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THE EFFECT OF CARCASS CONFORMATION CLASS (EUROP SYSTEM) ON THE SLAUGHTER QUALITY OF YOUNG CROSSBRED BEEF BULLS AND HOLSTEIN-FRIESIANS*

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Abstract

The objective of this study was to determine the effect of genotype and carcass conformation class on the slaughter quality of 200 young bulls, including 108 crossbred beef bulls and 92 Holstein-Friesians (HF), aged 21–22 months, selected in the lairage. The lean meat content was estimated and body measurements were taken before slaughter. After slaughter, the carcasses were graded according to the EUROP system, and carcass quality parameters were determined. Intramuscular fat was extracted from samples of *m. longissimus dorsi*, and the fatty acid profile of extracted fat was determined by gas chromatography. 61.11% carcasses of crossbred beef bulls were graded in the conformation class R, and 56.53% carcasses of Holstein-Friesians were classified as O. The majority of carcasses belonged to fat class 2, which was not consistent with intramuscular fat content. Within the same conformation classes, crossbred beef bulls were characterized by higher slaughter quality than Holstein-Friesian bulls. Meat from hybrid beef bulls had a higher (by 0.42% on average) content of fat with a more desirable composition. Since the population size of beef cattle will probably not increase in the nearest future, efforts should be continued to optimize the production of high-quality beef from dairy cattle herds.

Key words: beef bulls, slaughter quality, EUROP classification, fatty acids.

The quality of bovine carcasses is influenced by the selection of genetic material, production technology as well as the terms of slaughter animal purchase (Litwińczuk et al., 2006; Wajda et al., 2003). Only an objective evaluation can encourage produc-

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ers to raise the quality of their livestock. In an attempt to harmonize Poland's laws with EU legislation, the EUROP grid method of carcass classification was introduced in large meat processing plants. Countries that have introduced this popular classification system are the leading suppliers of high quality meat in Europe (Daszkiewicz et al., 2003; Florek, 2000).

Global improvements in quality of life raise consumer expectations toward food, including beef. The quality of beef is determined mostly by the sex, diet, slaughter age and genotype of animals (Smith et al., 2009). Intramuscular fat content significantly affects the sensory attributes of meat. A certain percentage of dark, firm, dry (DFD) meat, characterized by a low intramuscular fat content, a dark color and inconsistent acidification, was noted in young Black-and-White dual-purpose bulls (Nogalski, 2002). Until recently, bovine fat was generally regarded as an unhealthy carcass component due to relatively high levels of saturated fatty acids and cholesterol that increase the risk of ischemic heart disease (Wood et al., 2008). However, only some of the saturated fatty acids contribute to hypercholesterolemia, thrombogenesis (C 14:0 and C 16:0), increased risk of thrombosis and ischemic heart disease (C 18:0), whereas some monounsaturated fatty acids (e.g. oleic acid) have beneficial health effects (Florek et al., 2007). Recent studies have demonstrated that the fat of ruminants may offer certain health benefits (Clapham et al., 2005; Jump et al., 2006). Conjugated linoleic acid (CLA) is an intermediate product of the conversion of linolenic acid to stearic acid, produced through the action of anaerobic rumen bacteria. This natural substance is an antioxidant which inhibits the development of neoplastic diseases and stimulates the immune system (Clapham et al., 2005). A high ratio of *n-3* to *n-6* polyunsaturated fatty acids (PUFAs) (10–15:1 vs. the optimal ratio of 2–4:1) significantly increases the risk of lifestyle diseases (Breslow, 2006). Excess quantities of *n-6* fatty acids may block *n-3* fatty acids, thus contributing to insulin-dependent diabetes and hypercholesterolemia (Jump et al., 2006).

Prime quality beef is produced from beef breeds that account for less than 1% of Poland's entire cattle population. For this reason, beef production in Poland is based mainly on dairy cattle herds. The carcasses of this cattle are characterized by poorer slaughter and quality parameters (lower carcass dressing percentage and degree of conformation) compared to single-purpose beef cattle or crossbred cattle (Litwińczuk et al., 2012; Młynek and Guliński, 2007; Oprządek et al., 2007). Due to the fact that Black-and-White dual-purpose cattle have been crossbred with Holstein-Friesian dairy cattle, hybrid beef bulls should be used on a larger scale to increase beef production and improve beef quality (Bartoň et al., 2005; Voříšková et al., 2002; Wajda et al., 2004). The population of crossbred beef cattle can be expanded by inseminating dairy cows and heifers of lower genetic value with the semen of beef bulls. Research results show that that commercial crossing not only contributes to higher growth rates and better feed conversion ratios in the offspring, but it also improves carcass conformation and meat quality (Bartoň et al., 2005; Nogalski and Kijak, 2001; Nogalski, 2002; Voříšková et al., 2002). In Poland, the slaughter value of different cattle breeds and crossbreds has been investigated extensively, but few studies focus on the hybrids resulting from the crosses of purebred dairy cattle with beef cattle.

