FATTENING RESULTS, SLAUGHTER VALUE AND MEAT QUALITY OF HEIFERS AND YOUNG BULLS FED DIFFERENT DIETS IN THE LAST FOUR MONTHS BEFORE SLAUGHTER

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Abstract. The aim of the present study was to determine the effects of various feeding systems applied in the last four months before slaughter on the fattening results and slaughter quality of heifers and young bulls. The experiment was performed on 53 heifers of various genotypes (Black-and-White heifers and crossbred heifers produced by commercial crossing of Black-and-White cows and Limousine bulls) and 80 growing crossbred bulls (Black-and-White cows x Limousine, Charolaise or Simental bulls).

All heifers and bulls were fed the same diet, i.e. haylage *ad libitum* and 2 kg concentrate containing ground barley (72%), wheat bran (25%) and premix (3%), to approx. 300 kg and 345 kg body weight, respectively. Furthermore, the animals were randomly allocated into two feeding groups. The control group (25 heifers and 40 bulls) continued on the above diet, and the experimental group (28 heifers and 40 bulls) was fed the above diet supplemented with 0.4 kg feed concentrate.

Differentiated feeding in the last four months before slaughter, aimed at preparing slaughter animals for further handling, increased daily gains of heifers and young bulls by 56 g and 128 g, respectively. However, diet supplementation with the concentrate had no considerable effect on the carcass dressing percentage, weight loss during pre-slaughter handling or percentages of culinary cuts in the carcasses of heifers and young bulls. It did not affect the mean parameters of chemical composition and physico-chemical properties of heifer meat, either. Only better tenderness of meat from heifers given the feed concentrate during fattening was confirmed by a statistical analysis. Meat from bulls of the experimental group contained less dry matter and fat, and was lighter in color than meat from bulls of the control group.

Keywords: heifers, young bulls, fattening, slaughter value, meat quality, carcass dressing percentage.

TELYČIŲ IR BULIUKŲ, PASKUTINIUOSIUS KETURIS MĖNESIUS PRIEŠ SKERDIMĄ ŠERTŲ SKIRTINGAIS RACIONAIS, PENĖJIMO REZULTATAI, SKERDENOS VERTĖ IR MĖSOS KOKYBĖ

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Santrauka. Bandymo tikslas buvo nustatyti skirtingų šėrimo tipų, taikytų paskutiniuosius keturis mėnesius prieš skerdimą, poveikį telyčių ir buliukų penėjimo rodikliams bei skerdenos kokybei. Bandymai atlikti su 53 skirtingų genotipų telyčiomis (su juodmargėmis ir hibridinėmis, gautomis gamybiniu būdų sukryžminus juodmarges karves su limuzinų veislės buliais) ir su 80 penimų mišrūnų buliais (juodmargės karvės x limuzinai, šarolė ir simentalai).

Visos telyčios ir visi buliukai buvo šeriami tuo pačiu racionu, t. y. šienainiu *ad libitum* ir 2 kg koncentruotų pašarų, kurių sudėtyje – 72 proc. maltų miežių, 25 proc. kviečių sėlenų ir 3 proc. premiksų, tenkančių vidutiniškai 300 kg telyčių ir 345 kg buliukų gyvojo svorio. Po to šie galvijai buvo priskirti dviem šėrimo grupėms. Kontrolinė grupė (25 telyčios ir 40 buliukų) buvo šerta šiuo nustatytu racionu, o eksperimentinės grupės galvijai (28 telyčios ir 40 jaučių) šerti nustatytu racionu, papildytu 0,4 kg koncentruotų pašarų.

