

Histological characteristics in *Longissimus thoracis* muscle of Italian and Polish crossbreed horse

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Summary. Owing to high cost, meat horse domestic production does not meet internal market demand, that is why such a livestock is mainly imported from Eastern Europe Countries. Fibre type composition deeply influences post-mortem changes in the conversion of muscle to meat, as well as the product quality. The aim of this study was to investigate histological characteristics of muscle fibres and adipocytes related to two different horse genetic types (Abruzzese and Polish), sold in Italy. The two horse genetic types showed little variation in the fiber type of the meat, considering the least square means of all 3 fiber types (red, intermediate and white) found in the samples muscle. The alpha-white fibers were larger than beta-red and alpha-red ($P < 0.05$). Significant differences in distribution were found for most fibre types within breeds. A higher proportion of slow fibers was found in the *Longissimus* muscle of the TPR x Abruzzese ($P < 0.05$). The histological results showed that the two genetic types had small effect on the size of the LD fibers.

Key words: horses, fiber, fat, morphometric

Introduction

Locally produced horse meat in Italy does not meet internal market demand due to its high costs. Hence, slaughter horses are mainly imported from Eastern Europe Countries. Horse meat consumption is very high in some Italian regions such as Apulia and in the last few years has considerably increased. The fiber type composition deeply influences the post-mortem changes in the conversion of muscle to meat, as well as the product quality. Many recent studies found correlation between fiber type or size, and eating quality. However, the quality characteristics of individual muscles and the factors responsible for these quality traits are not well known (1). Skeletal muscle is composed of different fiber types, which are affected by various factors, such as sex, age, muscle type, breed and hormones (2). Muscle fiber characteristics influence meat quality characteristics such as color, water-holding capacity, marbling and the texture of meat (3). In this

regard, it is important to understand the relationship between muscle fiber characteristics and meat quality, and it is also necessary to characterize the muscle fiber in individual horse muscles. Generally, meat quality is determined by the marbling, color, firmness and texture. These quality traits are influenced by muscle fiber characteristics. However, the effects of muscle fiber characteristics on meat quality characteristics have not been studied extensively in horses, although many reports exist in cattle (4, 5), pig (6, 7), poultry (8) and lambs (9). Therefore, the aim of this study was to investigate the relationship between muscle fiber on the Italian and Polish crossbreed horse meat.

Methods

Ten horse for each genetic type (TPR x Abruzzese and TPR x Polish) were slaughtered at the age between 24 and 26 months. After slaughtering the

carcasses were chilled at 3°C for 24–36 h. Samples of *Longissimus dorsi* (LD) muscle were collected from all animals 4h after slaughter for the histochemical characterization of the muscular fibers. Some pieces of said muscle have been taken, and then immersed in liquid nitrogen for about 10 seconds. Cross section were cut and mounted on spindles before sectioning 15 mm thick using a Reichert-Jung freezing microtome. Serial sections mounted on glass microscope slides were stained with NADH-Tr, myofibrillar ATPase reacted at alkaline pH to differentiate muscle fibre type according to their oxidative and glycolytic capability (10), and hematoxylin according to the procedure outlined by Lillie (12) in order to stain fat cells in the intercellular space. Fibers were classified on the basis of stain reactions using the technique of Ashmore and Doerr (11): beta-red fibers were dark brown, alpha-red fibers were clear in the middle and surrounded by a blue ring, alpha-white fibers were clear. Sections were analysed using an Image Analyzer Vidas by Zeiss to determine fiber diameter. The percentage of each fiber type and its mean surface area was measured in two randomly selected areas on serial sections with an image analysis software program. On average, 200 fibers were analysed in each serial section. All data collected were subjected to analysis of variance and differences between the estimated average, evaluated with the “t” Student (13).

Results and Discussion

The muscle fibers in the LD muscle of the TPR x Abruzzese and TPR x Polish horses were divided into type beta-red, alpha-red and alpha-white (Fig. 1 and 2).

Least squares means for longissimus fiber type diameter and percentage are presented in figures 4 and 5. A clear difference in fiber type composition was observed among the Abruzzese and Polish breeds horse muscle. The LD muscle showed higher diameter (μm) for all three fiber types in Abruzzese horses (beta-Red 8,90 vs 6,28 $P < 0.01$; Alfa-Red 9,54 vs 8,14 $P < 0.05$; and alfa-White 9,57 vs 9,00). The alfa-White fibers are the largest of the three types. These results were in agreement with Cassens and Cooper (14), and Rosser (15) in cattle. Fiber type proportions for by each fiber type in Ld muscle, are summarized in Figure 5. On the average, Ld

