CHAPTER 4

4 LIVE ANIMAL AND CARCASS CHARACTERISTICS OF SOUTH AFRICAN INDIGENOUS GOATS

4.1 INTRODUCTION

The acceptability of a carcass lies in its perceived value, which includes the potential meat yield of the carcass (Kempster, 1983; Chrystall, 1998) and the eating quality of the meat (Chrystall, 1998). To processors, wholesalers and the producers to some extent, the value of the carcass lies mainly in its potential saleable meat yield (Chrystall, 1998). Traits such as the weight and conformation of the live animal and of the carcass as well as fat distribution within the carcass are therefore of great importance in the early stages of meat production. The proportion of high value cuts also plays an important role in as much as it reflects the amount of high quality meat that may be obtained from the carcass.

Although live animal and carcass attributes are principally concerned with the quantity of saleable meat that can be obtained from the carcass, they also have significant implications on the technological value of the carcass. These attributes influence the biochemical and physiological processes in meat during slaughter and chilling, and hence the resultant quality of the meat. Therefore, early identification of animal characteristics that affect meat quality is beneficial for the production of meat of acceptable quality.

The purpose of this chapter is to describe the carcasses of the sample of South African indigenous goats that were used to evaluate chevon quality in the subsequent chapters.

4.2 RESULTS

4.2.1 Live Animal and Carcass Characteristics

The effects of sex, age and pre-slaughter conditioning on the live animal and carcass characteristics of the South African indigenous goats are presented in Tables 4.1 to 4.3.

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4.2.1.1 Effect of sex on the live animal and carcass characteristics

Male goats were significantly bigger (*P*<0.0001) than the females (Table 4.1). Live weights of intact and castrated males were on average 5.44kg heavier and the chilled carcasses 2.32kg heavier than those of the females. Losses during dressing and chilling did not vary with sex (*P*>0.05). The overall mean DO% and chilling losses were respectively 40.55 ± 4.41% and 2.67 ± 1.03%.

Intact males had the largest frames, reflected by the broader chests (*P*<0.01) and longer carcasses (*P*=0.0001). The three sex classes however had similar LT area, whose overall mean was 10.79 ± 3.44cm^2. They also had similar internal fat content (*P*>0.05), whose overall means were 727±561g omental fat and 461±341g KKCF.

4.2.1.2 Effect of age on live animal and carcass characteristics

All weight and linear measurements increased significantly (*P*<0.01) with animal age as was expected (Table 4.2). The overall increases in live weight and carcass weights were 53% and 43%, respectively between the milk- and 8-teeth groups. Corresponding increases in chest girth, chest depth, carcass length, side length and buttock circumference were 18%, 13%, 13%, 15% and 15%, respectively. Dressing out percentages were not significantly affected by the age of the goats, though there was a tendency for the values to decrease with age (*P*=0.087). Chilling losses were highest for the 2-teeth group (*P*<0.05) but similar across all other age groups (*P*>0.05). Internal fat content increased significantly with the age of the goats (*P*<0.0001) such that the 8-teeth group had about twice as much omental and KKCF as the amounts occurring in the goats with up to two permanent incisors.

4.2.1.3 Effect of pre-slaughter conditioning on live animal and carcass characteristics

The goats that were conditioned prior to slaughter were bigger than the non-conditioned group (Table 4.3). The mean live weight of the former group was 4kg heavier (*P*=0.0004) and their carcasses were 3.6kg heavier (*P*=0.0001) than those of the non-conditioned goats. The carcasses of the pre-slaughter conditioned goats lost less weight during dressing (5.85% units) and chilling (0.93% units) compared to those of the non-conditioned group (*P*<0.0001).

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Table 4.1 Effect of sex on live animal and carcass characteristics of South African indigenous goats (means ± S.D.)

	Sex			
	Castrates	Females	Intact males	*P*- value
N	29	44	15	
Slaughter weight (kg)	36.03 ± 6.47[b]	31.41 ± 5.87[a]	37.66 ± 7.17[b]	<0.0001
Hot carcass weight (kg)	15.19 ± 3.62[b]	13.20 ± 2.84[a]	15.89 ± 3.90[b]	0.0023
Cold carcass weight (kg)	14.86 ± 3.55[b]	12.86 ± 2.84[a]	15.49 ± 3.88[b]	0.0021
Dressing out percentage	40.79 ± 3.66	40.99 ± 4.46	40.88 ± 5.50	0.9772
Chilling out percentage	2.15 ± 0.89	2.69 ± 1.06	2.62 ± 1.26	0.0979
Chest girth (cm)	78.20 ± 5.99[b]	74.75 ± 5.21[a]	79.52 ± 6.82[b]	0.0032
Chest depth (cm)	28.52 ± 1.94[a]	28.15 ± 1.67[a]	29.81 ± 1.58[b]	0.0035
Carcass length (cm)	69.80 ± 3.77[a]	67.48 ± 4.11[a]	72.66 ± 4.51[b]	<0.0001
Side length (cm)	63.69 ± 4.31	62.54 ± 4.10	64.29 ± 2.30	0.1956
Buttock circumference (cm)	52.83 ± 4.51	51.59 ± 4.32	53.00 ± 4.58	0.4793
M. longissimus thoracis area (cm^2)	12.24 ± 3.05	11.07 ± 3.19	12.39 ± 4.57	0.2118
Omental fat (g)	845 ± 376	739 ± 619	678 ± 438	0.2859
Kidney knob and channel fat (g)	547 ± 249	493 ± 368	455 ± 298	0.3458

[a, b] Means within a row with different superscripts differ significantly ($P < 0.05$)

Table 4.2 Effect of age on live animal and carcass characteristics of South African indigenous goats (means ± S.D.)

	Age class				
	0 teeth	2 teeth	4 to 6 teeth	8 teeth	*P*-value
N	16	32	20	20	
Slaughter weight (kg)	27.83 ± 3.81[a]	33.07 ± 5.66[b]	36.59 ± 6.39[c]	42.65 ± 3.92[d]	<0.0001
Hot carcass weight (kg)	12.06 ± 2.58[a]	14.11 ± 3.23[b]	15.58 ± 3.15[bc]	17.29 ± 2.84[c]	<0.0001
Cold carcass weight (kg)	11.81 ± 11.43[a]	13.69 ± 3.18[b]	15.22 ± 3.10[bc]	16.91 ± 2.88[c]	<0.0001
Dressing out percentage	42.15 ± 5.99	41.02 ± 3.36	41.37 ± 2.90	39.02 ± 4.34	0.0868
Chilling out percentage	2.24 ± 1.38[a]	3.04 ± 0.56[b]	2.40 ± 1.06[a]	2.28 ± 1.23[a]	0.0250
Chest girth (cm)	71.05 ± 3.44[a]	75.49 ± 4.74[b]	79.33 ± 6.89[c]	84.09 ± 2.39[d]	<0.0001
Chest depth (cm)	27.18 ± 1.68[a]	28.16 ± 1.70[b]	29.28 ± 1.53[c]	30.68 ± 0.99[d]	<0.0001
Carcass length (cm)	66.26 ± 3.73[a]	68.60 ± 4.22[b]	70.11 ± 3.07[b]	74.96 ± 3.22[c]	<0.0001
Side length (cm)	59.72 ± 2.48[a]	62.03 ± 3.31[b]	63.59 ± 3.72[b]	68.68 ± 2.43[c]	<0.0001
Buttock circumference (cm)	48.56 ± 3.36[a]	51.19 ± 3.76[b]	54.16 ± 5.36[c]	55.99 ± 3.10[c]	0.0001
M. longissimus thoracis area (cm^2)	11.10 ± 3.94	11.05 ± 3.35	12.50 ± 2.30	12.94 ± 3.07	0.3345
Omental fat (g)	553 ± 382[a]	554 ± 423[a]	711 ± 229[a]	1 197 ± 716[b]	<0.0001
Kidney knob and channel fat (g)	402 ± 302[ab]	357 ± 275[a]	533 ± 161[b]	700 ± 445[c]	<0.0001

[a, b, c] Means within a row with different superscripts differ significantly ($P < 0.05$)

Table 4.3 Effect of pre-slaughter conditioning on live animal and carcass characteristics of South African indigenous goats (means ± S.D.)

