Carcass value of the progeny of tested beef bulls

P. Polách[1], J. Šubrt[2], M. Bjelka[1], K. Uttendorfský[3], R. Filipčík[2]

[1]Research Institute for Cattle Breeding, Ltd., Rapotín, Czech Republic
[2]Mendel University of Agriculture and Forestry, Faculty of Agriculture, Brno, Czech Republic
[3]ZŘUD-Slaughterhouse Polička, Polička, Czech Republic

ABSTRACT: In the study focused on the estimation of the efficiency of beef cattle in the conditions of the Czech Republic, 361 half-carcasses of the offspring of crossbred bulls of tested young beef sires were dissected. The bulls were fattened together and slaughtered at the age of 500 ± 30 days. The tested breeds were Aberdeen Angus (AA), Blonde d'Aquitaine (BA), Belgian Blue (BB), Charolais (CH), Hereford (HE), Limousine (LI), and Piemontese (PI). The control groups were bulls of the Czech Pied (C) and Holstein (H) breeds. The best commercial class according to the SEUROP system was found in the offspring of Charolais sires (3.17). The fat content was the highest in the BB group (2.45) and the lowest ($P < 0.01$) in the PI group (1.50). The average hot carcass weight was 332.54 kg and was significantly ($P < 0.05$) the lowest in bulls of the HE group (290.50 kg). After dissection the dressing percentage of meat, bone, separable fat, and the meat/bone ratio were calculated. The average meat percentage in the carcass was 78.47%. The dressing percentage of meat of PI group was 80.33% and was the highest of all the groups ($P < 0.01$). H group showed the highest proportion of bones (19.79%), which was by 2% higher than in PI group. The content of separable fat ranged between 1.29 and 3.68%.

Keywords: beef cattle; bulls; commercial type; carcass quality; SEUROP; carcass composition

In animal breeding and husbandry extensive efforts have been exerted to more efficient production of leaner meat (Wegner *et al*., 2000). The breeding programmes of beef cattle involve carcass quality and the beef production traits are taken into account only indirectly. The net effects of the selection for improved efficiency of beef production depend on a large number of interacting effects within the production system. Considerable attention has been paid to the carcass traits of cattle, e.g. slaughter weight, lean and fat content and most of the traits have been found to be of high or moderate heritability (Gregory *et al*., 1994; Wheeler *et al*., 1996; Parkkonen *et al*., 2000). Some of the studies established a relationship between the breed of the sires and the carcass composition of slaughtered bulls. The objective of this study was to contribute to the elucidation of these relationships within beef cattle breeding in the Czech Republic.

MATERIAL AND METHODS

The bulls were fattened in 1997–2001 and slaughtered at the age of 500 ± 30 days. The average age at slaughter of all the groups of fattened bulls was 507 days, ranging between 514 and 498 days. The differences in the age between the individual groups were not statistically significant. The tested sire breeds were Aberdeen Angus (AA; 4 sires), Blonde d'Aquitaine (BA; 3 sires), Belgian Blue (BB; 1 sire), Charolais (CH; 14 sires), Hereford (HE; 4 sires), Limousine (LI; 4 sires), and Piemontese (PI; 4 sires). The cows used as dams came from a population of dairy cows. The control groups consisted of bulls of the Czech Pied (C; 2 sires) and Holstein (H; 7 sires) cattle. The feed ration was based on the methodology applied for the testing station and consisted of maize silage, lucerne silage and concentrates. The average daily gains during the fattening pe-

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riod ranged between 1 100 and 1 200 g. The bulls were slaughtered in the ZŘUD-Slaughterhouse in Polička. A total number of 361 tested bulls of various commercial types were slaughtered and analysed. The representation of the individual commercial types was given by the targeted selection of calves for the tests and based on the breed of the father (see the following table):

Commercial type/breed of father	Number of tested bulls
AA	33
BA	28
BB	11
C	11
CH	129
H	53
HE	10
LI	50
PI	36

The weight of dressed carcass and of kidney and pelvic fat was controlled in the course of slaughtering. Cooled right half-carcasses were cut into quarters between the 8th and 9th (pectoral) vertebra. The dissection of 361 half-carcasses of the progeny of the tested bulls was based on dissection standards of the meat industry of the Czech Republic. Determined were the weights of meat, bones and separable fat. The meat was divided into two groups. The 1st grade meat was meat from the shoulder, rump, loin and fillet. The other parts of carcasses were classified as 2nd grade meat. After dissection the dressing percentage of meat, bone, separable fat, and meat/bone ratio were calculated. The data analysis was processed using the Unistat programme version 4.53a.