The objective of this study was to determine the effect of genotype and carcass conformation class on the slaughter quality of young crossbred beef bulls, aged 21–22 months, raised in a semi-intensive production system, the most common beef production regime in Central Europe.

Material and methods

The experimental material comprised 200 young bulls, including 108 crossbred beef bulls (Holstein-Friesian cows crossed with bulls of the Limousin, Hereford or Simmental breeds) and 92 Holstein-Friesians. Young bulls of known origin, aged 21–22 months, were selected between 4 January 2011 and 30 March 2011 in an abattoir in north-eastern Poland. The animals were raised in a semi-intensive production system, and they were fed grass haylage, maize silage and concentrate. The bulls were transported to the lairage 15–20 hours prior to slaughter, and they were kept in individual boxes equipped with drinkers.

Live body measurements

The body weight of animals was determined immediately before slaughter, and lean content was estimated on a scale of 1 (low lean content) to 10 (very high lean content). The following live body measurements were performed: chest girth, height at sacrum, trunk length (from withers to the point of intersection with the line connecting coxal tubers with the spine) and width at hips.

Carcass measurements

The experimental bulls were sacrificed in accordance with industrial standards. Half-carcasses were weighed within an accuracy of 0.5 kg and evaluated based on EUROP system criteria by a trained grader. The right half-carcass was measured to determine: half-carcass length (from the first thoracic vertebra to pubic symphysis), front half-carcass width (at the level of the 5th rib) and leg circumference (at ¾ leg length, measured from the hock joint). Carcasses were chilled for 48 h (at a temperature of around 2ºC), and the pH of *m. gluteobiceps* was measured using the Testo 205 pH-meter with a penetration tip. Right half-carcasses were divided into primal cuts which were weighed to determine their percentage in the half-carcass. Samples of *m. longissimus dorsi* were collected from the loin (between the 11th and 13th thoracic vertebrae) to determine intramuscular fat content and the fatty acid profile. Intramuscular fat was extracted from samples of ground meat using the Büchi B-811 device according to Polish Standard PN-ISO 1444-2000. The concentrations of 33 fatty acids were determined by gas chromatography, in the Varian CP 3800 chromatograph equipped with a split/splitless injector and a flame-ionization detector (FID). 1 µl ester samples were placed on a capillary column with a length of 100 m and an internal diameter of 0.25 mm, with the CP-sil88 stationary phase. Helium was used as the carrier gas, injector temperature was 260ºC, and the total time of a single analysis was 68 min. The percentage of fatty acids was calculated using Galaxie software.

Statistical analysis

The results were analysed with the use of Statistica 9.0 software (Statsoft, 2009). The effect of bull genotype on conformation class and fat class was evaluated by the $\chi 2$ test:

$$\chi 2 = \sum [\frac{(fi - Fi)^2}{Fi}],$$

where:

fi – observed distribution,

Fi – expected distribution.

In the analysed population, R and O were the predominant classes, and a significantly (P≤0.01) higher number of carcasses of crossbred beef bulls (61.11%) than Holstein-Friesian carcasses were classified as conformation class R (Table 1). As regards conformation class O, the bull genotype had the reverse effect. None of the analysed carcasses were assigned to conformation class E. The bull genotype had no significant effect on carcass fat classes (Table 2), and the majority of carcasses were graded as fat class 2. Very few carcasses were categorized into conformation classes U and P, therefore only the carcasses graded as conformation class R are analysed in further parts of the study.

Table 1. Beef carcass conformation classes according to the EUROP system

Conformation class	Crossbred beef bulls		Holstein-Friesians		Statistical significance
	head	%	head	%	
U	10	9.26			
R	66	61.11	31	33.69	xx
O	30	27.78	52	56.53	xx
P	2	1.85	9	9.78	NS
Total	108	100	92	100	

xx – P≤0.01; NS – no significance.

