for 40 seconds at ~300 V using a portable STIMTECH medium voltage stimulation unit set with a 600 mA peak at 68 ms pulse interval and 1000 µs pulse width.

At 24 hours post slaughter a 5 g sample was taken from the *m. semitendinosus* (ST), *m. psoas major* (TL) and *m. adductor femoris* (AF) of each carcase half and stored at – 20 ºC until subsequent sarcomere length (SL) measurement. Samples of approximately 80 g were cut from the remaining muscle for shear force (SF; ~ 65 g) and ultimate pH (pHu; ~ 5 g) analysis, excluding the AF, from which two 80 g blocks (block 1; cranial, block 2; caudal) were obtained for an intramuscular SF comparison. All 80 g muscle blocks were vacuum packaged and aged for 10 days (ave. temp 3.1 ºC and 75.7 % humidity). Samples were frozen at – 20 ºC until subsequent analysis. Sarcomere length was analysed using laser diffraction [3]. Shear force samples were cooked and analysed using a Lloyd texture analyser fitted with a Warner Bratzler v shear blade [3]. Ultimate pH samples were homogenised and measured at 22 ºC [3].

Sarcomere and SF data for the three muscles (ST, TL and AF) was analysed separately using linear mixed models in Genstat (18th edition). Fixed effects for full models included hang and stimulation treatments, a treatment interaction term, pHu and carcase side, as well as SL for SF models (excluding the AF). Muscle SF block location (1; cranial and 2; caudal) was included as a cofactor within the AF SF model, along with a hang x stimulation x block location interaction. Carcase and kill day were included as random effects in all models. Cook batch and cook date were added as further random effects within SF models. Final models were determined using stepwise backward elimination of fixed effect terms not significant at the 0.05 level.

III. RESULTS AND DISCUSSION

Treatments had no effect on SL or SF in the ST (Table 1). This is in line with previous findings for beef.
Within the TL, the combination of processing techniques had a highly significant effect on SL, with AH + ES muscle exhibiting the greatest SL out of any treatment group (2.67 ± 0.07). Muscle from TS + ES carcases was statistically similar to muscle exposed to the control (AH + No ES; 2.09 ± 0.07 and 2.20 ± 0.07 µm respectively) suggesting ES may aid in overcoming TL shortening resulting from TS. While a treatment interaction was not observed for TL SF, hang method considered independently from stimulation had no effect ($P = 0.944$) on muscle SF, indicating there was no negative impacts of TS on overall tenderness in the TL (Table 1). This supports the findings of previous literature on alpaca [2]. Stimulation had a significant effect on TL SF, with non-ES muscle being 6.40 ± 1.85 N tougher than ES muscle.

Table 1. Predicted means (± standard errors) for muscle sarcomere length (SL) and shear force (SF) at each treatment level (stimulation and hang) and on an individual muscle basis (*m. semitendinosus;* ST, *m. psoas major*; TL and *m. adductor femoris*; AF).

	Stimulation		Hang	
	Yes	No	Achilles hung	Tenderstretch
SL (µm)				
ST	2.24 ± 0.05[a]	2.16 ± 0.05[a]	2.18 ± 0.05[a]	2.21 ± 0.06[a]
AF	1.90 ± 0.05[a]	1.83 ± 0.05[a]	1.75 ± 0.05[b]	1.98 ± 0.05[a]
SF (N)				
ST	46.3 ± 1.05[a]	47.3 ± 1.05[a]	47.5 ± 1.05[a]	46.1 ± 1.05[a]
TL	42.5 ± 1.60[b]	48.9 ± 1.60[a]	45.8 ± 1.58[a]	45.7 ± 1.61[a]

Superscripts are not applicable to means in different rows.

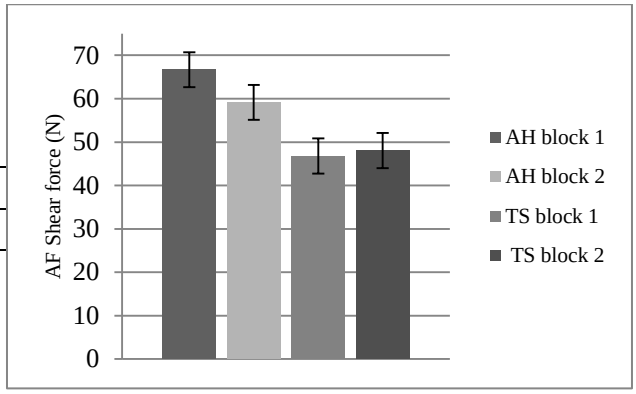

Figure 1. Predicted means **(±** standard errors**)** for the intramuscular (block 1; cranial location and block 2; caudal location) effect of hang method (Achilles hung; AH and Tenderstretched; TS) on the *m. adductor femoris* (AF).

Stimulation had no effect ($P = 0.209$) on SL in the AF. Hang method was highly significant ($P < 0.001$), with TS carcases exhibiting on average SL 0.23 (± 0.06) µm greater than Achilles hung carcases. Stimulation had no effect on SF in the AF, irrespective of within muscle SF block location. There was a significant ($P < 0.05$) hang by block interaction, with TS having a greater effect on AF SF block 1 than on block 2. This effect was such that SF values for block 1 were more in line with values for block 2 when carcases were TS, thereby decreasing within muscle variation (Figure 1).

IV. CONCLUSION

Tenderstretching improved tenderness and reduced variability within the AF of alpaca, without negatively affecting the TL. Electrical stimulation improved tenderness of the TL, while neither ES or TS changed ST tenderness. These results indicate that, when considered on a multiple muscle basis, ES in combination with TS will improve tenderness across the whole alpaca carcase. In addition, TS has the potential to improve the consistency of alpaca hind quarter muscles.

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