RESULTS AND DISCUSSION

The average carcass weight of the 361 slaughter bulls was 325.5 kg. The carcass weight basically corresponded to the weight category of the bulls (Table 1). The highest carcass weight, with a predominantly insignificant difference in age at the time of slaughter (498-514 days), was recorded in cattle of larger body framework, i.e. progeny of Ch, C and BA fathers. The lowest carcass weight was recorded in sons of HE and AA fathers ($P < 0.01$ and $P < 0.05$, respectively). Table 1 also classifies the carcasses on the basis of the SEUROP standard; this is a very important parameter that evaluates the quality of dressed carcass meat. The lean and fat content of the bull's body were evaluated. The highest proportion of lean was found out in the Charolais group (3.17 points); the classification of bulls of the AA and HE groups was not so favourable (i.e. 3.94; $P < 0.01$ and 3.80; $P > 0.01$, respectively). The best and highly significant (respectively $P < 0.01$ and $P < 0.05$) fat content of the carcass was recorded in the crossbred offspring of PI fathers (1.50 ± 0.56). The fat content of the BB group was nearly by 1 point (+0.95 point) lower (2.45 points). The fat content of LI group was also lower (1.88 ± 0.69). The inter-group variability of the fat content ranged between 27 and 52%. Classification of the lean content of the groups of slaughter bulls showed more balanced results. Šubrt *et al*. (2000) and Polách *et al*. (2000) reached similar conclusions in terms of the carcass quality.

The net weight gain ($P < 0.05$ and $P < 0.01$) (Table 2) was the lowest in the progeny of HE sires (579.56 ± 49.20 g/day). CH group showed the highest ($P < 0.01$) intensity of carcass growth (689.22 ± 64.38 g/day). The average value of the whole group was 661.30 ± 68.01 g/day. Teslík *et al*. (1995) found net weight gains in bulls C (575 g/day) and H (548 g per day), which were lower by about 106–104 g/day, respectively compared to our results. The results described by Polách *et al*. (2000) were lower and ranged from 37.21 g/day in AA group to 111.10 g per day in C group. Frelich and Voříšková (1997) reported lower values, i.e. 6.76 g/day in LI, 9.47 g per day in C, 17.52 g/ day in PI to 23.95 g/day in BA, and higher values in groups CH (3.18 g/ day), HE (30.24 g/day), BB (54.13 g/day) and AA (54.54 g per day). The content of the 1st grade meat in the carcass was 40.20 ± 2.25% in the whole group. The percentage (41.46%) was the highest in PI group and the lowest ($P < 0.01$) in HE (36.34%). Šubrt (1994) reported higher values in groups HE (36.72%) and C (37.27%) and lower values in the sons of PI(38.14%), BA (36.82%) and CH (36.72%) sires. Bartoň *et al*. (1998) discovered a higher content of 1st grade meat in breeds C, CH and BB. H group had the lowest ($P < 0.01$) proportion of 2nd grade meat (36.14%) and the C bulls the highest (40.68%). The average value of the whole set was 38.26%. Voříšková *et al*. (1998) reported higher values of about 5.82–8.56% and Šubrt (1994) reported similar results, i.e. by about 1.47–4.75% higher than ours.

The contents of prime cuts in the carcass are described in Table 3. The proportion of shoulder was