Diferencijuotas šėrimas paskutiniuosius keturis mėnesius prieš skerdžiant skirtas paruošti galvijus tolesniam apdorojimui, padidino telyčių ir bulių paros priesvorį 56 g ir 128 g. Tačiau raciono papildymas koncentratais neturėjo žymesnio poveikio skerdenos raumeningumui, svorio nuostoliams priešskerdiminio apdorojimo metu bei kulinarinio išpjaustymo procentui telyčių ir buliukų skerdenose. Raciono papildymas taip pat nedarė įtakos vidutiniams telyčių mėsos cheminės sudėties rodikliams bei fizinėms-cheminėms savybėms. Tik statistinė analizė patvirtino, kad, telyčių, šeriamų koncentruotais pašarais, mėsa būna minkštesnė. Eksperimentinės grupės buliukų mėsoje buvo mažiau sausųjų medžiagų ir riebalų, o jos spalva buvo šviesesnė nei kontrolinės grupės buliukų.

Raktažodžiai: telyčios, buliukai, penėjimas, skerdenos vertė, mėsos kokybė, skerdenos raumeningumo procentas.

Introduction. Pre-slaughter treatment is a source of great stress to animals. Many researchers share the opinion that animals should be prepared for slaughter as early as on the producer's farm. Studies conducted so far (Wajda et al., 1992/1993; Wichłacz et al., 1989; Wichłacz and Wajda, 1994; Ziemiński and Dobrzański, 1997),

primarily on growing bulls, show that high-energy feed provided in the last months preceding slaughter enables to increase daily gains, as well as to improve the slaughter value of animals and meat quality. In the present experiment heifers and young bulls were fed diets supplemented with a feed concentrate designed for the final stage of fattening in order to improve their fattening results and slaughter quality. The aim of the study was to determine the effects of various feeding systems applied in the last four months before slaughter on the fattening results and slaughter quality of heifers and young bulls.

Materials and Methods. The experiment was performed on 53 heifers of various genotypes (Black-and-White heifers and crossbred heifers produced by commercial crossing of Black-and-White cows and Limousine bulls) and 80 growing crossbred bulls (Black-and-White cows x Limousine, Charolaise or Simental bulls). All heifers and bulls were fed the same diet, i.e. haylage *ad libitum* and 2 kg concentrate containing ground barley (72%), wheat bran (25%) and premix (3%), to approx. 300 kg and 345 kg body weight respectively. Then the animals were randomly allocated to two feeding groups. The control group (25 heifers and 40 bulls) was fed the above diet, and the experimental group (28 heifers and 40 bulls) was fed the above diet supplemented with 0.4 kg feed concentrate composed of: rapeseed meal (00), soybean oil meal, cereal bran, molasses, rapeseed oil, limestone, salt, mineral-vitamin premix. The concentrate contained 34.00% crude protein, 7.00 MJ/kg net energy, 9.00% crude fiber, vitamins, micro- and macroelements.

The animals were fattened for four months. Then they were weighed and transported to a meat plant, where they were weighed again, on arrival and before slaughter. After slaughter and post-slaughter processing the carcasses were weighed and chilled (48 hours), and the right half-carcasses were divided into primal cuts. Culinary elements were cut out of the round of beef. Samples of the dorsal muscle (*m. longissimus dorsi*) were taken for meat quality analysis. The chemical composition of meat (concentrations of dry mater, fat, total protein and ash) (Budsławski, Drabent, 1972), water-holding capacity(Grau, Hamm, 1952), meat pH (with a "Radiometer" pH-meter with a GK 23311C electrode) and color lightness (Kortz et al., 1968). Meat color (1 point – light, 8 points - dark) and marbling (1 point – invisible, 5 points – very strong) were determined on fresh (15 minutes) cross-section areas of the samples. The sensory properties of meat were evaluated on samples prepared according to the method described by Baryłko-Pikielna et al. (1964).

All data were analyzed statistically separately for heifers and bulls, by a one-factor analysis of variance. Statistical significance of differences between means of groups was estimated by the Duncan test, using the computer program Statistica (ver. 5.5 A).

Results and Discussion. The fattening results achieved in the four months preceding slaughter are presented in Table 1. The mean body weights of heifers at the beginning and end of the experiment were higher in the control group than in the experimental one, but these differences were statistically non-significant. Heavier bulls were also randomly allocated to the control group (354.65 kg vs. 336.0 kg in the experimental group). This difference was statistically highly significant. Different results were obtained at the end of the experimental period, when the body weights of bulls were higher in the group fed a diet supplemented with the concentrate (these differences were not confirmed statistically).

