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Carcass traits and meat quality characteristics and fatty acid profile of Barbari goats as influenced by castration and slaughter age

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ABSTRACT

In this study, effects of castration and age at slaughter (12 and 15 months) were evaluated on carcass traits, physico-chemical, colour and textural properties as well as fatty acid profile of Barbari goat meat . Barbari goats (24: 12 each, intact and castrates) were divided into 4 groups, viz. intact 12, castrate 12, intact 15 and castrate 15 for the comparison of various parameters. Carcass traits, carcass components, composition and fat distribution differed significantly among 4 groups of goats. Moisture and fat contents in meat were significantly affected by slaughter age and castration while amount of protein and ash were affected by age. Water holding capacity (WHC) was found significantly higher in meat from older animals from both the groups. Water extractable (WEP), salt extractable (SEP) and total extractable (TEP) proteins were significantly affected by castration and age of slaughter. Meat from castrated goats was significantly lighter while meat from younger animals was redder. Shear force value and work of shear were significantly lower for castrated goat meat. Fatty acid C16:0 content increased with age while C18:0 significantly decreased. Oleic acid (C18:1) content was significantly higher in castrated animals while amount of linoleic acid (C18:2) was higher in intact animals and both the fatty acids increased with animal age. Total saturated fatty acids (SFA) and polyunsaturated fatty acids (PUFA) were high in meat from intact goats while monounsaturated fatty acids (MUFA) were found higher in castrated goat meat.

Key words: Castration, Colour, Fatty acid, Goat meat, Texture profile analysis

Quality of meat including safety of goat meat is affected by several pre-slaughter and post-slaughter factors (Suresh *et al*. 2012). The pre-slaughter factors include breed, age, sex, nutritional status, body weight, management etc. Studies on the fatty acid composition of muscle and adipose lipid tissue indicate that this is also influenced by the breed of the animal, animal age, animal sex, the quality and quantity of feed consumed and body weight. Effects of castration, slaughter age, fattening period, and breed on growth performance, carcass characteristics (Zamiri *et al*. 2012), panel assessment and aroma compounds (Madruga *et al*. 2000), nutritive value (Rajkumar *et al*. 2015) fatty acid profile (WerdiPratiwi *et al*. 2006) in various goat breed have been studied. However, there is no report on effects of castration and age of slaughter on carcass and meat quality characteristics in goat breed from India. Thus present work was undertaken to observe the effects of castration and age of slaughter on carcass characteristics, physico-chemical, colour, texture properties and fatty acid profile of Barbari goat meat.

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MATERIALS AND METHODS

Animals and their management: Barbari male kids (24, two-and-half months old; weaned at 90 days) from institute farm were used in this experiment. Study was initiated in November to determine the effect of castration on economic managemental intervention on performance of Barbari kids. Barbari goats with mean live weight of 6.10 kg were randomly allocated for the experiment. Barbari goats (24: 12 each, intact and castrates) were divided into 4 groups, viz. intact 12, castrate 12, intact 15 and castrate 15 for the comparison of various parameters. Kids in the group (castrate 12 and castrate 15) were castrated at two-and-half months of age using Burdizzo castrator at 2 sites in each side of the testicle. Kids were maintained on *ad lib.* group feeding and managemental conditions. Under this intensive production system, kids were provided *ad lib.* dry fodder such as gram straw *(Cicer arietinum*), guar hay *(Cymopsis tetragonoloba*), *arhar* straw *(Cajanus cajan*) and green fodder such as berseem *(Trifolium alexandrinum*) or oat *(Avena sativa*) and concentrate mixture containing 72% TDN and 16% DCP prepared from maize (15%), barley (20%), groundnut cake (35%), wheat bran (20%), molasses (7%), mineral mixture (2%) and salt (1%). Kids were weighed weekly until they reached their target slaughter weight. Twelve kids from intact 12 and castrate 12 group were slaughtered at 12 months of age and rest were

slaughtered at the age of 15 months.

Slaughter and carcass evaluation: Goats were fasted for 16–18 h with free access to water and animals were slaughtered in the experimental abattoir as per guidelines of slaughter ethics committee of the institute (Das *et al*. 2008). Dressed carcass comprised the body after removing head, skin, feet, non-carcass fats (cod, kidney and omental fat) and the viscera. Hot carcass weight and weights of non-carcass components (head, skin, feet) and visceral organs (kidney, heart, liver, lungs and trachea, spleen) were recorded.

