4-P17

COMPARATIVE STUDY ON THE MYOFIBER TYPE COMPOSITION AND THE FAT DEPOSIT IN *M.LONGISSIMUS THORACIS* BETWEEN YOUNG HEIFER GROUPS OF JAPANESE BLACK FED FREELY ON CONCENTRATE AND ROUGHAGE

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Background:

Mammalian skeletal muscle is composed of three myofiber types which are recognized histochemically as Type I (slow-twitch oxidative), type IIA (fast-twtch oxidative glycolytic) and type IIB (fast-twitch glycolytic). Type I myofibers play a main function in postural maintenance, and type IIA and type IIB are mobilized for strong muscle activity in locomotion.

Regional variation of myofiber type composition was observed in *M.longissimus thoracis* in Japanese Black steers and the different compositions between the different marbling scored muscles were demonstrated by Gotoh *et al.*(1994). In 3 pairs of Holstein twins, it was reported by Suzuki *et al.* (1976) that nutritional level of feed exerted a marked influence on the myofiber type composition.

Using the Japanese special system, Japanese Black cattle have been fattened on much concentrate feed for 20 months or more from about 5 months old and can produce an excellent marbling beef. But effect of concentrate feed on the muscle of the calf from 5 to 10 months of age has not been clarified yet.

Objective:

The purpose of this study is to demonstrate changes of the myofiber type composition and fat deposit in the longissimus muscle of the calf induced by different food qualities.

Methods:

The 6 heifers of Japanese Black were divided into 2 groups; one was freely fed on concentrate (group C) and another on roughage (group R) from 5 to 10 months of age. *M. longissimus thoracis* was excised from the carcass at 10 months and weighed without peripheral adipose tissue and tendon. The tissues were taken from the dorsal, central, ventral, medial and lateral area of the transverse muscle materials at level of the 6th (LTI), the 11th thoracis (LTII) and 5th lumber vertebra (LT III)(Figure 1) . Serial frozen sections were stained by histochemical reactions for alkaline- or acid-preincubated myosin ATPase and reduced nicotinamide adenine dinucleotide dehydrogenase activities and with Oil-red O and Azan staining methods. Volume percentages of intramuscular crude fat at LT I, LT II and LT III were measured with Soxhlet method. After Type I, IIA and IIB myofibbers were distinguished (Brooke and Kaiser, 1970), the percentage distribution and diameter in each type were measured. Adipose cell size was observed in the diameter.

Results and discussion:

More rapid growth rate of group C compared with group R was indicated by larger body and the muscle weight at 10 months of age (Table 1). At LT I and LT II, percentage of Type IIA myofibers was significantly larger in group R and conversely Type IIB in group C than each other at 5 % level (Table 2). From this result, it was indicated that the nutrition at different levels affected on a development of oxidative capacity of the muscle, which is coincident with the results of Suzuki *et al.* (1976). However, growth rate of the myofiber was not given any effects by the different nutritional levels because of the same size in each type between the groups.

Different volume percentages of fat between the groups were recognized at LT I and LT II and also different adipose cell sizes at LT II and LT III (Figures 2 and 3). Excess energy material resulted from the high concentrate feed was accumulated as fat deposit and also made the intramuscular adipose cells develop more rapidly.

From these results, it was suggested that the heifers fed high concentrate feed could get excess energy by two pathways, high intake and low expenditure of energy.

Conclusion:

The high plane of nutrition with concentrate could produce good growth of the heifers and growth rate of the longissimus muscle was accelerated by transformation of some smaller Type IIA myofibers to larger Type IIB lowering the oxidative capacity of the muscle. Excess energy brought from the both pathways was stored in adipose tissue and also in the intramuscular.

Pertinent Literature:

Brooke and Kaiser, 1970, *Archives of Neurology* 23: 369-379.

Gotoh *et al.*, 1994, *Animal Science and Technology (Japan)* 65: 454-463.

Suzuki *et al.*, 1976, *Tohoku Journal of Agricultural Research* 27: 20-25.

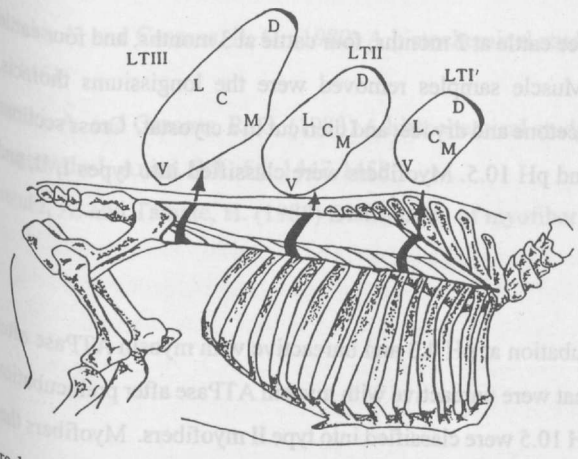

Figure 1. The illustration showing the location of specimens excised from *M. longissimus thoracis*. The specimens were obtained from the dorsal (D), central (C), ventral (V), medial (M) and lateral (L) areas of the cross portion at LTI, LTII and LTIII.

Figure 2. Percentage of fat

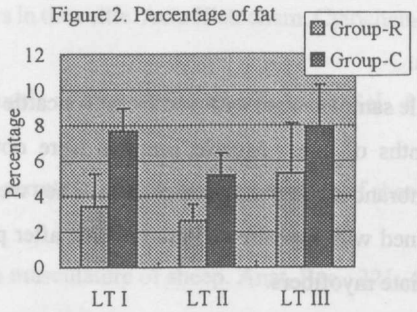

Figure 3. Diameter of fat cell

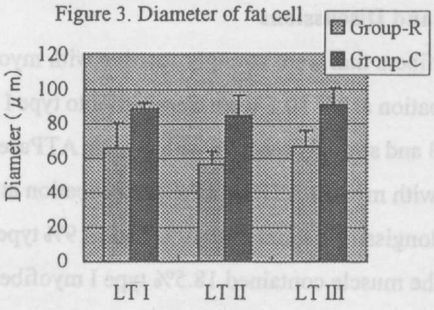

Table 1. Body weight and the weight of *M.longissimus thoracis* (LT)

Grooup	No.	Body weight (kg)	LT(g)
R	3	214±28*	2629±262*
C	3	272±22*	3433±320*

Mean±SD. *Significant between R and C ($p<0.05$).

Table 2. Myofiber type composition (Averages of each portion)

	Type I		Type IIA		Type IIB	
	R	C	R	C	R	C
LT I	25.3±2.7	25.4±3.5	18.3±2.6*	14.9±4.3*	56.4±3.0*	59.7±4.9*
LT II	20.5±3.9	19.9±5.0	24.6±4.3*	18.4±3.7*	54.9±4.9*	60.1±5.3*
LT III	24.6±6.1	25.4±5.9	23.1±4.6	19.7±6.0	52.3±6.8	54.9±6.9

Mean±SD. R: n=3, C: n=3. *Significant between group R and C ($p<0.05$).