

# Myofiber Number and Type in Twenty-five-day-old Beef Calves as Influenced by Breed Type

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## Story in Brief

Three muscles, the Longissimus dorsi (LD), the Semitendinosus (ST) and the Triceps brachii-lateral head (TBL) were excised from 25-day-old beef calves of different breed types and examined for total myofiber number and myofiber type distributions. Charolais calves possessed a significantly greater total number of myofibers as well as significantly greater numbers of  $\alpha$  white and  $\beta$  red myofibers per muscle cross sectional area. Expressed as a percentage of total myofibers, Angus calves had a greater percentage of  $\alpha$  white and  $\alpha$  red fibers while Charolais calves had a greater percentage of  $\beta$  red fibers. Data indicated that the Charolais calves possessed a greater potential for muscle growth but would mature slowly in comparison to the Angus calves, which would mature more rapidly and show a less extensive muscular development. This suggested an explanation for the differences in muscular size observed throughout development and at maturity in cattle of different breed types.

## Introduction

Gross carcass compositional differences between different breed types of cattle have been well documented; however, relatively little work has been done in determining the underlying causes of these gross differences. The present study was developed to trace some of the cellular changes in myofiber number and myofiber type which occur in two different breed types of cattle as they mature. It is generally accepted that myofiber number is fixed at, or shortly after, birth so that differences in muscularity between breeds occur as a result of differences in myofiber size increase. To some extent, myofiber size differences between breeds, within a particular muscle, may be due to differences in the distribution of the myofiber types. If distribution differences are readily apparent at a young age, then histological examination of muscle could be an effective tool for use in meat animal selection. Therefore, myofiber number and myofiber type distributions were examined in three muscles of Angus and Charolais calves at a young age.

## Materials and Methods

Animals for this investigation included three Angus and three Charolais calves, approximately 25 days old. Immediately post mortem the Longissimus dorsi (a section from the 12th rib to the fourth lumbar vertebra) (LD), the Semitendinosus (ST) and the Triceps brachii-lateral head (TBL) were removed, trimmed of external fat, wrapped in aluminum foil, frozen in liquid nitrogen and stored at negative 20°C until analyzed.

In preparation for sectioning, muscles were cross sectioned at 50 percent of their length, and a transverse section approximately 1 cm wide was removed. This section was visually divided into quadrants, and a 1/4-inch diameter core was removed from each quadrant. Cores were thawed in buffered saline, then refrozen on microtome chucks for sectioning at 12  $\mu$ . Four serial sections cut from each core were stained using either alkaline ATPase or an NADH procedure.

Total myofiber number and myofiber number by type were enumerated in a random field from a random quadrant of each tissue slice. Results were expressed as the average count of both stains. Using the measured muscle cross sectional area, these myofiber counts per tissue slice were adjusted to estimate fiber number per muscle cross sectional area.

## Results and Discussion

It was apparent from the results shown in Table 1 that, for each muscle examined, the Charolais calves had a significantly greater ( $P < .05$ ) total myofiber population than the Angus calves. This suggested that the Charolais calves had a greater muscle growth potential, since myofiber number is essentially fixed at birth and muscle growth is the result of an increase in myofiber size.

Table 2 portrays the total myofiber population as distributed by type per muscle cross sectional area. Charolais calves displayed a significantly greater ( $P < .05$ ) number of  $\alpha$  white and  $\beta$  red fibers for each muscle; however, the number of  $\alpha$  red fibers was not significantly different between breeds and varied with the muscle examined. In the LD muscle, the Charolais calves had approximately 33,000 more  $\alpha$  red fibers, but in both the ST and TBL muscles the Angus calves had approximately 5,000 more  $\alpha$  red fibers per muscle cross sectional area.

When the myofiber type data were expressed as a percentage of total myofibers (Table 3), results showed that the Angus calves had a greater percentage of  $\alpha$  white and  $\alpha$  red fibers and the Charolais calves had a greater percentage of  $\beta$  red fibers for each muscle. This indicated that, even at this early age, the muscles of the Angus calves were more mature than those of the Charolais.

**Table 1. Effect of breed on total myofiber number per muscle cross sectional area.**

Muscle	Breed	Myofiber number
LD	Angus	2.639 <sup>abc</sup>
	Charolais	2.861
ST	Angus	1.677
	Charolais	1.966
TBL	Angus	1.212
	Charolais	1.476

<sup>a</sup>Mean myofiber number across animals, sides, myofiber types, and stains.

<sup>b</sup>Significant difference between breeds for each muscle examined ( $P < .05$ ).

<sup>c</sup>Mean of 48 random counts in millions.

**Table 2. Effect of breed on myofiber number by type per muscle cross sectional area.**

Muscle	Breed	Myofiber number by type		
		$\alpha$ White*	$\alpha$ Red	$\beta$ Red*
LD	Angus	1.404 <sup>a</sup>	.511	.724
	Charolais	1.491	.478	.892
ST	Angus	.896	.385	.396
	Charolais	.966	.390	.610
TBL	Angus	.616	.210	.386
	Charolais	.687	.215	.574

<sup>a</sup>Mean of 48 random counts in millions.

\*Significant difference between breeds for each muscle examined ( $P < .05$ ).

**Table 3. Effect of breed on percent myofibers by type per muscle cross sectional area.**

Muscle	Breed	% Myofibers by Type		
		$\alpha$ White	$\alpha$ Red	$\beta$ Red
LD	Angus	53.18 <sup>a</sup>	19.33	27.50
	Charolais	52.40	16.68	30.92
ST	Angus	53.41	22.96	23.63
	Charolais	49.12	19.85	31.04
TBL	Angus	50.94	17.34	31.73
	Charolais	46.57	14.55	38.88

<sup>a</sup>Myofiber number by type per muscle cross sectional area expressed as a percentage of the total myofiber number per muscle cross sectional area.

The data presented above showed differences in both myofiber number and myofiber type distribution present in very young cattle of different breed types. This suggested that the young calves were already predisposed toward their ultimate mature muscular development. It would appear that these cellular parameters could be effectively used to estimate mature muscularity, thereby enhancing the selection of meat animals with the propensity for muscle development.