Fattening results can be estimated on the basis of daily gains. Heifers of the control group had lower daily gains (716.48 g) than those of the experimental group (772.56 g), but this difference was not proved by a statistical analysis. The feed concentrate added to the experimental diet had a highly significant effect on daily gains of young bulls, which amounted to 927.60 g in the experimental group, and were by about 128 g higher than in the control group. A higher variation within daily gains was observed in the control group than in the experimental one (206.46 g vs. 183.11 g). This shows that diet supplementation with the feed concentrate positively affected daily gains. Higher daily gains compensate for the cost of the concentrate, since they considerably reduce the duration of the fattening period and the amount of feed consumed. Wichłacz & Wajda (1994), Wichłacz et al. (1989) and Ziemiński & Dobrzański (1997) reported that diet supplementation with high-energy ingredients significantly increases daily gains in young bulls. According to Schwarz and Kirchgessner (1995 a; 1995 b), a high protein concentration in the ration enables to improve mean daily body weight gains.

After the completion of the experiment the animals were transported to a meat plant. The body weights of heifers and bulls after transportation and their pre-slaughter body weights were similar in both groups. Weight losses caused by pre-slaughter handling were slightly higher (non-significant differences) in the experimental group than in the control one. The carcass weights of both heifers and young bulls were at a similar level.

An important indicator of slaughter value is carcass dressing percentage. In our study carcass dressing percentage was calculated with respect to the body weights of heifers and bulls at the end of the experiment, and with respect to their pre-slaughter body weights. No statistically significant differences were found between the groups in the mean values of this index. The carcass dressing percentage determined in relation to the pre-slaughter body weights of heifers and young bulls oscillated around 55%, and diet supplementation with the concentrate in the pre-slaughter period had no significant effect on its level. Wajda et al. (1992/1993) conducted an experiment in which growing bulls were given feed mixtures with various high-energy supplements in the last few months before slaughter. The carcass dressing percentage obtained by these authors was also about 55%, and was not affected by the type of diet. The carcass dressing percentage recorded in this study may be considered satisfactory, as compared with reference data (Litwińczuk et al., 1992; Młynek, Litwińczuk, 2001; Wajda et al., 1991).

Table 1. **Body weights of heifers & of young bulls, daily gains, losses caused by pre-slaughter handling, carcass weights and indices of carcass dressing percentage**

Specification	Statistical measures	Heifers		Statistical significance of differences	Young bulls		Statistical significance of differences
		Feeding system			Feeding system		
		Control group	Experimental group		Control group	Experimental group	
Body weights at the beginning of the experiment (kg)	$\bar{\times}$	295,72	289,33	-	345,65	336,00	**
	s	34,10	37,40		31,06	31,69	
Body weights at the end of the experiment (kg)	$\bar{\times}$	437,16	433,11	-	455,35	460,55	-
	s	16,89	27,48		27,44	30,18	
Daily gains (g)	$\bar{\times}$	716,48	772,56	-	799,40	927,60	**
	s	120,23	140,57		206,46	183,11	
Body weights after transportation (kg)	$\bar{\times}$	421,92	418,15	-	437,65	438,75	-
	s	14,30	25,36		27,48	28,47	
Body weights before slaughter (kg)	$\bar{\times}$	419,18	413,00	-	425,70	428,15	-
	s	14,31	25,80		28,73	26,16	
Losses caused by pre-slaughter handling (%)	$\bar{\times}$	4,38	4,68	-	6,51	7,03	-
	s	8,37	11,14		1,57	2,06	
Carcass weight (kg)	$\bar{\times}$	228,38	225,65	-	235,36	235,74	-
	s	8,71	12,24		18,04	17,78	
Carcass dressing percentage I (%)	$\bar{\times}$	52,27	52,12	-	51,70	51,19	-
	s	1,35	1,88		1,89	2,83	
Carcass dressing percentage II (%)	$\bar{\times}$	54,74	54,90	-	55,29	55,01	-
	s	0,99	0,97		2,11	2,43	

