HISTOCHEMICAL AND BIOCHEMICAL PROPERTIES OF MUSCLES IN CHIANINA BREED

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SUMMARY

Consumer demand for leaner beef, with the production of quality lean tissue at least possible cost and improved for the palatability and acceptability of meat. Biological mechanisms operating during muscle development play a major role in determining final muscle mass, but researchers know relatively little about regulation of muscle growth in meat producing animals.

Twelve Chianina breed bulls of six months old were divided into two dietary treatment groups (low versus high energy) and slaughtered after four months on trial. A portion of the muscles *longissimus thoracis, semimembranosus, semitendinosus and triceps brachii* was removed 1h post-mortem and serial sections were stained for NADH-Tr and myosin ATPase, while intramuscular fat cells were stained with OIL-RED-O. Fiber types were classified as Red (bRed), White (aWhite) and Intermediate (aRed), according functional differences depend on the activity of their respective enzymic sistems. Their characteristics were expressed as a percentage, mean area (mm^2) and percentage area of fiber types using an image analysis system. The results of the present study show that the semitendinosus muscle has the largest fiber size for all three types, while the biggest adipose cells ($P < .05$) were founded in the triceps brachii muscle. The influence of diet don't show very differences, but the trend is for decrease of the fat cell size for animals fed with diet with low energy.

INTRODUCTION

Cryosections of bovine muscles stained for myofibrillar ATPase activity (Yambayamba, et al. 1991) and denoting three fiber types can be readily distinguished, regarding the metabolic and functional differences between red (b R), white (a w) and intermediate (a R) fibers (Ashmore and Doerr, et al. 1971). The difference is their diameter, that of red fibers being smaller than that of white. As their name indicates they differ also in colour and are physiologically slow with high oxidative and low myosine ATPase activities. White fibers are fast, with high glycolitic and myosin ATPase activies, while the intermediate fibers have a mixed oxidative-glycolitic activity (Nicastro, 1992). There are many factors that have been shown to influence the size and population of muscle fibers as age, sex, breed, muscles, nutrition and feeding programs (Solomon et al 1986; Nicastro et al 1991). The aim of this investigation was to study histobiochemical fiber properties and intramuscular fat cells in LT, SM, ST and TB muscle from Chianina breed cattle.

MATERIALS AND METHODS

Animals

For this experiment twenty Chianina bulls were divided in two groups, used in a 120-day feeding trial. Treatments were A) .76 Meat FU Kg/DM; and B) .94 Meat FU Kg/DM. Mean slaughter weight was Kg 450 at 10 months of age.

Sampling procedure

The longissimus thoracis (LT), semimembranosus (SM), semitendinosus (ST) and triceps brachii (TB) muscles were used for fibre type classification and intramuscular fat cells. Samples of the muscles above

cited were taken from the left side of the carcass 1h post-mortem.

Histochemical and biochemical analyses

Transverse serial cross sections (10 mm thick) were cut in a Reichert-Jung cryostat and stained with NADH-Tr (Engel and Broke, 1966) and myofibrillar adenosine triphosphatase (ATPase) reacted at alkaline pH (Guth et al. 1970).Fibers were classified into Red (b R), intermediate (a R) and white (a W) according to Ashmore and Doerr (1971). In order to stain fat cells in the intercellular space, sections from previously mentioned muscles were stained with OIL-Red-O and Hematoxylin according to Lillie (1965). Mean fibre cross-sectional area (mm^2) fibre, percentage type for each fibre type (%), fat cells area (mm2) and percentage-area for each fiber type were calculated (Nicastro and Maiorano, 1993a; 1993b), using an Image Analyzer by Zeiss.

Statistical analysis

The data were analyzed by the least squares method using the GLM procedure (SAS, 1989) assuming a mathematical model that including diet (medium and higher energy level).

RESULTS AND DISCUSSION

Least squares means for muscle fibre and fat cell size, percentage type and percentage area are shown in table 1. Differences in muscle fibre characteristics between the LT, SM, ST and TB muscles were found. The ST muscle presented largest fiber size for all three metabolic fiber types (3732.5 in Red; 4794.3 in Intermediate and 4766.2 mm^2 in White fibers; $P < .05$). Our results are in accord with Hunt and Hedrick (1977) who reported that the ST muscle is relatively white muscle.

More presence of Red and Intermediate fibers are observed in LT muscle (30.4; 39.2 %) and also in ST just for the aRed fibers (36.8%) with statistical significance ($P < .05$). The TB and SM showed the highest percentages of white fibers (48 and 50 %; $P < .05$). Hunt and Hedrich (1977) comparing the ST and LT muscles, reported that ST having the smaller percentage bRed and a larger percentage awhite fibers than the LT.

The LT shows a significant presence of b-Red and a-Red fiber percentage area (25.1 and 45.1 %), while the largest presence of a-White fibers is evidenced in the SM muscle. Based on fiber size the ST had the largest a-White fibers and the smaller percentage of b-Red. Comparing the four muscles the LT was the most aerobic muscle, the ST and TB were intermediate and the SM was the most anaerobic muscle. These results partially agree with Payne et al. (1992).

The Figg. 1, 2, 3 showed the effect of diet on characteristics of fibers. Johnson et al. (1981) indicated that as energy level in the ration increased, the percentage of intermediate fibers decreased and the percentage of white fibers increased. In a study involving different energy levels in the ration on muscle characteristics, Moody et al. (1980) reported a shift from intermediate to white fibers. The trend in our study is the same about the size of fibers and the percentage area with more presence of a-White and less presence of a-Red fibers in cattle fed with diet B (higher energy level).

CONCLUSIONS

The muscle fibre characteristics of Chianina cattle does not seem influenced by diet as well as used in this study. Between the muscles the LT evidenced higher presence of slow-oxidative fibers, while the SM fast-glycolitic fibers. Muscle which differs in function often differs in its metabolism and a better knowledge of the muscle development will help to produce high quality meat.

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