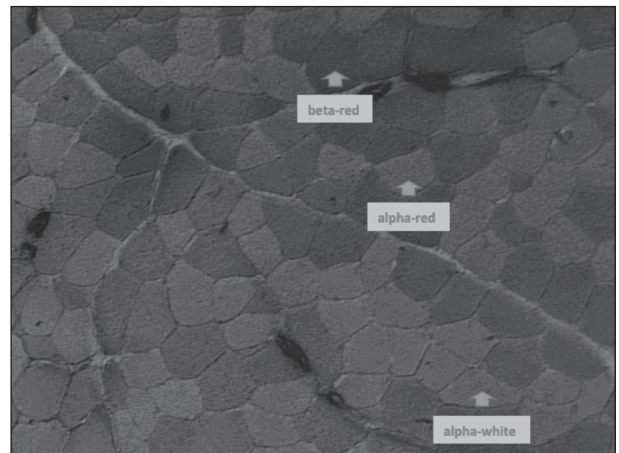


Figure 1. Section of LD muscle fibre type stained with ATP

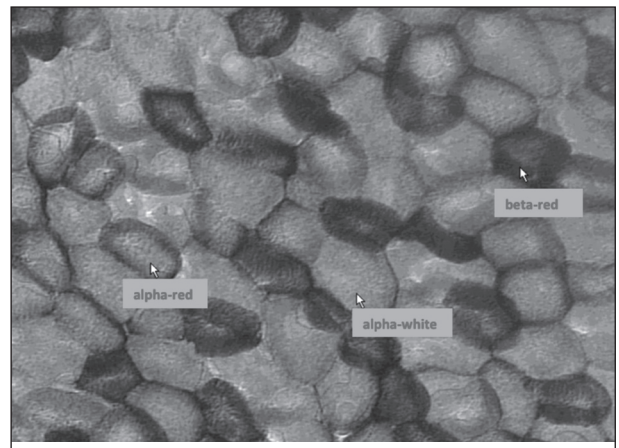


Figure 2. Section of LD muscle fibre type stained with NADH

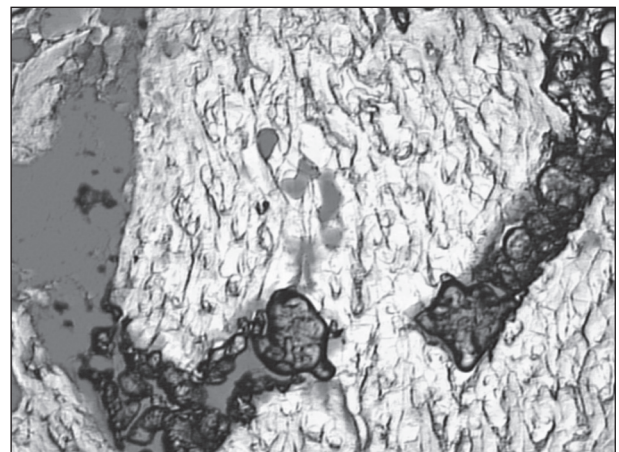


Figure 3. Section of LD intramuscular fat stained with Hematoxylin

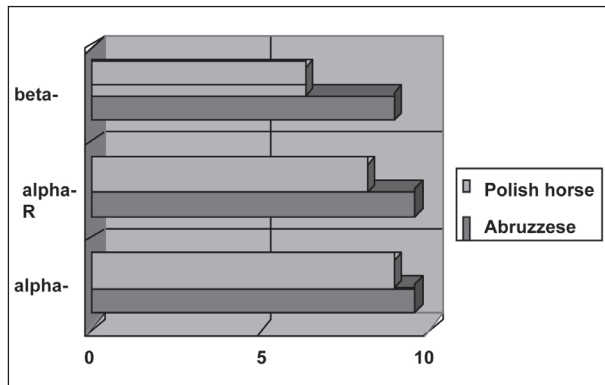


Figure 4. Diameter of muscle fibers in the LD muscle from horse of two genetic types (µm)

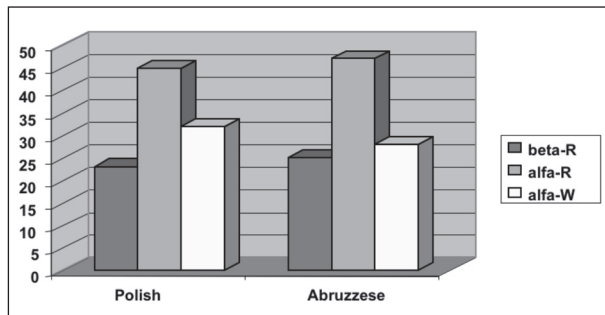


Figure 5. Distribution of muscle fibers in the LD muscle from horse of two genetic types (%)

muscle contained 25% Beta-Red type, 47% Alpha-Red type and 28% alpha-White fibers respectively in Polish horses. Fiber type proportion between Abruzzese and Polish horses was similar except for alpha-White (32% vs 28% $P < 0.05$) with higher percent in the Abruzzese crossbreed. The diameter of the adipocytes was larger in Abruzzese horses ($P < 0.05$), while the amount and the size of adipocytes in the Polish horse proved to be lower and smaller than the other genetic type. These results were in agreement with Henckel et al. (16) who reported that the intracellular fat content was positively correlated with the frequency of alpha-white fibres.

Conclusions

The results about the histological characteristics of the two genetic types evidenced little effect on the size of fiber type,

while the amount and the size of adipocytes proved to be lower in the LD muscle of the TPR x Polish horse meat.

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