Slovak J. Anim. Sci., 43, 2010 (3): 160 - 165
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ISSN 1337-9984

COMPARISON OF MEAT QUALITY IN BULLS AND COWS

K. ZAUJEC*, J. MOJTO, M. GONDEKOVÁ

Animal Production Research Centre Nitra, Slovak Republic

ABSTRACT

Comparison of quality and sensorial evaluation of meat was performed in two categories of animals: cows (n=69) and bulls (n=52). We have found highly significant differences between the categories in basic characteristics of animals. The greatest differences were found in age, weight of carcass, conformation, fatness and marbling of meat.
Observation of meat quality in these categories showed approximately the same qualitative parameters in both categories. Significant results were noticed in the parameters total water and intramuscular fat in favour of the bulls. The other results varied, though the more favourable parameters of meat quality were in the category of bulls. More favourable results were observed in sensorial evaluation of meat in the category of bulls also.

Key words: cows; bulls; meat quality; sensory panel

INTRODUCTION

Carcass and technological values of animals were taken into consideration mostly when evaluating the slaughter cattle in our country. Meat quality was underestimated. If attention was paid to beef quality, it was usually studied in slaughter bulls (Mojto et al. 1998, 1999, 2004; Šubrt and Schmidt 1994; Zaujec et al. 2005; Fiems et al. 2000; Yamada et al. 2009). According to many authors (Cranweel et al. 1996; Haberman et al. 2002; Sawyer et al. 2004; Patten et al. 2008) live weight before slaughter influences the quality of meat. Orellana et al. (2008) affirmed the influence of live weight before slaughter in bulls coming from Argentina. Mojto et al. (1998) indicated the tendency to paler meat and low content of intramuscular fat in slaughter bulls with dressing percentage of about 70 %. Hodgson et al. (1992) and Johnson and Rogers (1997) recommended to introduce subclasses to improve quality of meat in bulls and cows. At present, because of lack of slaughter bulls, cows are slaughtered to a higher degree in order to meet the demand of the market for beef. Cows' meat is considered to be of lower quality than the meat of bulls mostly from empiric reason. Higher age at slaughter is reported as the reason for worse quality of cows' meat. Similarly Galli et al. (2008) give an age at slaughter as the main reason for 80 % culling of cows. Minchin et al. (2008) mentioned that age can influence the quality of beef, mainly in young and old animals. Some experiments of other authors prove that higher live weight influences colour of meat, intramuscular fat, and shear force of meat. According to Pritchard and Burg (1993) the influence of live weight on quality of cows' meat became evident mainly in slaughter calves, which were classified within P and O classes.

***Correspondence:** E-mail: zaujec@cvzv.sk
Kvetoslav Zaujec, Animal Production Research Centre Nitra, Research Institute of Animal Production Nitra, 951 41 Lužianky, Slovak Republic
Tel. +421 37 6546 195

Received: April 4, 2010
Accepted: July 8, 2010

Sensorial evaluation of meat becomes important also, mainly if it is thermally processed. Sensorial parameters of beef are important at consumption of thermally processed meat. For the consumer flavour is dominant out of sensorial parameters (Rhodes et al., 1955; Van Syckle and Brough, 1958; Ramsey et al., 1963). Koch et al. (1982), McKeith et al. (1985) and Galli et al. (2008) confirmed this statement in their works. Aumaitre (1999), Harrington (1994) and Goodson et al. (2002) reported difference in the quality of meat between male and female sex mainly in its preparation.

Objective of this work was to compare meat quality between slaughter bulls and slaughter cows with regard to sensorial parameters of meat.

MATERIAL AND METHOD

Animals

Slaughter cows (69 animals) and slaughter bulls (52 animals) of different breeds were used in this experiment. Breeds composition was as follows:

Bulls:	Black and White Holstein:	17 heads
	Red and White Holstein:	17 heads
	Simmental:	18 heads
Cows:	Black and White Holstein:	26 heads
	Red and White Holstein:	5 heads
	Simmental:	17 heads
	Crossbreds of Black and White Holstein (HxS):	12 heads
	Simmental crossbreds (SxR. SxH):	9 heads

Basic characteristic of this set is in table 1. The animals came from different agricultural enterprises and they were killed at the slaughter house in Dunajská Streda. The carcasses were evaluated after killing according to the regulation No. 206/2007 MA SK. We replaced classes of conformation with numbers: P-1, O-2, R-3, U-4, and E-5 to calculate the average class of conformation. The weight of warm carcass was detected after the classification. This indication served us further to calculate live weight before slaughter, which was obtained after multiplying the weight of warm carcass by the coefficient relevant for the given category.