	Pre-slaughter conditioning		
	Non-conditioned	Conditioned	*P*- value
N	49	39	
Slaughter weight (kg)	31.85 ± 6.08	35.88 ± 5.86	0.0004
Hot carcass weight (kg)	12.49 ± 2.86	16.06 ± 2.70	<0.0001
Cold carcass weight (kg)	12.11 ± 2.81	15.72 ± 2.66	<0.0001
Dressing out percentage	37.91 ± 3.61	43.86 ± 2.78	<0.0001
Chilling out percentage	3.08 ± 1.05	2.15 ± 0.73	<0.0001
Chest girth (cm)	75.52 ± 6.08	77.58 ± 5.13	0.0088
Chest depth (cm)	28.52 ± 1.93	28.47 ± 1.61	0.2305
Carcass length (cm)	68.43 ± 3.65	69.58 ± 4.64	0.0624
Side length (cm)	62.33 ± 4.44	63.86 ± 3.40	0.0280
Buttock circumference (cm)	51.47 ± 4.97	52.68 ± 3.70	0.0065
M. longissimus thoracis area (cm^2)	8.99 ± 2.32	13.82 ± 2.83	<0.0001
Omental fat (g)	314 ± 245	1 238 ± 716	<0.0001
Kidney knob and channel fat (g)	228 ± 162	741 ± 286	<0.001

Chest girth, side length and buttock circumference of the carcasses of the pre-slaughter conditioned goats were all significantly greater than those of the non-conditioned goats (P<0.05) by about 2.5% each. Other measurements; carcass length and chest depth, were not affected by pre-slaughter conditioning (P>0.05). Notable differences between the two conditioning groups were the LT area and fat content (P<0.0001). The LT area, omental fat and KKCF values for the pre-slaughter conditioned group were, respectively, 54%, 294% and 225% greater than the values of the non-conditioned group. Thus, the effect of pre-slaughter conditioning was to increase the overall size of the goats and the fat content, and to reduce the losses during dressing and chilling.

4.2.1.4 Interaction effects of sex, age and pre-slaughter conditioning on live animal and carcass characteristics

Table 4.4 summarises the first order interaction effects of sex, age and pre-slaughter conditioning on live animal and carcass characteristics with significant effects (P<0.05) highlighted. Significant interaction effects of pre-slaughter conditioning and sex are illustrated in Figure 4.1. Dressing out percentages of the pre-slaughter conditioned goats were higher than for the non-conditioned goats (P<0.05), more so for the intact males than the castrates and females (Figure 4.1i). However, the values within each conditioning group did not differ significantly (P>0.05). Conversely, chilling losses from the carcasses of the conditioned females and intact males were significantly lower (P<0.05) than those of the non-conditioned ones (Figure 4.1ii). Chilling losses from the carcasses of the castrates were not significantly affected by pre-slaughter conditioning (P>0.05). Non-conditioned females and pre-slaughter conditioned intact males had the broadest chests (P<0.05), which were significantly broader than those of the non-conditioned castrates (Figure 4.1iii).

The interaction effects of age and sex on DO% and chest depth are illustrated in Figure 4.2. Whereas the DO% of the females and intact males declined significantly with the age of the goats (P<0.05), that of the castrates was not significantly affected by age (P>0.05). Chest depth measurements for all three sexes increased with the age of the goats (Figure 4.2ii). The increases were significant for the castrates and females (P<0.05) but not the intact males (P>0.05).

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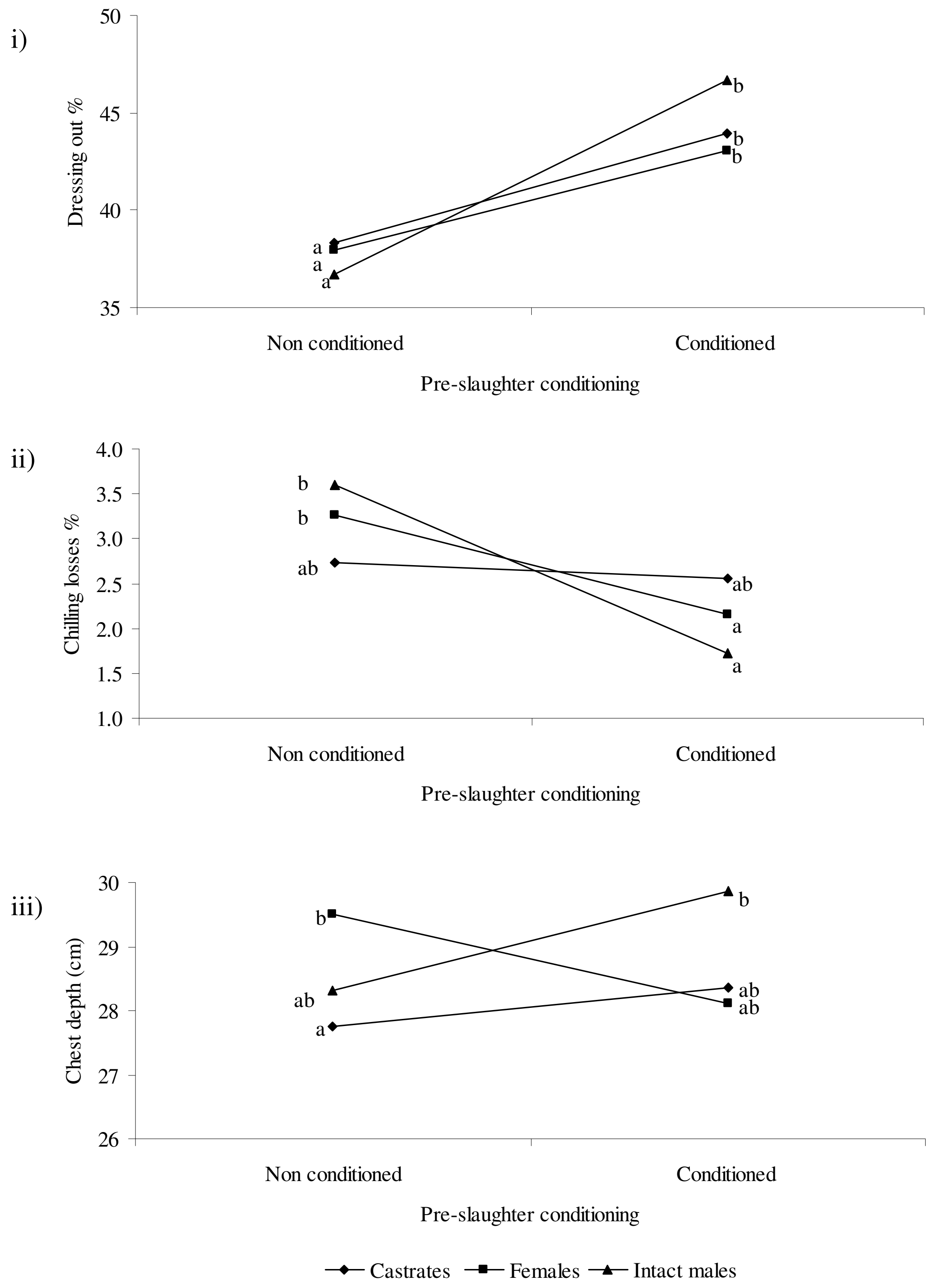
Table 4.4 *P*-values of the first order interaction effects of sex, age and pre-slaughter conditioning on live animal and carcass characteristic of South African indigenous goats

	Interaction effect		
	Age(sex)[1]	Sex*pre-slaughter conditioning	Pre-slaughter conditioning(age)[2]
Slaughter weight (kg)	0.6376	0.7093	0.2805
Hot carcass weight (kg)	0.5354	0.3667	0.3557
Cold carcass weight (kg)	0.5308	0.3178	0.37498
Dressing out percentage	**0.0015**	**0.0023**	0.0588
Chilling out percentage	0.3893	**0.0134**	0.1522
Chest girth (cm)	0.1329	0.4396	0.2011
Chest depth (cm)	**0.0267**	**0.0276**	0.3790
Carcass length (cm)	0.3474	0.0597	0.3754
Side length (cm)	0.4995	0.5700	0.4099
Buttock circumference (cm)	0.6811	0.1703	0.5716
M. longissimus thoracis area (cm^2)	0.2156	0.3121	0.5227
Omental fat (g)	0.5786	0.5630	0.3071
Kidney knob and channel fat (g)	0.1048	0.4429	0.4007

NB: 1- sex effects were nested in age effects (§ 3.8.1 refers)

