INSTRUMENTAL AND SENSORY MEAT TENDERNESS IN 13 HEAVY LAMB MUSCLES

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Abstract- The aim of this study was to describe sarcomere length, instrumental and sensory meat tenderness and their associations in 13 heavy lamb skeletal muscles. Sarcomere length, instrumental (WB-shear force) and sensory tenderness were determined 24 h after slaughter in muscles *Semitendinosus*, *Longissimus lumborum*, *Semimembranosus*, Cranial *Gluteobiceps*, *Adductor*, *Gluteus medius*, *Triceps brachii caput longum*, *Psoas major*, *Rectus femoris*, *Vastus lateralis*, *Serratus ventralis*, *Infraspinatus* and *Supraspinatus* of five crossbred heavy lambs. Muscle *Psoas major* showed the lowest shear force value and the highest sensory tenderness rating. Muscle *Semimembranosus* showed the highest shear force value, whereas muscle *Serratus ventralis* received the lowest sensory tenderness rating. Muscles showing the longest sarcomeres were *Psoas major* and *Semitendinosus*, whereas muscles with the shortest sarcomeres included *Longissimus lumborum*, *Adductor* and *Semimembranosus*. Sarcomere length was not correlated to either instrumental or sensory tenderness, whereas instrumental and sensory tenderness were moderately correlated. This is the first description of instrumental and sensory meat tenderness covering the major muscles of heavy lambs. Results of the present study suggest that for a better understanding of heavy lamb individual muscle tenderness, both instrumental and sensory evaluations should be used.

Keywords: Meat tenderness, Meat quality, Sheep.

I. INTRODUCTION

Generally, meat tenderness can be assessed through either instrumental or sensory measurements. Although instrumental measurements are needed to ensure consistent product quality, since human perception of meat palatability is derived from a complex interaction of sensory and physical processes, both instrumental and sensory methods should be combined in order to fully characterize meat quality (1).

Additionally, sarcomere length can also be used as an indirect determinant of meat tenderness, since muscle contraction during the onset of rigor is considered one of the main factors affecting meat tenderness (2).

Although, intermuscular differences in instrumental meat tenderness have been described for several muscles from medium wool × fine wool crossbred wethers (3), no studies were found describing sarcomere length, instrumental and sensory meat tenderness in the major muscles of crossbred heavy lambs.

Thus the aim of this study was to describe sarcomere length, instrumental and sensory meat tenderness and their associations in 13 heavy lamb skeletal muscles.

II. MATERIALS AND METHODS

Five 14-month-old (8 milk teeth) Poll Dorset crossbred heavy-ram lambs with live weights of 71.9 ± 1.67 Kg (mean ± SEM) were used in this study. Meat quality traits were determined 24 h after slaughter in muscles *Semitendinosus*, *Longissimus lumborum*, *Semimembranosus*, Cranial *Gluteobiceps*, *Adductor*, *Gluteus medius*, *Triceps brachii caput longum*, *Psoas major*, *Rectus femoris*, *Vastus lateralis*, *Serratus ventralis*, *Infraspinatus* and *Supraspinatus*.

Sarcomere length was determined histologically in 2.5 % glutaraldehyde-fixed samples using an image analysis system (Infinity analyze®, Toronto, Canada) to obtain 30 measurements/muscle. Instrumental tenderness was determined in cooked meat through Warner Bratzler (WB) shear force with an Instron series 3342. Sensory tenderness and global acceptability were determined through consumer panel sessions including 180 consumers (110 male and 70 female). A balanced incomplete block design and a ten point discontinued scale were used. Intermuscular differences in meat quality traits were analyzed by ANOVA (P<0.05). Pearson correlation coefficients between meat quality traits were generated across all muscles.

III. RESULTS AND DISCUSSION

The various muscles studied showed differences in all the studied variables (Table 1). Regarding instrumental tenderness ranking, our results disagree with those reported by Tschirhart-Hoelscher *et al.* (3). Such differences are expected since Tschirhart-Hoelscher *et al.* (3) described meat tenderness for 7-day-aged muscles. Also, differences between both reports could be due to differences in animal biotypes (4). Nevertheless, a very similar instrumental muscle tenderness ranking has been described in cattle (5).

