Effect of housing method, final body weight and sex on abilities for fattening and value of carcasses of Boer goats

Auswirkungen des Tierhaltungssystems, des Endgewichts und des Geschlechts auf Mastleistung und Schlachtkörperqualität von Buren Ziegen

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Zusammenfassung
Ziel dieses Projektes ist es, die Auswirkungen von Tierhaltungssystem, Endgewicht und Geschlecht auf Mastparameter und Schlachtkörperwert von in Österreich gezüchteten Buren Ziegen zu erforschen. Der Versuch wurde vom Institut für Nutztierforschung des LFZ Raumberg-Gumpenstein in Österreich an 109 Buren Ziegen über drei Versuchssaisonen (2003-2005) hinweg durchgeführt. Kitze beiderlei Geschlechts wurden in zwei Haltungssystemen (Stallhaltung und Weide) gehalten, bis das Schlachtgewicht von 18 bzw. 30 kg erreicht war. Der Einfluss auf die durchschnittlichen täglichen Zunahmen während der Mastperiode, Parameter der Schlachtleistung, der Anteil der Teilstücke sowie die Gewebeverteilung wurden untersucht. Die Untersuchungen zeigten Unterschiede bei den Mastparametern, die auf die Stallhaltung bzw. Weidehaltung zurückzuführen waren. Auf grund der erhaltenen Ergebnisse sollten entsprechende Produktionssysteme an die individuellen Bedürfnisse der Züchter ebenso angepasst werden wie an spezifische Betriebsumstände und Zuchtbedingungen sowie an lokale Marketing-Erfordernisse.
Die Ergebnisse könnten auch für eine erste Betriebsanalyse hinsichtlich Kosten und Einkommen für die Züchter genützt werden. Des Weiteren sind die Ergebnisse im Rahmen künstlicher Modelle zweckdienlich für weitere Untersuchungen der wirtschaftlichen Rentabilität. Die Produktion von Buren Kitzen könnte eine gute Zuchtalternative für die österreichischen Bergbauern sein.

Schlagworte: Buren Ziegen, Mast, Schlachtkörper, Schlachtleistung

Abstract
The objective of our study is to present the effect of housing method, final body weight and sex on fattening parameters and value of carcasses of Boer kids bred under Alpine conditions. The experiment was carried out at the Institute of Livestock Research at LFZ Raumberg-Gumpenstein, Austria, on 109 Boer kids during 3 experimental seasons (2003-2005). Kids of both sexes were kept under two housing methods (indoor and pasture) till the slaughter live weight of 18 and 30 kg. The effect of average daily gain during fattening period, slaughter parameters, cuts' content and tissue distribution were calculated. The study showed differences in fattening parameters within the Boer goat due to indoor and pasture housing systems. Proper production system due to obtained results should be adjusted to individual needs of breeder, specific farm circumstances

and breeding conditions as well as to the local marketing requirements. The results might be also used for primal enterprise analysis of costs and incomes for the breeders. Also obtained results might be useful in further investigations of economic profitability using artificial models. The production of kids of Boer goat might be good breeding alternative for farmers in Alps.