Table 1. Carcass characteristics

Commercial type	No.	Average	Standard deviation	Variation coefficient (%)	Statistical test[1]
Hot carcass (kg)					
Total	361	332.54	32.76	9.85	
AA	33	312.06	25.29	8.10	h, he, ba
BA	28	336.29	38.65	11.49	HE, aa
BB	11	322.82	20.08	6.22	–
C	11	339.36	22.93	6.76	HE
CH	129	346.49	31.54	9.10	AA, HE, LI, PI
H	53	333.92	23.68	7.09	HE, aa
HE	10	290.50	24.38	8.39	BA, C, CH, PI, aa, li
LI	50	319.86	29.30	9.16	CH, he
PI	36	326.55	35.56	10.88	CH, HE
Meat class (SEUROP)[2]					
Total	361	3.40	0.70	20.59	
AA	33	3.94	0.50	12.69	CH, LI, PI, h
BA	28	3.57	0.57	15.97	–
BB	11	3.27	1.01	30.89	–
C	11	3.27	0.47	14.37	–
CH	129	3.17	0.73	23.03	AA, h
H	53	3.53	0.54	15.30	aa, ch
HE	10	3.80	0.42	11.05	–
LI	50	3.40	0.67	19.71	AA
PI	36	3.36	0.72	21.43	AA
Fat class (SEUROP)[2]					
Total	361	2.16	0.75	34.72	
AA	33	2.21	0.60	27.15	PI
BA	28	2.32	0.55	23.71	PI
BB	11	2.45	0.69	28.16	PI
C	11	1.91	0.83	43.46	–
CH	129	2.37	0.70	29.54	PI
H	53	2.25	0.83	36.89	PI
HE	10	2.20	1.14	51.82	pi
LI	50	1.88	0.69	36.70	CH, pi
PI	36	1.50	0.56	37.33	AA, BA, BB, CH, H, li, he

[1]$P > 0.01$ = AA, BA, BB, C, CH, H, HE, LI, PI

$P > 0.05$ = aa, ba, bb, c, ch, h, he, li, pi

[2]scores scale for SEUROP (Meat class S = 1, E = 2, U = 3, R = 4, O = 5, P = 6; Fat class 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5)

Table 2. Parameters of carcass yield

Commercial type	No.	Average	Standard deviation	Variation coefficient (%)	Statistical test[1]
Net weight gain (g/day)					
Total	361	661.30	68.01	10.28	
AA	33	621.56	50.16	8.07	CH, ba
BA	28	674.15	78.49	11.64	HE, aa
BB	11	644.97	40.17	6.23	–
C	11	681.87	46.60	6.83	HE
CH	129	689.22	64.38	9.34	AA, H, HE, LI, pi
H	53	652.80	66.45	10.18	CH, he
HE	10	579.56	49.20	8.49	AA, BA, C, ch, h, li, pi
LI	50	639.56	56.82	8.88	CH, he
PI	36	651.82	71.25	10.93	CH, he
1st grade meat (%)					
Total	361	40.20	2.25	5.59	
AA	33	39.29	2.39	6.09	H, PI, ch, li
BA	28	39.40	1.79	4.55	H, PI, ch, li
BB	11	40.62	1.33	3.28	C, HE
C	11	37.07	1.81	4.87	BB, CH, H, LI, PI
CH	129	40.35	2.19	5.44	C, HE, aa, ba, pi
H	53	40.99	1.20	2.94	AA, BA, C, HE
HE	10	36.34	0.85	2.34	BB, CH, H, LI, PI
LI	50	40.52	2.26	5.59	C, HE, aa, ba
PI	36	41.46	2.06	4.96	AA, BA, C, HE, ch
2nd grade meat (%)					
Total	361	38.26	2.48	6.49	
AA	33	38.32	3.01	7.86	H, c
BA	28	39.37	2.41	6.13	H
BB	11	38.46	1.44	3.75	H
C	11	40.68	2.28	5.61	H, aa, ch
CH	129	38.16	2.34	6.14	H, c
H	53	36.14	1.47	4.07	AA, BA, C, CH, HE, LI, PI, bb
HE	10	40.32	0.83	2.05	H
LI	50	38.68	2.38	6.14	H
PI	36	38.87	2.37	6.10	H

[1]($P > 0.01$) = AA, BA, BB, C, CH, H, HE, LI, PI
($P > 0.05$) = aa, ba, bb, c, ch, h, he, li, pi