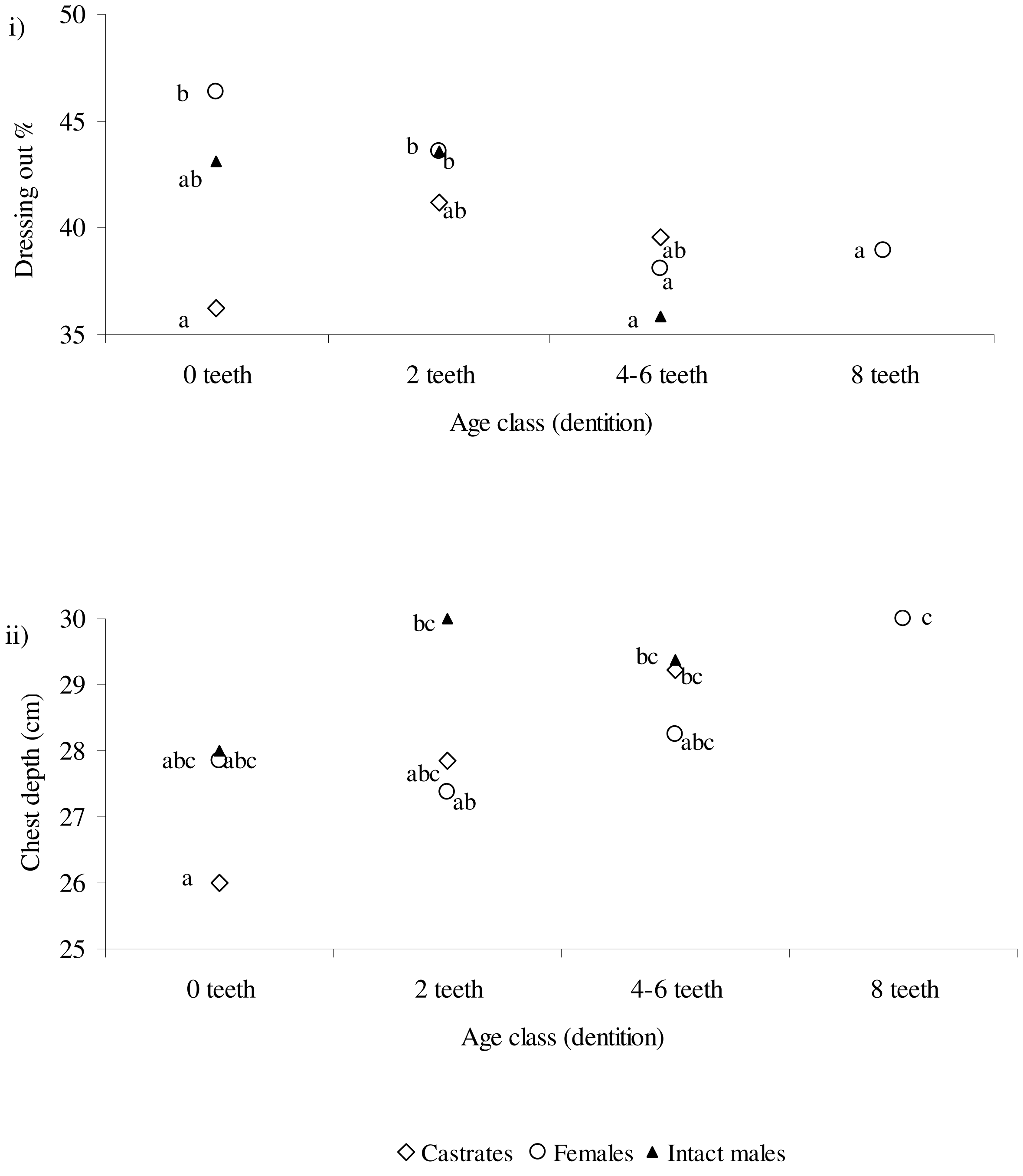
2- Age effects were nested in conditioning effects (§ 3.8.1 refers)

Significant interaction effects (P<0.05) are in bold face



<u>NB</u> Points within a graph with different letters 'a' or 'b' differ significantly (*P*<0.05)

Figure 4.1 The effects of the interaction between pre-slaughter conditioning and sex on i) dressing out percentage, ii) chilling losses percentage, and iii) chest depth (cm)



NB Points within a graph with different letters 'a' or 'b' or 'c' differ significantly (P<0.05)

Figure 4.2 The effects of the interaction between age and sex on i) dressing out percentage and ii) chest depth (cm)

4.2.2 Carcass Composition

Means and standard deviations of the weights and proportions of each joint and weights and proportions of dissectible tissues in the right half of each carcass are presented for each sex (Tables 4.5–4.8), age (Tables 4.10–4.13) and pre-slaughter conditioning group (415–4.18) In addition the proportions of each dissectible tissue in the joints are presented (Tables 4.9, 4.14 and 4.19). Significant first order interaction effects are evaluated (Figures 4.3 and 4.4).

4.2.2.1 Effect of sex on carcass composition

The weights of all the joints were significantly affected ($P<0.01$) by the sex of the goats (Table 4.5). Intact males typically had the heaviest necks, which were 1.3 times and 1.5 times the weights of those of the castrates and females, respectively. The variation of the weights of the rest of the joints followed a similar trend compared to the variation in the weights of entire carcasses with sex. That is, the weights of the joints from the intact and castrated males were similar but those from the female carcasses were lighter ($P<0.05$).

On average the intact males had a significant 2.4% units more weight in the neck and about 1.5% units less weight in the hind limb compared to the females and castrates ($P<0.01$, Table 4.6). Fore limb, dorsal trunk and ventral trunk percentages did not differ significantly amongst the sexes ($P>0.05$). Overall mean proportions of the joints were 19.08±1.39%, 20.74±1.58% and 18.31±2.42%, respectively.

Female goats had the least lean content ($P<0.001$) amongst the three sexes (Table 4.7) while the intact and castrated males had similar quantities ($P>0.05$). The bone weights of the three sexes differed significantly ($P<0.0001$). Intact males had the heaviest bones which were, respectively 1.1 and 1.3 times heavier than the bones of the castrates and females.

The amount of intermuscular fat in the carcass was not significantly affected by the sex of the goats ($P>0.05$). However, the females and castrates yielded about 1.5 times as much subcutaneous fat as the intact males ($P=0.003$). Total fat yield from castrated males was greatest and that from intact males the least ($P=0.032$). Meat yield did not differ significantly with the sex of the goats ($P>0.05$). Means for the indices were 2.95±0.38 lean/bone and 3.67±0.68 lean-and-fat/bone ratios.

Table 4.5 Effect of sex on joint weights (kg) of the right carcass halves of South African indigenous goats (means ± S.D.)

	Sex			*P*-value
	Castrates	Females	Males	
N	29	44	15	
Neck	812 ± 207^{b}	684 ± 164^{a}	1 037 ± 386^{c}	<0.0001
Fore limb	1 311 ± 305^{b}	1 109 ± 214^{a}	1 337 ± 263^{b}	0.0007
Dorsal trunk	1 418 ± 354^{b}	1 246 ± 334^{a}	1 518 ± 418^{b}	0.0061
Ventral trunk	1 335 ± 364^{b}	1 113 ± 370^{a}	1 365 ± 484^{b}	0.0166
Hind limb	2 052 ± 480^{b}	1 747 ± 329^{a}	2 034 ± 417^{b}	0.0030

$^{a, b}$ Means within the same row with different superscripts differ significantly (*P*<0.05)

Table 4.6 Effect of sex on joint proportions (%) in the right carcass halves of South African indigenous goats (means ± S.D.)

	Sex			
Characteristic	Castrates	Females	Males	*P*-value
N	29	44	15	
Neck	11.69 ± 1.33^{a}	11.66 ± 1.24^{a}	14.04 ± 1.79^{b}	0.0001
Fore limb	19.08 ± 1.03	18.93 ± 1.39	18.71 ± 1.69	0.6438
Dorsal trunk	20.33 ± 1.56	20.98 ± 1.59	20.79 ± 1.06	0.2809
Ventral trunk	19.04 ± 2.02	18.65 ± 2.49	18.15 ± 2.66	0.4408
Hind limb	29.85 ± 1.46^{b}	29.77 ± 1.87^{b}	28.31 ± 2.14^{a}	0.0048

$^{a, b}$ Means within the same row with different superscripts differ significantly (*P*<0.05)

Table 4.7 Effect of sex on tissue content (g) and meat yield indices of the right carcass halves of South African indigenous goats (means ± S.D.)

Characteristic	Sex			*P*-value
	Castrates	Females	Intact males	
N	29	44	15	
Lean	4 273 ± 1 018[b]	3 600 ± 766[a]	4 772 ± 1 259[b]	0.0001
Bone	1 405 ± 246[b]	1 239 ± 168[a]	1 556 ± 255[c]	<0.0001
Intermuscular fat	808 ± 284	696 ± 461	666 ± 398	0.1661
Subcutaneous fat	380 ± 208[b]	315 ± 173[b]	224 ± 129[a]	0.0033
Total carcass fat	1 188 ± 469[b]	1 011 ± 613[ab]	890 ± 494[a]	0.0321
Lean/bone	3.04 ± 0.31	2.90 ± 0.41	3.07 ± 0.44	0.4767
Lean-and-fat/bone	3.89 ± 0.52	3.72 ± 0.73	3.64 ± 0.70	0.7209

[a, b] Means within the same row with different superscripts differ significantly (*P*<0.05)

Table 4.8 Effect of sex on proportions of the dissectible tissues (%) in the right carcass halves of South African indigenous goats (means ± S.D.)