The hot carcass was split into fore and hind quarter at the intersection of 12^{th} and 13^{th} vertebrae. Loin eye area was recorded on the cut surface of the *Longissimus dorsi* muscle at the interface of 12^{th} and 13^{th} ribs on both the sides of the carcass after taking impression on tracing paper and measured with a planimeter with optical tracer and reported in cm^2. The GR measurement (soft tissue thickness 11 cm from the midline on 12^{th} rib) was recorded as the average of two measurements with digital Vernier calliper probe. Back fat thickness was determined by taking the average of two measurements at the mid length of the *L. dorsi* muscle on either side of the midline. Dressed carcasses were split along the midline and halves were dissected into lean meat, fat and bone. Data were expressed as % of slaughter weight. The *Longissimus dorsi* muscles was collected, packed in low-density polyethylene (LDPE) bags and stored for 24 h at 4±1°C. After chilling, meat samples were analysed for different meat quality attributes.

Meat quality evaluation: Samples were analysed in duplicate for moisture, fat, crude protein (N × 6.25) and ash (AOAC 1995). Muscle pH was determined by blending 10 g of sample with 50 ml of distilled water using a digital pH meter. Waterholding capacity was measured as per Sierra (1973). Soluble proteins in meat samples were determined according to Ryu *et al*. (2005). Method used by Hornsey (1956) was adopted for measurement of total pigments.

Instrumental colour value: The colour parameter of the meat was monitored by evaluating Hunter "*L*", "*a*" and "*b*" values using ColorTec (Das *et al*. 2015). Hunter *L* (lightness), *a* (redness) and *b* (yellowness) values were measured on the surface of *Longissimus dorsi* from four randomly chosen spots.

Texture profile analysis (TPA): Shear force value and work of shearing were evaluated using the texturometer as per the method described by Rajkumar *et al*. (2016).

Fatty acid profile: A direct and simple method of O'Fallon *et al*. (2007) was followed for fat extraction and preparation of fatty acid methyl esters (FAME) of meat samples (Rajkumar *et al*. 2016). Fatty acids were identified by comparing their retention times with the fatty acid methyl standards and were expressed as % of total fatty acids.

Statistical analysis: Data generated (n=6 for carcass traits, components, composition and fat distribution; n=12 for physicochemical characteristics, texture profile analysis and fatty acid profile; n=24 for colour) in the present study for various parameters were analysed by one-way analysis of variance (ANOVA) using the SPSS software for windows (version 17.0, SPSS, Inc., Chicago, IL). Statistical significance was identified at the 95% confidence level ($P<0.05$). The values were presented as mean along with standard error (mean±standard error).

RESULTS AND DISCUSSION

Carcass and non-carcass traits: Effect of slaughter age and castration on carcass traits and carcass components of Barbari goats is presented in Table 1. Live and carcass weights of goats were significantly affected ($P<0.05$) by age of slaughter, though castration had no significant effects. There was no significant effect of the castration and slaughter age on the dressing per cent of the carcasses. The result was in agreement with the finding of Bayraktaroçlu *et al*. (1988) who did not find any significant difference in the dressing per cent of intact and castrated goats. However, Koyuncu *et al*. (2007) reported significant difference in dressing per cent of intact and castrated goats. There was significant effect ($P<0.05$) of castration and slaughter age on weight of fore quarter where older goats had higher weight but weight for the castrated goats was lower than the corresponding intact animal's fore quarter. As regard to the hind quarter weight, 15 months old intact and castrated animal had significantly higher ($P<0.05$) weight as compared to the respective 12 months old goats. However, castration did not affect ($P>0.05$) the hind quarter weight. GR measurement for castrated goats was higher with significant effect ($P<0.05$) in the older animals than the corresponding intact goats. In the castrated goats, significant effect of slaughter age was noticed on GR measurements. Loin eye area for the intact goats was higher ($P>0.05$) than the castrated one. In both intact and castrated goat, carcasses loin eye area nonsignificantly increased with increasing slaughter age. According to Zamiri *et al*. (2012), the cross sectional area of the *Longissimus dorsi* muscle and percentage lean in the carcass increased, as the fattening period increased. Back fat was significantly higher for 15 months old goats and castration significantly increased ($P<0.05$) the thickness of back fat. Zamiri *et al*. (2012) reported non-significantly higher back fat depth in the castrates than in intact goats. No significant differences in the breast fat were observed among various groups of carcasses.

