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THE EFFECT OF SEX AND AGE AT SLAUGHTER ON SOME CARCASS AND MEAT QUALITY TRAITS OF BOER KIDS

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This study investigated some carcass and meat quality traits of Boer kids (17 male and 17 female) at two different average slaughter ages (83 and 139 days). Jointed cuts of half carcasses arranged from the greatest to the smallest were: hind leg (28.5%), rib and flank (21.2%), shoulder (19.3%), back (8.5%), loin (7.9%), neck (7.6%) and chuck (3.4%). Male kids had significantly higher percentage of the neck cuts ($p \leq 0.001$) while females had significantly higher percentage of rib and flank cuts ($p \leq 0.05$). At higher slaughter ages neck ($p \leq 0.05$) and chuck ($p \leq 0.001$) percentages significantly decreased and rib and flank ($p \leq 0.001$) percentage significantly increased. On average, hind leg had 72.2 % of muscle, 8.6 % of fat and 18.8 % of bone. Female kids had higher muscle and lower bone hind leg content than males ($p \leq 0.01$). Hind leg bone content significantly decreased at higher slaughter age ($p \leq 0.01$). Meat from male kids displayed significantly higher cie L($p \leq 0.001$) and b*($p \leq 0.05$) values than females. At higher slaughter age L* values significantly decreased ($p \leq 0.01$) while a* and b* values significantly increased ($p \leq 0.001$; $p \leq 0.01$).*

Key words: carcass traits, kids, meat quality, sex, slaughter age

INTRODUCTION

Increased consumer desire for leaner meat (Potochoida *et al*., 1990), slow development of subcutaneous fat (Warnington and Kirton, 1990), and a good source of desirable fatty acids are the main reasons of a worldwide tendency for a rapid increase in demand of goat meat (Stankov *et al*., 2002). Although consumer perceptions of meat quality varies among countries, ethnic and age groups, Dhanda *et al*. (1999b) reported that meat quality of goats is influenced by genetic type, age, sex and nutritional conditions.

Relating to the potential of increased age and body weight at slaughter of goat kids to maximize meat production there is little published information. A few researches which have studied carcass value of goat kids slaughtered at different body weights and age have yielded varying results (Pieniak-Lendzion *et al*., 2010). Mattos *et al*. (2006) highlighted body weight and age at slaughter as one of the

most important items to valorise a carcass, whose main goal should be to obtain higher final weight in shorter time in feedlot, in order to meet the demands of the consumer. Shrestha and Fahmy (2007) reported that breeds with a potential to increase profitability are those with heavier weights at maturity and genetic propensity for meat production, such as the Boer goat. The Boer goat is a famous meat purpose breed well known for its rapid growth, excellent meat quality and high fertility (Greyling, 2000; Malan, 2000). Slovenia imported Boer goat from Germany and Austria in 1997. Thereon, Boer goat has widespread through the whole Slovenia and today is the most numerous Slovenian goat breed (Kompan *et al*., 2011). It is reared mostly extensively and the kids are slaughtered very young with lower slaughter weights.

In order to achieve higher production and a final product with a high quality the strategy could be to explore differences in carcass and meat quality traits at different ages at slaughter. Therefore, the objective of this study was to evaluate some carcass and meat quality traits of male and female Boer kids at two different slaughter ages.

MATERIAL AND METHODS

Animals

A total of thirty-four kids (17 male and 17 female) of the Boer breed were used in the study. Until weaning the kids were reared in flock with their does at three different farms under controlled conditions. After weaning, the kids were chosen from the farms and transported at the Educational and Research Animal Husbandry Centre in Logatec, where they were fed with commercial concentrate (18% crude protein, 2.2% crude fat, 7.9% crude fibre, 7.8% ash) and hay *ad libitum*. Water and salt blocks were also available *ad libitum*. The kids were weighted every two weeks, until they reached the predetermined slaughter weight of 20 kg (Group 1) and 30 kg (Group 2). The first group (Group 1) comprised of 9 male and 8 female kids and the second group (Group 2) of 8 male and 9 female kids. The average age of slaughter for animals in the study was 83 days (Group 1) and 139 days (Group 2), respectively.

Slaughtering

When kids reached predetermined slaughter weight they were weighted and transported to the experimental abattoir at Zootechnical Department of Biotechnical Faculty in Domžale, placed approximately 50 km from Logatec. After arrival at the abattoir, kids were placed in covered yards and fasted for 12 h with free access to water. Additionally, kids were weighed immediately prior to slaughter (slaughter weight, SW). The dressed carcass comprised body after removing the skin, lower limb parts (at the carpal, i.e. tarsal joint) and the viscera. Testes and scrotal fat were also removed while kidneys, kidney and pelvic fat were retained in the carcass (according to the methodology of Colomer-Rocher *et al*., 1987).