Characteristic	Sex			*P*-value
	Castrates	Females	Intact males	
N	29	44	15	
Lean	62.11 ± 2.96[a]	61.37 ± 4.92[a]	65.95 ± 2.66[b]	<0.0001
Bone	20.89 ± 2.60	21.45 ± 3.36	22.25 ± 3.79	0.2837
Intermuscular fat	10.99 ± 2.85[b]	11.22 ± 5.23[b]	8.11 ± 4.46[a]	0.0037
Subcutaneous fat	5.13 ± 2.25[b]	5.14 ± 2.07[b]	2.69 ± 1.53[a]	<0.0001
Total carcass fat	16.12 ± 4.63[b]	16.36 ± 6.85[b]	10.81 ± 5.20[a]	<0.0001

[a, b, c] Means within the same row with different superscripts differ significantly (*P*<0.05)

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The percentages of lean, intermuscular fat and subcutaneous fat in the right carcass half were significantly affected ($P<0.01$) by the sex of the goats (Table 4.8) but bone percentages were not ($P>0.05$). Lean percentage was highest in the intact males whose mean was on average 4.21% units greater than the means of the females and castrates. Both the intermuscular and subcutaneous fat percentages were highest in the female and least in the intact male carcasses ($P<0.01$). Intact males had about 1.4 times less intermuscular fat and nearly two times less subcutaneous fat that the castrates and females. Consequently intact males' total carcass fat percentage was 6.2% units lower than the values for the castrates and females.

Within each joint (Table 4.9), the proportion of lean was generally highest in the intact males ($P<0.01$) but castrates and female goats had similar proportions. The proportion of bone in each joint (except the hind limb) was similar amongst the three sex groups ($P>0.05$). The hind limb bone percentage of intact males was a significant 2.03% units greater than that of the females ($P<0.05$) while that of the castrates did not differ from either the intact males or the females ($P>0.05$).

Intermuscular fat proportions in the fore limb, dorsal trunk and hind limb all differed significantly with the sex of the goats ($P<0.05$). The highest percentages were in the joints of the female and castrated goats. Ventral trunk intermuscular fat percentage was not affected by the sex of the goats ($P>0.05$).

Subcutaneous fat percentage in all the joints was significantly affected by the sex of the goats ($P<0.05$). Within each of the joints, the females and castrates had similar proportions of subcutaneous fat, which were about twice as much as that in the same depots of the intact males. The three sex groups all significantly differed in hind limb subcutaneous fat percentage ($P<0.0001$). Castrates had the highest proportion of 4.68% and intact males the least by a factor of 2.2.

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Table 4.9 Effect of sex on proportions of the dissectible tissues (%) within joints of the right carcass halves of South African indigenous goats (means ± S.D.)

	Sex			
	Castrates	Females	Intact males	*P*-value
N	29	44	15	
Lean: Neck	60.84 ± 5.13[a]	56.10 ± 6.74[a]	67.13 ± 4.04[b]	<0.0001
Fore limb	64.17 ± 1.94[a]	64.63 ± 4.29[a]	68.43 ± 3.86[b]	0.0002
Dorsal trunk	57.17 ± 3.62[a]	56.19 ± 6.47[a]	60.84 ± 4.22[b]	0.0075
Ventral trunk	57.19 ± 8.21[a]	55.54 ± 7.55[a]	61.62 ± 5.64[b]	0.0038
Hind limb	68.25 ± 2.26[a]	69.02 ± 3.77[ab]	70.77 ± 2.80[b]	0.0373
Bone: Neck	20.51 ± 4.36	23.01 ± 4.96	20.52 ± 4.87	0.0800
Fore limb	22.14 ± 3.10	21.75 ± 3.23	23.27 ± 3.24	0.2442
Dorsal trunk	26.42 ± 5.23	26.78 ± 5.00	27.60 ± 5.32	0.6973
Ventral trunk	15.69 ± 2.96	15.84 ± 4.92	17. 43 ± 6.00	0.4227
Hind limb	19.90 ± 2.34[a]	20.61 ± 2.46[ab]	21.93 ± 2.63[b]	0.0172
Intermuscular fat: Neck	14.27 ± 4.41[b]	14.65 ± 7.93[b]	10.70 ± 6.04[a]	0.0174
Fore limb	8.91 ± 3.25[b]	9.28 ± 5.85[b]	4.96 ± 3.59[a]	0.0049
Dorsal trunk	10.26 ± 3.71[b]	10.45 ± 6.29[b]	6.86 ± 4.41[a]	0.0106
Ventral trunk	17.90 ± 6.01	19.20 ± 9.35	15.38 ± 9.19	0.1567
Hind limb	6.60 ± 2.06[b]	6.19 ± 2.19[b]	4.39 ± 2.10[a]	0.0021
Subcutaneous fat: Neck	3.36 ± 3.14[b]	4.68 ± 3.60[b]	1.26 ± 1.39[a]	0.0061
Fore limb	4.04 ± 1.91[b]	3.72 ± 1.86[b]	2.47 ± 1.80[a]	0.0272
Dorsal trunk	5.04 ± 2.83[b]	5.79 ± 4.00[b]	3.15 ± 1.80[a]	0.0163
Ventral trunk	8.04 ± 5.62[b]	8.49 ± 5.22[b]	4.28 ± 4.24[a]	0.0297
Hind limb	4.68 ± 1.86[c]	3.57 ± 2.38[b]	2.17 ± 1.13[a]	<0.0001

[a, b, c] Means within the same row with different superscripts differ significantly ($P<0.05$)

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4.2.2.2 Effect of age on carcass composition

The weights of all the joints increased significantly (*P*<0.01) with age of the goats (Table 4.10). The 2- and 4-to-6 teeth groups tended to have joints of similar weights (*P*<0.05). Percentages of the neck, fore limb and dorsal trunk were similar amongst (*P*>0.05) the goats in the different age classes (Table 4.11). Percentage of the ventral trunk was lowest in the 2-teeth group and conversely that of the hind limb was highest in the same group (*P*<0.01). The rest of the age classes had similar proportions of the two joints.

Except for subcutaneous fat, all tissue weights significantly increased (*P*<0.001) with the age of the goats (Table 4.12). However, the yield indices, lean/bone and lean-and-fat/bone, were not affected by the age of the goats.

The highest proportions of lean were in the 2-teeth and the 4-to-6 teeth groups (*P*=0.008), which had about 64% lean (Table 4.13). The milk-teeth kids had the lowest proportion of about 62%. The proportions of bone and subcutaneous fat were not significantly affected by the age of the goats (*P*>0.05). However, intermuscular and total carcass fat percentages tended to be lowest in the 2-to-6 teeth groups and highest in the full mouth group (*P*<0.05).

Within the fore limb, dorsal trunk, and hind limb, the percentage of lean varied significantly (*P*<0.01) with the age of the goats (Table 4.14). As was the case within the entire right half carcasses, the percentages tended to be higher for the 2-to-6 teeth groups and lower for the milk-teeth and full mouth groups. Intermuscular fat percentages of the neck and fore limb were not significantly affected by age (*P*>0.05). However, the dorsal trunks of the 8-teeth group had significantly the highest percentage intermuscular fat (*P*=0.006). The mean intermuscular fat percentage in the 8-teeth group averaged 3.98% units more than the younger goats. In the ventral trunk and hind limb, the 2-to-6 teeth groups generally had lower intermuscular fat percentages than the milk- and 8-teeth groups (*P*<0.05).

Only the subcutaneous fat percentage of the hind limb was significantly affected by the age of the goats (*P*=0.002). The proportion was lowest in the younger goats with up to 2-teeth (average of 2.75%) and increased to 4.74% in the 8-teeth group.

Table 4.10 Effect of age on joint weights (kg) of the right carcass halves of South African indigenous goats (means ± S.D.)

	Age class				
	0 teeth	2 teeth	4 to 6 teeth	8 teeth	*P*-value
N					
Neck	712 ± 239[a]	817 ± 298[ab]	865 ± 188[bc]	982 ± 160[c]	0.0043
Fore limb	1 037 ± 180[a]	1 219 ± 245[b]	1 324 ± 260[bc]	1 430 ± 239[c]	<0.0001
Dorsal trunk	1 135 ± 230[a]	1 349 ± 350[b]	1 418 ± 306[b]	1 675 ± 348[c]	<0.0001
Ventral trunk	1 056 ± 334[a]	1 112 ± 358[a]	1 343 ± 332[b]	1 571 ± 445[c]	<0.0001
Hind limb	1 627 ± 295[a]	1 908 ± 374[b]	2 035 ± 413[bc]	2 208 ± 355[c]	0.0001

[a, b, c] Means within the same row with different superscripts differ significantly (*P*<0.05)

Table 4.11 Effect of age on the joint proportions (%) in the right carcass halves of South African indigenous goats (means ± S.D.)

	Age class				
Characteristic	0 teeth	2 teeth	4 to 6 teeth	8 teeth	*P*-value
N					
Neck	12.63 ± 1.60	12.47 ± 1.87	12.23 ± 1.56	12.52 ± 1.20	0.8691
Fore limb	18.81 ± 1.35	19.26 ± 1.26	19.21 ± 1.12	18.34 ± 1.51	0.0918
Dorsal trunk	20.41 ± 1.09	21.01 ± 1.27	20.06 ± 1.73	21.31 ± 1.61	0.0771
Ventral trunk	18.70 ± 2.69[b]	17.06 ± 1.71[a]	19.16 ± 2.42[b]	19.55 ± 2.94[b]	0.0047
Hind limb	29.45 ± 1.63[ab]	30.20 ± 2.20[b]	29.33 ± 1.10[ab]	28.27 ± 2.14[a]	0.0055

[a, b, c] Means within the same row with different superscripts differ significantly (*P*<0.05)

Table 4.12 Effect of age on dissectible tissue content (g) and meat yield indices of the right carcass halves of South African indigenous goats (means ± S.D.)

