FATTENING RESULTS AND CARCSS QUALITY OF YOUNG BULLS PRODUCED BY MATING POLISH BLACK-AND-WHITE COWS TO CHAROLAISE AND SIMENTAL SIRES

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Abstract. The experiment was performed on 49 young crossbred bulls (Polish Black-and-White cows x Charolaise or Simental bulls). It constituted a part of a bull progeny testing program aimed at determining the suitability of beef bulls for crossing with Polish Black-and-White cows. In the study the progeny (8 to 11 young bulls) of three Simental and two Charolaise sires were examined. The young bulls were fattened from approx. 120 kg to approx. 500 kg body weight. During experiment the animals were kept in the same barn and were fed identically. It was found that the young bulls by Charolaise sires, compared with those by Simental sires, showed a tendency towards higher birth weights and higher gains. They also utilized fewer oat units per kg of body weight gain and were characterized by a higher carcass dressing percentage, higher proportions of primary elements in the carcass and better quality of meat. The evaluation of three Simental and two Charolaise bulls, performed on the basis of the slaughter value and meat quality of their progeny, confirmed their suitability for mating to Polish Black-and-White cows. This indicates that suitability for commercial crossing with dairy cows should be one of selection criteria in the case of beef bulls, as appropriate selection may substantially improve the fattening results and slaughter value of beef cattle.
Keywords: bulls, Charolaise, Simental, progeny testing.

BULIUKŲ, GAUTŲ SUKRYŽMINUS LENKIJOS JUODMARGES KARVES SU ŠAROLĖ AR SIMENTALIO VEISLIŲ REPRODUKTORIAIS, PENĖJIMO REZULTATAI IR SKERDENŲ KOKYBĖ

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Santrauka. Tyrimas atliktas su 49 buliukais, gautais sukryžminus Lenkijos juodmarges karves su Šarolė, Simentalio veislės reproduktoriais. Bandymo tikslas buvo nustatyti bulių palikuonių, gautų sukryžminus mėsinius bulius su Lenkijos juodmargių veislės karvėmis, tinkamumą. Bandymui atrinkti trijų Simentalio bei dviejų Šarolė veislių reproduktorių palikuonys (8–11 buliukų), kurie buvo penimi nuo 120 iki 500 kg kūno masės. Eksperimento metu visų grupių gyvuliai buvo identiškai laikomi ir šeriami. Stebima tendencija, kad Šarolė veislės reproduktorių palikuonys, lyginant su Simentalio veislės reproduktorių palikuonimis, 1 kilogramui kūno masės priaugti sunaudojo mažiau pašarų. Remiantis tiriamų palikuonių kontrolinio skerdimo duomenimis bei mėsos kokybės tyrimais, patvirtinamas Šarolė bei Simentalio veislių reproduktorių kryžminimo su Lenkijos juodmargėmis karvėmis tinkamumas. Tyrimai rodo, kad mėsinių bulių kryžminimas su pieninių karvių veislėmis turėtų būti vienas iš atrankos kriterijų, nes tinkama atranka žymiai pagerintų mėsinių galvijų penėjimo rezultatus bei skerdenų vertę.
Raktažodžiai: buliai, Šarolė, simentaliai, palikuonių tyrimas.

Introduction. Results of numerous studies (Oprządek *et al.*, 2001; Trela *et al.*, 1998; Zalewski *et al.*, 1994) show that the fattening results and slaughter value of cattle depend, to a high degree, on breed. In countries with a long tradition of culinary beef production, it is based on beef breeds. In countries where the population of beef cattle is low, good-quality beef can be obtained from crossbreeds produced by mating dairy cows to beef bulls, e.g. Charolaise or Simental (Zięba, 2000).

The objective of the present study was to determine the fattening results and slaughter value of young crossbred bulls (Polish Black-and-White cows x Charolaise or Simental bulls).

Materials and Methods. The experiment was performed on 49 young crossbred bulls (Polish Black-and-White cows x Charolaise or Simental bulls). It constituted a part of a bull progeny testing program aimed at determining the suitability of beef bulls for crossing with Polish Black-and-White cows. The progeny (8 to 11 young bulls) of three Simental and two Charolaise sires were examined in the study (Tables 1 and 2).