Muscle pH was determined using a pH meter (MA 130, Metter Toledo) with a combined electrode by insertion in the *longissimus dorsi* muscle (behind last rib)

45 min (pH_{45}) and 24 h (pH_{24}) after slaughter. Meat colour was measured as a triplicate on the cross section of *longissimus dorsi* muscle after 30 min of exposure to air by chromo meter (Minolta CR 300) and expressed as CIE L*a*b* values.

Carcasses were kept at room temperature for 2 h, and then chilled at 4°C for 24 h in a conventional chiller. After chilling, carcasses were weighted (cold carcass weight, CCW) and split down the dorsal midline. The right sides were divided into neck, shoulder, chuck, back, loin, rib and flank, and hind leg (Figure 1). Each cut was separately weighted and expressed as a percentage of CCW. Right hind leg was further separated into muscle, subcutaneous fat and bone and also expressed as a percentage of CCW. Dressing percentage (DP) was defined as a ratio of cold carcass weight (CCW) to slaughter weight.

Statistical analysis

The data were analyzed using MIXED procedures of SAS/STAT software package (SAS Institute, 2008). The analysis was performed according to the following linear model: y_{ijk} $\mu+S_i+G_j+e_{ijk}$, where: y_{ijk}=dependent variable; μ=overall mean; S_i=fixed effect of sex ($_i$=male, female); G_j=fixed effect of group ($_j$=Group 1, Group 2); e_{ijk}=residual error. Least squares means of carcass and meat quality traits were computed and tested for differences using Scheffe's test. Differences detected at the 0.05 level or less were considered statistically significant.

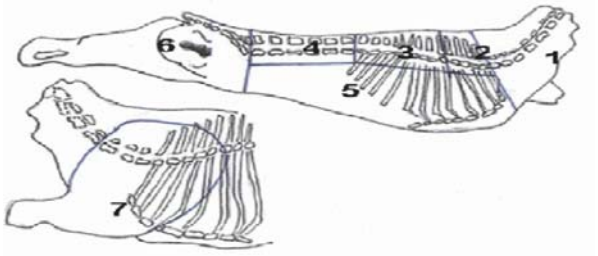

Figure 1. Goat carcass cuts
1 – neck; 2 – chuck; 3 – back; 4 – loin; 5 – rib and flank; 6 – hind leg; 7 – shoulder

RESULTS AND DISCUSSION

Carcass traits of male and female Boer kids at different slaughter ages are presented in Table 1. An average slaughter weight of Boer kids was 27.4 kg, respectively. Male kids at slaughter were significantly heavier ($p\leq0.01$) than the females by 3 kg. Due to the fact that under identical feeding and management conditions male kids grew faster and had higher slaughter weights than females they had also higher cold carcass weights. Average values for slaughter weight of Group 1 and Group 2 were within the predetermined ones and therefore significantly different ($p\leq0.001$). Consequently, these differences influenced the average values of cold carcass weights (Table 1). Literature reports indicated that dressing percentage in goats varies between 38 and 56 % and it dependents on

breed, sex, age, weight and conformation (Anjaneyulu and Joshi, 1995; El Hag and El Shargi, 1996; Dhanda *et al.,* 1999a; Getahun, 2001). According to the above mentioned, the average values for dressing percentage in our study were within the range for goats (Table 1). Although mean values for dressing percentage between sexes were not significantly different, females (47.1 %) had slightly higher values than male kids (45.3 %). These results are in agreement with Mahgoub *et al*. (2005) who reported lower dressing percentage for male than for female Omani Jebel Akhdar goats.

Cuts of half carcasses arranged from greatest to smallest were: hind leg (28.5%), rib and flank (21.2%), shoulder (19.3%), back (8.5%), loin (7.9%), neck (7.6%) and chuck (3.4%). The percentages of these cuts, except of the neck percentage, are lower than those obtained by Mayi and Alkass (2010) on kids slaughtered at 3-4 and 6 months of age. These differences could be due to different cutting procedures. Sex and age at slaughter did not affect the percentage contribution of the kidney (Table 1). Female kids had significantly higher ($p \leq 0.05$) percentage of the kidney fat than males. The findings agree with Mahgoub *et al*. (2002) who reported that there was a trend of intact male kids having the lowest and females the highest kidney fat percentage. Slaughter age had no significant effect on the percentage contribution of kidney fat.