	Age class				*P*-value
	0 teeth	2 teeth	4 to 6 teeth	8 teeth	
N	16	32	21	19	
Lean	3 428 ± 770[a]	4 141 ± 1 008[b]	4 451 ± 992[bc]	4 841 ± 807[c]	0.0002
Bone	1 210 ± 200[a]	1 374 ± 242[b]	1 440 ± 229[b]	1 575 ± 124[c]	<0.0001
Intermuscular fat	632 ± 328[a]	542 ± 299[a]	707 ± 251[a]	1 013 ± 567[b]	<0.0001
Subcutaneous fat	252 ± 158	283 ± 179	327 ± 142	364 ± 201	0.1630
Total carcass fat	884 ±475[a]	825 ± 436[a]	1 034 ± 353[a]	1 377 ± 752[b]	0.0002
Lean/bone	2.83 ± 0.38	3.01 ± 0.26	3.09 ± 0.36	3.07 ± 0.54	0.2745
Lean-and-fat/bone	3.56 ± 0.70	3.61 ± 0.43	3.81 ± 0.53	3.95 ± 0.94	0.5332

[a, b, c] Means within the same row with different superscripts differ significantly ($P<0.05$)

Table 4.13 Effect of age on the proportions of dissectible tissues (%) in the right carcass halves of South African indigenous goats (means ± S.D.)

	Age class				*P*-value
	0 teeth	2 teeth	4 to 6 teeth	8 teeth	
N	16	32	21	19	
Lean	61.82 ± 4.21[a]	64.68 ± 3.46[c]	63.94 ± 2.97[bc]	62.13 ± 5.81[ab]	0.0077
Bone	22.23 ± 3.38	21.91 ± 1.91	21.13 ± 3.02	20.86 ± 4.32	0.4740
Intermuscular fat	10.83 ± 4.45[bc]	8.09 ± 3.27[a]	9.56 ± 3.27[ab]	11.94 ± 6.43[c]	0.0009
Subcutaneous fat	4.32 ± 2.32	4.29 ± 2.15	4.54 ± 1.96	4.14 ± 2.12	0.9293
Total carcass fat	15.15 ± 6.54[b]	12.38 ± 4.74[a]	14.10 ± 4.51[ab]	16.08 ± 8.25[b]	0.0266

[a, b, c] Means within the same row with different superscripts differ significantly ($P<0.05$)

Table 4.14 Effect of age on the proportions of the dissectible tissues (%) within joints of the right carcass halves of South African indigenous goats (means ± S.D.)

	Age class				
	0 teeth	2 teeth	4 to 6 teeth	8 teeth	*P*-value
N					
Lean: Neck	58.65 ± 5.57	60.87 ± 6.64	62.67 ± 6.10	63.23 ± 7.66	0.0667
Fore limb	63.17 ± 3.68[a]	67.07 ± 3.14[b]	66.47 ± 3.32[b]	66.26 ± 4.42[b]	0.0016
Dorsal trunk	56.83 ± 5.71[ab]	60.54 ± 4.19[c]	59.06 ± 4.06[bc]	55.82 ± 7.67[a]	0.0064
Ventral trunk	58.25 ± 7.94	58.35 ± 7.08	59.37 ± 6.47	56.50 ± 7.63	0.5126
Hind limb	68.39 ± 2.60[a]	71.39 ± 2.77[b]	69.48 ± 2.74[ab]	68.13 ± 4.34[a]	0.0033
Bone: Neck	22.60 ± 5.54	22.00 ± 4.01	20.59 ± 4.70	20.20 ± 4.80	0.3801
Fore limb	23.73 ± 3.37[b]	23.08 ± 2.59[b]	21.04 ± 3.19[a]	21.70 ± 4.06[ab]	0.0366
Dorsal trunk	27.71 ± 5.38	26.48 ± 3.50	27.18 ± 4.69	26.35 ± 6.11	0.7956
Ventral trunk	15.51 ± 3.78	17.10 ± 2.49	16.40 ± 5.23	16.27 ± 6.61	0.7204
Hind limb	21.69 ± 2.25	20.70 ± 1.87	20.74 ± 2.49	20.11 ± 2.98	0.2773
Intermuscular fat: Neck	13.76 ± 5.40	12.04 ± 5.16	12.36 ± 4.52	14.67 ± 9.64	0.2269
Fore limb	8.61 ± 4.77	5.69 ± 4.76	7.82 ± 4.12	8.75 ± 6.20	0.0887
Dorsal trunk	9.03 ± 3.74[a]	7.56 ± 5.16[a]	8.14 ±3.04[a]	12.03 ± 7.16[b]	0.0059
Ventral trunk	19.46 ± 8.65[b]	14.55 ± 7.00[a]	16.40 ± 5.98[ab]	19.56 ± 11.11[b]	0.0213
Hind limb	6.33 ± 2.28[b]	4.52 ± 1.79[a]	5.52 ± 2.34[ab]	6.53 ± 2.43[b]	0.0055
Subcutaneous fat: Neck	3.70 ± 3.09	4.21 ± 3.91	3.15 ± 2.80	1.33 ± 2.40	0.0723
Fore limb	3.81 ± 1.94	3.35 ± 1.80	3.92 ± 2.17	2.56 ± 1.54	0.1695
Dorsal trunk	5.34 ± 4.39	3.97 ± 3.50	5.09 ± 1.78	4.25 ± 3.82	0.4170
Ventral trunk	6.13 ± 3.56	8.87 ± 5.48	6.44 ± 5.87	6.30 ± 4.71	0.2826
Hind limb	3.01 ± 1.53[ab]	2.50 ± 2.10[a]	3.63 ± 1.39[bc]	4.74 ± 2.84[c]	0.0015

[a, b, c] Means within the same row with different superscripts differ significantly (P<0.05)

4.2.2.3 Effect of pre-slaughter conditioning on carcass composition

All the carcass joints of the pre-slaughter conditioned goats were significantly bigger (P<0.0001) than those of the non-conditioned ones (Table 4.15). The ratios of the conditioned to the non-conditioned goat joints were 1.35, 1.20, 1.37, 1.41 and 1.20 for the neck, fore limb, dorsal trunk, ventral trunk and hind limb, respectively. The percentages of the neck and dorsal trunk were similar (P>0.05) between the two conditioning groups (Table 4.16). However, the fore and hind limb proportions were greater in the carcasses of the non-conditioned goats (P<0.001), while the ventral trunk percentage was greater in the carcasses of the pre-slaughter conditioned goats (P<0.0001).

All dissectible tissues of the carcasses of the pre-slaughter conditioned goats were significantly heavier (P<0.05) than those of the non-conditioned ones (Table 4.17). The yield indices were improved by conditioning (P<0.01). The lean/bone was 1.1 times higher and the lean-and-fat/bone ratio 1.25 times higher in the carcasses of the pre-slaughter conditioned compared to those of the non-conditioned goats.

The lean and bone percentages were higher in the carcasses of the non-conditioned goats (P<0.0001) while all carcass fat proportions were higher (P<0.0001) in the carcasses of the goats that were conditioned prior to slaughter (Table 4.18). Within each joint, the lean and bone percentages were consistently higher (P<0.05) in the non-conditioned goats (Table 4.19). Conversely, intermuscular fat percentages were consistently higher (P<0.01) in the joints of the pre-slaughter conditioned goats. Subcutaneous fat percentage was not as variable as the other tissues. Only that of the dorsal trunk and the hind limb was significantly increased by pre-slaughter conditioning (P<0.0001).

4.2.2.4 Interaction effects of sex, age and pre-slaughter conditioning on carcass composition

There were significant interaction effects of age and pre-slaughter conditioning, and sex and pre-slaughter conditioning on some of the carcass composition variables. These are illustrated in Figures 4.3 and 4.4. None of the age by sex effects were significant (P>0.05).

Table 4.15 Effect of pre-slaughter conditioning on joint weights (kg) of the right carcass halves of South African indigenous goats (means ± S.D.)

	Pre-slaughter conditioning		
	Non-conditioned	Pre-slaughter conditioned	*P*-value
N	49	39	
Neck	667 ± 160	903 ± 269	<0.0001
Fore limb	1 104 ± 234	1 324 ± 220	<0.0001
Dorsal trunk	1 139 ± 273	1 559 ± 314	<0.0001
Ventral trunk	1 000 ± 339	1 413 ± 324	<0.0001
Hind limb	1 723 ± 369	2 072 ± 342	0.0001

Table 4.16 Effect of pre-slaughter conditioning on proportions of the joints (%) in the right carcass halves of South African indigenous goats (means ± S.D.)

