EFFECTS OF DIFFERENT FEEDING STRATEGIES ON PERIMYSIAL STRENGTH IN COOKED MEAT FROM ADULT NELLORE FEMALES

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Abstract – The aim of this study was to evaluate the possible changes in the physical characteristics of perimysium from semitendinosus muscles of Nellore adult females subjected to different weight gain regimes. The cull cows used in the experiment were 4-12 years old. The animals were subjected to two experimental feeding strategies during the dry season. In the first experiment the cows were kept on grazing system and were subjected to one of the feeding strategies: M. maintenance; CG. restriction followed by supplementation to promote compensatory growth. In the second experiment the animals were kept in feedlot and subjected to different body weight gains: AG. Average gain (0.8 kg.day-1); HG. High gain (1.2 kg.day-1). The resistance to rupture of perimysium isolated from cooked semitendinosus muscle was determined by the measurement of the breaking strength, extension at the breaking point and maximum modulus. However, no differences were seen in either Warner-Bratzler peak force or in any perimysial characteristic between the feeding strategies used.

Key Words – cull cows, compensatory growth, connective tissue, meat toughness.

I. INTRODUCTION

In 2010, 29.265 million cattle were slaughtered in Brazil [1], where 45.2% were females. The majority were cull cows, with an average age of six years, and are directed for slaughter due to reproductive inefficiency [2]. Manipulation of growth rate by nutritional strategies has been extensively studied in order to assess the impact of changes in carcass components and meat. This study aims to verify whether feeding strategies may change the intramuscular connective tissue contribution to cooked meat toughness in meat from adult zebu females.

II. MATERIALS AND METHODS

This work consisted of two experimental trials. Both experiments were performed at the Brazilian National Beef Cattle Research Center/EMBRAPA with Nellore females, aged 4-12 years. In the first experiment, 26 cows were randomly assigned to two different groups of the feeding strategies during the dry season: M – high forage availability to promote weight maintenance of cows with high body condition score; CG – low forage availability/weight loss followed by supplementation to promote weight gain of cows with low body score.

In the second experiment, 19 animals with low body condition score (4.5 ± 0.3) were randomly assigned to the following groups: HG - Repository gain - 1.2 kg of live weight gain / day; AG - Slow gain - 0.8 kg / day. The diet was formulated using feed ingredients nutritional values [3].

Mechanical analysis was performed on perimysial tissue isolated from *Semitendinosus* muscle, following the methodology described by Lewis & Purslow [4]. This technique allows the isolation of the perimysium and a direct measure of the intrinsic properties of the tissue after cooking. Transverse steaks (2.5 cm thick) were cut from muscles 24 hours after slaughter, packaged in plastic bags, and heated in water bath at 80 ° C for 1 hour. After cooking and cooling, perimysial tissue surrounding larger muscle fiber bundles were separated manually with the aid of tweezers and scalpels and submitted to tensile testing using a device developed in the laboratory of Dr. Peter Purslow, University Guelph, Canada [see 4]. Previous reports [5, 6], show that the fibrous structure of perimysium in beef *Semitendinosus* muscle is retained after cooking the meat at 80 ° C. For the shear force analysis of steaks, subsamples were taken in longitudinal orientation of muscle fibers, and analyzed using a TA-texturometer TX Plus (Stable Microsystems). Statistical analyzes were performed using the statistical program SAS [7].

III. RESULTS AND DISCUSSION

In accord with previous studies on the mechanical structure of cooked meat [6, 8] the separation of intact perimysial strips from the surface of the cooked muscle fibre bundles is relatively easy. Even after cooking the collagen fibre network of the perimysium is intact and appears to be the main contributor to the mechanical strength.

There were no differences in the rupture properties of the perimysium , either in terms of the breaking strength of the perimysium, perimysial extension to breaking point or maximum modulus (stiffness) due to feeding strategies tested (Table 1). Although there were correlations between perimysial strength and modulus, there was no significant correlation between perimysial strength and the Warner-Bratzler peak shear force for the whole cooked muscle. However, the sheer force also did not change due to feeding strategy.

There are few studies dealing with the basic mechanical properties of perimysium stretched to the point of rupture. These are the first results comparing animals submitted to different strategies and weight gain rates. This technique should be an important tool to determine how the strategies alter the resistance and the properties of of the connective tissue component of cooked meat toughness. However, in these experiments, the feeding strategies employed were not successful in eliciting differences in meat toughness.

Several factors may have contributed to the lack of differences seen in perimysial properties. Cooking may have hidden differences that would result from different strategies. Differences in proteolytic activity during the 24 hours *post-mortem* may have been masked as there is a low correlation between perimysial strength raw versus cooked at 80°C [9]. The fact that these cows were 4-12 years old may mean that the feeding strategies used have no effect on the perimysium because of the very high stability of the mature crosslinks at this age. It is also known that the connective tissue in this beef muscle has a high proportion of elastin compared to other beef muscles, and this again may confound the results.

At this point, there is no indication that the lack of differences in perimysial strength reported here reflect anything other than a lack of effect of the feeding strategies use to significantly alter meat toughness, but it remains to be proved that perimysial strength at the cooking temperature tested would yield relevant information about overall variations in shear force. However, further analyses including the proteolytic process involved in meat ageing will help in elucidating the impact of weight gain rate on the tenderness of meat from cull cows.

Table 1 - Physical characteristics of perimyium isolated from *Semitendinosus* muscle and Warner Bratzler shear force values (whole muscle) from Nellore cows submitted to different feeding strategies

	S F[a](kg)	BSP[b] (g)	EPB[c] (%)	MM[c](g/mm)
Experiment 1				
CG	8.09±0,43	37.85±4,7	130.40±5,8	12.42±1,4
M	7.70±0,24	42.50±4,6	138.87±5,6	11.70±1,3
P	NS	NS	NS	NS
Experiment 2				
AG	6.71±0,91	35.52±6,4	114.37±6,7	12.05±1,9
HG	6.72±0,72	35.36±3,5	118.69±5,3	12.11±1,1
P	NS	NS	NS	NS

[a]SF: peak shear force; [b]BSP: breaking strength of the perimysium; [c]EPB: perimysium extension at the breaking point; [d]MM: maximum modulus. NS: non significant ($p>0.05$). Feeding regimes: CG- compensatory growth, M- maintenance. AG- average gain, HG – high gain.

IV. CONCLUSION

Although difference in live weight gain were achieved under the different feeding strategies, no effects on the strength of the perimysium in cooked *Semitendinosus* or shear force values for the cooked muscle could be found.

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