THE QUALITY OF MEAT FROM THE CARCASSES OF BULLS FROM CROSSING POLISH BLACK-AND-WHITE COWS WITH LIMOUSINE BULLS CLASSIFIED INTO THE DIFFERENT CLASSES IN THE EUROP SYSTEM

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Summary. The study involved 28 bulls obtained from crossing Polish Black-and-White cows with Limousine bulls. The animals were kept in the same barn and were fed identically during experiment. Experimental fattening was started when body weights of the bulls were ca. 150 kg. It lasted for 14 months until slaughter of bulls. The carcasses of the experimental bulls were classified based on the EUROP system into the U (7 bulls), R (14 bulls) and O (7 bulls) conformation classes and into 1 (7 bulls), 2 (14 bulls) and 3 (7 bulls) fatness classes. It was found that bulls with greater body weight and greater index of dressing percentage fell into higher conformation and fatness classes. The meat (*m. longissimus dorsi)* from carcasses belonging to U class had a significantly greater percentage content of dry matter and fat than the meat from R and O classes. The sensory evaluation of cooked meat showed a slightly lower quality of meat from carcasses classified as R. On the other hand, the sensory evaluation of fried meat indicated a reduced juiciness of meat from carcasses belonging to U class. The meat from bull carcasses classed to 3 fatness class in the EUROP system had significantly lower pH value than the meat from carcasses belonging to 2 class as well as reduced water-holding ability than meat from carcasses classed to 1 and 2 classes. The sensory evaluation of cooked meat showed that the meat from carcasses classed to 3 fatness class had the best quality and the meat from carcasses belonging to 1 class had the lowest quality.
Key words: bulls, the EUROP classification, meat quality.

BULIŲ REPRODUKTORIŲ, GAUTŲ SUKRYŽMINUS JUODMARGES KARVES SU LIMUZINŲ BULIAIS, SKERDIENOS MĖSOS, SUKLASIFIKUOTOS Į SKIRTINGAS EUROP SISTEMOS KLASES, KOKYBĖ

Santrauka. Bandymams buvo atrinkti 28 mišrūnai buliai, gauti, sukryžminus juodmarges karves su limuzinų buliais. Galvijai per penėjimo laikotarpį (14 mėnesių) buvo laikomi tame pačiame tvarte ir šeriami vienodai, kol pasiekė 150 kg kūno masę, t. y. iki skerdimo. Atlikus kontrolinį skerdimą, tiriamų bulių skerdienos buvo suklasifikuotos pagal EUROP sistemą į U (7 buliai), R (14 bulių) ir O (7 buliai), pagal raumeningumo klases į I (7 buliai), II (14 bulių) ir III (7 buliai) riebumo klases. Nustatyta, kad didesnio kūno svorio ir didesnio išpjaustymo procento indekso buliai pateko į aukštesnio raumeningumo ir riebumo klases. Mėsa (*m. longissimus dorsi)* iš skerdienos, priklausančios U klasei, turėjo žymiai didesnį procentinį sausųjų medžiagų ir riebalų kiekį negu R ir O kategorijų mėsa. Skoninės virtos mėsos įvertinimas parodė šiek tiek žemesnę mėsos iš skerdienos, klasifikuojamos kaip R, kokybę. Iš kitos pusės, juntamasis keptos mėsos įvertinimas parodė mažesnį mėsos iš skerdienos, priklausančios U klasei, sultingumą. Mėsa iš bulių skerdienos, priskirta III riebumo klasei pagal EUROP sistemą, turėjo žymiai žemesnę pH vertę, negu mėsa iš skerdienų, priklausančių II klasei, taip pat mažesnį vandens rišlumą palyginti su mėsa iš skerdienų, priskirtų I ir II klasėms. Skoninis virtos mėsos įvertinimas parodė, kad mėsos iš skerdienų, priskirtų III riebalų išsidėstymo klasei, kokybė buvo geriausia, o mėsa iš skerdienų, priklausančių I klasei, buvo blogiausios kokybės.
Raktažodžiai: buliai, EUROP klasifikacija, mėsos kokybė.

Introduction. In countries with a long tradition of culinary beef production, producers are of the opinion that good quality beef can only be obtained from meat cattle and from meat bulls and milk cow crossbreeds (Homer et al., 1997; Jasiorowski et al., 1996). Moreover, it is believed that good quality beef is determined by both the cattle breed and their appropriate slaughter value. Therefore, carcasses with well-formed muscles and moderate fatness are recommended for the production of culinary beef. In practice, these are carcasses that were classified based on the EUROP system into E, U and R conformation classes and into 2 or 3 fatness class (Kropiwnicki, 2000; Wajda and Daszkiewicz, 2000).