Regarding sarcomere length, our results are also consistent with previous reports for different ovine muscles (3; 6-7).

Table 1: Meat quality traits (means ± pooled SEM): WB shear force, sarcomere length, sensory tenderness and global acceptability in different heavy lamb muscles.

Muscle	Sarcomere length (µm)	WB shear force (Kg)	Sensory tenderness	Global acceptability
Serratus ventralis	2.24 ± 0.07^{bc}	2.28 ± 0.26^{abcde}	5.98 ± 0.48^{c}	6.12 ± 0.42^{c}
Supraspinatus	2.07 ± 0.07^{cd}	2.28 ± 0.26^{abcde}	6.04 ± 0.43^{c}	6.70 ± 0.37^{bc}
Infraspinatus	2.19 ± 0.07^{bc}	2.40 ± 0.26^{abcde}	7.66 ± 0.43^{ab}	7.46 ± 0.37^{ab}
Psoas major	2.64 ± 0.07^{a}	1.77 ± 0.26^{e}	8.46 ± 0.43^{a}	7.92 ± 0.37^{a}
Triceps brachii caput longum	2.27 ± 0.07^{b}	2.51 ± 0.26^{abcd}	6.74 ± 0.43^{bc}	6.84 ± 0.37^{bc}
Cranial *Gluteobiceps*	1.88 ± 0.07^{de}	2.23 ± 0.26^{abcde}	7.54 ± 0.43^{ab}	7.44 ± 0.37^{ab}
Vastus lateralis	1.89 ± 0.07^{de}	2.01 ± 0.29^{abcde}	7.30 ± 0.43^{ab}	7.20 ± 0.37^{abc}
Rectus femoris	2.11 ± 0.07^{bc}	2.13 ± 0.26^{abcde}	7.52 ± 0.43^{ab}	7.30 ± 0.37^{ab}
Longissimus lumborum	$1.86 \pm 0.07_{e}$	$1.92 \pm 0.29_{cde}$	8.08 ± 0.43^{a}	7.68 ± 0.37^{ab}
Gluteus medius	1.90 ± 0.07^{de}	1.81 ± 0.26^{de}	8.22 ± 0.48^{a}	7.60 ± 0.42^{ab}
Adductor	1.85 ± 0.09^{e}	2.2 ± 0.29^{abcde}	7.78 ± 0.43^{ab}	7.22 ± 0.37^{abc}
Semimembranosus	1.72 ± 0.07^{e}	2.73 ± 0.26^{ab}	6.62 ± 0.43^{bc}	6.96 ± 0.37^{abc}
Semitendinosus	2.49 ± 0.07^{a}	2.56 ± 0.26^{abc}	6.86 ± 0.43^{bc}	6.78 ± 0.37^{bc}

Within a column, muscles not followed by the same superscript are different (P<0.05).

Although we found no previous studies describing muscle rankings for sensory tenderness in sheep, results of the present study showed some important similarities to those reported by Rhee *et al.* (8) for several bovine muscles.

Moreover, in the present study the only significant correlations detected between sensory and instrumental meat quality traits were the negative associations of both sensory tenderness (-0.39; P=0.01) and global acceptability (-0.41; P=0.01) with WB shear force. In the ovine species Safari *et al*. (9) found an intense negative correlation between WB shear force and sensory tenderness exclusively for muscle *Longissimus thoracis et lumborum*. However, our results suggest that among a large and heterogeneous group of muscles, associations between instrumental and sensory tenderness may not be that strong.

Additionally, in the present study no correlations were detected between sarcomere length and meat tenderness. This is in agreement with Tschirhart-Hoelscher *et al*. (3) and suggests that among a large and heterogeneous group of heavy lamb muscles, sarcomere length may not be able to explain intermuscular differences in meat tenderness by itself.

IV. CONCLUSIONS

In brief, this is the first description of instrumental and sensory meat tenderness covering the major muscles of heavy lambs. Results of the present study suggest that for a better understanding of heavy lamb individual muscle tenderness, both instrumental and sensory evaluations should be used.

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