Table 2. Beef carcass fat classes according to the EUROP system

Fat class	Crossbred beef bulls		Holstein-Friesians		Statistical significance
	head	%	head	%	
1	34	31.49	29	31.52	NS
2	73	67.58	63	68.48	NS
3	1	0.93			
Total	108	100	92	100	

NS – no significance.

The effect of bull genotype (crossbred beef bulls and Holstein-Friesians) and conformation classes on live body measurements, carcass characteristics and the fatty acid profile was evaluated by least squares analysis of variance using the following model:

$$Y_{ijklm} = \mu + A_i + B_j + (AB)_{ij} + e_{ij}$$

where:

Y_{ij} – value of analysed parameters,
μ – population mean,
A_i – effect of the i^th bull genotype (1, 2),
B_j – effect of the j^th carcass conformation class (1, 2),
$(AB)_{ij}$ – genotype × conformation class interaction,
e_{ij} – random error.

Results

Young crossbred beef bulls whose carcasses were categorized into conformation class R were characterized by insignificantly higher values of height at sacrum and lower values of trunk length in comparison with dairy Holstein-Friesians (Table 3). Width at hips was significantly (P≤0.05) smaller and chest girth was larger in crossbred beef bulls, which testifies to a higher lean meat content of their carcasses, as demonstrated by the results of live body measurements. Holstein-Friesian bulls with carcasses in conformation class O were taller, and their chest girth was larger in comparison with crossbred beef bulls. The differences in the remaining body measurements were similar to those noted in conformation class R.

Table 3. Selected live body measurements of bulls representing different genotypes and carcass conformation classes

Traits	Statistical measures	Conformation class R		Conformation class O		Interaction
		crossbred beef bulls	Holstein--Friesians	crossbred beef bulls	Holstein--Friesians	
Number	N	66	31	30	52	
Height at sacrum (cm)	x	137.6	136.5	136.0	137.5	
	sd	4.97	6.92	7.41	6.52	
Chest girth (cm)	x	202.5	201.2	197.6	198.3	
	sd	10.44	15.28	11.74	8.96	
Width at hips (cm)	x	48.7 x	49.8 x	46.9	48.0	
	sd	2.63	2.73	4.79	2.37	
Trunk length (cm)	x	98.1	99.4	96.5	97.8	
	sd	6.12	5.53	7.88	5.82	
Live estimation muscle content (points)	x	7.4	6.9	5.4	5.0	
	sd	1.08	0.98	1.96	1.43	

Within carcass conformation classes x – P≤0.05.

Regardless of breed, class R bulls were heavier than class O bulls (Table 4). Holstein-Friesian bulls were characterized by high body weight gains, and their body weight exceeded 600 kg already at the age of 21–22 months. The average difference in carcass dressing percentage in conformation class R was significant (P≤0.05), reaching +1.40% to the advantage of crossbred beef bulls. The difference between crossbred beef bulls whose carcasses were assigned to conformation classes R and O was 3.44%. There was a significant (P≤0.05) interaction between genotype and conformation class with respect to carcass dressing percentage. The expected differences in carcass dressing percentage between crossbred beef bulls and Holstein-Friesians were noted only in animals whose carcasses were graded as conformation class R. Genotype and conformation class were weakly correlated with fat scores in the carcass classification process under the EUROP scheme. Chilled carcasses were characterized by optimal levels of muscle acidification (pH 5.52–5.56). No significant differences were noted in half-carcass measurements within the analysed conformation classes. In comparison with Holstein-Friesians, the carcasses of crossbred beef bulls in class R were characterized by significantly larger leg circumference, which points to superior muscular conformation of the latter. The cross-sectional area of *m. longissimus dorsi* was significantly (P≤0.01) larger in crossbred beef bulls. The mean difference was 11.3 cm^2 in conformation class R, and 10.7 cm^2 in class O.