As regard to the non-carcass traits, blood per cent among different groups of goats did not differ significantly. Percent head and skin were significantly higher ($P<0.05$) for intact goats. Louca *et al*. (1977) reported significantly higher ratio of skin to slaughter weight in intact male kids than castrates. According to Zamiri *et al*. (2012), the sum weights of hard drops i.e., head, skin, pes and manus, as a percentage of the slaughter weight was higher in intact goats, compared to the castrates. Fore canon per cent was significantly higher for 12 months intact goats with respect to the 15 months castrated goats while hind canon was the lowest for 15 months intact animals. Gastrointestinal tract per cent for the 12 months castrated goats was significantly

Table 1. Effect of castration and slaughter age on carcass traits and carcass components of Barbari goats

Parameter	Intact 12	Castrate 12	Intact 15	Castrate 15
		Carcass traits		
Live weight (kg)	34.64±0.66^{b}	32.01±0.63^{b}	45.65±1.14^{a}	41.72±2.36^{a}
Carcass weight (kg)	18.16±0.43^{b}	16.49±0.29^{b}	23.27±0.57^{a}	21.54±1.30^{a}
Dressing per cent (%)	52.42±0.61	51.54±0.19	51.02±0.95	51.58±0.24
Fore quarter (kg)	10.59±0.24^{b}	9.03±0.16^{c}	13.78±0.39^{a}	11.77±0.63^{b}
Hind quarter (kg)	7.57±0.20^{b}	7.46±0.19^{b}	9.48±0.24^{a}	9.86±0.63^{a}
GR measurement (mm)	4.29±0.46^{b}	5.68±0.22^{b}	6.20±0.36^{b}	11.28±2.19^{a}
Loin eye area (cm^{2})	15.30±0.89^{ab}	13.39±1.12^{b}	16.97±0.60^{a}	15.78±1.46^{ab}
Back fat (mm)	2.59±0.12^{c}	3.50±0.43^{bc}	3.99±0.49^{ab}	4.95±0.31^{a}
Breast fat (cm)	27.52±0.70	28.94±0.66	28.02±1.79	28.69±0.84
		Non-carcass traits		
Blood (%)	4.00±0.07	4.29±0.07	4.27±0.17	4.03±0.15
Head (%)	6.30±0.27^{a}	5.25±0.16^{bc}	5.64±0.40^{ab}	4.64±0.22^{c}
Skin (%)	8.50±0.28^{a}	5.99±0.16^{b}	9.14±0.35^{a}	5.66±0.20^{b}
Fore canon (%)	1.22±0.03^{a}	1.18±0.04^{ab}	1.10±0.02^{ab}	1.07±0.07^{b}
Hind canon (%)	0.87±0.02^{ab}	0.90±0.02^{a}	0.76±0.02^{c}	0.82±0.04^{b}
GI tract (%)	7.66±0.18^{b}	8.90±0.23^{a}	7.73±0.43^{b}	7.81±0.47^{b}
Lung and trachea (%)	1.32±0.05^{a}	1.25±0.05^{ab}	1.14±0.04^{bc}	1.04±0.03^{c}
Testes (%)	0.55±0.02^{a}	0.00	0.54±0.03^{a}	0.00
Pancreas (%)	0.15±0.01^{b}	0.20±0.02^{ab}	0.20±0.02^{ab}	0.25±0.02^{a}
Spleen (%)	0.17±0.02	0.23±0.02	0.20±0.02	0.22±0.02
Kidney (%)	0.28±0.01^{a}	0.27±0.01^{a}	0.26±0.01^{a}	0.23±0.01^{b}
Liver (%)	1.64±0.05^{a}	1.60±0.04^{a}	1.59±0.06^{a}	1.32±0.03^{b}
Heart (%)	0.35±0.02	0.42±0.06	0.39±0.01	0.35±0.02

^{a,b,c}Means bearing different superscripts in a row differ significantly (P<0.05)