The young bulls were fattened from approx. 120 kg to approx. 500 kg body weight. Over the entire experimental period they were kept in a tying stall with litter, and had access to drinkers. The feeding conditions were the same for all experimental bulls – a group feeding system based

on farm-made feed (meadow hay and haylage supplemented with two to three kg concentrates). The amount of concentrate added to diets depended on the body weights of bulls, i.e. to 200 kg body weight – 2 kg, to 350 kg body weight – 3 kg, followed by 4 kg until the end of fattening.

After the completion of the fattening period the bulls were transported to a meat plant (transportation time – approx. five hours, distance – 180 km), where they stayed at the lairage for approx. 20 hours. Before slaughter the bulls were weighed. After slaughter hot carcass weight (without kidney fat and kidneys) was determined. Then the carcasses were chilled (2-4°C, 48 hours) and the right half-carcasses were divided into primary elements, according to the relevant standards (Polish Standards for the Meat Industry). The proportions of the most valuable culinary elements (fillet, loin, bavette, topside, silverside) in the carcass, and the percentages of fat and bones obtained from the neck, round of beef, shoulder, loin, shin and shank, were analyzed. Samples of the dorsal muscle (*m. longissimus dorsi*) were taken from the segment between the 11th and 13th four thoracic vertebra for meat quality analysis. They were put into vacuum polyethylene bags and stored at a temperature of 0-2° C for five days. Meat color was determined on fresh cross-section areas of the samples (1 point – light, 8 points - dark). Then a part of each meat sample was used for a taste-panel evaluation. The other part was minced and used to determine the basic chemical composition and physicochemical properties. The sensory properties (juiciness and tenderness) of cooked meat (Znaniecki, 1983) were evaluated according to a 5-point scale (1 point – the lowest score, 5 points – the highest score) (PN-ISO 4121: 1998). An analysis of the physicochemical properties of meat included the determination of the percentages of dry matter, crude protein, fat and ash by conventional methods, pH measurement ("Radiometer" pH-meter with a GK 23311C electrode), color lightness ("Specol" spectrocolorimeter with a R 45/O remission attachment, at a wavelength of 560 nm) and water-holding capacity (Van Oeckel, 1999).

The data were analyzed statistically by the Student's t-test and a one-factor analysis of variance, using the computer program *Statistica* 6.0.

Results and Discussion. The problem of improving beef quality is still topical, especially in the countries where beef cattle populations are small. Crossbreeds obtained by mating dairy cows to beef bulls may be used for culinary beef production. The objective of the present study was to determine the fattening results and slaughter value of young crossbred bulls (Polish Black-and-White cows x Charolaise or Simental bulls) (Tables 1 and 3), and the effects of sires on these parameters (Tables 2 and 4).

Table 1. **Fattening results and slaughter value of calves sired by Simental and Charolaise bulls**

Specification	Sire breed			
	Simental		Charolaise	
	$\bar{x}$	s	$\bar{x}$	s
Number of calves (head)	28		21	
Birth weights of calves (kg)	41.46	3.82	42.43	6.39
Daily gains during control fattening (g)	983	71	1017	67
Oat unit utilization per kg body weight gain	7.34 ^{xx}	0.59	6.29	0.36
Protein utilization per kg body weight gain (g)	979.61	83.92	923.19	87.69
Body weights of bulls before slaughter (kg)	522.25	40.73	518.76	36.55
Cold carcass weight (kg)	250.30	22.12	276.43^{xx}	20.99
Carcass dressing percentage (%)	50.52	1.29	55.02 ^{xx}	1.03
Percentage in the carcass: Fillet	1.25	0.14	1.20	0.17
Loin	2.28	0.34	2.70 ^{x}	0.44
Silverside	3.02	0.37	3.48 ^{x}	0.28
Topside	3.85	0.57	4.17	0.46
Bavette	1.25	0.13	1.43 ^{xx}	0.14
Thick flank	3.27	0.26	3.23	0.22
Best ribs	4.55	1.01	4.90 ^{x}	0.61
Fat	2.42	0.67	3.38 ^{x}	0.76
Bones	14.44 ^{xx}	1.74	12.29	0.71

