ACTERISTICS OF MUSCLE FIBERS IN BULLS REGARDING GROWTH INTENSITY AND FAT RATE IN CARCASSES

ŠKORJANC[1], M. ČEPON[1], M. ERJAVEC[2]

Technical Department, Biotechnical Fac., Univ. Ljubljana, 61230 Domžale, SLOVENIA

ool of Agriculture, Univ. Maribor, 62000 Maribor, SLOVENIA

mary

main objective of this research was to analyse Simmental (S) bulls from progeny and Simmental x Montbeliarde crossbreeds (SxM). Samples were taken 24 to 35 hours after slaughter from the middle part of musculus gissimus dorsi (MLD) after 7th rib in the right carcass half. Right carcass halves were devided to body ts, where the rates of meat, fat, thendon and bones were measured. On the basis of myosin ATPase activity (PADYKULA and HERMAN, 1955) muscle fibers were devided to type I and type II, and to red and white on the is of their SDHase activity (NACHLAS et al., 1957). By computer aided method (PERNUŠ et al., 1986) it was sible to measure minimal diameter, area and extent of each muscle fiber from the photograph. In 1 mm^2 of le area (OSTERC, 1974) the number of muscle fibers of each type was determined. With higher fat percentage carcass the rate of red muscle fibers decreased, while the rate of white muscle fibers in MLD increased. Due higher daily gain the rate of muscle fibers type I decreased, and the rate of type II increased. Simental s had statistically significant effect on the rate of all four muscle fiber types, while genotype of SxM s had statistically significant effect on analysed characteristics of type I muscle fibers, as well as on number of muscle fibers type I and II per 1 mm^2 of the sample.

oduction

cles in mammals consist of different muscle fibers where the prevailing type in certain muscle determins its racteristic and appearance (MOWAFY et al., 1972). With postnatal growth in cattle, the size and the rate of ticular muscle fiber changes (TRENKLE and MAY, 1983). The changing processes are very intense in the loin ion (CORNFORTH et al., 1973). The main objective of this research was to find out whether there is an eraction between muscle fiber characteristics, growth intensity and fat rate in carcasses.

erial and methods

mental bulls (S) (13) of three sires and Simmental x Montbeliarde (SxM) crossbreeds (18) of two sires were en at progeny testing station KOZJAK. The calves, aged in average 57.3 to 61.3 days were kept in quarantine 3.5 months of age and were fed quality hay, as well as TL starter during this period. When they were 3.5 ths old, they were weighed and moved to testing stable. From this time their feed consisted of 3 kg TL rter and 1 kg hay. After two months the calves were weighed again and their daily ration was changed. TL was stituted by TL pit. 1, they got 1 kg hay and maize silage. When they weighed over 200 kg their feed was posed of 8 kg maize silage, 2 kg maize corn silage, 1.5 kg superconcentrate, and 0.5 kg hay. The bulls were shed every two months and when they were 480 days old they were slaughtered. With rough dissection the right rcass half was devided to meat, fat, tendons and bones.

er samples were taken 24 to 35 hours after slaughter from the middle part of musculus longissimus dorsi (MLD) er 7th rib and preserved in liquid nitrogen (ŠKORJANC, 1991). Frosen peaces of muscle were cut to 10 u ckness. On serial cuts the SDH-ase activity (NACHLAS et al., 1957) and mATP-ase activity (PADYKULA and MAN, 1955) was determined according to modified Ca method. On photographs the characteristics of type I and , red (R) and white (W) muscle fibers were studied separately. With computer aided analysis the minimal meter, area and extent of muscle fibers were determined according to the method, described by PERNUŠ et al. 986). The number and rate of muscle fibers in certain type were determined by method described by OSTERC (1974).

ta was statistically treated by LSMLMW programme (HARVEY, 1987). The influence of breed, weight gain of bulls, of the fat rate in carcass halves on studied characteristics was observed. The following model was used for istical analysis:

$$y_{ijklm} = u + B_i + S_{ij} + b_1 DG_k + b_2 \%F_l + e_{ijklm}$$

Y_{ijklm} = studied characteristics

u = mean value for studied characteristics

B_i = effect i - certain breed (i = 1, 2)

S_{ij} = effect j - certain sire (j = 1, 2 ...., 5) i - certain breed

b_1 = partial coefficient of linear regression Y_{ijklm} on DG_k

DG_k = weight gain from 150^{th} to 450^{th} day of age

b_2 = partial coefficient for linear regression Y_{ijklm} on $\%F_1$

$\%F_1$ = fat rate in carcass

e_{ijklm} = random deviation from model

Results and discussion

Table 1 presents LSQ values for minimal diameter, area and extent on cross-section, as well as the rate and number of muscle fibers of particular type per sample cut area unit.