Table 3. Content of prime cuts from carcass

Commercial type	No	Average	Standard deviation	Variation coefficient (%)	Statistical test[1]
Shoulder (%)					
Total	361	7.00	0.94	13.50	
AA	33	6.76	0.67	9.89	BA, BB, ch
BA	28	7.79	1.12	14.32	AA, C, CH, H, HE, LI, PI
BB	11	8.07	0.67	8.36	AA, C, CH, H, HE, LI, PI
C	11	6.22	0.42	6.83	ba, bb, ch
CH	129	7.21	0.95	13.23	BA, BB, C, H, HE, aa
H	53	6.42	0.48	7.42	BA, BB, CH, li, pi
HE	10	6.17	0.25	3.98	BA, BB, CH
LI	50	6.88	0.99	14.35	BA, BB, h
PI	36	6.97	0.76	10.96	BA, BB, h
Rump (%)					
Total	361	19.23	1.93	10.04	
AA	33	18.08	1.48	8.16	BA, BB, CH, LI, PI
BA	28	20.66	2.21	10.69	AA, C, H, HE, ch, pi
BB	11	21.19	0.49	2.32	AA, C, H, HE, ch, li, pi
C	11	17.50	1.18	6.76	BA, BB, CH, LI, PI
CH	129	19.75	1.72	8.72	AA, C, H, HE, ba, bb
H	53	17.47	0.95	5.41	BA, BB, CH, LI, PI
HE	10	16.79	1.11	6.61	BA, BB, CH, LI, PI
LI	50	19.93	1.72	8.61	AA, C, H, HE, bb
PI	36	19.51	1.50	7.71	AA, C, H, HE, ba, bb
Loin (%)					
Total	361	4.20	1.07	25.46	
AA	33	4.08	0.84	20.50	PI, c
BA	28	3.96	1.22	30.92	PI, bb
BB	11	3.24	0.32	9.96	C, LI, PI, ba
C	11	4.99	1.03	20.57	BB, aa, ch, h
CH	129	4.03	1.01	24.95	LI, PI, c
H	53	3.96	0.53	13.46	PI, c, li
HE	10	4.11	1.45	35.25	Pi
LI	50	4.56	1.27	27.93	BB, CH, h, pi
PI	36	5.09	0.99	19.54	AA, BA, BB, CH, H, he, li
Fillet (%)					
Total	361	1.42	0.30	21.19	
AA	33	1.32	0.19	14.53	BA, BB, ch, li
BA	28	1.64	0.29	17.78	AA, C, CH, H, HE, PI, li
BB	11	1.73	0.17	10.01	AA, C, H, HE, PI, ch, li
C	11	1.25	0.14	10.89	BA, BB
CH	129	1.47	0.23	15.69	BA, H, aa, bb, he
H	53	1.22	0.11	8.92	BA, BB, CH, LI
HE	10	1.20	0.12	9.56	BA, BB, ch, li
LI	50	1.50	0.54	36.14	H, aa, ba, bb, he
PI	36	1.38	0.13	9.32	BA, BB

[1]($P > 0.01$) = AA, BA, BB, C, CH, H, HE, LI, PI
($P > 0.05$) = aa, ba, bb, c, ch, h, he, li, pi

Table 4. Content of tissues in carcass

Commercial type	No	Average	Standard deviation	Variation coefficient (%)	Statistical test[1]
Meat (%)					
Total	361	78.47	1.65	2.10	
AA	33	77.61	1.55	2.00	BA, CH, LI, PI, bb
BA	28	78.77	2.07	2.63	AA, H, HE, PI
BB	11	79.09	0.79	1.00	H, HE, aa, pi
C	11	77.75	1.96	2.52	PI, li
CH	129	78.51	1.30	1.66	AA, H, HE, PI, li
H	53	77.13	0.99	1.28	BA, BB, CH, LI, PI
HE	10	76.66	1.14	1.49	BA, BB, CH, LI, PI
LI	50	79.21	1.32	1.67	AA, H, HE, PI, c, ch
PI	36	80.33	1.39	1.73	AA, BA, C, CH, H, HE, LI, bb
Bone (%)					
Total	361	18.77	1.28	6.82	
AA	33	19.55	1.38	7.06	BA, CH, LI, PI, c
BA	28	18.34	1.22	6.65	AA, H, pi
BB	11	18.84	0.90	4.78	H
C	11	18.47	0.92	4.98	H, aa
CH	129	18.83	1.16	6.16	AA, H, LI, PI
H	53	19.79	0.94	4.75	BA, C, CH, LI, PI, bb, he
HE	10	18.72	0.76	4.06	h, pi
LI	50	18.19	1.06	5.83	AA, CH, H, pi
PI	36	17.36	1.16	6.59	AA, CH, H, ba, bb, he, li
Fat (%)					
Total	361	1.97	1.02	51.78	
AA	33	2.03	1.10	54.19	HE, PI
BA	28	2.10	1.92	91.43	HE, PI
BB	11	1.35	0.46	34.07	H, HE
C	11	2.25	1.11	49.33	HE, pi
CH	129	1.86	0.80	43.01	H, HE, PI
H	53	2.49	0.67	26.91	BB, CH, HE, LI, PI
HE	10	3.68	1.20	32.61	AA, BA, BB, C, CH, H, LI, PI
LI	50	1.79	0.67	37.43	H, HE, pi
PI	36	1.29	0.54	41.86	AA, BA, CH, H, HE, c, li
Meat/bone ratio					
Total	361	4.20	0.36	8.57	
AA	33	3.99	0.35	8.77	BA, CH, LI, PI
BA	28	4.32	0.34	7.87	AA, H, PI,
BB	11	4.21	0.24	5.70	PI, h
C	11	4.22	0.27	6.40	PI, h
CH	129	4.19	0.31	7.40	AA, H, LI, PI
H	53	3.91	0.22	5.63	BA, CH, LI, PI, bb, c
HE	10	4.10	0.20	4.88	PI
LI	50	4.37	0.31	7.09	AA, H, CH
PI	36	4.59	0.38	8.28	AA, BA, BB, C, CH, H, HE, LI