^{x} – significant differences at P≤ 0.05; ^{xx} - significant differences at P≤ 0.01

Difficult calving is one of the problems taken into account while evaluating the suitability of beef bulls, especially Charolaise ones, for commercial crossing with dairy cows (Piasecki *et al.*, 2000). It follows that in selection work much attention is paid to birth weight of calves. In the present experiment the average birth weight of calves sired by Charolaise bulls was 42.43 kg, and by Simental bulls – 41.46 kg (Table 1). The difference between means of groups was statistically non-significant. Higher variation in birth weight was observed in

crossbreeds sired by Charolaise bulls. A statistically significant difference was noted in the birth weight of calves sired by different Simental bulls (Table 2). This indicates that not only breed, but also individual traits of a bull used for crossing with dairy cows are important.

Mean daily gains for the entire fattening period were slightly higher in the group of young bulls by Charolaise sires, compared with those by Simental sires (1017 g vs. 983 g), but in both cases they were satisfactory (Table 1), since the optimum daily gains of young bulls should vary from 800 to 1100 g (Jasiorowski *et al.*, 1996). Lower body weight gains do not ensure the desirable slaughter value, and higher are too expensive due to larger amounts of concentrates and higher carcass fatness. A slightly higher level of oat unit and protein utilization per kg of body weight gain was observed in Polish Black-and-White x Simental crossbreeds. Similarly as in the case of the birth weight of calves, the individual traits of Simental bulls used for reproduction significantly affected the daily gains of calves and nutrient utilization per kg body weight gain (Table 2).

Table 2. **Fattening results and proportions of elements in the carcasses of calves sired by Simental and Charolaise bulls**

Specification	Statistical measures	Simental sires			Charolaise sires	
		Nagold	Srabau	Balax	Olbrzym	Lechpol
Number of calves (head)		9	8	11	10	11
Birth weights of calves (kg)	$\bar{x}$	39.44[a]	40.63	43.73[a]	41.10	43.64
	s	1.67	4.17	3.88	6.90	5.95
Daily gains during control fattening (g)	$\bar{x}$	965	1023	969	1003	1029
	s	88	59	56	66	69
Oat unit utilization per kg body weight gain	$\bar{x}$	7.41	6.93	7.59	6.29	6.28
	s	0.71	0.33	0.44	0.36	0.38
Body weights of bulls before slaughter (kg)	$\bar{x}$	499.78[a]	518.88	543.09[a]	524.70	513.36
	s	37.71	47.94	28.14	37.77	36.33
Cold carcass weight (kg)	$\bar{x}$	236.31[A]	246.40	264.58[A]	278.92	274.16
	s	19.18	23.26	15.34	22.83	20.01
Carcass dressing percentage (%)	$\bar{x}$	50.58	50.92	50.18	54.69	55.32
	s	1.26	1.21	1.38	1.11	0.90
Percentage in the carcass: Polędwica Fillet	$\bar{x}$	1.29	1.25	1.21	1.03	1.32[x]
	s	0.13	0.14	0.14	0.10	0.11
Loin	$\bar{x}$	2.49[A]	2.33	2.06[A]	2.34[x]	3.02
	s	0.24	0.44	0.19	0.22	0.31
Silverside	$\bar{x}$	3.04	3.16	2.90	3.40	3.56
	s	0.29	0.53	0.26	0.30	0.25
Topside	$\bar{x}$	3.75	4.22	3.68	4.55[xx]	3.82
	s	0.45	0.81	0.31	0.31	0.22
Bavette	$\bar{x}$	1.25	1.32	1.20	1.39	1.47
	s	0.15	0.14	0.10	0.16	0.11
Thick flank	$\bar{x}$	3.25	3.25	3.30	3.23	3.24
	s	0.32	0.18	0.29	0.26	0.19
Best ribs	$\bar{x}$	4.89	4.47	4.32	4.48	5.28[xx]
	s	0.25	1.25	1.21	0.26	0.60
Fat	$\bar{x}$	2.54	2.65	2.17	3.75[x]	3.04
	s	0.51	0.32	0.90	0.69	0.67
Bones	$\bar{x}$	15.32	14.41	13.73	12.47	12.14
	s	2.59	0.84	1.02	0.87	0.51

For calves sired by Simental bulls the values followed by the same letters differ significantly: aa - P≤ 0.05; AA - P≤ 001; for calves sired by Charolaise bulls the values followed by the same letters differ significantly [x] – P≤ 0,05; [xx] - P≤ 0.01.