Except for the neck, rib and flank percentage, which were significantly different in the present study, other carcass cuts between sexes did not differ significantly. Male kids had significantly higher percentage of neck cuts ($p \leq 0.001$) while females had significantly higher percentage of rib and flank cuts ($p \leq 0.05$). Partially, this agrees with Ringdorfer *et al*. (2011) who reported higher neck percentage in male kids and higher loin percentage in females.

There were significant differences between ages at slaughter for the percentage contribution of some primal cuts. At higher slaughter ages neck and chuck percentage decreased and rib and flank percentage increased (Table 1). Peña *et al*. (2007) also reported increased rib percentage and decreased neck percentage at higher slaughter ages and weights. Wilson (1958) and Colomer-Rocher *et al*. (1992) indicated that with increasing slaughter ages and weights in kids the percentage of shoulder and hind leg decreased while the percentage of ribs, flank and neck increased. Furthermore, Zimerman *et al*. (2008) found that at higher slaughter ages in kids the hind leg percent increased, shoulder and neck percentage decreased while rib and flank were not significantly different.

To evaluate carcass tissue composition in the present study, the hind leg (Argüello *et al*., 2001) was used as a good predictor. On average, the hind leg had 72.2% of muscle, 8.6% of fat and 18.8% of bone. There were significant variations between sexes in the percentage of muscle and bone hind leg cut. Female kids had higher muscle and lower bone hind leg content than males ($p \leq 0.01$). Hind leg fat content between male and female kids had not been significantly different. Fat is late maturing tissue, achieving its highest proportions at higher body weights (Kadim *et al*., 2003). Thus, absence of differences between genders could be attributed to lower average weights of animals in this study. In addition, fat is considered to be the most variable tissue in carcasses (Shorthose and Harris, 1991).

Table 1. Least-squares means (± SE) of carcass traits of male and female Boer kids at two different slaughter ages

Trait	Intercept	SE	Male (n=17)	Female (n=17)	SE	Sig.	Group 1 (n=17)	Group 2 (n=17)	SE	Sig.
SW, kg	27.50	0.912	25.49	22.41	0.814	**	18.86	29.04	0.813	***
CCW, kg	12.77	0.697	11.61	10.55	0.642	*	8.85	13.30	0.641	***
DP, %	46.46	1.363	45.37	47.10	1.273	ns	46.79	45.62	1.271	ns
Kidney, %	0.78	0.032	0.80	0.79	0.029	ns	0.80	0.79	0.029	ns
Kidney fat, %	2.27	0.221	1.77	2.28	0.197	*	2.03	2.02	0.196	ns
Neck, %	7.67	0.221	8.59	7.87	0.205	***	8.43	8.03	0.205	*
Chuck, %	3.46	0.096	3.70	3.63	0.086	ns	3.84	3.49	0.086	***
Shoulder, %	19.33	0.684	20.43	19.08	0.599	ns	19.52	20.00	0.598	ns
Back, %	8.53	0.135	8.57	8.59	0.115	ns	8.65	8.52	0.115	ns
Loin, %	7.90	0.131	7.89	8.02	0.106	ns	8.07	7.84	0.106	ns
Rib and flank, %	21.23	0.348	19.57	20.44	0.311	*	19.22	20.79	0.310	***
Hind leg, %	28.52	0.356	28.72	28.44	0.313	ns	28.49	28.67	0.195	ns
Hind leg composition, %										
muscle	72.22	0.636	69.13	71.62	0.506	**	69.77	70.97	0.509	ns
fat	8.69	0.479	8.78	8.12	0.164	ns	7.88	9.02	0.454	ns
bone	18.82	0.525	22.18	19.98	0.430	**	22.24	19.92	0.431	**

Sig.: level of significance, ns: not significant, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Table 2. Least-squares means (± SE) of meat quality traits of male and female Boer kids at two different slaughter ages

Trait	Intercept	SE	Male (n=17)	Female (n=17)	SE	Sig.	Group 1 (n=17)	Group 2 (n=17)	SE	Sig.
pH_{45}	5.91	0.040	6.01	6.03	0.034	ns	6.04	5.95	0.034	ns
pH_{24}	5.52	0.019	5.48	5.53	0.016	ns	5.51	5.50	0.016	ns
CIE L*	41.34	1.259	46.18	42.18	1.154	***	45.02	43.34	1.152	**
a*	17.81	0.496	16.64	16.76	0.426	ns	15.65	17.75	0.425	***
b*	7.10	0.313	7.40	6.64	0.277	*	6.55	7.48	0.277	**