Key words: Boer kids, fattening, carcasses, slaughter performance

1. Introduction

Since last decades goat meat production has become more and more popular in Europe due to the increasing interests of producing red meat of excellent quality. Besides the Spanish breed in Europe, there are no goat breeds, which are typical meat producers. For this reason, many European countries decided to import the Boer goat breed. Due to high potential of adaptability of Boer goat to various environmental conditions (Casey and van Niekerk 1988; Erasmus, 2000) it was important to check and adjust the proper production system to gain an optimal meat production due to local agricultural conditions. Moreover, the Boer goat is considered to be a desired component in commercial crossing to improve the meat abilities of many local breeds around the world (Dhanda et al., 1999; Stanisz and Gut, 2003; Werdi Pratiwi et al., 2006).
Meat production may be characterized by growth and development parameters, carcass characteristics and distribution of carcass tissues, therefore various parameters e.g. average daily gain, dressing percentage, anatomical distribution of muscles and content of lean, fat and bone were studied in goats (Mahgoub and Lodge, 1996; Maiorano et al., 2001; Kadim et al., Marichal et al., 2003; Mahgoub et al., Todaro et al., 2004; Webb et al., 2006). As it is said at the Boer Goat Breeders' Association of South Africa (http://www.studbook.co.za/Society/B.Goat/) that dressing percentage fluctuates between 48 and 60%, which is strongly linked to age and quality of animals. In study of Lu (2001), the author indicated that Boer goats have a faster growing rate than other goat breeds. Under good nutritional conditions, the daily gain of the Boer goat could achieve approx. 200 g/day. Growth rate influence reaching the marketing weight, what means that the faster raised kids could be sold earlier. Also van Niekerk and Casey (1988) reported that the Boer goats have a high meat-yield potential. Moreover, Oman et al.(2000) indicated that crossbreeding of non-strictly meat goat breed with Boer goat might improve carcass characteristics, what was also reported by other scientists (for review Niżnikowski et al., 2003; Stanisz and Gut, 2003; Niżnikowski et al., 2006; Shrestha and Fahmy, 2007).
The aim of this paper is to present the effect of housing method, final body weight and sex of kids on fattening parameters and value of carcasses under harsh conditions of Alpine region.

2. Materials and methods

2.1. Animals and live measurements

The experiment was carried out at the Institute of Livestock Research at LFZ Raumberg-Gumpenstein, Austria, in 2003-2005 covering 3 experimental seasons. Each year the Boer goat kids (either from indoor or pasture housing method) were breeding till the final slaughter live weight of both either 18 or 30 kg. Data of fattening parameters to calculate daily gains were collected once a week while kids were kept in

individual pens. These animals which gained their slaughter weight being with mothers were slaughtered. Body weights of kids were collected at birth and twice a week when they were with mothers and once a week when they were fattened in individual pens till the final slaughter weight. Average daily gains (ADG) were calculated due to the formula: ADG = (a-b)/c, where: ADG is average daily gain (g/day), a – final body weight (kg), b – initial body weight (kg), c – length of fattening (day). Also the age at slaughter (days) was taken into account. Obtained results were used in further calculations and comparisons.

2.2. Measurements at slaughter

All kids at slaughter age were weighted and starved for 24 hours and weighted again before slaughter in the LFZ abattoir. After slaughter the hot carcasses (with pelvic fat and kidneys) were weighted in the 1st hour and then stored at 4ºC in a chilling room for next 24 hours postmortem and weighted again. Furthermore, the left half of carcass was separated into 7 primary cuts (neck, neck end, chop, loin, shoulder, leg and breast) due to the guidelines provided by the DLG (German Agriculture Society) (Fuchs and Fuchs, 1989) and each cuts' weight (kg) was obtained as well as the cuts' contents (%) in whole carcass were calculated. Then each cut was separated into the lean, fat and bone tissues and the content of each tissue in each cut and in total carcass were calculated.

2.3. Statistical analysis

Housing method (H), final slaughter weight (W) and sex (S) of kids were concerned as the main effects. Also the effect of the year of experiment was considered, nevertheless it was not included in tables.

The statistical model for fattening parameters is presented to be as following: $y_{ijk} = \mu + H_i + S_j + D_k + (HS)_{ij} + (HD)_{ik} + (SD)_{jk} + e_{ijk}$ and the statistical model for slaughter traits is presented to be: $y_{ijkl} = \mu + H_i + S_j + D_k + W_l + (HS)_{il} + (HW)_{ij} + (WS)_{jk} + (WD)_{jl} + e_{ijkl}$, where: μ – mean; H_i – effect of housing method (i=indoor, pasture); S_j – effect of sex (j=male, female); D_k – effect of the year of experiment (k=2003, 2004, 2005); W_l – effect of final slaughter weight (l=18 or 30 kg); $(HS)_{ij}$ – interaction: housing method*sex; $(HW)_{il}$ – interaction: housing method*final slaughter weight; $(HD)_{ik}$ – interaction: housing method*the year of experiment; $(WS)_{jk}$ – interaction: final slaughter weight*sex; $(WD)_{jl}$ – interaction: final slaughter weight*the year of experiment; $(SD)_{jk}$ – interaction: sex*the year of experiment; e_{ijkl} – residual error.