[1]($P > 0.01$) = AA, BA, BB, C, CH, H, HE, LI, PI
($P > 0.05$) = aa, ba, bb, c, ch, h, he, li, pi

the highest in the BB group (8.07 ± 0.67%), and the lowest in the HE progeny (6.17 ± 0.25%). Statistically significant differences at levels ($P < 0.01$) and ($P < 0.05$) were found between the groups. Nová and Louda (2000) found similar proportions of shoulder. HE group (16.79%) had the lowest average proportion of rump, followed by groups H < C < AA < PI < CH < LI < BA < BB (21.19%). Polách (1998) described higher values in crossbred sons of beef bulls AA (21.88%), BA (24.05%), BB (24.01%), CH (23.21%) and LI (23.68%). Nová and Louda (2000) indicated 19.5% as the average rump percentage. The percentage of loin ranged from 3.24% (BB) to 5.09% in sons of the PI sires ($P < 0.01$). The average for the whole set was 4.20%. Polách (1998) reported values from 5.00% in C to 5.25 in AA. According to Voříšková *et al*. (1998) a lower value (3.21–3.76%) was achieved in crossbred bulls. HE group had the lowest percentage of fillet, i.e. 1.20%. The statistically significantly ($P < 0.01$) highest percentage (1.73%) was recorded in the offspring of BB sires. Nová and Louda (2000) indicated a higher average value of the fillet percentage, i.e. 1.9%. Polách (1998), Voříšková *et al*. (1998) reported lower contents of the fillet.

After dissection the dressing percentage of meat, bone, separable fat, and meat/bone ratio were calculated (Table 4). The average meat percentage in the carcass was 78.47%. In PI group the dressing percentage of meat was 80.33 ± 1.39%, the highest of all the groups of the set ($P < 0.01$), and was followed by groups LI > BB > BA > CH > C > H > AA > HE (76.66%). Bartoň *et al*. (1998) determined higher values of the meat content for crossbred bulls of CH (81.70%), BB (82.20%), and C (80.80%). However, Voříšková *et al*. (1998) reported lower values in crossbred bulls (74.47–77.74% in AA and BA, respectively). Suchánek *et al*. (1990) stated that the meat content in the carcass of C bulls was 78.50%. The highest percentage of bones was found in H group (19.79%). It was by 2% more than PI group. The content of separable fat was 1.29–3.68% (PI and HE, respectively). Our results were similar to the studies of Keane *et al*. (1990), and Keane (1994). The differences in the percentage of separable fat yield were highly significant ($P < 0.01$). The highest value (3.68 ± 1.20%) was recorded in HE group. The value (4.59 ± 0.38) of the meat/bone ratio was the statistically highly significantly ($P < 0.01$) highest in PI group. It was associated with the highest percentage yield of meat and the lowest percentage of bones in this group. Crossbreeding dairy cows with sires of beef breeds improved the quality of the carcass of their offspring. However, crossbreeding with small frame breeds (AA, HE) impaired the quality of the carcass.