Carcass dressing percentage I – index calculated in relation to body weights at the end of the experiment
Carcass dressing percentage II - index calculated in relation to pre-slaughter body weights
**Significant differences between mean values at $P \leq 0.01$

Due to the fat that beef from young slaughter cattle is designed primarily for culinary purposes, particular attention is paid to the percentages of carcass elements that can be used for preparing a beef steak or roast beef (Wajda, Hutnikiewicz, 1998). In our experiment there were small differences between the groups in the percentages of such culinary cuts as fillet, loin, topside, silverside, thick flank, rump and bavette (Table 2). Slightly higher percentages of the most valuable cuts, i.e. fillet and loin, were recorded in the carcasses of heifers and bulls of the experimental group.

The nutritive value of food products, including meat, depends on their chemical composition. That is why the quality of meat from heifers and bulls, as dependent on differentiated feeding in the pre-slaughter period, was examined in the present study (Table 3). An analysis of dry matter percentage in meat from heifers did not show significant differences between the groups. Meat from bulls of the control group contained more dry matter, compared with meat from bulls of the experimental group. This difference was statistically highly significant. While evaluating the chemical composition of culinary beef, special emphasis is laid on fat content and distribution in muscular tissue (marbling). This is related to the impact of intramuscular fat on the organoleptic properties of meat (Bach, Dünkel, 1993; Pospiech, Borzuta, 1998; Kołczak, 2000). In our study the mean percentage of fat was higher in meat from heifers that received the concentrate (2.94%) than in meat from the control heifers (2.73%). However, this difference was statistically non-significant. The score for fat distribution in muscular tissue was somewhat higher in the case of heifers of the control group (1.93 points vs. 1.92 points in the experimental group). Fat concentration was very low in beef from bulls of both groups (0.47% - 0.60%). A consequence of such a low fat content was a low score for marbling of the dorsal muscle – about 1 point in both groups. There were no statistically significant differences between the groups in the mean percentages of crude protein and mineral components in meat from heifers and young bulls.

Table 2. **Cold half-carcass weights and percentages of retail culinary cuts in meat from heifers & of young bulls**

Specification	Statistical measures	Heifers		Statistical significance of differences	Young bulls		Statistical significance of differences
		Feeding system			Feeding system		
		Control group	Experimental group		Control group	Experimental group	
Cold half-carcass weight (kg)	$\bar{x}$	109,28	110,63	-	115,41	115,89	-
	s	4,18	8,09		7,68	8,94	
Fillet (%)	$\bar{x}$	1,28	1,29	-	1,18	1,19	-
	s	0,10	0,15		0,11	0,15	
Loin (%)	$\bar{x}$	5,71	5,72	-	1,67	1,74	-
	s	0,32	0,49		0,24	0,22	
Topside (%)	$\bar{x}$	3,43	3,47	-	3,71	3,61	-
	s	0,43	0,39		0,35	0,36	
Silverside (%)	$\bar{x}$	3,04	3,09	-	3,76	3,62	-
	s	0,38	0,52		0,41	0,36	
Thick flank (%)	$\bar{x}$	3,04	3,02	-	3,22	3,20	-
	s	0,20	0,25		0,25	0,27	
Rump (%)	$\bar{x}$	1,62	1,56	-	2,50	2,47	-
	s	0,14	0,22		0,36	0,32	
Bavette (%)	$\bar{x}$	1,27	1,05	-	1,59	1,54	-
	s	0,15	0,52		0,28	0,17	

The physicochemical properties of meat play a key role in a post-slaughter evaluation, since they decide whether the raw material is to be used for processing or culinary purposes (Zin, Krupa, 1994). The physicochemical parameters of beef analyzed most often are: pH, water-holding capacity and color. The production of culinary beef is aimed at achieving a light color and low pH. A high reaction of muscular tissue is conducive to the development of bacterial microflora, which considerably shortens the shelf-life of meat. According to Wichłacz et al. (1989), a high pH of beef (above 5.8) is the main reason for its dark color (DFD meat). In this study the mean pH values in the groups of heifers ranged from 5.40 (experimental) to 5.41 (control). In the case of bulls the mean pH levels were 5.46 in the control group and 5.51 in the experimental one. The differences between these values were statistically non-significant. No DFD meat samples were found.

