

COMPARATIVE TESTING OF SLAUGHTER TRAITS AND MEAT QUALITY OF MALE AND FEMALE SIMMENTAL CATTLE

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Abstract: The paper presents the results of comparative testing of slaughter traits and meat quality of male (A) and female (B) young cattle of domestic Simmental breed. The sample included a total of 30 heads, 15 in each group. Cattle were slaughtered at the same age with an average mass of about 660 kg in the group (A), and about 500 kg in the group (B). The study results show that cattle of group (A) achieved statistically ($p < 0.001$) significantly higher share of pre slaughter mass and mass of warm carcass sides while female cattle achieved statistically ($p < 0.01$) significantly higher share of kidney fat. The share of tissues in the three rib cut showed statistical differences between the groups, in the share of the *M. longissimus dorsi* that was statistically ($p < 0.05$) significantly higher in male cattle and the share of fat was statistically ($p < 0.01$) significantly higher in group (B). The chemical composition of *M. longissimus dorsi* statistically ($p < 0.05$) differed significantly in the share of water which was higher in male cattle while the cattle of group (B) had statistically ($p < 0.01$) significantly higher share of lipids. As for the technological quality, cooking loss of *M. longissimus dorsi* was statistically ($p < 0.01$) significantly higher in young cattle of group (A), while the tenderness/softness of *M. longissimus dorsi* ($p < 0.01$) was significantly better in young cattle of group (B). Sensory characteristics of *M. longissimus dorsi* differed statistically ($p < 0.001$) significantly in the tenderness of the meat that was better in young cattle of group (B). Male Simmental cattle had better slaughter performance and meat quality characteristics, except tenderness of meat which was better in female cattle.

Key words: slaughter traits, meat quality, *M. longissimus dorsi*

Introduction

In recent years, improved techniques for beef production have considerably increased the production of calves, offering not only a higher number of males for

slaughter, but also increasing the number of replacement heifers, giving the producer the option to be more rigid for selection pressure on the cow herd, and to the packing plants, a greater offer of cull females (*Vaz et al., 2002*).

Beef meat is characterized by good nutritional value, which sets it apart from other types of meat and makes it very esteemed food. The importance of meat in human nutrition is well known and it is considered the indispensable and the best-quality component of proper and well balanced diet (*Petričević et al., 2015*).

As far as the quality of beef is concerned, special significance is given to breed, feeding method and sex of animals intended for slaughter (*Bures et al., 2006*). In modern society, consumer acceptance of beef depends on two major aspects of meat quality, nutritional quality which is objective and 'eating' quality as perceived by the consumer – flavor, juiciness, tenderness and color– which is highly subjective (*Venkata et al., 2015*). Major factors which improve the appearance of meat consist of color, retention of fluid and fat content of meat or marbling. Tenderness of meat is affected by various factors like feeding regime, pre-slaughter treatment, slaughtering procedures, post mortem cooling, electrical stimulation and ageing of meat, age and sex of the slaughtered animal, and genetic makeup of the animals being consumed for meat production (*Strydom et al. 2000; Bonfatti et al. 2013*).

The share of tissues and meat, in retail cuts, define their quality, value and market demand. Information on the content of tissue in main carcass parts that are available in the literature are mainly related to a particular anatomical region of the carcass, with large variations in regard to the cutting procedures of carcasses and heterogeneity of material used in the study (breed, gender, age, level of fattening, etc.) (*M. Petričević et al., 2011*).

It appears that bulls and heifers of the same breed entering the finishing period at the same age and fed the same diet need different times to reach the optimum endpoint. The results of such comparison are, however, limited in the literature (*D. Bureš and L. Bartoň, 2012*).

Sex of the cattle greatly affects the texture of beef, which is due to the presence of intra-muscular fat content and smaller muscle fiber diameter in cows, making the meat tenderer than bulls (*Church and Wood, 1992*).