Chemical analyses

At the slaughter house meat samples from the right carcass side between 9^{th} – 10^{th} ribs 48 hours were taken after killing. The meat samples were wrapped into microten wrapping bags and stored in portable refrigerator at the temperature 4ºC during the transport (approx. 1 hour). The samples were adjusted to 20ºC after the transport. Then a number of parameters were studied in meat. Marbling of meat was assessed at fresh cut. Degree of marbling was determined on the basis of a 10 point American scale (USDA 1997), where 1- very abundant marbling, 10 - traces or practically devoid of marbling. Percentage of proteins, fat and total water content was assessed in 100 g of minced meat sample in the Infratec 1265 Meat Analyser. Combined glass electrode and portable pH meter (type 3071) were used to measure pH_{48} value. Values of meat colour (L, a, b) were measured on cutting area of *m. longissimus dorsi* by the Mini Scan E Plus apparatus (Hunter lab., USA). The method of Grau-Hamm (modified by Palanská and Hašek 1976) was used to assess water holding capacity. Shear force of meat was measured in a sample of grilled meat on day 7 after killing the animals. Meat sample (thickness 2.5 cm, *m. longissimus dorsi*) was put into a contact grill, PM-1015 model (RM Gastro, Czech Republic) and grilled at a temperature 200º C for 4 minutes. After grilling the value of shear force was measured in grams and converted to kg in the Texture Analyser TA.XT2i (Stable Microsystems, England).

Sensorial parameters

Sensorial parameters of meat were assessed by 5 point scale (Jedlička 1988) valid for all sorts of meat (5 points – very distinctive property, 1 point – inexpressive property of meat). Among meat properties the following ones were assessed: flavour, taste, juiciness and tenderness.

Statistics

All results were calculated as a mean (x) and standard deviation (s). Differences in means between categories were tested in individual parameters by Two-Sample t-test, using the Statistix for Windows software, version 8 (Analytical Software, Tallahassee, USA). Mean values were statistically evaluated by significance of differences at $P< 0.05$.

Objective of this work was to verify the hypothesis whether slaughter cows have worse or approximately the same meat quality as bulls.

RESULTS AND DISCUSSION

Significant differences were found in all studied parameters of basic characteristics in animals (Tab. 1). The lowest significance ($P<0.05$) was found in the parameter live weight before slaughter. It can be caused by the calculation of carcass weight as there different calculation coefficients in both categories are used. Lower carcass weight was found in cows when compared with that in bulls. Difference between categories in this parameter was highly significant ($P<0.001$). Carcass weight influenced the incorporation of carcasses into classes of conformation. The average value of conformation in cows was 1.71, which corresponds with classes P and O. In bulls the average value was 2.30,

Tab1e 1: Basic characteristics of animals and carcass

Parameter	cows			bulls			t- test
	n	$\bar{x}$	s	n	$\bar{x}$	s	
age (days)	69	2220.00	862.39	52	662.31	103.73	+++
final live weight (kg)	69	539.56	113.02	52	565.96	80.61	+
carcass weight (kg)	69	278.12	58.25	52	310.97	44.29	+++
conformation score	69	1.71	0.64	52	2.30	0.50	+++
fatness score	69	2.07	0.95	52	1.46	0.64	+++
marbling score	69	7.63	1.52	52	8.57	0.72	+++

+ P < 0,05, +++ P < 0,001; conformation score: 1- P(very poor conformation),... 5 – E (very good conformation); fatness score: 1 – very lean ... 5 very fat; marbling score: 1 – very abundant ... 10 - traces or practically devoid

which corresponds with classes O and R. In classes of fatness we noticed more surface fat in cows than in bulls. In both parameters highly significant differences between the categories were observed (P<0.001). Similar results were reported by Zaujec and Mojto (2007) and Zaujec et al. (2006) in bulls. Gondeková et al. (2008) obtained similar results in cows. In general it is valid, that the more surface fat is on the carcasses, the more intramuscular fat is in them. This fact was affirmed in our research work. Almost degree 8 of marbling was noticed in cows, which is slight marbling, in bulls it was almost degree 9, which are only traces of marbling in meat. Similar results were reported by Gondeková et al. (2008) and also Patten et al. (2008) in slaughter cows. On the contrary, Zaujec et al. (2006) noticed marbling degree 8 in bulls. Prado et al. (2008) noticed marbling degree 6 in Aberdeen Angus crosses. It appears from the obtained results that animals with markedly lower content of intramuscular fat are killed in Slovakia more often than in the USA. It can be related to the fact that inhabitants in Slovakia prefer meat with lower content of intramuscular fat.