By analysing the meat efficiency of bulls of the most frequently fattened commercial types in conditions of the Czech Republic, important differences in the quality rating (SEUROP) and composition of the carcasses were discovered. The highest rating of the lean content was recorded in carcasses of the progeny of bulls of larger body frames (Charolais, Blonde d'Aquitaine, Czech Pied, and/or Belgian Blue); however, technological analyses of total meat gains showed that these breeds were only slightly above the average of the whole group of the studied slaughter bulls. The carcass composition (meat, fat and bone yields) of the progeny of Limousin and Piemontese bulls was more favourable. The differences in the proportion of rump, shoulder and fillet of the Belgian Blue breed were highly significant ($P < 0.01$). The muscle content of crosses with the PI, LI and BB breeds based on the SEUROP standard was slightly below the average of the whole set of slaughter bulls, while the classification of the fat content was rated as the highest in the progeny of PI and LI fathers. Continuous evaluations of the quality and results of dissection of the carcasses of fattened commercial cattle types are very important when observing the requirements for the improvement of the quality of jointed meat and meat products.

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ABSTRAKT

Jatečná hodnota potomstva testovaných býků masných plemen

Tato studie je zaměřena na posouzení jatečné hodnoty masných užitkových typů skotu v podmínkách České republiky. V této práci bylo rozbouráno 361 jatečných polovin býků, kříženců s masnými plemeny. V otcovské pozici křížení byli použiti testovaní mladí býci těchto plemen: aberdeen angus (AA), blonde d'aquitaine (BA), belgické modré (BB), charolais (CH), hereford (HE), limousine (LI) a piemontese (PI). Kontrolní skupiny byly tvořeny býky po otcích plemen české strakaté (C) a holštýnské (H). Býci byli společně vykrmováni a poráženi v jednotném věku 500 ± 30 dnů. Porážky byly provedeny v podniku ZŘUD-Masokombinát Polička, a.s. Při porážce byla zjišťována hmotnost teplého jatečně upraveného těla a jeho klasifikace za zmasilost a protučnění dle systému SEUROP. Nejlepší zatřídění za zmasilost dosáhli potomci po otcích plemene charolais (3,17). Nejvyšší stupeň protučnění vykazovala skupina BB (2,45) a nejnižší ($P < 0,01$) skupina PI (1,50). Průměrná hmotnost teplého jatečně upraveného těla byla 332,54 kg a průkazně ($P < 0,05$) nejnižší hodnotu jsme stanovili u býků HE (290,50 kg). Jatečná těla byla po 24hodinovém vychlazení rozdělena mezi osmým a devátým žebrem do čtvrtí. Po rozbourání pravých jatečných polovin byly vypočteny hodnoty výtěžnosti masa, kostí a oddělitelného loje a poměr maso/kosti. Nejvyšší intenzita růstu vyjádřená netto přírůstkem byla stanovena u potomků po plemenících CH (689,22 g/den); tato hodnota se vysoce průkazně ($P < 0,01$) lišila od nejnižší dosažené úrovně 579,56 g/den (HE). Rozdíl mezi maximální (41,46 %; PI) a minimální (36,34 %; HE) hodnotou podílu masa I. jakosti činil 5,12 % ($P < 0,01$). Nejnižší hodnotu zastoupení masa II. jakosti vykázala skupina H (36,14 %). Při posuzování podílů nejcennějších částí (plec, kýta, roštěnec a svíčková) byly mezi skupinami nalezeny statisticky vysoce významné rozdíly na hladinách $P < 0,05$ i $P < 0,01$. V průměru se podíl masa v jatečném těle pohyboval na úrovni 78,47 %. Statisticky vysoce signifikantně ($P < 0,01$) nejvyšší hodnotu podílu masa vykázala skupina PI (80,33 %). Nejvyšší procentické zastoupení kostí bylo stanoveno u kontrolní skupiny H (19,79 %), což bylo o 2 % více než u skupiny PI. Podíl oddělitelného tuku se pohyboval v rozmezí 1,29–3,68 %.

Klíčová slova: masný skot; býci; komerční typy; kvalita jatečného těla; SEUROP; skladba jatečného těla

Corresponding Author

Prof. Ing. Jan Šubrt, CSc., Mendelova zemědělská a lesnická univerzita v Brně, Ústav chovu hospodářských zvířat, Zemědělská 1, 613 00 Brno, Česká republika
Tel. +420 545 133 242, e-mail: subrt@mendelu.cz