Materials and Methods

The study was conducted on male and female fattening young cattle – two groups were formed group A (n= 15) male cattle and group B (n=15) female cattle. Fattening was carried out on the experimental cattle farm of the Institute for Animal Husbandry, Belgrade-Zemun. The cattle were fed diet with whole plant silage, hay and concentrate. Both groups of cattle were of same age. Day before slaughtering cattle received no food, only water. Animals were weighed immediately before slaughter, and then slaughtered according to standard

commercial procedures, in the experimental slaughterhouse, and chemical analysis performed in the Laboratory of the Institute for Animal Husbandry. Three rib cut 9-10-11 rib was separated from the left chilled carcass side, cut at the cranial edge of the 9th and 11th rib and cut parallel to the spinal column. On scale with an accuracy of 0.001 kg, muscle mass (especially measured *M. longissimus dorsi*), fat and connective tissue and bone were measured. The chemical composition of the *M. longissimus dorsi* sample was performed: the water content - the method of drying the sample at 103 ± 2 °C (SRPS ISO 1442, 1998), the fat content - extraction method by Soxhlet (SRPS ISO 1444, 1998), the amount of mineral matter (ash) - by annealing the sample at 550 ± 25 °C (ISO 936, 1999) and protein content - Kjeldahl method according to (ISO 937, 1992).

Technological properties of the sample *M. longissimus dorsi*, namely: cooking loss was determined on the basis of the mass difference of the piece of meat (size: 3 x 4 x 1.5 cm and a mass of about 70 grams) before and after cooking in distilled water (where the ratio of meat and water was 1: 2) in a closed glass vessel (at 100°C for 10 minutes) and expressed as the percentage relative to the mass of the sample prior to cooking (*Official Gazette of SFRY no. 2/85, 12/85 and 24/86*); roasting loss was determined on the basis of the difference in mass of the pieces of meat before and after cooking; the cut of *M. longissimus dorsi* muscle, which was transversely cut to provide the direction of muscle fibers, weighing 150 ± 1 g was wrapped in aluminum foil and baked for 25 minutes at 250°C. Subsequently, it was extracted from the foil and immediately measured. The softness (tenderness) of meat was determined using consistency meter by *Volodkevich (1938)* by cutting pieces of meat transversely to the direction of the muscle fibers. Determination of total pigments according to *Horsney (Bunning and Hamm, 1970)* and instrumental color measurement was done using Chroma Meter CR-400 (Minolta, Japan), which had been previously calibrated in relation to a standard white surface (illumination D65, viewing angle 2° and the opening of the probe 8 mm) on fresh meat samples (24 hours *post-mortem*). Samples of meat were cut off and left 30 min in air to stabilize colour. Colour values are represented in the CIE L*a*b* system (*CIE 1976*), where L* is a measure indicating lightness of meat. Three readings for each sample of meat were carried out and their average value were used for statistical data processing. The pH value of the meat 24 hours *post mortem* was measured using the pH meter with combined stab electrode Hanna HI 83141 (Hanna Instruments, USA). The scores of taste, aroma, juiciness/succulence and tenderness of the meat were determined after cooking and after roasting. Seven semi trained assessors were included in sensory evaluation. The quantitative descriptive scale of 5 points was used for each evaluated parameter: marbling: 1-very bad marbling, 2- bad marbling, 3-neither good nor bad marbling, 4-good marbling, 5-very good marbling; taste and odor: 1-very bad, 2-bad, 3-neither good nor bad, 4-good, 5-very good; Softness/tenderness: 1-very

firm, 2-firm, 3-neither firm nor soft, 4 soft, 5-very soft; juiciness/succulence: 1-very dry, 2-dry, 3-neither dry nor succulent, 4-succulent, 5-very succulent.

The obtained data were analyzed using analysis of variance in single factorial experiment (One-way ANOVA) by SPSS Statistics 20. The statistical significance of differences between mean values was determined by t-test.

Results and Discussion

Table 1 shows the average slaughter values of the studied beef cattle. As expected, male cattle were statistically ($p < 0.001$) significantly heavier than the female cattle at the end of the fattening period. Warm carcass mass was statistically ($p < 0.001$) significantly higher in male cattle compared to group (B). Similar results were obtained in the research of *Bureš and Bartoň (2012)* who state the warm carcass mass of male beef cattle of 388.2 kg and 299.6 kg of female beef cattle.