Table 2. Effect of castration and slaughter age on carcass composition and fat distribution in Barbari goats

Parameter	Intact 12	Castrate 12	Intact 15	Castrate 15
Meat (%)	33.04±0.89^{b}	28.20±0.75^{c}	36.84±1.01^{a}	29.12±0.46^{c}
Fat (%)	5.14±0.52^{b}	9.89±1.02^{a}	4.44±0.19^{b}	11.37±1.59^{a}
Bone (%)	13.26±0.23^{a}	13.20±0.25^{ab}	12.44±0.32^{ab}	12.37±0.28^{b}
Meat bone ratio	2.49±0.07^{b}	2.14±0.06^{c}	2.97±0.09^{a}	2.36±0.07^{b}
Cod fat (%)	0.47±0.04^{c}	0.73±0.03^{b}	0.51±0.04^{c}	0.96±0.08^{a}
Kidney fat (%)	1.49±0.08^{b}	2.10±0.41^{b}	2.02±0.28^{b}	3.60±0.33^{a}
Omental fat (%)	1.70±0.16^{c}	2.42±0.21^{bc}	3.13±0.53^{b}	4.36±0.17^{a}
Mesenteric fat (%)	0.44±0.07^{b}	0.71±0.02^{a}	0.59±0.05^{ab}	0.57±0.06^{ab}

^{a,b,c}Means bearing different superscripts in a row differ significantly (P<0.05).

higher (P<0.05) when compared to other groups of goats. Per cent lung and trachea was lower (P<0.05) for 15 months old castrated goats while pancreas was significantly higher. As per the expectation per cent testes was significantly higher (P<0.05) in intact goats than in castrates where residual testes was not collected. Kidney and liver per cent for 15 months castrated goats was significantly lower than the other groups of animals. There were no significant differences in the heart per cent among different groups.

Carcass composition and fat distribution: Intact goats carcasses had significantly higher (P<0.05) meat per cent which increased with age of slaughter while lower fat as compared to respective castrated goat carcasses (Table 2). Bone per cent decreased with the age of slaughter and 15 months old castrated goat carcasses had significantly lower (P<0.05) value. The percentage of lean meat in the carcass of the intact goats was higher that were fattened for five months while at this stage bone per cent in castrates was lower (Zamiri *et al*. 2012). According to Haddad *et al*. (2006), intact lamb had leaner bone in legs compared to the castrated lambs. However, Koyuncu *et al*. (2007) did not find any significant difference in the bone content of intact males and castrates. Meat-bone ratio for the intact goat carcasses was significantly higher (P<0.05) than the corresponding castrated goat carcasses and this ratio increased with the age of slaughter. Koyuncu *et al*. (2007) did not find any significant difference in the muscle:bone ratio between intact and castrated kids, though reported ratio was much lower than the value recorded in our study. In general, animals with higher muscle:bone ratios have higher

fat:bone ratios, so that, in many cases, those with higher muscle: bone ratios have lower muscle:carcass ratios (Berg and Butterfield 1976). This indicates that the muscle:bone ratio calculation can be very misleading as an indicator of carcass value. As the animal grows, bone tissue growth rate diminishes while muscle growth rate remains the same (Koyuncu *et al*. 2007). Fat deposits such as cod fat, kidney fat and omental fats were significantly higher (P<0.05) in castrated goats and increased with increasing slaughter age. Bayraktaroçlu *et al*. (1988) recorded that early castration of Saanen × Kilis goats significantly increased the body fat deposition except for the back fat cover. Castrated goats which slaughtered at the age of twenty four months had higher total fat, carcass fat, internal fat and kidney fat (Ruvuna *et al*. 1992). As regard to the mesenteric fat, 12 months castrated goats had significantly higher (P<0.05) per cent which decreased as the slaughter age advanced.