The mean body weights of young bulls before slaughter were similar in both groups – approx. 520 kg (Table 1). However, a post-slaughter analysis of carcass weight showed that the carcasses of crossbreeds by

Charolaise sires were by about 26 kg heavier. This resulted from the fact that the average carcass dressing percentage of calves sired by Charolaise bulls amounted to 55%, and was significantly (by 4.50%) higher ($P \leq 0.01$) than in the other group (Table 1). The bulls used for crossing with Polish Black-and-White cows had no considerable effect on the carcass dressing percentage of their progeny (Table 2). The carcass dressing percentage of crossbreeds by Simental sires obtained in the present experiment must be considered low, compared with the results reported by other authors, i.e. from approx. 53% to approx. 56% (Choroszy *et al.*, 1994; Litwińczuk *et al.*, 1999a; 1999b; Trela *et al.*, 1998; Zalewski *et al.*, 1994).

The slaughter value of cattle is related primarily to the percentages of elements showing the highest market value. The most valuable elements obtained from beef carcass cutting are fillet and loin. There were no significant differences in the fillet content of carcasses of crossbreeds by Charolaise and Simental sires. The percentage of loin was significantly ($P \leq 0.05$) higher in the carcasses of calves sired by Charolaise bulls (Table 1). In addition, considerable differences were found in the proportions of the above elements between the progeny of different bulls used for insemination (Table 2). Other valuable culinary elements, obtained from round of beef, are silverside, topside, bavette and thick flank. Table 1 shows that the percentages of these elements, as well as best ribs, were the highest in the carcasses of crossbred bulls by Charolaise sires. The carcasses of Polish Black-and-White x Simental crossbreeds had higher proportions of bones and a lower fat content in particular elements (Table 1). These values were also affected by the individual traits of bulls used for mating (Table 2).

Meat quality was estimated analyzing the basic chemical composition and physicochemical and sensory properties of samples taken from the dorsal muscle (*m. longissimus dorsi*) (Tables 3 and 4). The concentrations of dry matter, protein, and ash in the meat from crossbred bulls were similar in both groups (Table 2). The individual traits of Simental bulls significantly affected the percentages of dry matter, protein and ash in the meat from their progeny (Table 3).

Table 3. **Chemical composition and physicochemical and sensory properties of meat from calves sired by Simental and Charolaise bulls**

Specification	Statistical measures	Sire breed	
		Simental	Charolaise
Dry matter (%)	$\bar{x}$	23.22	23.54
	s	0.59	1.23
Protein (%)	$\bar{x}$	21.48	21.04
	s	0.63	0.74
Fat (%)	$\bar{x}$	0.87	1.64 ^{x}
	s	0.42	0.69
Ash (%)	$\bar{x}$	1.08	1.02
	s	0.11	0.08
Color (points)	$\bar{x}$	6.12 ^{xx}	4.45
	s	1.02	1.25
Color lightness (%)	$\bar{x}$	12.71	15.33 ^{x}
	s	2.11	3.48
pH_u	$\bar{x}$	6.36 ^{xx}	5.52
	s	0.46	0.37
Water-holding capacity (cm^2)	$\bar{x}$	5.69	9.16 ^{xx}
	s	2.51	2.66
Tenderness (points)	$\bar{x}$	4.91	4.74
	s	0.24	0.26
Juiciness (points)	$\bar{x}$	4.93	5.00
	s	0.18	0.00

^{x} – significant differences at $P \leq 0.05$; ^{xx} - significant differences at $P \leq 0.01$

Beef quality is also related to the content of intramuscular fat and its distribution, referred to as marbling. According to Bogner (1985), an increase in intramuscular fat level is accompanied by higher scores for such quality factors as tenderness and juiciness. In the present study the meat from Polish Black-and-White x Charolaise bulls contained significantly more intramuscular fat (1.64%) than the meat from Polish Black-and-White x Simental bulls (0.87%) (Table 3). Many authors (Bach and Dünkel, 1993; Wajda 1998) share the opinion that good-quality beef should contain 1.5% intramuscular fat. The meat from calves sired by Charolaise bulls meets this requirement.