	Pre-slaughter conditioning		
	Non-conditioned	Pre-slaughter conditioned	*P*-value
N	49	39	
Neck	11.87 ± 1.39	12.27 ± 1.89	0.7698
Fore limb	19.69 ± 1.18	18.31 ± 1.25	0.0008
Dorsal trunk	20.23 ± 1.60	21.39 ± 1.30	0.7081
Ventral trunk	17.48 ± 2.43	19.35 ± 2.00	<0.0001
Hind limb	30.72 ± 1.44	28.66 ± 1.94	0.0004

Table 4.17 Effect of pre-slaughter conditioning on tissue content (g), and yield indices of the right carcass halves of South African indigenous goats (means ± S.D.)

	Pre-slaughter conditioning		
	Non-conditioned	Pre-slaughter conditioned	*P*-value
N	49	39	
Lean	3 692 ± 874	4 367 ± 945	0.0004
Bone	1 295 ± 204	1 401 ± 224	0.0111
Intermuscular fat	397 ± 254	1 000 ± 337	<0.0001
Subcutaneous fat	202 ± 132	434 ± 162	<0.0001
Total carcass fat	599 ± 363	1 434 ± 439	<0.0001
Lean/bone	2.84 ± 0.39	3.10 ± 0.33	0.0097
Lean-and-fat/bone	3.30 ± 0.58	4.14 ± 0.48	<0.0001

Table 4.18 Effect of pre-slaughter conditioning on proportions of the tissues (%) in joints of the right carcass halves of South African indigenous goats (means ± S.D.)

	Pre-slaughter conditioning		
Characteristic	Non-conditioned	Pre-slaughter conditioned	*P*-value
N	49	39	
Lean	65.52 ± 2.88	59.88 ± 4.26	<0.0001
Bone	23.46 ± 3.08	19.44 ± 1.74	<0.0001
Intermuscular fat	6.76 ± 3.11	13.72 ± 3.77	<0.0001
Subcutaneous fat	3.42 ± 1.74	6.00 ± 1.96	<0.0001
Total carcass fat	10.18 ± 4.33	19.72 ± 4.74	<0.0001

Table 4.19 Effect of pre-slaughter conditioning on proportions of dissectible tissues in the joints of the right carcass halves of South African indigenous goats (means ± S.D.)

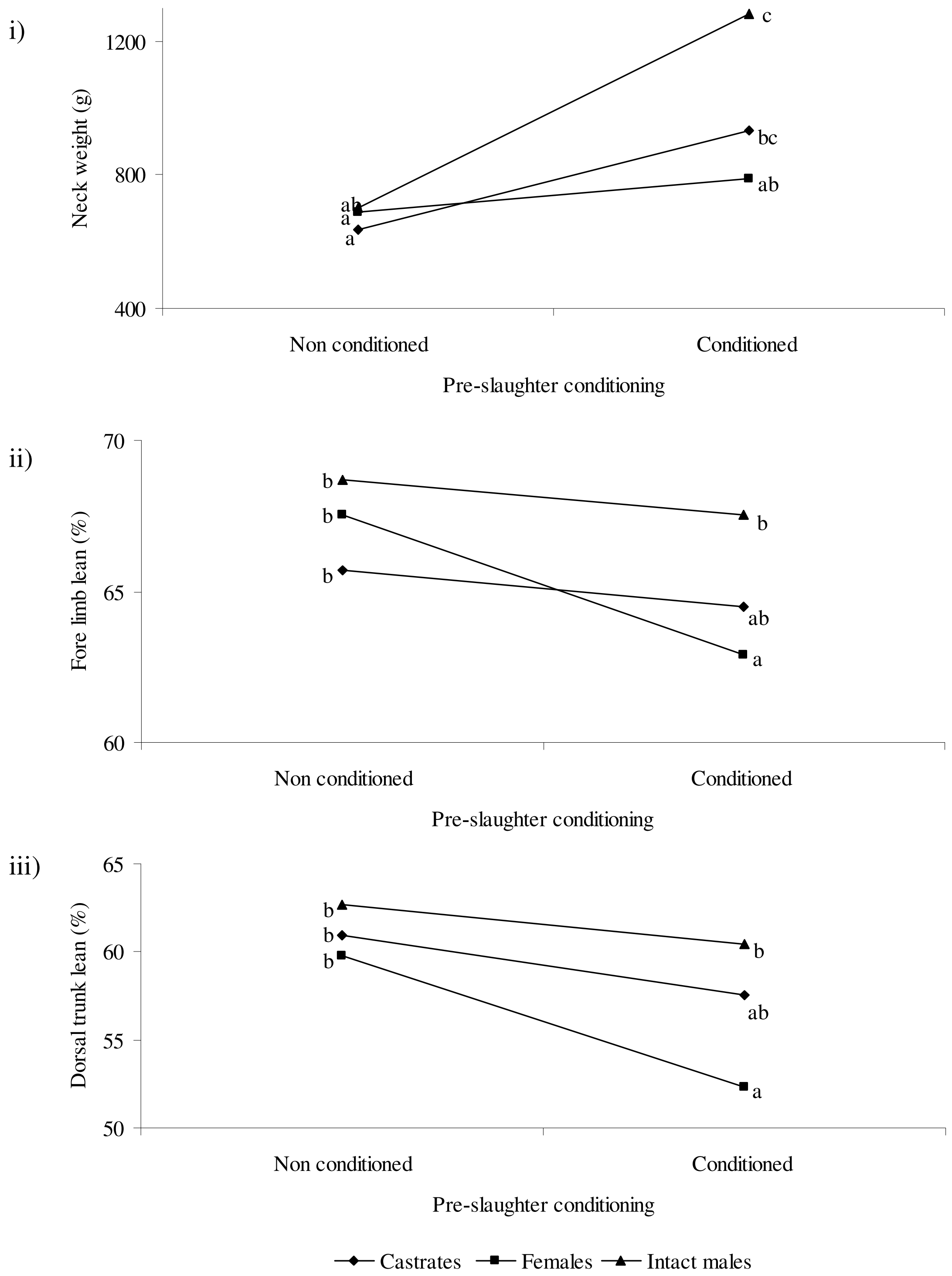
	Pre-slaughter conditioning		
	Non-conditioned	Pre-slaughter conditioned	*P*-value
N	49	39	
Lean: Neck	63.14 ± 5.32	55.85 ± 6.71	0.0091
Fore limb	66.89 ± 3.06	64.03 ± 3.96	0.0018
Dorsal trunk	60.79 ± 4.27	54.73 ± 5.93	0.0014
Ventral trunk	62.96 ± 5.93	51.30 ± 5.59	<0.0001
Hind limb	70.31 ± 2.63	68.62 ± 3.75	0.0227
Bone: Neck	24.17 ± 4.51	19.55 ± 3.62	0.0009
Fore limb	23.91 ± 3.38	20.49 ± 2.19	0.0012
Dorsal trunk	29.83 ± 4.74	23.56 ± 3.19	0.0005
Ventral trunk	18.24 ± 4.91	14.23 ± 2.97	0.0023
Hind limb	21.81 ± 2.52	19.31 ± 1.80	0.0025
Intermuscular fat: Neck	8.26 ± 4.40	19.01 ± 4.87	<0.0001
Fore limb	5.45 ± 3.44	10.62 ± 5.52	0.0005
Dorsal trunk	5.67 ± 3.05	13.34 ± 5.58	<0.0001
Ventral trunk	11.20 ± 6.04	23.19 ± 6.61	<0.0001
Hind limb	4.96 ± 2.22	6.60 ± 1.99	0.0051
Subcutaneous fat: Neck	3.35 ± 3.11	4.34 ± 3.42	0.5472
Fore limb	3.08 ± 1.87	4.08 ± 1.77	0.2226
Dorsal trunk	2.78 ± 1.59	7.14 ± 3.79	<0.0001
Ventral trunk	6.35 ± 5.00	9.64 ± 5.36	0.2202
Hind limb	2.34 ± 1.39	4.72 ± 2.34	<0.0001

CHAPTER 4

Pre-slaughter conditioned intact males and castrates had significantly heavier necks than their non- conditioned counterparts but the females were not affected (*P*=0.010, Figure 4.3i). The means for the castrates, females and intact males were respectively 635±177, 689±151and 700±130g for the non-conditioned goats and 933±111, 789±162 and 1281±343g for the pre-slaughter conditioned goats. Both fore limb (*P*=0.035) and dorsal trunk (*P*=0.0497) lean percentages were lower for the pre-slaughter conditioned compared to the non-conditioned goats (Figure 4.3ii and iii). The difference in the proportion of lean between the conditioning groups was significant for the females (*P*<0.05) but not the male sexes (*P*>0.05). The fore limb lean percentages for the castrates, females and intact males were 65.69±2.03, 67.52±3.32 and 68.68±3.77 for the non-conditioned goats and 64.50±1.35, 62.92±3.89 and 67.54±4.17 for the pre-slaughter conditioned goats, respectively. The corresponding dorsal trunk mean lean percentages were, respectively 60.94±3.71, 59.81±4.16, 62.72±5.67, and 57.52±1.66, 52.35±6.09 and 60.45±0.90.