Consumers usually evaluate beef on the basis of color. In the present experiment beef color was evaluated instrumentally, with a spectrocolorimeter, and by a subjective method. No significant differences were observed in the color of meat from heifers. Both light reflection coefficient and meat color (points) were at a similar level in both groups. In the case of bulls, beef color evaluated subjectively was similar in the control and experimental group. An instrumental analysis showed that meat from the experimental bulls was highly significantly lighter in color than meat from the control bulls. There were no significant differences between the groups of heifers and bulls in the mean values of water-holding capacity.

Despite the use of more objective methods for meat quality evaluation, still much weight is attached to a sensory analysis, especially of meat tenderness and juiciness, considered key quality factors of beef. Table 3 presents the results of an organoleptic evaluation of beef tenderness and juiciness. As regards the tenderness of meat from heifers, the difference between means of groups amounted to 0.39 points and was significant at a level of $P \leq 0.05$. Meat from heifers of the experimental group, fed a diet supplemented with the concentrate, was more tender. As for juiciness, no significant differences were found between the groups. An organoleptic evaluation of the tenderness and juiciness of beef from bulls did not show statistically significant differences between the means of groups. Bulls of both the control and experimental group received the highest score (5 points) for meat juiciness. Meat from bulls fed a supplemented diet displayed a tendency to better tenderness (4.10 points vs. 3.99 points in the control group).

Conclusions

1. Differentiated feeding in the last four months before slaughter, aimed at preparing slaughter animals for further handling, increased daily gains of heifers and young bulls by 56 g and 128 g respectively. However, diet supplementation with the concentrate had no considerable effect on the carcass dressing percentage, weight loss during pre-slaughter handling or percentages

of culinary cuts in the carcasses of heifers and young bulls.

2. The feed concentrate tested in the study did not affect the mean parameters of chemical composition and physicochemical properties of heifer meat. Only better tenderness of meat from heifers given the feed concentrate during fattening was confirmed by a statistical analysis. Meat from bulls of the experimental group contained less dry matter and fat, and was lighter in color than meat from bulls of the control group.

Table 3. **Chemical composition, marbling, physicochemical properties and palatability score of meat from heifers & young bulls**

Specification	Statistical measures	Feeding system			
		Heifers		Young bulls	
		Control group	Experimental group	Control group	Experimental group
Dry matter (%)	$\bar{x}$	25,10	26,00	23,84	23,36
	s	1,09	0,85	0,65	0,53
Crude fat (%)	$\bar{x}$	2,73	2,94	0,60	0,47
	s	1,16	0,65	0,34	0,22
Marbling (points)	$\bar{x}$	1,93	1,92	1,05	1,07
	s	0,39	0,48	0,15	0,14
Total protein (%)	$\bar{x}$	21,47	21,64	21,42	21,31
	s	0,54	0,59	0,55	0,73
Ash (%)	$\bar{x}$	1,13	1,11	1,23	1,22
	s	0,07	0,08	0,07	0,10
PH	$\bar{x}$	5,41	5,40	5,46	5,51
	s	0,10	0,11	0,14	0,23
Water holding capacity (cm^2)	$\bar{x}$	6,03	5,52	6,93	7,15
	s	1,10	1,33	1,44	1,73
Meat color (points)	$\bar{x}$	5,62	5,68	5,83	5,85
	s	0,61	0,70	0,46	0,50
Color brightness (%)	$\bar{x}$	12,43	11,48	10,33	11,25
	s	1,92	1,63	1,21	1,58
Tenderness (points)	$\bar{x}$	4,19	4,58	3,99	4,10
	s	0,67	0,63	0,71	0,60
Juiciness (points)	$\bar{x}$	4,86	4,88	5,00	5,00
	s	0,23	0,22	0,00	0,00

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