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Short communication

Histochemical fiber types in 16 heavy-lamb skeletal muscles

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ABSTRACT

In order to histochemically describe contractile and metabolic fiber types in 16 heavy-lamb muscles, samples were taken from nine cross-bred heavy lambs. Relevant intermuscular differences were detected regarding fiber typing. Muscle *Longissimus lumborum* showed larger type II fibers than muscle *Longissimus thoracis* ($P < 0.05$). Muscles *Triceps brachii caput longum* and *caput laterale* differed in their contractile and metabolic characteristics ($P < 0.05$). Histochemical contractile and metabolic differences were also detected between muscles Cranial and Caudal *Gluteobiceps*, *Supraspinatus* and *Infraspinatus*, and *Vastus lateralis* and *Rectus femoris* ($P < 0.05$). Our present results contribute knowledge about sheep muscular histophysiology, and demonstrate for the first time the existence of specific intermuscular differences in fiber typing. The present study may also contribute to developing optimal commercial uses of each muscle for the meat industry.

1. Introduction

Generally, it is accepted that muscle fiber diversity can affect meat quality (Klont et al., 1998; Lefaucheur, 2010). Contractile and metabolic properties are of paramount importance regarding muscle fiber heterogeneity. Indeed, skeletal muscle fibers are frequently classified according to both their contractile characteristics and their metabolic characteristics (Lefaucheur, 2010).

In the ovine species only a few studies have described muscle fiber composition in a relatively high number of muscles (Suzuki, 1971; Briand et al., 1981; Suzuki and Tamate, 1988; Sayd et al., 1998). Additionally, as far as we know, no one has described metabolic and contractile fiber characteristics in the major muscles of meat-producing heavy lambs. Therefore, since muscle fiber characteristics might differ between biotypes and ages (Lefaucheur, 2010), a study describing and comparing contractile and metabolic fiber characteristics among the major muscles of cross-bred heavy lambs, might contribute to define fiber-type profiles of muscles in order to suggest optimal commercial uses for each muscle.

Thus, the aim of this study was to describe and compare the distribution and morphometric characteristics of contractile and metabolic muscle fibers in 16 cross-bred heavy-lamb muscles.

2. Materials and methods

2.1. Animals and sampling

All procedures were carried out in accordance with the regulations of the Animal Experimentation Committee (CHEA, Universidad de la República, Uruguay).

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Nine 14-month-old male Poll Dorset cross-bred heavy-lambs with live weights ranging 67–76 kg were used in this study. Their pre- and post-weaning growth rates were 230 and 120 g/day, respectively. Pre-weaning, lambs grazed on *Trifolium pratense* and *Cichorium intybus* grasslands. After weaning, they fed on soy-crop (*Glycine max*) and grain sorghum supplementation (1% of live weight).

Immediately after slaughter, samples were taken from the mid superficial belly of the *Semitendinosus*, *Longissimus lumborum*, *Longissimus thoracis*, *Semimembranosus*, Caudal *Gluteobiceps*, Cranial *Gluteobiceps*, *Adductor*, *Gluteus medius*, *Triceps brachii caput longum*, *Triceps brachii caput laterale*, *Psoas major*, *Rectus femoris*, *Vastus lateralis*, *Serratus ventralis*, *Infraspinatus* and *Supraspinatus* muscles. Samples were fixed (frozen) in liquid nitrogen and stored (−20 °C) until processing. Sample fixation never exceeded 30 min after animal death. Samples were included in cryostat embedding medium (Cryomatrix, Thermo Shandon Limited, USA), and 24 μm-thick sections were cut in a cryostat.

2.2. Histochemistry, fiber typing and morphometric analysis

Sections were treated with the myosin ATPase stain as performed in sheep (Peinado et al., 2004). Alkaline (pH 10.35), and acid (pH 4.35) preincubations revealed slow (type I) and fast (type II) fibers (Dubowitz and Brooke, 1973). Results were validated (Greenwood et al., 2000) using alkaline preincubated mATPase activity (alkali-stable or -labile mATPase). The nicotinic adenine dinucleotide (reduced) tetrazolium reductase (NADH-TR) technique was used (Dubowitz and Brooke, 1973) to classify fibers as oxidative (strongly stained), intermediate (weakly stained) or glycolytic (negatively stained).