The eating quality of beef is also related to the physicochemical properties of raw material. It is a universally accepted view that beef intended for ripening should be of a light-red color, with pH to 6.0. In this experiment the meat from crossbred bulls by Charolaise

sires showed desirable acidity, whereas the pH of the meat from crossbreeds by Simental sires was typical of the DFD defect (Table 3). A consequence of the lower mean pH value of meat from Polish Black-and-White x Charolaise calves was its lighter color and lower water holding-capacity (Table 3). Moreover, significant differences were recorded in the reaction, color and water-holding capacity of meat from Polish Black-and-White x Simental crossbreeds, depending on the bulls used for crossing (Table 4).

Table 4. **Chemical composition and physicochemical and sensory properties of meat from calves sired by different Simental and Charolaise bulls**

Specification	Statistical measures	Simental sires			Charolaise sires	
		Nagold	Srabau	Balax	Olbrzym	Lechpol
Dry matter (%)	$\bar{x}$	23.25	23.63 ^{A}	22.90 ^{A}	23.96	23.15
	s	0.36	0.46	0.67	1.20	1.17
Protein (%)	$\bar{x}$	21.18 ^{a}	21.88 ^{a}	21.44	21.16	20.93
	s	0.41	0.32	0.80	0.49	0.92
Fat (%)	$\bar{x}$	0.74	0.76	1.07	1.74	1.56
	s	0.24	0.25	0.57	1.05	0.75
Ash (%)	$\bar{x}$	1.16 ^{A}	1.17 ^{B}	0.96 ^{AB}	1.05	0.99
	s	0.03	0.05	0.06	0.09	0.06
Color points)	$\bar{x}$	5.67 ^{A}	5.44 ^{B}	7.00 ^{AB}	4.25	4.64
	s	1.03	0.86	0.22	1.36	1.19
Color lightness (%)	$\bar{x}$	13.89 ^{A}	14.25 ^{B}	10.64 ^{AB}	13.30	17.18 ^{xx}
	s	1.54	1..39	0.92	3.33	2.52
pH_u	$\bar{x}$	6.10 ^{A}	6.05 ^{B}	6.79 ^{AB}	5.49	5.55
	s	0.39	0.37	0.09	0.41	0.35
Water-holding capacity (cm^2)	$\bar{x}$	7.47 ^{A}	7.19 ^{B}	3.14 ^{AB}	9.68	8.69
	s	1.84	1.65	0.80	2.88	2.47
Tenderness (points)	$\bar{x}$	4.72 ^{AB}	5.00 ^{A}	5.00 ^{B}	4.85	4.64
	s	0.36	0.00	0.00	0.24	0.23
Juiciness (points)	$\bar{x}$	4.94	4.87	4.95	5.00	5.00
	s	0.17	0.23	0.15	0.00	0.00

For calves sired by Simental bulls the values followed by the same letters differ significantly: aa - P≤ 0.05; AA - P≤ 001; for calves sired by Charolaise bulls the values followed by the same letters differ significantly ^{x} – P≤ 0,05; ^{xx} - P≤ 0.01.

The meat from young bulls of both groups received high scores in a taste-panel evaluation. In the case of Polish Black-and-White x Simental crossbred bulls it was related to the very high pH of meat (Tables 3, 4).

Conclusions

1. The young bulls by Charolaise sires, compared with those by Simental sires, showed a tendency towards higher birth weights and higher gains. They also utilized fewer oat units per kg body weight gain and were characterized by a higher carcass dressing percentage, higher proportions of primary elements in the carcass and better quality of meat.

2. The evaluation of three Simental and two Charolaise bulls, performed on the basis of the slaughter value and meat quality of their progeny, confirmed their suitability for mating to Polish Black-and-White cows. This indicates that suitability for commercial crossing with dairy cows should be one of selection criteria in the case of beef bulls, as appropriate selection may substantially improve the fattening results and slaughter value of beef cattle.

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