The share of kidney fat was statistically ($p < 0.001$) significantly higher in young cattle of group (B). *Petričević et al. (2013)* suggest that the share of kidney fat was 0.80% in male beef cattle of average pre slaughter body mass of 615.4 kg, which is similar to results obtained in this experiment. *Bartoň et al. (2006)* in their research report the share of kidney fat 1.40% for male cattle of Simmental breed.

Table 1. Average values of slaughter traits of beef cattle

Indicator	A	B	t-test
Pre-slaughter mass (kg)	660.91±66.85	504.88 ± 31.93	***
Warm carcass mass (kg)	387.05± 41.37	292.21± 15.86	***
Warm carcass dressing percentage (%)	58.50 ± 0.73	57.92 ± 1.25	ns
Kidney fat (tallow) (%)	0.68 ± 0.30	1.97 ± 0.65	***

ns – not significant

*** significant at the level of ($p < 0.001$)

The share of different tissues in three rib cut is shown in Table 2. Share of *M. longissimus dorsi* differed significantly between groups ($p < 0.05$). The higher share of *M. longissimus dorsi* by 4.81% was recorded in male cattle compared to the group (B). A statistically significant difference was found in the share of fat tissue ($p < 0.01$), which was higher in young cattle of group (B). *Aleksić et al. (2005)* in their research report the proportion of fatty tissue of three rib cut of 8.34% for male cattle of Simmental breed.

Taking into consideration the higher share of the muscle tissue and lower share of fat tissue the advantage is on the side of young cattle of group (A).

Table 2. Share of tissues in three rib cut

Item	A	B	t-test
Three rib cut (%)			
<i>M. longissimus dorsi</i>	34.77 ± 2.70	29.96 ± 6.53	*
Remaining muscle tissue	29.86 ± 4.66	32.06 ± 4.03	ns
Fat tissue	13.25 ± 4.02	19.93 ± 5.25	**
Binding tissue	0.98 ± 0.36	0.84 ± 0.42	ns
Bones	20.51 ± 2.73	16.96 ± 4.65	ns

ns – not significant

* significant at the level of (p<0.05)

** significant at the level of (p<0.01)

The chemical composition of *M. longissimus dorsi* is shown in Table 3. Statistically (p<0.05), significant difference was found in the water content that was higher in male cattle and lipid content, which was statistically (p<0.01) significantly higher in beef cattle the group (B). Štoković *et al.* (2013) report the water content of 75.16% and lipid 3.28% for male young cattle of domestic Simmental breed. Kelava *et al.* (2013) suggest that the share of lipid of 1.79% for male cattle, which is similar to results in the present study. In the study of Petričević *et al.* (2013) the water content of 75.29% and lipid content of 1.57% are reported for male cattle of Simmental breed.

Table 3. Chemical composition of *M. longissimus dorsi*

Item	A	B	t-test
Water, (%)	75.04 ± 1.00	73.54 ± 1.36	*
Lipid, (%)	1.46 ± 0.64	3.33 ± 1.76	**
Ash, (%)	1.11 ± 0.04	1.07 ± 0.08	ns
Protein, (%)	22.38 ± 0.75	22.04 ± 1.23	ns

ns – not significant

* significant at the level of (p<0.05)

** significant at the level of (p<0.01)

Table 4 shows the technological characteristics of *M. longissimus dorsi*. Statistically (p<0.01) significant difference was found in the cooking loss, which was greater in male cattle and softness/tenderness of *M. longissimus dorsi*, which was more favorable in group (B).

In their study Petričević *et al.* (2013) report the value of the cooking loss of meat tenderness of 37.10% and 9.30%, respectively, for male young cattle of domestic Simmental breed and the results of research of Aleksić *et al.* (2013) show the cooking loss 34.21%.

Table 4. Technological characteristics/properties of *M. longissimus dorsi*

Item	A	B	t-test
Cooking loss, %	42.92 ± 1.81	26.64 ± 14.98	**
Roasting loss, %	38.76 ± 1.71	38.81 ± 2.37	ns
Colour (L*)	38.78 ± 1.93	38.44 ± 2.73	ns
Tenderness	14.09 ± 2.14	9.77 ± 3.86	**
pH ₂₄	5.53 ± 0.06	5.52 ± 0.05	ns

ns – not significant

** significant at the level of (p<0.01)

The sensory characteristics of cooked meat are shown in Table 5. Tenderness and flavor have been identified as the most important attributes that determine eating quality of Europeans (*Glitsch, 2000*). Tenderness is one of the major criteria that contributes most to eating satisfaction and consumers are willing to pay more for tender beef (*Wheeler and Koohmaraie, 1994; Chambaz et al., 2003*).

