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Effect of Hanging Methods on Sarcomere Length and Palatability Varies between and within Muscles

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Introduction

When pelvic hanging was applied to the carcass pre-rigor, that places tension on the major leg and loin muscles, which either minimises shortening, or stretches the muscles with subsequent improvement in tenderness (Sorheim and Hildrum, 2002). The technique has been used to underpin a number of carcass quality assurance schemes focused on eating quality (Ferguson *et al.*, 1999). The magnitude of the tenderstretch effect on palatability depends upon the origin and insertion points for individual muscles and although this effect has been documented for the major muscles in the hindlimb (Ferguson *et al.*, 1999), the effect on many of the minor muscles has not been reported. Tornberg (1996) proposed a model to explain the effect of sarcomere length on tenderness of raw muscle tissue and cooked meat. She suggested that stretched muscle in the raw state was tougher than non-stretched one due largely to a smaller viscous component in the muscle structure. On the other hand, when the stretched muscle was cooked upon 60℃ or above where connective tissue began to contract became tender than non-stretched one. This suggested that the effects of sarcomere length on tenderness of cooked meat is dependent on the nature of muscle (eg., connective tissue content). Thus the current study was conducted to investigate the effect of different hanging techniques (achilles tendon, aitch bone and pelvic ligament) on sarcomere, and its relation palatability of selected hindlimb.

Materials and Methods

1. Experimental Design, Animals, Treatment, Sampling and Measurement

Thirty-four carcass sides (224 ± 37 kg, P8 fat thickness 6 ± 3 mm) from Angus 17 steers were randomly allocated to one of three hanging methods (Achilles tendon,

Table 1. Predicted sarcomere length as a function of hanging method (Hang) and different positions (Pos) within selected muscles from normally hung (AT) and tenderstretch sides hung by either the aitch bone (TS aitch), or the ligament (TS lig) after adjustment for side and a random animal effect

	Pos[Φ]	Hanging method				Significant level		
		AT	TS aitch	TS Lig	Av. SE	Hang	Pos	Hang x Pos
Gluteus medius	A	1.8	2.1	2.2	0.07	0.0001	0.0222	0.4272
	B	ND[Φ]	ND	ND				
	C	1.8	2.1	2.4				
Vastus lateralis	A	2.0	2.4	2.3	0.07	0.0001	0.4286	0.4162
	B	2.1	2.4	2.3				
Semitendinosus	A	1.9	2.3	2.6	0.05	0.0001	0.7336	0.0153
	B	2.1	2.2	2.5				
Abductor		1.9	2.6	2.7	0.09	0.0001		
Gracilis		3.3	3.1	2.8	0.08	0.0035		
Gluteus profundus		2.0	1.5	1.7	0.07	0.0022		
Gastrocinemius		2.6	2.0	1.8	0.05	0.0001		
Vastus medialis		1.8	2.7	2.5	0.08	0.0001		
Vastus intermedius		2.1	2.8	3.0	0.01	0.0009		
Rectus femoris		2.0	2.3	2.1	0.05	0.0002		

[Φ]Cranial to caudal, proximal to distal positions within the muscles were coded as A, B, C and D, [Φ]ND: not determined.

tenderstretch by the aitch bone (AT), tenderstretch by the pelvic ligament (TS lig). Sides were electrically stimulated by a high voltage stimulation system for 30 seconds (850 RMS Volts, 14 pps) at 40 min after slaughter prior to rehanging individual sides according to the treatment. Carcasses were then placed at a 2℃ chiller overnight. The following day after slaughter mm. rectus femoris, vastus intermedius, vastus lateralis, vastus medialis, gastrocnemius, gluteus profundus, gluteus medius, adductor, gracilis and semimembranosus were taken. All measurements and sample preparation were processed as described by Hwang et al. (2002).