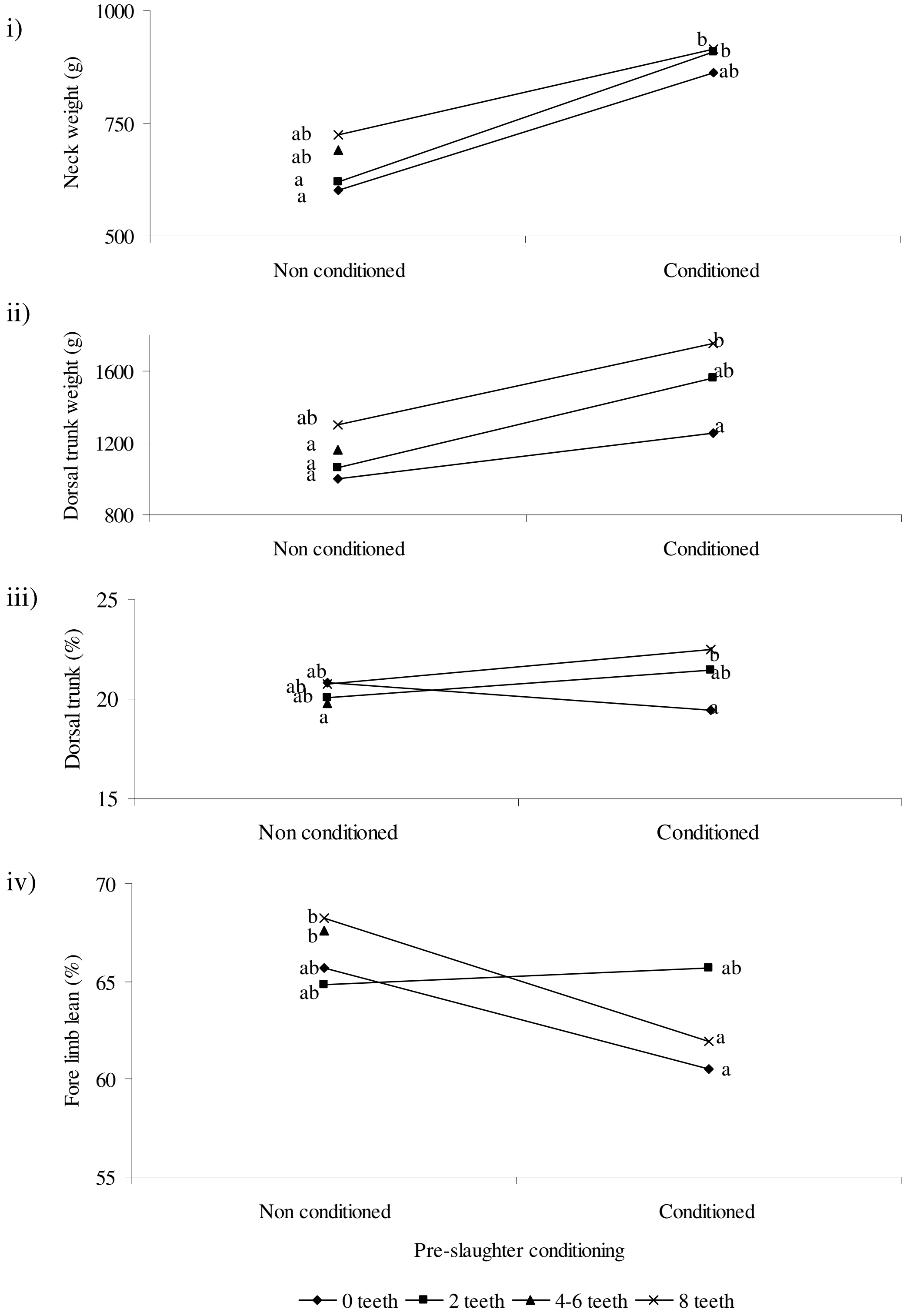
The neck (*P*=0.030) and dorsal trunk (*P*=0.046) were heavier in the pre-slaughter conditioned than the non-conditioned goats (Figure 4.4i and ii). Pre-slaughter conditioning led to significantly heavier necks of the 2-teeth group (*P*<0.05) but not those of the milk, and 8-teeth groups (*P*>0.05). The neck weight means for the non-conditioned goats were similar (*P*>0.05) and were 600±90, 621±158, 689±188 and 724±137g for milk-, 2-, 4-to-6 and 8-teeth goats. The means for the conditioned goats were 861±325, 909±301 and 914±123g for the milk-, 2- and 8-teeth goats, respectively.

The dorsal trunks of the pre-slaughter conditioned 8-teeth goats were significantly heavier than those of all the non-conditioned younger goats and of the conditioned milk-teeth goats (*P*<0.05). The dorsal trunk weight means were 1000±122, 1062±214, 1159±306 and 1297±290g for the milk-, 2-, 4-to-6 and 8-teeth non-conditioned goats and 1253±290, 1561±293 and 1755±234g for the milk-, 2- and 8-teeth conditioned goats, respectively.



<u>NB</u> Points within a graph with different letters ‘a’ or ‘b’ differ significantly (*P*<0.05)

Figure 4.3 Pre-slaughter conditioning and sex interaction effects on (i) neck weight (g), (ii) fore limb lean %, and (iii) dorsal trunk lean (%)



NB Points within a graph with different letters 'a' or 'b' differ significantly ($P<0.05$)

Figure 4.4 Pre-slaughter conditioning and age interaction effects on (i) neck weight (g), (ii) dorsal trunk weight (%), (iii) dorsal trunk (%), and (iv) fore limb lean (%)

The proportions of the dorsal trunk were similar (*P*>0.05) for all the age groups in the non-conditioned group (Figure 4.4iii) and comprised approximately 20.3% of the right half carcass. Amongst the pre-slaughter conditioned goats, the percentage of the dorsal trunk in the milk-teeth kids was significantly smaller than in the 8-teeth group (*P*=0.033). The mean percentages for pre-slaughter conditioned milk-, 2- and 8-teeth goats were 19.46±0.67, 21.47±1.03 and 22.49±0.72, respectively. Fore limb lean percentages tended to decline (*P*=0.038) with pre-slaughter conditioning of the milk and 8-teeth goats (Figure 4.3iv). The difference in the proportions of this tissue between the non-conditioned and pre-slaughter conditioned groups was significant for the 8-teeth group only (*P*<0.05). The mean fore limb lean percentages for the non-conditioned goats were 65.66±1.95, 64.8±1.81 and 67.62±3.32, 68.20±3.26 for the milk, 2, 4-to-6 and 8-teeth goats, respectively. Those for the pre-slaughter conditioned goats were 60.54±3.77, 65.69±3.48 and 61.94±2.96% for the milk, 2 and 8-teeth goats, respectively.

4.3 DISCUSSION

4.3.1 Live Animal and Carcass Characteristics

Live weight and chest girth have been used in several studies to define the size of small ruminants (e.g. Owen, 1975; Mukherjee, Singh and Mishra, 1981, 1986; Simela et al., 2000a; Atta and El Khidir, 2004). The live weight, chest girth and carcass measurements of the goats used in this study compare well to other breeds in the region, namely the Tswana goats of Botswana (Fisher, Frost, Owen and Norman, 1976; Owen and Norman, 1977) and the Matebele goats of Zimbabwe (Simela et al., 2000a). For example, the reported mean chest girth for castrated Matebele goats ranged from 59.8cm to 83.3cm between the milk- and 8-teeth stages (Simela et al., 2000a). The average live weight of these castrates when they are marketed in the commercial sector ranged from a stipulated minimum of 25kg (Hatendi, 1993) to about 41kg at the 6-teeth stage (Simela et al., 2000a). Side length and chest depth measurements of carcasses of mixed sex ranged from 57.0cm and 27.7cm at the milk-teeth stage to 66.2 and 31.4cm at the 6-to-8 teeth stage (Simela, Ndlovu and Sibanda, 1999). The corresponding carcass weights were 12.5kg, 13.3kg, 16.3kg and 19.7kg, respectively for the milk, 2-, 4- and 6-to-8 teeth groups (Simela et al., 1999).

The side length and chest depth for the Tswana castrated goats ranged from 55.3cm and 25.9cm at the milk-teeth stage to 64.4cm and 31.1cm at the six-teeth stage (Owen and Norman, 1977), respectively. The corresponding range of live weights was 24kg to 41kg and the carcass weights of the milk-, 2-, 4- and 6-teeth castrates were 9.89kg, 11.69kg and 13.87kg and 17.67kg, respectively. Corresponding measurements in this study (Tables 4.1 to 4.3) compare well to these reported values.

In essence the South African indigenous goats are of the same type as the large goats of southern Africa that are described by Mason (1981). Due to their size, many researchers are of the opinion that these large southern African goat breeds have a high potential for commercial chevon production.