The effects of factors and interactions on all examined traits were estimated using the least square means analysis (LSM) in Statgraphics Plus software v. 5.1 for Windows (2001). The differences between groups in the year of experiment were checked due to the Student-Neuman-Keuls method.

3. Results and discussion

3.1. Fattening parameters

The effect of housing method (H) and sex (S) on average daily gain (ADG) (g/day) and fattening period (days) due to final slaughter live weight in Boer kids is shown in table 1. The influence of sex appeared to be statistically important in both AGD and age at slaughter. In case of the group of kids from birth to 18 kg the effect of sex was significant ($p \leq 0.05$) in ADG and highly significant ($p \leq 0.01$) in age at slaughter. In case

of the group of kids from 18 to 30 kg the differences between males and females were highly significant both in AGD as well as age at slaughter. The effect of housing method influenced significantly ($p \leq 0.05$) both AGD and age at slaughter only in the older group of kids from 18 to 30 kg and kids from indoor housing grew up better requiring less days to gain the final weight than kids from the same weight group kept on pasture. Average daily gains of the animals fattened till 30 kg were over 200 g/day and were affected by housing system ($p \leq 0.05$) and sex of kids ($p \leq 0.001$) as well. Barry and Godke (1997) reported that the fastest growers among young Boer goats achieved 163.0 g/day in 1989. The same authors mentioned also the ADG over 100 days to be 213.0 and 184.0 g/day in male and female kids of German breeding, respectively, what shows similar tendency to our results. Similar values of ADG were reported also by Rahmann (2001).

Changes of average daily gain (ADG) (g/day) within the fattening period due to housing method and sex of Boer kids is presented on the figure 1. Effect of housing method in male kids of both fattening groups was not as large as it was obtained in female kids where the benefits from fattening (higher ADG and faster growth) were more desired in the indoor housing. Lu (2001) showed the growth ability of kids to be the best till 41 kg of live weight. Also Ringdorfer et al. (2001) indicates similar values for growth traits.

3.2. Slaughter performance

The effect of housing method, final slaughter weight and sex on slaughter parameters of Boer kids is shown in table 2. All factors influenced the slaughter age and pelvic fat content at highly significant level ($p \leq 0.001$). The same tendency in affecting the pelvic fat content was reported by Ringdorfer et al. (2001). Higher ratio of pelvic fat in the housing system of fattening kids might suggest the higher fat content of the carcasses (tab. 4).

Kids from indoor housing grew faster than kids from pasture. Moreover male kids developed earlier than females. The slaughter weight of 18 kg was possible to achieve within 91.41 days by kids, whereas the 30 kg of live weight was achieved after 149.01 days. Kids from the group fattened till 18 kg had lower skin content than kids from the group fattened till 30 kg. Moreover, no effect of chosen factors was observed at weight losses after 24-hrs starving, although the differences were observed. The dressing percentage was affected statistically by housing method ($p \leq 0.001$), final slaughter weight ($p \leq 0.01$) and sex ($p \leq 0.05$). Kids from the indoor housing had significantly ($p \leq 0.001$) better dressing percentage than kids kept outside. Older kids from the group fattened till 30 kg had higher dressing percentage than kids fattened till 18 kg. Also male kids had lower dressing percentage than female kids. Barry and Godke (1997) reported dressing percentage for 8-10-months-old kids to be 48%. These authors suggested also, that the carcass weight should not be heavier than 23 kg (live-mass weight of ca. 38-43 kg) due to the thin layer of fat over the carcass.

Table 3 presents the influence of housing method, final slaughter weight and sex on cuts' ratio (%) in carcass of Boer kids. The ratios of shoulder and breast were significantly influenced by all mentioned factors. Sex of kids influenced the neck and loin ratios at significance level of $p \leq 0.01$ and neck end at $p \leq 0.05$ The neck and neck end ratios appeared to be higher in male than in female kids in contrast to the loin ratio, which was lower in males. Final slaughter weight influenced the chop ratio at $p \leq 0.05$ and the leg ratio at $p \leq 0.001$. Chop ratio was higher in the group of 18 kg than in the group of 30 kg. Similar results tendency was observed in the leg ratio. The housing