Table 2. Predicted MQ4[δ] scores as a function of hanging method (Hang) and different positions (Pos) within selected muscles from normally hung (AT) and tenderstretch sides hung by either the aitch bone (TS aitch), or the ligament (TS lig) after adjustment for side and a random animal effect

	Pos[Φ]	Hanging method				Significant level		
		AT	TS aitch	TS Lig	Av. SE	Hang	Pos	Hang × Pos
Gluteus medius	A	54.1	60.6	62.0	2.52	0.0004	0.0524	0.6598
	B	54.3	61.8	58.8				
	C	55.9	67.5	64.4				
Vastus lateralis	A	40.1	51.2	43.3	2.92	0.0013	0.0595	0.6935
	B	34.3	45.9	41.7				
Semitendinosus	A	36.7	36.6	36.0	2.0	0.426	0.001	0.3814
	B	40.8	46.3	43.2				
Abductor		49.8	58.3	55.5	2.50	0.0996		
Gracilis		55.7	59.6	55.3	2.10	0.1460		
Gluteus profundus		63.6	62.7	58.9	2.71	0.3941		
Gastrocinemius		52.7	47.2	41.0	2.90	0.0167		
Vastus medialis		59.5	66.7	63.0	2.10	0.0817		
Vastus intermedius		54.6	62.4	53.6	2.20	0.0206		
Rectus femoris		48.3	56.4	53.0	1.90	0.0348		

[δ] MQ4= 0.4 x tenderness + 0.1 x juiciness + 0.2 x flavour + 0.3 x overall acceptability.

[Φ] Cranial to caudal, proximal to distal positions within the muscles were coded as A, B, C and D.

Results and Discussion

Tables 1 and 2 show the predicted means for sarcomere length, and MQ4 scores for 10 hindlimb muscles. Given the geological location of attached muscles and variations in tenderstretching tension within individual muscle (Ahnstrom *et al.*, 2006), more a greater variation in sarcomere length for the treated muscles was expected. However, while tenderstretch (by either suspension method) resulted in longer sarcomeres for most positions within the major leg muscle than did conventional hanging method, limited variation in sarcomere length within a muscle was noticeable. On the other hand, in some minor muscles of the hindlimb and loin (M*m. gluteus profundus, gastronemius,* and *gracilis*) tenderstetch allowed the muscles fibres to shorten. In particular, it was of interest that the effects of shortened sarcomeres by tenderstretch on tenderness varied between muscles. In the case of *m. gastrocinemius* reduction in sensory tenderness concomitant with reduced sarcomeres by tenderstretch, while for the *mm. gracilis* and *gluteus profundus* the decrease in palatability was not apparent despite of significant ($p<0.05$) reduction in sarcomere length by tenderstretch. The current data demonstrated that the effect of tenderstretch on the length of sarcomeres and its influence on palatability varied between muscles. The effect of tenderstretch method (ie, aitch bone versus ligament) on sarcomere length varied with muscle, but there was a trend for the ligament hung to result in longer sarcomeres than aitch bone hung, although the increase was generally small. In spite of this trend in sarcomere length, there was a trend for aitch hanging to produce more palatable meat than the ligament hanging method in most muscles.

Summary

Current study was conducted to investigate the effect of different hanging techniques (achilles tendon, aitch bone and pelvic ligament) on variations in sarcomere length and palatability within and between muscles using thirty-four Angus steer sides. Results showed that tenderstretch (by either suspension method) resulted in longer sarcomeres for most positions within the major leg muscle than did conventional hanging method, but in some minor muscles (eg., *mm. gluteus profundus, gastronemius,* and *gracilis*) tenderstetch allowed the muscles fibres to shorten. Some tenderstretched muscles (e.g., *m. gluteus profundus,* 1.5 μm) appeared not to toughen even at very low sarcomere lengths, while others toughened at higher sarcomere lengths. The current data demonstrated that the effect of tenderstretch on the length of sarcomeres and its influence on palatability varied between muscles. Overall the difference between the two tenderstretch methods was for the aitch method to produce meat that was 3.2 units more palatable than the ligament hanging method.

References

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