The mean dressing out percentages varied between 38% and 44%, which generally agrees with the values reported for various goat breeds worldwide (Devendra and Owen, 1983, Kadim, Mahgoub, Al-Ajmi, Al-Maqbaly, Al-Saqri and Ritchie, 2004) as well as the large southern African goats (Owen and Norman, 1977; Simela, Gumede, Ndlovu and Sibanda, 2000c). For the latter breeds, Owen and Norman (1977) obtained values ranging from 43.1% for milk-teeth kids to 48.3% for full-mouthed castrated Tswana goats. Full mouthed females had a DO% of 39.7%. Simela et al. (2000c) obtained values ranging from 42.3% to 46.8% for Matebele goats weighing from 25kg to over 45kg. One abattoir that slaughtered goats in Zimbabwe used an estimation of about 42% (Hatendi, 1993).Therefore, the DO% values that were observed in the present study are in line with what is observed in commercial slaughter situations.

A large source of the variation in DO% is the gut contents which may account for as much as 26% of the live weight of the animal (Owen et al., 1983). Post-weaning gut contents are particularly affected by the diet of the goats prior to slaughter. Gaili, Ghanem and Mukhtar (1972) noted that after 24 hours off feed but with access to water, unfattened goats averaged 18% gut content whereas those off a fattening diet averaged 8.8%. The goats employed in the current study were weighed prior to feeding, 24 hours after the last feeding session in order to minimise differences in live weight due to gut content.

In addition to heavier carcasses and increased carcass fat, a higher plane of nutrition also typically results in a higher DO% (Devendra and Owen, 1983; Oman, Waldron, Griffin and Savell, 1999) as was observed herein. According to Hogg et al. (1992), fattened goats are expected to dress out 2–3% more than those coming off pastures. Such a difference occurred between the non-conditioned and pre-slaughter conditioned groups of this study. Further to this, the intact males proved more productive in response to pre-slaughter conditioning in that the increase in their dressing out percentage and decrease in the chilling losses were greater than those of the castrates or the females (Figure 4.1).

Chilling losses in this study averaged less than the 3% that is usually estimated for chevon (Government of Zimbabwe, 1995) and beef (Offer et al., 1984) carcasses. In Simela et al. (2000b) such low chilling losses were associated with CCW of 16.9kg and above. In this study the lower values may have been due to that the goats were generally in good condition at slaughter. However when the goats were separated into non-condition and pre-slaughter conditioned groups, the advantages of improved nutrition were evident in the 30% decrease in chilling losses.

4.3.2 Joint and Tissue Composition of the Carcasses

The tissue distribution of the goat carcasses in this study averaged 63% lean, 22% bone, 10% intermuscular fat and 5% subcutaneous fat. These values are within the ranges that have been reported for other goat breeds (Devendra and Owen, 1983; Kirton, 1988; Simela et al., 1999; refer to § 2.2.3.1). Low carcass fat is one of the main attractions to chevon production. However the low and rather invariable subcutaneous fat cover is a particular cause for concern in commercial chevon production since it is often well below the levels considered necessary for effective carcass chilling, without the risk of cold shortening (Smith et al., 1976; Dikeman, 1996). The low subcutaneous cover has also contributed to the downgrading of goat carcasses in a number of commercial enterprises, particularly where the classification/grading schedules that are employed are based on those of lamb and mutton (Pike et al., 1973b; Simela et al., 1999). Several scientists (Devendra and Owen, 1983, Kirton, 1988; Prasad and Kirton, 1992; Simela et al., 1998) have emphasised this misconception and recommended well-researched classification systems that are indicative of the possible end use of the carcass rather than nominal carcass quality. Such an approach would better cater for diverse consumer populations with different expectations, such as occurs in South Africa.

Typically, the intact males tended to yield leaner carcasses with less cavity fat than the females. Such a trend has been observed amongst cattle, whereby steers reportedly have 40% more omental and kidney fat, 71% more subcutaneous fat and 26% more intermuscular fat than bulls (Brännäng, 1971 as cited by Pearson, 1990). In this study the castrated and intact males differed significantly in carcass fat content. Castrates attained percentages of intermuscular and subcutaneous fat that were 41% and 91% greater than the respective percentages in the intact males. Pearson (1990) also discussed the differences in the proportion of the quarters within beef carcasses: bulls reportedly have some 2.5% more fore quarter than steers. Similar differences were obtained in this study when just the neck and hind limbs were compared; the intact males had about 2.4% units more neck and 1.5% units less hind limb than the castrates. Therefore, the tissue distributions of the goats were typical of the trends with the sexes.

The lean carcasses, coupled with the faster growth of the intact males (Louca, Ecomides and Hancock, 1977; Allan and Holst, 1989; Aregheore, 1995) are the basis for the drive to produce young intact males in preference to castrates and females. However, at sexual maturity and beyond, meat from intact males is believed to have an unacceptably strong odour (Norman, 1991), which leads to the downgrading of their carcasses. A further deterrent to the production of males could be that they have a lower proportion of the western-style high value hind quarter (Table 4.6) than the castrates and females. However the preferred carcass weights would affect the extent that the differing joint proportions influence the value of the carcass. Furthermore, the impact of the effect of sex on the proportions of the joints within the carcass will also depend on the relative importance of these joints or the cuts arising from them to the consumers.

No standards have been set for the presentation of chevon to consumers to date. However, in a chevon industry survey carried out in Zimbabwe, indications were that most consumers that purchase chevon from retail outlets prefer cuts and joints. Unfortunately that study did not delve further into the nature of the preferred cuts and joints. The general trend in commercial chevon production is to use similar cuts to lamb (Wilson, 1992). The effectiveness of this in marketing chevon is debatable since the two species differ in distribution of joints within the carcass as well as the dissectible tissues within the joints (Casey, 1982). In lamb the western-style high value cuts are associated with the loin region (dorsal trunk) and the hind limb. The composition of the hind limb of goats seems suitable for the production of high value cuts in that it has a low fat and high lean content. Although the dorsal trunk also has a low fat content, it tends to be bony. This is attested to by the high bone (27%) and low lean content (58%) of the cut as well as the relatively small LT areas, especially when compared to sheep (Gaili et al., 1972; Riley, Savell, Johnson, Smith and Shelton, 1989). The implications of this are that the rib and loin cuts from goat carcasses would not be as meaty as similar cuts derived from the dorsal trunk of sheep.

An additional consideration in the jointing of goat carcasses is the classification of the cuts according to their perceived value to consumers. Previous research shows that the preference for the cuts varies with cultural backgrounds. Whereas in most of the western world, cuts from the hind limb and the dorsal region are of prime value and the breast region is of low value, a high preference for the breasts has been shown in some studies conducted in Africa and Asia (Wilson, 1992; Prasad and Kirton, 1992). An understanding of the market needs within each country is therefore essential for the development of a market for chevon.

A previously reported phenomenon with unimproved goats is that there is little variation in the lean/bone index with sex and age (Simela et al., 1999). This phenomenon is in line with the fact that goats are relatively late maturing and hence age-related changes in the proportions of tissues do not occur until a late stage (Owen et al., 1978). This has been demonstrated by the relatively high growth coefficients for lean, bone and fat, particularly when compared to those of sheep. Owen et al. (1978) reported Tswana goat lean, bone and fat growth coefficients of 1.1697, 0.7756 and 1.9947 respectively. Corresponding values for Boer goats reported by Casey (1982) were 1.0754, 0.7685 and 1.9877 whereas the average values for the sheep breeds were 0.9112, 0.6959 and 2.0962 for lean, bone and fat, respectively. The meat yield indices, including the *M. longissimus* area, are however increased by improved nutrition (Gaili et al., 1972; Mtenga and Kitaly, 1990; Johnson and McGowan, 1998; Oman et al., 1999). The increases would obviously be more evident and consequential in young growing animals than in old goats, and amongst the former, in intact males than in castrates and females (Louca et al., 1977; Allan and Holst, 1989).

CHAPTER 4

4.4 SUMMARY

The results of this chapter showed that the indigenous goats of South Africa belong to the large breeds that are considered to have a high potential for chevon production. These goats have a high lean and low fat content that is typical of most goat breeds. The intact males seemed particularly suited for high chevon yield because they were heavy, had a high lean and low fat content and losses during dressing and chilling were reduced by improved nutrition. Goats between the two- and six-teeth stages were high yielding because they had heavy carcasses with weights that were comparable to goats in the eight teeth group. Additionally, the two-to-six teeth groups yielded proportionately more lean, more so in the joints that are considered as of high value, the hind limb and dorsal trunk.

Within the goat carcasses, the hind limb seems most ideal for the high lean, low fat, high value cuts. The dorsal trunk was bony and yielded less lean, which may not make it a high value cut in terms of saleable meat yield.

Pre-slaughter conditioning improved the overall size of the goats. It also reduced the losses from the goats during slaughter and chilling. Although pre-slaughter conditioning reduced the percentage of lean and increased that of fat, it also improved the meat yield indices.