method affected the shoulder ratio at p≤0.05 and was lower in the indoor group than in the pasture group. Moreover, significantly (p≤0.01) higher breast ratio was observed in indoor group than in pasture group. Higher ratio of chop (p≤0.05), shoulder (p≤0.01) and leg (p≤0.001) was observed in the group fattened till 18 kg than in the group of kids till 30 kg. Significantly lower (p≤0.001) ratio of breast was observed in the group of kids till 18 kg. In male kids the ratio of neck (p≤0.01), neck end (p≤0.05) and shoulder (p≤0.001) was statistically higher than in female kids. Female kids appeared to have higher ratio of loin (p≤0.01) and breast (p≤0.001) than male kids. Obtained values, especially in the effect of final slaughter weight on the shoulder, leg and breast contents, were slightly higher to these presented by Ringdorfer et al. (2001), probably due to the genotype of analyzed animals (pure Boer and BoerxSaanen crossing).

3.2. Tissue characteristic

The tissue characteristic (lean, fat and bone) of carcass and cuts separately in Boer kids due to housing method, final slaughter weight and sex is presented in table 4.

Total carcass. Lean (p≤0.01), fat and bone ratios in whole carcass depended statistically on sex of kids. Final slaughter weight influenced the fat and bone contents at p≤0.01 and p≤0.001, respectively. The effect of housing method was statistically important (p≤0.05) only in fat ratio. Lean ratio was higher in male kids than in female kids. Kids from the indoor housing method had higher fat content than these from pasture system. Also kids from the group of 18 kg had lower fat content than kids from the group of 30 kg. Female kids had higher fat ratio than male kids. Bone ratio was higher in the group of 18 kg and in male kids than in the group of 30 kg and in female kids. The present results are similar to those obtained by (Marinova et al., 2001; Sen et al., 2004).

For the 4 basic cuts: leg, shoulder, loin and chop, the tissues content varies as follows:

Chop. Lean content was not influenced by any of factors. Fat and bone contents were influenced by final slaughter weight and sex of kids at p≤0.001. Fat content was lower in the group of 18 kg than in the group of 30 kg and lower in male kids than in female kids. Bone content was higher in the group of 18 kg than in the group of 30 kg and higher in male kids than in female kids. **Loin.** Lean content was not influenced by any of factors. Fat and bone contents depended on the final slaughter weight and sex, both at p≤0.001. Fat content was lower in the group of 18 kg than in the group of 30 kg and lower in male kids than in female kids. Bone content was higher in the group of 18 kg than in the group of 30 kg and higher in male kids than in female kids. **Shoulder.** Lean content was influenced by sex (p≤0.01) and was higher in male kids than in female kids. Fat and bone contents depended on the final slaughter weight and sex, both at p≤0.001. Fat content was lower in the group of 18 kg than in the group of 30 kg and lower in male kids than in female kids. Bone content was higher in the group of 18 kg than in the group of 30 kg and higher in male kids than in female kids. **Leg.** Lean content was influenced by the final slaughter weight (p≤0.01) and was lower in the group of 18 kg than in the group of 30 kg. Fat and bone contents depended on the final slaughter weight and sex, both at p≤0.001. Fat content was lower in the group of 18 kg than in the group of 30 kg and lower in male kids than in female kids. Bone content was higher in the group of 18 kg than in the group of 30 kg and higher in male kids than in female kids. Similar results of tissue composition were obtained by Oman et al. (2000) for Boer crosses with Spanish goat. Goat carcasses of Florida native breed seemed to show less fat content (Johnson et al., 1998) although the results of one-step crosses of Angora and

Saanen with Boer goat in India showed similarity to the present results (Dhanda et al., 1999).