The majority of analyses to verify the above recommendations were carried out on animals originating from mass purchase organized by a meat plant. The cattle originated from different producers who used different conditions of rearing and feeding and, in consequence, could have had an effect on the obtained results. In order to eliminate the effect of those factors, the present experiment involved crossbred bulls originating from one producer and fed in identical way throughout the fattening period.

The aim of this paper was to compare the quality of meat from the carcasses of bulls from crossing Polish Black-and-White cows with Limousine bulls classed in the EUROP system to U, R and O conformation classes and to 1, 2 and 3 fatness classes.

Material and Methods. The study involved 28 crossbread bulls obtained from cross-breeding Polish Black-and-White cows with Limousine bulls. The animals were kept in the same barn and were fed identically

during experiment. Experimental fattening was started when body weights of the bulls were ca. 150 kg. It lasted for 14 months until slaughter of bulls. During the fattening period the animals received rye extract with increased dry matter content (23%), straw, 2 kg concentrate and vitamin and mineral mix.

The bulls delivered to the meat plant were kept in lairage for about 20 hours and then slaughtered. After post-slaughter treatment, the carcasses were weighed, classified and labelled according to the EUROP system. The conformation and fatness classes of carcass in the EUROP system were experimental factors in the present study. The experimental carcasses were classified into U, R and O conformation classes and 1, 2 and 3 fatness classes. The number of carcasses falling into particular classes was given in Table 1.

Table 1. **Pre-slaughter weight, carcass weight and dressing percentage of bulls**

Specification	Stat. measur.	Conformation class of carcass in the EUROP system			Fatness class of carcass in the EUROP system		
		U	R	O	1	2	3
Number of carcasses (heads)		7	14	7	7	14	7
Pre-slaughter weight (kg)	$\bar{x}$	589,00^{A}	565,14^{B}	465,71^{AB}	537,00^{Aa}	580,00^{A}	565,00^{a}
	s	30,13	28,62	34,82	18,37	25,38	17,92
Hot carcass weight (kg)	$\bar{x}$	342,50^{A}	320,89^{B}	250,93^{AB}	305,00^{ab}	331,61^{a}	328,33^{b}
	s	20,20	21,21	24,96	9,53	21,58	10,32
Dressing percentage (%)	$\bar{x}$	58,16^{a}	56,80	53,81^{a}	56,81	57,19	58,12
	s	2,34	2,95	2,15	1,32	3,16	1,31

Values followed by the same letters differ significantly, AB-P ≤ 0,01; ab- P ≤ 0,05

After cooling (48h, temp. 2-4°C), the carcasses were elemented. From roastbeef (between the 11 and 13 pectoral vertebrate), sections of the *m. longissimus dorsi* were taken for evaluation of meat quality. The quality of the meat was analyzed 72 h after animal slaughter. The analyses included the determination of:

– dry matter content, fat content – by the Soxhlet method; crude, soluble protein and non-protein nitrogen content (after protein precipitation with trichloroacetic acid) – by the Kjeldahl method and ash content (Budsławski and Drabent, 1972);

– meat reaction – determined on the basic of pH of meat water homogenates (the ratio between meat and distilled water was 1:1) using a pH-meter (Radiometer) and an electrode GK 2311C (Znaniecki, 1983);

– color brightness – determined on the basic of the percentage of light reflection against the surface of minced meat using a spectrocolorimeter "Specol" and remission attachment R45/0, at a wavelength of 560 nm (Znaniecki, 1983);

– water-holding capacity by the Grau and Hamm method (Znaniecki, 1983);

– meat marbling - with the use of a 5-point scale (this parameter was estimated applying the standards established at the Institute of the Meat and Fat Industry in Poznań: 1 point – invisible marbling, 2 points – hardly visible, 3 points – visible, 4 points – well visible, 5 points – very well visible marbling);

– meat colour - with the use of the Soicarni standards.

The sensory properties, i.e. the aroma, palatability, juiciness and tenderness, of cooked beef (Znaniecki, 1983) were evaluated on a 5-point scale (1 point –the worst, 5 points – the best) (PN-ISO 4121: 1998). Evaluation of meat tenderness and juiciness was also carried out for fried meat (Wajda and Daszkiewicz, 2001a).

Statistical calculations were completed with the use of computer software - *Statistica, version* 6.0 based on two-factor variance analysis. The statistical significance of differences between the averages from groups was calculated based on a Duncan test.

Results and Discussion. In order to properly determine the pricelist for cattle purchase in the EUROP system, it is essential to know the differences in slaughter value and meat quality between conformation and fatness classes of carcass. Due to a lack of statistically significant correlations between the analyzed factors, the results of meat quality analysis will be discussed separately for conformation and fatness classes of carcasses.