Table 4. Carcass characteristics of bulls representing different genotypes and carcass conformation classes

Traits	Statistical measures	Conformation class R		Conformation class O		Interaction
		crossbred beef bulls	Holstein--Friesians	crossbred beef bulls	Holstein--Friesians	
Body weight before slaughter (kg)	x	637.3	632.7	575.5	605.3	-
	sd	81.09	110.48	98.24	66.61	
Dressing percentage	x	57.85x	56.44x	54.41	54.28	x
	sd	2.37	2.24	2.04	2.21	
Fat class according to the EUROP system	x	1.70	1.82	1.68	1.67	-
	sd	0.39	0.36	0.37	0.32	
pH of cold carcass	x	5.52	5.56	5.54	5.55	-
	sd	0.18	0.07	0.07	0.17	
Leg circumference (cm)	x	117.9 x	114.4 x	116.0	116.2	-
	sd	4.88	6.08	5.33	3.50	
Half-carcass length (cm)	x	143.9	141.7	146.9	148.8	-
	sd	6.30	4.27	10.37	5.32	
Half-carcass width (cm)	x	74.7	73.2	75.3	75.6	-
	sd	3.59	3.36	5.22	4.80	
Rib eye area (cm^2)	x	92. 5xx	81.2 xx	84.8 xx	74.1 xx	-
	sd	13.97	15.60	14.82	14.56	

Within carcass conformation classes x – P≤0.05; xx – P<0.01.

Half-carcass weight was significantly (P≤0.05) affected by the interaction between genotype and conformation class (Table 5). The above can be attributed to differences in weight at slaughter and carcass dressing percentage. The slaughter quality of cattle is determined by the proportion of cuts with the highest market value in the total carcass weight. A higher proportion of premium retail cuts in carcass hindquarters was reported in crossbreed beef bulls in comparison with Holstein-Friesians, and in class R carcasses in comparison with class O carcasses. Regardless of conformation class, the carcasses of crossbred beef bulls were characterized by a higher proportion of sirloin than Holstein-Friesians. The percentage of loin, another high-quality retail cut, was also higher in crossbred beef cattle. Within conformation class R, a significantly (P≤0.05) higher proportion of topside was observed in crossbred beef bulls, whereas in conformation class O, the carcasses of crossbred beef bulls had a significantly higher percentage of bavette in comparison with the carcasses of Holstein-Friesians.

Table 5. Percentage of retail cuts in the carcasses of bulls representing different genotypes and carcass conformation classes

Traits	Statistical measures	Conformation class R		Conformation class O		Interaction
		crossbred beef bulls	Holstein--Friesians	crossbred beef bulls	Holstein--Friesians	
Half-carcass weight (kg)	x	174.3	168.4	148.5	153.9	x
	sd	25.76	25.56	32.66	17.47	
Percentage in half-carcass:						
sirloin	x	2.23	2.14	2.17	2.02	-
	sd	0.35	0.35	0.25	0.46	
tenderloin	x	1.22	1.15	1.14	1.08	-
	sd	0.20	0.09	0.18	0.20	
topside	x	5.80 x	5.02 x	5.48	5.25	-
	sd	0.69	1.19	0.69	0.56	
silverside	x	4.01	4.05	3.35	4.13	-
	sd	1.06	0.54	1.01	0.65	
thick flank	x	3.82	3.90	3.89	3.70	-
	sd	0.55	1.23	0.73	0.35	
bavette	x	1.67	1.62	1.63 x	1.42 x	-
	sd	0.29	0.22	0.33	0.27	
rump	x	3.60	3.50	3.55	3.18	-
	sd	1.06	0.67	0.91	0.42	

Within carcass conformation classes x – P≤0.05.

The *m. longissimus dorsi* of class O carcasses contained more intramuscular fat, compared with class R carcasses (Table 6). With regard to genotype, significantly higher levels (P≤0.05) of intramuscular fat were noted in the *m. longissimus dorsi* of crossbred beef bulls, compared with Holstein-Friesians, in both conformation classes. Carcass classification to fat classes in line with the EUROP system showed no differences between the analysed genotypes, thus suggesting a similar intramuscular fat content.

Intramuscular fat extracted from the *m. longissimus dorsi* of crossbred beef bulls contained from 49.22% to 51.07% saturated fatty acids (SFAs), subject to conformation class and genotype (Table 6). The level of biologically active acids is also an important consideration. Within conformation class R, significantly (P≤0.05) higher levels of CLA (main isomer of conjugated linoleic acid cis-9, trans-11) were found in the meat of crossbred beef bulls than in Holstein-Friesians. In conformation class R, intramuscular fat had a significantly (P≤0.05) higher proportion of total PUFAs in crossbred beef bulls (4.22%) than in Holstein-Friesians (3.51%). In conformation class O, the proportion of PUFAs was insignificantly higher (0.13%) in Holstein-Friesian bulls. In our study, genotype and carcass conformation class did not affect the *n-6/n-3* PUFA ratio which was determined in the range of 4.14 (crossbred beef bulls, conformation class O) to 4.52 (crossbred beef bulls, conformation class R).