Morphometric analyses were carried out using an image analysis system (Infinity analyze®, Toronto, Canada). The percentages of different contractile (types I and II) and metabolic fibers (oxidative, intermediate and glycolytic) were calculated by counting at least 500 fibers from random microscopic fields. The fiber diameter was measured at its minimum

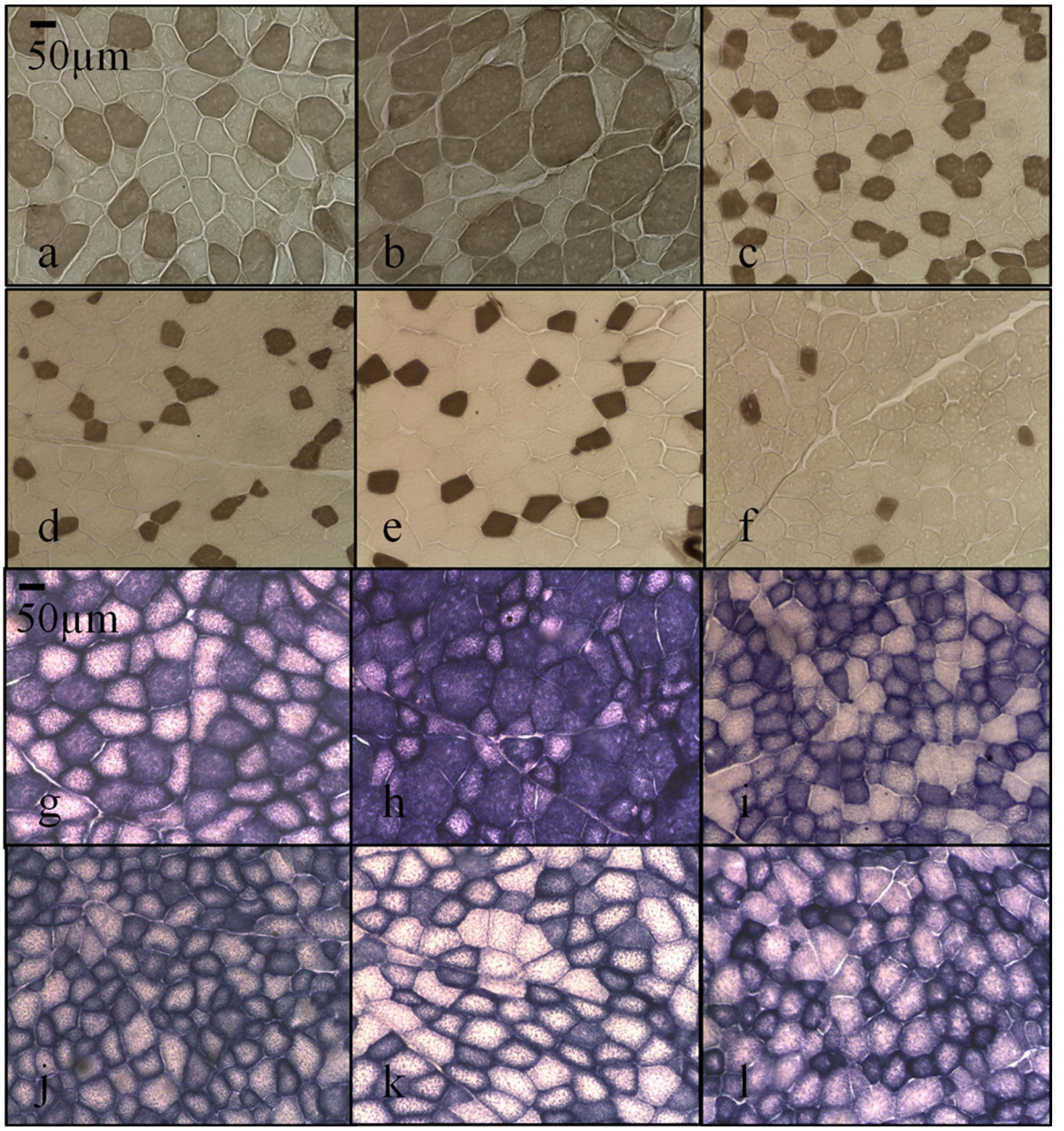

Fig. 1. Histological sections of heavy lamb muscles treated with the myosin ATPase stain (a–f) and with the NADH-TZ reaction (g–l). (a, g) Muscle *Infraspinatus*; (b, h) muscle *Serratus ventralis*; (c, i) muscle *Psoas major*; (d, j) muscle *Adductor*; (e, k) muscle *Rectus femoris*; and (f, l) muscle *Semitendinosus*.