An analysis of the pre-slaughter weight and the bull carcass weight (Table 1) found the highest average values of these characteristics for carcasses classified into conformation class U and the lowest was found for carcasses representing class O. Statistically highly significant differences were observed between classes O and U and R. In addition, the average index of dressing percentage of bulls, whose carcasses were classified into higher conformation classes, increased (Table 1). Statistically significant differences were found between class O and classes U and R. Higher values of the index of dressing percentage at higher conformation classes of beef carcasses were also confirmed by other authors (Młynek and Litwińczuk, 2000).

Meat quality is a determining factor of meat suitability for culinary purposes. Table 2 presents the results of the analysis of chemical composition and marbling evaluation as well as physico-chemical properties of meat. The meat from carcasses classified into class U had the highest average content of dry matter, while meat from carcasses classified as class O had the lowest dry matter content. The difference between the averages of class U and R was statistically significant and the difference between class U and O was highly significant.

Table 2. **Basic chemical composition, marbling and physico-chemical properties of meat**

Specification	Stat. measur.	Conformation class of carcass in the EUROP system			Fatness class of carcass in the EUROP system		
		U	R	O	1	2	3
Dry matter (%)	$\bar{x}$	$24,97^{Aa}$	$24,01^{a}$	$23,67^{A}$	24,00	24,29	25,01
	s	1,11	0,67	0,71	0,92	0,86	1,02
Fat (%)	$\bar{x}$	$2,08^{AB}$	$0,99^{A}$	$0,80^{B}$	0,95	1,31	1,60
	s	0,90	0,43	0,29	0,53	0,75	0,98
Marbling (points)	$\bar{x}$	1,87	1,78	1,64	1,62	1,85	2,08
	s	0,85	0,64	0,74	0,47	0,71	0,97
Crude protein (%)	$\bar{x}$	21,56	21,33	21,69	21,51	21,35	21,79
	s	0,86	0,82	0,63	0,79	0,84	0,74
Soluble protein (%)	$\bar{x}$	5,63	5,52	5,53	5,49	5,56	5,74
	s	0,22	0,37	0,29	0,26	0,36	0,28
Non-protein nitrogen (%)	$\bar{x}$	0,42	0,42	0,42	0,42	0,42	0,42
	s	0,01	0,02	0,02	0,02	0,02	0,01
Ash (%)	$\bar{x}$	1,04	1,08	1,11	1,04	1,08	1,07
	s	0,03	0,11	0,10	0,61	0,11	0,04
pH	$\bar{x}$	5,32	5,36	5,54	5,30	$5,37^{a}$	$5,21^{a}$
	s	0,09	0,13	0,32	0,14	0,12	0,04
Water-holding capacity (cm^2)	$\bar{x}$	8,35	8,25	7,79	$8,06^{A}$	$8,33^{a}$	$9,48^{Aa}$
	s	0,74	0,70	1,28	0,61	0,72	1,09
Colour brightness (%)	$\bar{x}$	11,75	11,28	10,71	12,25	11,14	11,66
	s	0,95	1,54	1,70	0,50	1,51	1,75
Colour (points)	$\bar{x}$	4,75	5,28	5,50	4,37	5,39	4,66
	s	0,86	0,97	1,08	1,10	0,81	0,81

Values followed by the same letters differ significantly, AB-$P \leq 0,01$; aa- $P \leq 0,05$

The content of intramuscular fat is one of the most important elements considered in the evaluation of beef quality. It is due to its positive role in the formation of meat sensory properties (Bejerholm et al., 1986; Park et al., 2001). The research showed that the meat from carcasses from class U had considerably greater ($P \leq 0,01$) content of fat than meat representing classes R and O. The average fat content in class U was 2,08%, while in class R it was 0,99% and class O it equaled 0,80%. Differences in fat content in meat from carcasses of class U, R and O correlated with the evaluation of meat marbling. The average values of evaluation of this feature were slightly different and were statistically insignificant. The contents of crude protein, soluble protein, non-protein nitrogen and ash were similar in meat from carcasses classified into different conformation classes.

Besides the chemical composition, meat culinary and technological value is determined by its physico-chemical properties. The main physico-chemical indicators of meat include: pH, colour and water-holding capacity. The study results did not indicate significant differences between meat from carcasses classified into different conformation classes in respect of the above properties and their average values indicated good meat quality.

The sensory evaluation of cooked meat (Table 3), except the evaluation of meat tenderness, did not show significant differences in the quality of meat from carcasses classified as class U, R and O. Generally, it was found that the meat from carcasses from class R had slightly lower sensory quality. On the other hand, the evaluation of fried meat (Table 3) indicated the reduced juiciness of meat from carcasses belonging to U class.