Table 6. Fatty acid profile of the *longissimus dorsi* muscle (% of the total fatty acid pool)

Fatty acids	Statistical measures	Conformation class R		Conformation class O		Interaction
		crossbred beef bulls	Holstein--Friesians	crossbred beef bulls	Holstein--Friesians	
Intramuscular fat content (%)	x	1.43 x	0.97 x	1.67 x	1.28 x	-
	sd	0.80	0.58	0.88	0.67	
C 14:0	x	2.66	2.88	2.83	2.65	x
	sd	0.59	0.76	0.82	0.51	
C 16:0	x	26.38	27.75	28.21	25.64	-
	sd	5.25	1.80	2.63	6.84	
C 18:0	x	18.11	17.12	17.13	18.28	-
	sd	4.90	4.24	3.89	4.66	
C 18:1	x	1.28	1.07	1.08	1.03	-
	sd	0.84	0.49	0.43	0.33	
C 18:1	x	37.80	38.00	37.03	38.60	-
	sd	4.38	3.62	6.10	4.39	
C 18:2	x	2.44	2.13	2.27	2.36	-
	sd	0.55	0.47	0.48	0.67	
C 18:3	x	0.61	0.53	0.59	0.57	-
	sd	0.29	0.14	0.16	0.15	
CLA *(Cis 9, Trans 11)*	x	0.27 x	0.21 x	0.24	0.22	-
	sd	0.10	0.05	0.06	0.06	
C 20:4	x	0.33	0.21	0.30	0.36	-
	sd	0.23	0.10	0.17	0.31	
C 20:5 EPA	x	0.08	0.04	0.06	0.07	-
	sd	0.09	0.03	0.05	0.05	
C 22:5 DPA	x	0.18	0.10	0.18	0.18	-
	sd	0.14	0.05	0.10	0.10	
SFA	x	49.74	50.15	51.07	49.22	-
	sd	4.94	4.36	6.83	5.50	
UFA	x	50.30	49.91	48.93	50.76	-
	sd	4.95	4.26	6.83	5.48	
MUFA	x	46.09	46.40	45.01	46.71	-
	sd	4.80	4.53	6.42	5.24	
PUFA	x	4.22 x	3.50 x	3.92	4.05	-
	sd	1.23	0.58	0.83	1.16	
n-6	x	2.77	2.35	2.57	2.72	-
	sd	0.75	0.49	0.63	0.93	
n-3	x	0.70	0.57	0.65	0.64	-
	sd	0.34	0.14	0.19	0.18	
n6/n3	x	4.52	4.34	4.14	4.37	-
	sd	1.59	1.33	1.29	1.31	

Within carcass conformation classes x – $P \leq 0.05$.

Discussion

It was shown that the genotype did not affect the body size of slaughter cattle. The exception was width at hips, which was higher in class R dairy bulls. Leg circumference and rib eye area were higher in hybrids, which testifies to their higher slaughter value. In the EUROP system, the price a farmer receives is calculated by multiplying the carcass weight by the classification price for a particular category of animal. Carcass dressing percentage is, therefore, an important consideration for beef producers (Wajda et al., 2003). In this experiment, the carcass dressing percentage of Holstein-Friesian bulls was 2–3% higher than that noted in a previous study of Black-and-White bulls (Nogalski and Kijak, 2001). The observed difference could have resulted from higher slaughter weight of Holstein-Friesians (which is positively correlated with dressing percentage), in comparison with Black-and-White bulls (Wajda et al., 2003). According to Pfuhl et al. (2007), greater fat deposition in Holstein-Friesians can be attributed to the breed's ability to accumulate energy reserves for the first stage of lactation. Chilled carcasses were characterized by optimal levels of muscle acidification. This study did not validate the results of previous experiments where many Black-and-White carcasses showed low levels of acidification (Nogalski, 2002). Sirloin is the most valuable cut of the beef carcass (Wajda et al., 2003). Intramuscular fat enhances the flavor and aroma of meat. Its optimal content varies subject to carcass muscle, and it contributes to tenderness and juiciness of beef (Kołczak, 2008). Carcass classification to fat classes in line with the EUROP system showed no differences between the analysed genotypes, thus suggesting a similar intramuscular fat content. However, chemical analyses revealed higher intramuscular fat concentrations in the meat of crossbred beef bulls, indicating that carcass fatness grading in the EUROP system is not consistent with intramuscular fat content. Similar observations were made by Węglarz (2010).