4. Conclusion

Presented results may guide to the following observations:
Male kids can be fattened till 30 kg, irrespective of the fattening system.
It is better to fattening female kids till 18 kg in both fattening systems
Indoor housing system is slightly better than pasture system of fattening in faster growth and gaining final body weight as well as in the average daily gains.
Indoor fattening of kids gave higher dressing percentage together with higher fat content in whole carcass.
Higher fat ratio was observed both in heavier kids (group of 30kg) and in female kids.
Male kids had lower fat ratio, but higher lean and bone ratios than female kids.
Fattening systems affected bone ratio ($p \leq 0.01$) in loin as well as lean and fat ratios in breast ($p \leq 0.05$).
In the tissue composition of 4 valuable cuts (shoulder, chop, loin and leg), the significant influence of final body weight and sex was only observed in the bone and fat ratios.
The lean ratio in leg was statistically ($p \leq 0.01$) affected by final body weight, but in the shoulder the lean ratio was affected ($p \leq 0.01$) by the sex of kids.
In general, the study showed differences in fattening parameters within the Boer goat due to indoor and pasture housing systems. The results do not clarify which production system should be directly applied for farmers. Therefore, proper production system should be adjust to individual needs of breeder, due to farm circumstances and breeding conditions as well as to the local marketing requirements. The results might be also used for primal enterprise analysis of costs and incomes for the breeders. The production of kids of Boer goat might be good alternative for farmers in Alps. Also obtained results might be useful in further investigations of economic profitability using artificial models.

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Table 1 Effects of housing method (H) and sex (S) on average daily gain (g/day) and fattening (days) due to final slaughter weight in Boer

Items	Factors							
	Housing method (H)				Sex (S)			
	indoor		pasture		males		females	
	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N
Average Daily Gain (g/day)								
Birth – 18 kg	166.48±5.03	40	158.51±3.91	66	170.55*±4.46	53	154.45*±4.41	53
18 – 30 kg	233.60*±7.83	19	209.70*±6.48	28	241.48***±6.97	25	201.83***±7.28	22
Fattening (days)								
Birth – 18 kg	88.69±3.25	40	95.11±2.53	66	86.09**±2.88	53	97.70**±2.85	53
18 – 30 kg	50.59*±2.21	19	58.00*±1.83	28	48.94***±1.97	25	59.64***±2.06	22

Significance at: ***-P<0.001, ** - P<0.01, * - P<0.05

Figure 1 Changes of average daily gain (ADG) (g/day) within the fattening period due to housing method, final body weight and sex of Boer kids