Sig.: level of significance, ns: not significant, $*p \le 0.05$, $**p \le 0.01$, $***p \le 0.001$

Hind leg bone content significantly decreased at higher slaughter age ($p \leq 0.01$) while hind leg muscle and fat content were not significant at higher slaughter age. Singh *et al*. (1991) and Dhanda *et al*. (1999a) also documented that in primal cuts the percentage of bone decreased significantly with age and weight. Contrary to results of the present study, Mayi and Alkas (2010) found that Meriz kids fattened for 150 days had slightly and insignificantly more content of hind leg muscles (64.1% vs. 63.9%) and bone (19.3% vs. 18.6%) and less content of fat (17.4% vs. 16.5%) compared to those fattened for 90 days.

Meat quality traits of male and female Boer kids at different slaughter ages are presented in Table 2. The pH values (pH_{45} and pH_{45}) indicate a proper course of glycolysis and are similar to those reported by Marichal *et al*. (2003) and Stanisz *et al*. (2009). As in the research of Simela *et al*. (2004) and Bonvillani *et al*. (2010) in the present study sex and slaughter age had no significant influence on pH_{45} and pH_{24} values. The average meat colour values for L*(lightness), a*(redness) and b*(yellowness) were 41.34, 17.81 and 7.10, respectively. Meat from male kids displayed significantly higher L* ($p \leq 0.001$) and b*($p \leq 0.05$) values than females. These results are partially in agreement with Bonvillani *et al*. (2010) who reported that male kids had significantly higher L* and a* values than females. Contrary, Todaro *et al*. (2002) and Rodrigues *et al*. (2004) did not find significant differences in meat colour parameters between male and female kids. The age of slaughter had significant influence on all meat colour parameters (Table 2). As in the research by Dhanda *et al*. (1999c), indicating a darker muscle colour and more yellow fat colour, in our study L* values decreased ($p \leq 0.01$) while a* and b* values increased ($p \leq 0.001$; $p \leq 0.01$) at higher slaughter age.

CONCLUSIONS

In the present work, sex and age at slaughter had some influence on the studied traits. Female kids had more kidney fat and higher rib and flank percentage while males had only higher neck percentage. Hind leg composition showed that female kids had higher muscle and lower bone content than males. Compared to female kids, males had significantly lighter meat colour. Increasing slaughter age from 83 to 139 days, except for higher rib and flank and lower bone hind leg content, did not show advantages in carcass cut contribution. Regardless of these results, and because of the fact that Boer goat is a breed with huge meat production potential, it would be interesting to conduct a study to investigate the effects of some other feeding and management conditions on carcass and meat quality traits. Additionally, at higher slaughter age this study showed darker meat colour and more yellow fat colour. As meat colour is used by consumers opinion to judge visual meat quality it would be interesting to conduct more detailed studies with consumers included.

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UTICAJ POLA I STAROSNOG DOBA NA KVALITET TRUPOVA I MESA BOER JARADI

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SADRŽAJ

U ovoj studiji su prikazani rezultati određivanja kvaliteta trupova i mesa Boer jaradi (17 muških i 17 ženskih) u uzrastu od 83 i 139 dana. Procentualna težinska zastupljenost pojedinih delova trupa bila je (od najtežih prema najlakšim): but (28,5%), rebra i slabine (21,2%), plećka (19,3%), leđa (8,5%), bubrežnjak (7,9%) i otpad (3,4%). Muška jarad je imala značajno teže vratove ($p \leq 0,001$) a ženska rebra i slabine ($p \leq 0,05$). Sa starošću jaradi, značajno se smanjivalo procentualno učešće vrata ($p \leq 0,05$) i otpada ($p \leq 0,001$) a povećavalo učešće rebara i slabina ($p \leq 0,001$). U proseku je u butovima bilo 72% mesa, 8,6% masti i 18,8% kostiju. Ženska jarad je procentualno imala više mesa a manje kostiju u butovima ($p \leq$

0,01). Procenat kostiju u butovima se značajno smanjivao u većem uzrastu ($p \leq 0,01$). Meso muških zivotinja je imalo značajno veće L i b vrednosti u odnosu na žensku jarad ($p \leq 0,001$ i $p \leq 0,05$ respektivno). Sa uzrastom se L vrednost značajno smanjivala ($p \leq 00,01$) dok su se vrednosti a i b značajno povećavale ($p \leq 0,001$; $p \leq 0,01$).