

CHANGES IN PERCENTAGE OF TYPE I MYOFIBERS IN MUSCLE OF THE CATTLE DURING GROWTH

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Background:

Skeletal muscles of domestic animals are composed of myofiber types, which differ in histochemical properties. Myofibers are classified broadly into types I and II myofibers by differences in reactivity of histochemical myosin ATPase (Suzuki and Cassens, 1980, 1983). In the thigh of sheep, the deep portion of the quadriceps muscle that involves postural maintenance has many type I myofibers, whereas the semitendinosus and semimembranosus muscles that function in locomotion contain numerous type II myofibers (Suzuki and Tamate, 1988).

Type I myofibers of muscles in the pig and sheep increase from birth to 16 weeks of age (Suzuki and Cassens, 1980, 1983). The transformation from part of type II myofibers into type I myofibers via intermediate myofibers causes increases in type I myofibers in the muscles. Changes in composition of myofiber types are assumed to occur in muscles of growing cattle.

Objectives:

The purpose of the present study was to examine increases in type I myofibers in muscles of young cattle during growth.

Methods:

Muscle samples were removed from five cattle (Holstein) at 1 month, three cattle at 2 months, four cattle at 3 months, and four cattle at 5 months of age. Muscle samples were obtained at an abattoir. Muscle samples removed were the longissimus thoracis, semimembranosus, and masseter muscle. They were frozen in a mixture of acetone and dry ice, and then cut in a cryostat. Cross sections were stained with myosin ATPase reaction after preincubation at pH 4.3 and pH 10.5. Myofibers were classified into types I, II, and intermediate myofibers.

Results and Discussions

Myofibers that were strongly reactive with myosin ATPase after preincubation at pH 4.3 and unreactive with myosin ATPase after preincubation at pH 10.5 were classified into type I myofibers. Myofibers that were unreactive with myosin ATPase after preincubation at pH 4.3 and strongly reactive with myosin ATPase after preincubation at pH 10.5 were classified into type II myofibers. Myofibers that reacted with myosin ATPase after preincubation at pH 4.3 and 10.5 were classified into intermediate myofibers.

The longissimus thoracis muscle had 23.9% type I myofibers, 71.9% type II myofibers, and 4.2% intermediate myofibers. At 5 months of age, the muscle contained 18.5% type I myofibers, 74.6% type II myofibers, and 6.9% intermediate myofibers.

The semimembranosus muscle had 13.7% type I myofibers, 81.5% type II myofibers, and 4.8% intermediate myofibers. At 5 months of age, the muscle had 14.6% type I myofibers, 80.8% type II myofibers, and 4.6% intermediate myofibers.

The masseter muscle had 43.7% type I myofibers, 11.8% type II myofibers, and 44.5% intermediate myofibers at 1 month of age. The muscle was composed of 72.5% type I myofibers and 27.5% intermediate myofibers at 5 months of age. Type II myofibers disappeared from 2 months onward in the masseter muscle.

Type I myofibers did not increase in the longissimus thoracis and semimembranosus muscles from 1 month to 5 months of age. The longissimus thoracis muscles have 16.5-27.5% type I myofibers and the semimembranosus muscles have 16.0% type I myofibers of the adult cattle (Iwamoto et al., 1991; Suzuki and Tamate, 1974). The percentage of type I myofibers in the muscles of the adult cattle is

similar to that of the young cattle. However, the muscles had 4.6 to 6.9% intermediate myofibers at 5 months of age. The fact suggests that type I myofibers increase slightly in percentage by transformation from intermediate myofibers into type I myofibers from 5 months onward. The intermediate myofibers have been shown to be transitional myofibers in transformation from type II myofibers into type I myofibers in muscles of the growing pig and sheep (Suzuki and Cassens, 1980; 1983).

In the masseter muscle, type I myofibers increased in percentage from 1 month to 5 months of age. Type II myofibers disappeared and intermediate myofibers accounted for 43.7% at 2 months of age. The disappearance of type II myofibers indicates that type II myofibers were transformed into intermediate types. The masseter muscle of the adult cattle is composed only of type I myofibers (Suzuki and Tamate, 1974).

In the growing pig and sheep (Suzuki and Cassens, 1980; 1983), type I myofibers increase in percentage from birth until 16 weeks of age. In the cattle, type I myofibers seem to increase slightly and gradually in percentage by transformation from intermediate myofibers into type I myofibers in the longissimus thoracis and semimembranosus muscles from 5 months onward. In the masseter muscle, the intermediate myofibers must be transformed into type I myofibers with increases in time spent grazing and ruminating from 5 months onward.

Conclusions:

In the cattle, type I myofibers increase slightly in percentage in the longissimus thoracis and semimembranosus muscles from 1 month onward. In the masseter muscle, type I myofibers increase greatly in percentage from 1 month onward.

Pertinent literature:

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