Variance analysis proved that SxM fathers had a statistically significant influence on minimal diameter, area and extent of muscle fibers. Studying type II and W muscle fiber characteristics, no statistically significant differences between breeds of sires was noticed. With increased fat rate in carcass, statistically significant decrease of type II minimal diameter was observed (b = -0.95). This process is most probably connected to the change of intermediar to type II muscle fibers, and thus the average minimal diameter of type II decreased. By increased fat rate in carcass, statistically significant decrease of R muscle fiber (b = -0.93), and increase W muscle fiber rate (b = 0.92) also occured. Similar changing process of certain muscle fiber types in loin in bulls and calves of Hereford and Holstein breed was noticed by CORNFORTH et al. (1973). Yet the research conclusion of CORNFORTH's et al. (1973) differs from SOLOMON's et al. (1986) CORNFORTH et al. (1973) stated that according to increased weitht gain, the rate of Red muscle fibers decreased, tha rate of intermediar muscle fibers stayed unchanged, while the rate of glycolitic fibers increased.

Table 1: Minimal diameter, area and extent on cross-section, the rate number of muscle fibers in different muscle fiber types per sample cut area unit

Source of variability Muscle fiber characteristics	Sires (S)	Sires (SxM)	Daily gain (150-450 days) b_1	Fat % in carcass b_2
Type I				
Min.diameter (um)	47.52	47.67*	- 0.02	0.32
Extent (um)	692.72	686.76*	- 0.11	1.44
Area (um)	2922.84	2884.84*	- 0.92	8.44
Type II				
Min. diameter (um)	50.40	51.20	0.00	- 0.95*
Extent (um)	783.89	821.29	- 0.04	- 2.75
Area (um^2)	3486.08	3656.69	0.03	-34.33
Red				
Min.diameter (um)	53.81	50.06	- 0.03	0.24
Extent (um)	796.77	746.42	- 0.17	2.02
Area (um^2)	3571.04	3171.87	- 1.21	15.91
White				
Min.diameter (um)	59.08	59.40	- 0.02	-0.45
Extent (um)	931.67	955.84	- 0.13	1.28
Area (um^2)	4578.70	4703.05	- 0.76	-6.46
Type I %	35.41**	36.72	- 0.02**	0.02
Type II %	64.59**	63.28	0.02**	-0.02
Type R %	40.86*	40.15	0.00	-0.92*
Type W %	59.14*	59.85	0.00	0.92*
No m.f. I and II/mm^2	209.20	220.27**	0.08	2.73
No of m.f. R and W/mm^2	191.82	200.60	0.07	3.42

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

SOLOMON et al. (1986) established that by increased body weight of Angus and Brahman bulls, the rate of intermediar fibers decreased, and the rate of glycolitic fibres increased. Statistically significant decrease of type II muscle fiber rate (b = -0.02) was due to increased daily gain in the period from 150^{th} to 450^{th} day

clusion

our research the muscle fiber characteristics of bulls and their connection to growth intensity and fat rate carcasses were studied. Despite the small number of tested animals, the following conclusions can be sented:

by higher fat percentage rate, the average minimal diameter of type II decreased in MLD, presumably on the account of transformation of intermediar (narrower than type II) to type II muscle fibers,

by increased daily gain, the rate of type I muscle fibers decreased, while the rate of type II muscle fibers in MLD increased,

by higher fat percentage rate, the rate of Red muscle fibers decreased, while the rate of White muscle fibers in MLD increased,

AM sires had statistically significant effect on type I studied muscle fiber characteristics, as well on the number of type I and II muscle fibers per area unit.

ferences

DNFORTH B.P., SCHWARTZ W.C., CRAMER D.A., 1973. Growth differentiation of muscle fibers in cattle. J. Anim. ., 36, 1196-1197

OVEY W.R., 1985. Parmcard, Parameter Card Generation Program for LSMLMW, Mixed Model Least-Squares and ximum Likelihood Computer Program. Department of Dairy Science The Ohio State University Columbus, Ohio, 46

NAFEY M., KASTENSCHMIDT L.L., CASSENS R.G., 1972. A method for the separation of fiber types from skeletal scle. J. Anim. Sci., 34, 563-568

NOLAS M.M., TSOU K., De SOUZA E., CHENG C., SELIGMAN A.M., 1957. Cytochemical demonstration of succinic ydrogenase by the use of a new p-nitrophenyl substituted ditetrazole. J. Histochem. Cytochem, 5, 420-436

TERC J., 1974. Premer in število mišičnih vlaken v musculusu longissimusu dorsi v povezavi s proizvodnimi ytnostmi nekaterih govejih pasem v Sloveniji. Doctors dissertation, 67

OVKULA H.A., HERMAN E., 1955. The specificy of the histochemical method for adenosin triphosphatase. J. stochem. Cytochem., 3, 170-195

ENIUS F., BJELOGRLIČ Z., ERŽEN I., 1986. A computer - aided method for muscle type quantification. Acta ereol., 5, 49-54

LOMON M.B., WEST R.L., HANTGES J.F., 1986. Growth and muscle development characteristics of purebreed Angus d Brachmam bulls. Growth 50, 51-67

KOPJANC D., 1991. Muscle fibre types of musculus longissimus dorsi in cattle of different breeds. Master of ience thesis. Domžale, Biotechnical faculty, 62

ENKLE A., VENABLE J.H., WUTHIER P.R., HENRICKSON R.L., 1962. Relationsship of fiber diameter to tenderness d meatiness as influenced by bovine age. J. Anim. Sci., 21, 33-36