The final commercial value of beef carcass in the EUROP system is also determined by its fatness class. The experimental bull carcasses were classified into 1, 2 and 3 fatness classes. Based on the data from Table 1, carcasses classified to class 1 had the lowest average pre-slaughter weight, carcass weight and the lowest index of dressing percentage.

The analysis of chemical composition and marbling (Table 2) did not reveal significant differences between the averages of the analyzed fatness classes. However, the tendency of fat content to increase and, in consequence, an increase in the dry matter as well as the increase in meat marbling was observed in the meat from carcasses classified into higher fatness classes.

The evaluation of physico-chemical properties of meat (Table 2) showed the high level of its acidity of the meat from carcasses representing all three fatness classes. The lowest average pH value (5,21) was found in meat from carcasses classified into 3 fatness class and the highest value (5,37) was found in meat representing class 2. The difference between these average values was statistically significant. It was found that an increase in fatness class of carcass was accompanied by a decrease in water holding capacity of meat. The worst properties in this respect were observed in meat from carcasses classified into 3 fatness class and was confirmed statistically. The colour of meat originating from carcasses representing classes 1, 2 and 3 did not differ significantly.

Table 3. **Organoleptic properties of meat (points)**

Specification	Stat. measur.	Conformation class of carcass in the EUROP system			Fatness class of carcass in the EUROP system		
		U	R	O	1	2	3
Aroma – intensity	$\bar{x}$	5,00	5,00	5,00	5,00	5,00	5,00
	s	0,00	0,00	0,00	0,00	0,00	0,00
Aroma - desirability	$\bar{x}$	5,00	5,00	5,00	5,00	5,00	5,00
	s	0,00	0,00	0,00	0,00	0,00	0,00
Taste - intensity	$\bar{x}$	4,75	4,46	4,71	4,25	4,60	4,91
	s	0,50	0,74	0,75	0,95	0,62	0,20
Taste - desirability	$\bar{x}$	4,75	4,46	4,71	4,25	4,60	4,91
	s	0,50	0,74	0,75	0,95	0,62	0,20
Tenderness	$\bar{x}$	3,75	$3,57^{a}$	$4,28^{a}$	$3,12^{AB}$	$3,75^{A}$	$3,81^{B}$
	s	0,28	0,51	0,75	0,25	0,42	0,25
Juiciness	$\bar{x}$	3,75	3,39	3,92	$3,12^{a}$	3,57	$3,83^{a}$
	s	0,28	0,48	0,83	0,25	0,47	0,40
Tenderness *	$\bar{x}$	3,62	3,67	3,64	3,62	3,67	3,41
	s	0,25	0,74	0,89	0,47	0,72	0,58
Juiciness *	$\bar{x}$	4,37	4,96	5,00	5,00	4,78	5,00
	s	0,75	0,13	0,00	0,00	0,46	0,00

Values followed by the same letters differ significantly, AB-P ≤ 0,01; aa - P ≤ 0,05

* - evaluation of fried meat

The sensory evaluation of cooked meat (Table 3) indicated that the meat originating from carcasses classified into 3 fatness class had the best quality and the meat from class 1 had the worst quality. The differences between the average evaluations of juiciness and tenderness were confirmed statistically. On the other hand, the average sensory evaluations of fired meat in respect of juiciness and tenderness were very similar (Table 3).

The results from the present study into the evaluation of the quality of meat from carcasses originating from Polish Black-and-White and Limousine crossbreeds and classified, based on the EUROP system, into U, R and O conformation classes and 1, 2 and 3 fatness classes agree with the results of previous studies (Florek and Litwińczuk, 2001; Wajda and Daszkiewicz, 2000; Wajda and Daszkiewicz, 2001b). It was found that the differences in the quality of the meat from carcasses classified into the analyzed conformation and fatness classes, to the greatest degree concerned the chemical composition (dry matter, fat) and the meat marbling, while the meat physico-chemical and sensory properties were of least importance.

Conclusions

1. It was found that bulls with greater body weight and greater index of dressing percentage were classified into higher conformation and fatness classes in the EUROP system.

2. An analysis of the quality of meat from carcasses classified into different conformation classes based on the EUROP system, showed that the meat from carcasses representing class U had significant greater content of dry matter and fat than the meat from carcasses from class R and O. A sensory evaluation of cooked meat showed a slightly lower quality of meat from carcasses from class R. On the other hand, a sensory evaluation of fried meat indicated a reduced juiciness in meat from carcasses from class U.

3. The carcasses classified based on the EUROP system to 3 fatness class had a significantly lower pH value than the meat from carcasses from class 2 and lower water-holding capacity than the meat from carcasses from classes 1 and 2. A sensory evaluation of cooked meat showed that the meat from carcasses classified into 3 fatness class had the best quality and the meat from carcasses from class 1 had the lowest quality.

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