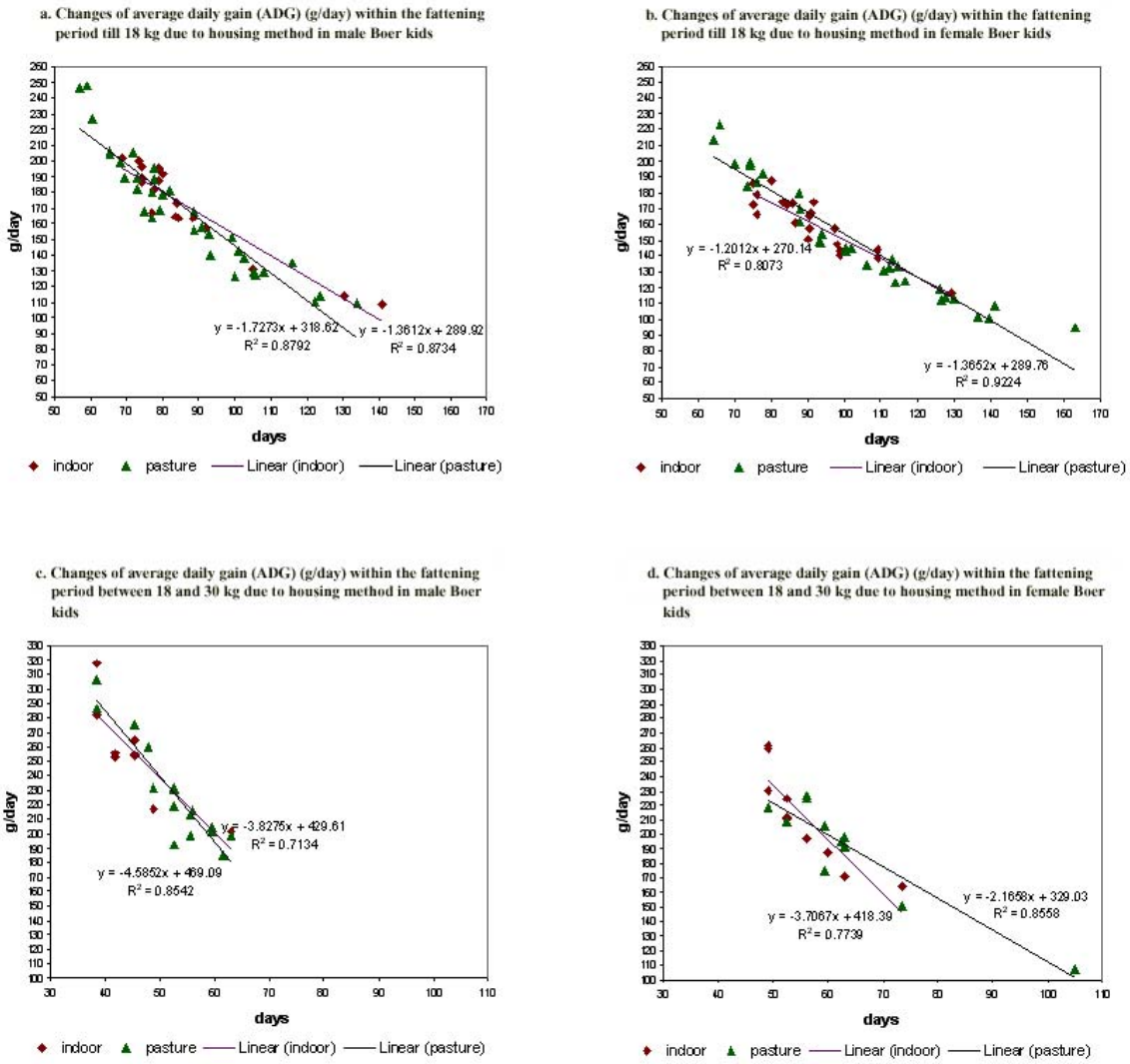

Table 2 Effects of housing method (H), final slaughter weight (W) and sex (S) on slaughter parameters of Boer kids

Items	Factors					
	Housing method (H)		Final slaughter weight (W)		Sex (S)	
	indoor	pasture	18 kg	30 kg	male	female
	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
N	55	54	58	51	63	46
Slaughter age (days)	112.45***±2.61	128.02***±2.59	91.41***±2.51	149.01***±2.71	113.23***±2.37	127.24***±2.86
Slaughter weight (kg)	23.19±0.12	23.07±0.12	17.45***±0.12	28.80***±0.13	23.15±0.12	23.11±0.14
Weight losses after 24 hrs starving (%)	6.84±0.35	6.29±0.35	6.68±0.34	6.45±0.37	6.43±0.32	6.70±0.39
Dressing percentage (%)	49.60***±0.33	47.99***±0.32	48.14**±0.31	49.45**±0.34	48.20*±0.30	49.39*±0.36
Skin (%)	8.21±0.08	8.36±0.08	8.06**±0.08	8.51**±0.09	8.26±0.08	8.31±0.09
Pelvic fat (%)	2.51***±0.09	1.93***±0.09	1.70***±0.09	2.74***±0.10	1.61***±0.08	2.83***±0.10

Significance at: *** - P<0.001, ** - P<0.01, * - P<0.05

Table 3 Effects of housing method (H), final slaughter weight (W) and sex (S) on cuts' content in carcasses of Boer kids

Item	Factors					
	Housing method (H)		Final slaughter weight (W)		Sex (S)	
	indoor	pasture	18 kg	30 kg	male	female
	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
N	55	54	58	51	63	46
Neck (%)	8.33±0.12	8.42±0.12	8.45±0.11	8.30±0.12	8.60**±0.11	8.15**±0.13
Neck end (%)	5.88±0.06	5.92±0.06	5.99±0.06	5.82±0.07	6.00*±0.06	5.80*±0.07
Chop (%)	8.32±0.08	8.39±0.08	8.47*±0.08	8.24*±0.08	8.46±0.08	8.25±0.09
Loin (%)	6.90±0.09	7.10±0.09	6.99±0.09	7.02±0.10	6.79**±0.09	7.22**±0.10
Shoulder (%)	19.52*±0.12	19.91*±0.12	20.03**±0.12	19.40**±0.13	20.10***±0.11	19.34***±0.13
Leg (%)	31.95±0.13	31.96±0.13	32.33***±0.13	31.58***±0.14	31.92±0.12	31.99±0.15
Breast (%)	19.09**±0.21	18.31**±0.21	17.74***±0.20	19.65+***0.22	18.14***±0.19	19.26***±0.23

