NOTA BREVE

COLLAGEN TYPE I AND III IN BOVINE MUSCLES

COLÁGENO DE TIPO I Y III EN MÚSCULOS BOVINOS

Blanco, M.R.1 and C.R. Alonso2

1Facultad de Ciencias Agrarias. Universidad Nacional de Lomas de Zamora. Camino de Cintura Km. 2, Llavirus, Bs. As, Argentina. TE/Fax: 54-11-4282-6263. E-mail: mrblanco2004@yahoo.com.ar

ADDITIONAL KEYWORDS


PALABRAS CLAVE ADICIONALES


SUMMARY

Type I and III collagen fibres are the major component of the intramuscular connective tissue and its occurrence and characteristics is a factor contributing to the tenderness of meat. The techniques to determine tenderness are always performed post mortem. The purpose of this study was to determine the proportion of above fibres in the Longissimus thoracis (LT) and Gluteus medius (GM) muscles in both sexes in the Criolla Argentina bovine breed in vivo. Muscular samples were taken by biopsies; histological cuts were treated with the picrosirius-red polarization method (Montes, 1996). The study of collagen organization was obtained by light microscope, with Polaroid filters and ocular reticulum composed by lines. The GM of males showed the higher amount of type I fibres. Type III fibres only showed differences in GM in both sexes but not between muscles and males exhibited the highest amount of them too. When we compared type I and III fibres in the same muscle; a higher amount of type III is presented between sexes but not between muscles. Collagen fibres type I determination by the present histological technique could be used as a potential indicator of tenderness in steers and heifers.

RESUMEN

Las fibras de colágeno de tipo I y III son el mayor componente del tejido conectivo intramuscular. Su presencia y características influyen en la terneza de la carne y las técnicas actuales para determinar la terneza se realizan post mortem. El objetivo de este estudio fue determinar in vivo la proporción de estas fibras en dos músculos Longissimus thoracis y Gluteus medius en ambos sexos de bovinos de la raza Criolla Argentina, Biotipo Patagónico. Se realizaron biopsias musculares para obtener cortes histológicos, que fueron tratados con el método de picrosirius-red con polarización (Montes, 1996). Las fibras fueron analizadas con microscopía óptica con filtros Polaroid y con un ocular con retículo de líneas. La mayor cantidad de fibras tipo I se observó en el músculo GM en machos. Se encontraron diferencias significativas en el porcentaje de fibras tipo III para GM entre sexos, presentando los machos el mayor porcentaje. Al comparar los dos tipos de fibras en el mismo músculo, se ha observado una mayor cantidad de fibras tipo III entre sexos, pero no entre músculos. La determinación de fibras de tipo I con la presente técnica histológica es un indicador potencial para determinar la terneza.
INTRODUCTION

Collagen fibres are formed by collagen type I, and reticulin fibres are rich in collagen type III. Morphologically there are three collagen depots in muscle: the epimysium, perimysium and endomysium (Ham, 1969). The fibrous of collagen represents as much as 95-97 percent of total amount of collagen in skeletal muscle.

Tenderness varies mainly due two causes: muscular fibres and the connective tissue that covers them. There are marked differences in fibre type composition of connective tissue in muscles, both within and between animals, which may influence meat quality and depend on factors such as body location, age, sex and breed (Essén-Gustavsson, 1995).

Studies relating histological evaluation of connective tissue to meat quality are limited. In recent years, work to reduce unwanted meat toughness has largely been focussed on post-mortem proteolysis of the cytoskeletal and myofibrillar proteins within muscle fibres (Purslow, 2005).

Tenderness is measurable by sensory panels but there is expensive and tedious and cross comparison among results is difficult. Warner-Bratzler (WB) shear device is the most widely instrument mechanical methods used to assess meat tenderness quantitatively, but this procedure has been criticized for several reasons.

The aim of the present research was to determine in vivo, the amount of type I and III fibres in LT and GM muscles of males and females of bovine Criolla breed, to characterize this animals and perhaps determined tenderness by this technique.

MATERIALS AND METHODS

Blocks of muscle samples were taken from of the LT and GM muscles of bovine of the Criolla Argentina breed. These animals -which stayed isolated in Los Glaciares National Park (Sta. Cruz, Argentina) were captured and brought to the Faculty of Cs. Agrarias, UNLZ.

Five males and five females, ten months of age, were used according the international laws and regulation for the animal welfare and biopsies were done to remove samples of muscles. Samples were processed as usual to obtain histological cuts (5 µm) and then were stained with picrosirius red solution (Montes, 1996). The fibres were evaluated using polarization microscopy and were counted with a 200X magnifying by means of a reticular ocular.

The means of collagen and reticular fibres were analysed through ANOVA, GraphPad InstStat version 3.05, 2000.

RESULTS AND DISCUSSION

The type I fibres found in males and females, in LT and GM muscles are shown in table I.