Variable results were noticed in chemical parameters of meat (Tab. 2). In the parameter total water statistically significant results were found between the categories (P<0.001). In cows these values were lower than in bulls. It stands to reason as the older animals have lower capability to bind water than the young animals. We did not notice statistically significant differences between categories in content of total proteins. The value was almost the same in both categories (20.52 g.100 g^{-1} or 20.85 g.100 g^{-1}). Faucitano et al. (2008) found higher values in the content of proteins (over 22 g.100 g^{-1}). Similarly Mojto et al. (2004) noticed higher values in the content of proteins than were measured by us. Highly significant differences (P<0.001) were found in the content of intramuscular fat. Higher content of intramuscular fat was noticed in cows (over 3.5 g.100 g^{-1}) compared with bulls (over 1.5 g.100 g^{-1}). In this case the fact was affirmed that fatness, marbling and intramuscular fat may influence each other. Mojto et al. (2004) found higher values of intramuscular fat in bulls. The value of pH_{48} was almost the same in both categories. Increased pH_{48} value was noticed in bulls (over 6) compared with cows. No deviations were occurred in meat quality in form of DFD in spite of quite high pH values in both categories. Kim et al. (1998) reported lower pH values in the Hanwoo breed when comparing bulls and cows. Similarly Mojto et al. (2004) noticed lower pH values in

Table 2: Qualitative parameters of meat

Parameter	cows			bulls			t- test
	n	$\bar{x}$	s	n	$\bar{x}$	s	
total water (g.100g^{-1})	69	74.95	2.36	52	76.36	0.98	+++
proteins (g.100g^{-1})	69	20.52	0.65	52	20.85	0.48	
intramuscular fat (g.100g^{-1})	69	3.52	2.52	52	1.78	0.80	+++
pH_{48}	69	5.92	0.41	52	6.11	0.46	
meat colour lightness L	69	29.70	2.82	52	30.63	3.32	
redness a	69	10.62	2.47	52	9.42	2.41	
yellowness b	69	7.03	1.29	52	6.86	1.67	
water holding capacitance (g.100g^{-1})	69	25.95	5.52	52	26.74	3.72	
shear force (kg)	69	11.19	4.30	52	9.91	3.46	

+++P < 0.001

bulls. The parameter colour of meat is closely connected to pH value. Our experiment did not affirm the fact that meat with higher pH value is of darker colour. We found out that lower value of colour (L value) and therefore meat of darker colour was in cows. Meat of cows showed also higher saturation of colour (a value) than meat of bulls. Galli et al. (2008), Kim et al. (1998), Kim et al. (2003) detected somewhat higher values in meat colour (L value) and saturation of colour in cows. French et al. (2001), Orellana et al. (2009) noticed higher values in colour and saturation in meat of bulls. Generally, the opinion prevails, that the higher pH value and darker meat, the lower value water holding capacity should occur. Our study did not affirm lower value of water holding capacity in the category of bulls. The bulls had higher value of water holding capacity (26.74 g.100 g^{-1}) and higher pH value (6.11) compared to cows (25.95 g.100 g^{-1} or 5.92). Difference in average values between both categories was not statistically significant. Shear force in grilled meat was higher in cows (over 10 kg) than in bulls (nearly 10 kg). For this parameter the conclusions of Yamazaki et al. (1989) that the intramuscular fat influences shear force in meat were not affirmed. Higher shear force in grilled meat of cows can be caused by less tender muscle fibres as well as by higher content of insoluble elastin. Gondeková et al. (2008) detected similar results in slaughter cows. On the contrary, Crouse et al. (1989) and Ramsey et al. (1963) found much lower values of shear force in bulls (5.88 kg or 6.35 kg).

In the category of bulls, more favourable results were unambiguously detected in sensorial parameters (table 3), though the results were not statistically significant almost in all parameters. French et al. (2001) noticed similar results in bulls also. On the contrary, Cerdeńo et al. (2006) and Faucitano et al. (2008) recorded better results in panel evaluation, than those noticed in our experiment with bulls. Similarly, Kim and Lee (2003) noticed better sensorial evaluation in cows. Higher significance ($P<0.05$) in the parameter flavour was manifested in the category of bulls. We can agree with the authors Koch et al. (1982), McKeith et al. (1985) and Galli et al. (2008) that flavour is the dominant parameter of sensorial evaluation, as we noticed the highest number of points (3.53 or 3.80) in both categories.

CONCLUSION

Comparison of meat in categories of bulls and cows showed that the meat quality in cows is approximately the same as in bulls. In some parameters cows had even better results than bulls (water holding capacity, pH value). Similar results were obtained in panel evaluation; better results were noticed in bulls. Worse results in the category of cows can be caused by higher age at slaughter.

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Table 3: Sensory evaluation of meat quality

Traits	cows			bulls			t- test
	n	$\bar{x}$	s	n	$\bar{x}$	s	
flavour	69	3.53	0.49	52	3.80	0.62	+
taste	69	3.37	0.61	52	3.71	0.61	
tenderness	69	3.25	0.83	52	3.58	0.82	
juiciness	69	3.27	0.69	52	3.57	0.74	

+ $P < 0.05$

Scale: 1 – without flavour. taste. tenderness. juiciness. .... 5 – very high flavour. taste. tenderness. juiciness

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