Significance at: *** - P<0.001, ** - P<0.01, * - P<0.05

Table 4 Effects of housing method (H), final slaughter weight (W) and sex (S) on percentage of lean, fat and bone in whole carcass and each of cuts in Boer kids

Item	Factors					
	Housing method (H)		Final slaughter weight (W)		Sex (S)	
	indoor	pasture	18 kg	30 kg	male	female
	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
N	55	54	58	51	63	46
Total (%)						
Lean	59.38±0.39	60.29±0.39	59.87±0.38	59.80±0.41	61.03**±0.36	58.65**±0.43
Fat	18.75*±0.44	17.46*±0.44	15.96**±0.43	20.23**±0.46	15.92**±0.40	20.29**±0.49
Bone	21.88±0.20	22.25±0.20	24.17***±0.19	19.95***±0.21	23.06***±0.18	21.07***±0.22
Neck (%)						
Lean	59.22±0.63	59.44±0.63	58.14**±0.61	60.52**±0.66	61.25**±0.58	57.42**±0.69
Fat	14.69±0.47	14.10±0.47	13.74±0.45	15.05±0.49	12.98±0.43	15.81±0.51
Bone	26.22±0.50	26.36±0.49	28.11**±0.48	24.47**±0.52	25.80±0.45	26.78±0.54
Neck end (%)						
Lean	58.69±0.56	59.10±0.55	58.47±0.54	59.31±0.58	60.14**±0.51	57.64**±0.61
Fat	15.15±0.52	14.87±0.52	13.19***±0.50	16.83***±0.54	13.41±0.47	16.61±0.57
Bone	26.16±0.36	26.03±0.36	28.34***±0.35	23.85***±0.38	26.44±0.33	25.75±0.40
Chop (%)						
Lean	52.31±0.57	53.05±0.57	52.09±0.55	53.27±0.60	53.37±0.52	51.99±0.63
Fat	19.96±0.63	19.13±0.63	16.54***±0.61	22.56***±0.66	16.94***±0.57	22.16***±0.69
Bone	27.73±0.54	27.82±0.54	31.37***±0.52	24.18***±0.56	29.70***±0.49	25.85***±0.59
Loin (%)						
Lean	55.37±0.93	54.32±0.93	54.00±0.90	55.69±0.67	55.48±0.85	54.22±1.02
Fat	20.07±0.82	19.26±0.82	16.59***±0.79	22.74***±0.86	17.39***±0.75	21.95***±0.90
Bone	24.56**±0.55	26.42**±0.55	29.40***±0.53	21.57***±0.58	27.14***±0.50	23.84***±0.61
Shoulder (%)						
Lean	61.71±0.43	62.49±0.43	62.46±0.42	61.75±0.45	62.94**±0.39	61.26**±0.47
Fat	17.36±0.48	16.41±0.47	14.83***±0.46	18.94***±0.50	15.09***±0.43	18.68***±0.52
Bone	20.93±0.17	21.10±0.17	22.72***±0.16	19.31***±0.18	21.97***±0.15	20.06***±0.19
Leg (%)						
Lean	65.87±0.29	66.42±0.29	65.53**±0.28	66.76**±0.31	66.22±0.27	66.07±0.32
Fat	12.95±0.30	12.15±0.30	11.48***±0.29	13.62***±0.31	11.47***±0.27	13.63***±0.33
Bone	21.19±0.18	21.43±0.18	23.00***±0.18	19.62***±0.19	22.32***±0.17	20.30***±0.20
Breast (%)						
Lean	51.43*±0.84	53.97*±0.83	54.34**±0.81	51.06**±0.87	55.82***±0.76	49.58***±0.92
Fat	31.38*±0.91	28.40*±0.91	26.53***±0.87	33.25***±0.94	25.70***±0.83	34.08***±1.00
Bone	17.19±0.24	17.63±0.24	19.14***±0.24	15.69***±0.25	18.48***±0.22	16.34***±0.27

Significance at: *** - P<0.001, ** - P<0.01, * - P<0.05