The type III fibres found in males and females, in LT and GM muscles are shown in table II.

Type I and III fibres in the same muscle are shown in table III.

According to the results obtained from this present study the recount of type I fibres has shown significant
difference ($p \leq 0.05$) between muscles in males. A highest percentage was observed in GM muscle. We have also found significant differences between the two sexes of both muscles.

Regarding type III, no differences in the percentages of fibers between the two muscles of the same animal were found, but significant differences ($p \leq 0.05$) between the two sexes of the GM muscle, showing the highest percentage in males.

Females present a lower percentage of type I, these results coincide with reports that describe differences in the contents of collagen in the meat between sexes at the same age, presenting females meat more tender (Huerta-Leidenz and Rios, 1993).

Seideman et al. (1982), postulated that the connective tissue is related to the difference the tenderness between bulls and steers, while other authors mentioned that the tenderer muscles have a lower percentage of type III collagen (Bailey et al., 1979). On the other hand, (Light et al., 1985) describe that the percentage of type III collagen of six different muscles are not related to meat tenderness. Burson et al. (1986), informed that the type III fibers did not differ in bulls and steers even though steers have more tenderness. However it was reported that the percentage of type III fibers did not correlate with the values of tenderness obtained through a sampler’s panel or by WB method, but it did correlate with the percentage of soluble intramuscular collagen.

Nakamura et al. (2003) reported that type I fibers in the LT muscle is markedly less to that contained in the semitendinosus muscle (ST). The LT showed a thin perimysium with only a few bands as it is protected from the torsion by the vertebral lumbar and thoracic column with its limited Table I. Type I fibres in LT and GM (percent). (Fibras de tipo I en LT y GM, p.100).

<table>
<thead>
<tr>
<th></th>
<th>Steers</th>
<th>N</th>
<th>Heifers</th>
<th>N</th>
<th>Means</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>9.29±4.1*</td>
<td>5</td>
<td>5.12±1.8*</td>
<td>5</td>
<td>7.2</td>
<td>10</td>
</tr>
<tr>
<td>LT</td>
<td>6.3±2.3*</td>
<td>5</td>
<td>4.7±1.8*</td>
<td>5</td>
<td>5.5</td>
<td>10</td>
</tr>
<tr>
<td>Means</td>
<td>7.79</td>
<td>10</td>
<td>4.91</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Values in the same column or file with different letters are significantly different ($p<0.05$).

Table II. Type III fibres in LT and GM muscles (percent). (Fibras tipo III en los músculos LT y GM, p.100).

<table>
<thead>
<tr>
<th></th>
<th>Steers</th>
<th>N</th>
<th>Heifers</th>
<th>N</th>
<th>Means</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>12.9±4*</td>
<td>5</td>
<td>10.0±2.4*</td>
<td>5</td>
<td>11.4</td>
<td>10</td>
</tr>
<tr>
<td>LT</td>
<td>11.5±3.9*</td>
<td>5</td>
<td>10.4±2.9*</td>
<td>5</td>
<td>10.9</td>
<td>10</td>
</tr>
<tr>
<td>Means</td>
<td>12.2</td>
<td>10</td>
<td>10.2</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Values in the same column or file with different letters are significantly different ($p<0.05$).

Table III. Relationship between type I and III fibres in the same muscle (percent). (Relaciones entre las fibras I y III en el mismo músculo).

<table>
<thead>
<tr>
<th></th>
<th>Steers</th>
<th>N</th>
<th>Heifers</th>
<th>N</th>
<th>Means</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>1.6±0.2*</td>
<td>4</td>
<td>2.1±0.4*</td>
<td>4</td>
<td>1.9±0.4</td>
<td>8</td>
</tr>
<tr>
<td>LT</td>
<td>1.9±0.4*</td>
<td>4</td>
<td>2.5±0.4*</td>
<td>4</td>
<td>2.2±0.4</td>
<td>8</td>
</tr>
<tr>
<td>Means</td>
<td>1.8±0.3</td>
<td>8</td>
<td>2.3±0.4</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Values in the same column or file with different letters are significantly different ($p<0.05$).
flexibility. In our particular case the LT and GM muscles were compared finding less quantity of collagen of type I in LT than in GM (locomotive muscle like the ST).

Therefore, the percentage of type I fibers could be a possible indicator of bovine muscle tenderness as more have been found in males (less tenderness) than in females, and more in GM muscle that shows less tenderness than LT (postural muscle).

CONCLUSIONS

Collagen type I determination by the present histological technique could be used as a potential indicator of tenderness in steers and heifers.

ACKNOWLEDGEMENTS

To the technical assistance of O. Rivera MV. and G. López MV.

REFERENCES


GraphPad Instat, Versión 3.05, created Sep. 2000. GraphPad Software Inc.