A high proportion of SFAs and a low proportion of PUFAs in meat fat results from the hydrogenation of dietary fat by the ruminal microflora (De Smet et al., 2000). For optimal results, beef producers should decrease the concentrations of SFAs in fat and/or increase the content of PUFAs, in particular *n-3* fatty acids (Kołczak, 2008). In studies analysing the composition of intramuscular fat in *m. longissimus dorsi* in various cattle breeds, Lengyel et al., (2003) and Florek et al., (2007) reported 47.9% and 44.72% SFAs, respectively, in young Holstein-Friesian bulls, whereas Węglarz (2010) noted 37.43% SFAs in Black-and-White bulls. Our results do not corroborate the findings of De Smet et al. (2000), who demonstrated that an increase in bovine carcass fatness is accompanied by an increase in the concentrations of SFAs and MUFAs and a decrease in PUFA content. A low proportion of PUFAs in the fatty acid profile could be related to the age of bulls at slaughter (21–22 months). Lengyel et al. (2003) noted that the PUFA content of intramuscular fat in *m. longissimus dorsi* decreases with age, reaching 25.5% at 7 months, 18.4% at 14 months and 13.6% at 19 months. The *n-6/n-3* fatty acid ratio recommended by the FAO and WHO is around 5.0 (Kołczak, 2008). In our study, the *n-6/n-3* PUFA ratio offered even greater health benefits.

It is concluded that:

1. Based on the EUROP carcass classification system, the majority of carcasses of crossbred beef bulls were classified into conformation class R, and the carcasses of Holstein-Friesians were classified into class O. Most carcasses were assigned to fat class 2, and fat scores were not consistent with intramuscular fat content.

2. Within the same conformation classes, crossbred beef bulls were characterized by higher slaughter quality than Holstein-Friesian bulls. Meat from crossbred beef bulls had a higher content of fat with a more desirable fatty acid profile (a higher proportion of functional fatty acids).

3. The growth rate of beef cattle population in Poland is slow, and it is unlikely to increase rapidly in the near future, which is why efforts should be made to optimize the production of high-quality beef from dairy cattle herds. This will provide additional income to farmers and increase the consumption of beef.

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Porównanie wartości rzeźnej buhajków mieszańców mięsnych i holsztyno-fryzów w zależności od klasy uformowania w systemie EUROP

STRESZCZENIE

Badano wpływ genotypu i klasy uformowania tuszy na wartość rzeźną 200 buhajków. W magazynie żywca wybrano sztuki w wieku 21–22 miesięcy, z czego 108 były to mieszańce mięsne a 92 holsztyno-fryzy (ho). Przed ubojem oceniano ich umięśnienie i wykonano pomiary zoometryczne ciała. Po uboju sklasyfikowane tusze według systemu EUROP poddano szczegółowej ocenie wartości rzeźnej. Z próbki mięśnia najdłuższego grzbietu wyekstrahowano tłuszcz śródmięśniowy, w którym metodą chromatografii gazowej określono udział kwasów tłuszczowych. W klasyfikacji EUROP tusze buhajków mieszańców mięsnych w 61,11% uzyskały klasę uformowania R, a tusze holsztyno-fryzów w 56,53% oceniano jako O. W ocenie otłuszczenia dominowała klasa 2. i ocena otłuszczenia nie była zbieżna z zawartością tłuszczu śródmięśniowego. W obrębie jednakowych klas uformowania, mieszańce mięsne charakteryzowały się wyższą wartością rzeźną, w porównaniu z holsztyno-fryzami. Ponadto mięso ich zawierało średnio o 0,42% więcej tłuszczu o korzystniejszym składzie procentowym. Wobec braku realnych perspektyw na szybkie zwiększenie się wielkość populacji bydła ras mięsnych, należy prowadzić badania w kierunku opracowania metod optymalnej produkcji wołowiny o podwyższonej jakości w oparciu o stada mleczne.