Based on the results of sensory evaluation of *M. longissimus dorsi*, softness/tenderness of meat in female cattle was statistically (p<0.001) significantly better. Differences in sensory characteristics can be attributed to a different content of intramuscular fat (*Christensen et al., 2011*).

Table 5. Sensory properties of *M. longissimus dorsi*

Item	A	B	t-test
Cooked meat			
Aroma	5.00 ± 0.00	4.81 ± 0.37	ns
Taste	4.86 ± 0.23	4.68 ± 0.59	ns
Tenderness	3.00 ± 0.59	4.37 ± 0.58	***
Succulence	3.45 ± 0.42	4.06 ± 1.05	ns

ns – not significant

*** significant at the level of (p<0.001)

Conclusion

Based on the results of the test can be concluded:

- male cattle achieved statistically significantly (p<0.001) greater pre slaughter body mass and mass of warm carcass and significantly (p<0.001) lower share of kidney fat;
- male cattle achieved statistically significantly (p<0.01) higher share of *M. longissimus dorsi* and significantly (p<0.05) lower share of fat tissue in three rib cut;

- male cattle had statistically significantly ($p < 0.05$) more water in the *M. longissimus dorsi* and significantly ($p < 0.01$) lower lipid content;
- male cattle had statistically significantly ($p < 0.01$) greater cooking loss, while the female cattle had significantly ($p < 0.01$) better tenderness of meat;
- sensory properties of meat differed significantly ($p < 0.001$) only in regard to meat tenderness that was better in young cattle of group (B), i.e. female cattle had more tender meat.

Based on this we can conclude that male cattle of domestic Simmental breed have better slaughter traits and meat quality characteristics except tenderness of meat which is better in female beef cattle.

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Uporedno ispitivanje klaničnih osobina i kvaliteta mesa muške i ženske junadi simentalске rase

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Rezime

U radu su prikazani rezultati uporednog ispitivanja klaničnih osobina i kvaliteta mesa muške (A) i ženske (B) junadi domaće simentalске rase. Uzorkom je obuhvaćeno ukupno 30 grla, po 15 u svakoj grupi. Junad su zaklana u istom uzrastu sa prosečnom težinom u grupi (A) oko 660 kg i grupi (B) oko 500 kg. Dobijeni rezultati istraživanja pokazuju da su junad grupe (A) ostvarila statistički ($p < 0.001$) značajno veći udeo mase pred klanje i mase toplih polutki dok su junadi grupe (B) ostvarila statistički ($p < 0.001$) značajno veći udeo bubrežnog loja. Udeo tkiva u trorebarnom isečku se statistički razlikovao među grupama i to u udelu *M. longissimus dorsi* koji je bio statistički ($p < 0.05$) značajno veći kod junadi grupe (A) i udelu masnog tkiva koji je bio statistički ($p < 0.01$) značajno veći u grupi (B). Hemijski sastav *M. longissimus dorsi* se statistički ($p < 0.05$) značajno razlikovao u

udelu vode koji je bio veći kod junadi grupe (A) dok su junad grupe (B) imala statistički ($p < 0.01$) značajno veći udeo masti. Što se tiče tehnološkog kvaliteta, kalo kuvanja *M. longissimus dorsi* je statistički ($p < 0.01$) značajno bio veći kod junadi grupe (A) dok je mekoća *M. longissimus dorsi* ($p < 0.01$) značajno bila bolja kod junadi grupe (B). Senzorne karakteristike *M. longissimus dorsi* su se statistički ($p < 0.001$) značajno razlikovale u mekoći mesa koja je bila bolja kod junadi grupe (B). Muška junad domaće simentalске rase imala su bolje klanične osobine i karakteristike kvaliteta mesa sem mekoće mesa koja je bolja kod ženske junadi.

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