Physico-chemical characteristics: Effect of slaughter age and castration on various physico-chemical characteristics of goat meat is presented in Table 3. Proximate analysis of goat meat from different group showed that castration and slaughter age both reduced the amount moisture in the meat though effect of castration was found more significant (P<0.05) and meat from 15 months old castrated goats had the lowest moisture content. Kamble *et al*. (1989) reported a general reduction in moisture content of goat meat with increasing slaughter age or weight. Castration of goats significantly increased (P<0.05) the fat content in meat and the effect was more pronounced in meat from 15 months old goats. With castration, the internal fat and carcass fat content increased and carcass lean content decreased (Zamiri *et al*. 2012). Protein content in the meat from intact goat was comparatively higher and the amount was significantly higher (P<0.05) in meat from 15 months old goats when compared with meat from 12 months old goats. Slaughter age significantly influenced the protein content of goat meat samples; goats slaughtered at 175 days had the lowest protein content, and those slaughtered at 310 days had the highest (Madruga *et al*. 1999). Kirton (1970) also observed increase in protein in older animals, meat from 15 months old intact and castrated goats had significantly higher (P<0.05) ash content than the corresponding 12 months old goat meat. Contrary to this, Kamble *et al*. (1989) observed ash content decreased with increase in age. Madruga *et al*. (1999) reported that fat, protein content increased with increasing slaughter age while moisture decreased. According to these workers, meat from castrated animal contained less moisture and protein and more fat and ash than the intact goats.

Water holding capacity in meat from 15 months old goats was significantly higher (P<0.05) as compared to 12 months old goats. However, castration had non-significant effect on the WHC of goat meat. The result indicate that meat from old goats will have more juiciness and cooking yield. Slaughter age and castration did not show any significant effect (P>0.05) on the total pigment of goat meat. Amount of water extractable proteins (WEP) were significantly increased by castration and slaughter age. Salt extractable proteins were significantly decreased (P<0.05) by slaughter age. Meat from castrated 12 months goat had significantly lower (P<0.05) salt extractable proteins (SEP) than the meat from 12 months intact goats. However at 15 months

Table 3. Effect of castration and slaughter age on physico-chemical characteristics of Barbari goat meat

Parameter	Intact 12	Castrate 12	Intact 15	Castrate 15
Moisture (%)	75.20±0.13^{a}	72.83±0.20^{b}	74.76±0.22^{a}	70.57±0.88^{c}
Fat (%)	2.27±0.24^{c}	4.82±0.32^{b}	2.75±0.31^{c}	7.67±1.20^{a}
Protein (%)	20.07±0.32^{bc}	19.28±0.41^{c}	21.20±0.35^{a}	20.87±0.24^{ab}
Ash (%)	0.92±0.04^{b}	0.98±0.03^{b}	1.13±0.03^{a}	1.13±0.05^{a}
pH	5.67±0.05	5.69±0.02	5.69±0.05	5.68±0.05
WHC (%)	64.46±0.93^{b}	64.22±0.62^{b}	77.82±1.04^{a}	76.64±1.08^{a}
Pigment (ppm)	139.51±5.33	130.79±3.16	134.87±2.49	133.50±4.09
WEP (mg/g)	42.07±0.69^{d}	54.31±1.14^{c}	73.37±2.07^{b}	83.38±1.35^{a}
SEP (mg/g)	245.92±1.95^{a}	225.32±1.23^{b}	115.46±2.54^{c}	118.33±2.87^{c}
TEP (mg/g)	287.99±2.18^{a}	279.63±0.74^{b}	188.83±3.09^{d}	201.71±3.78^{c}

^{a,b,c}Means bearing different superscripts in a row differ significantly (P<0.05).

Table 4. Effect of castration and slaughter age on Hunter colour parameters and textural properties of Barbari goat meat

Parameter	Intact 12	Castrate 12	Intact 15	Castrate 15
Lightness	16.52±0.33^{b}	18.31±0.64^{a}	16.61±0.45^{b}	16.95±0.47^{ab}
Redness	12.90±0.28^{a}	12.49±0.28^{a}	10.52±0.30^{b}	10.50±0.34^{b}
Yellowness	4.63±0.17	4.64±0.16	4.57±0.15	4.74±0.20
Shear force* (N/cm^{2})	43.65±1.68^{a}	29.38±1.62^{c}	42.27±1.53^{a}	34.64±1.20^{b}
Work of shear* (Ns)	19.25±0.86^{a}	14.00±1.00b^{c}	15.38±0.70^{b}	12.00±0.43^{c}

^{a,b,c}Means bearing different superscripts in a row differ significantly (P<0.05).

Table 5. Effect of castration and slaughter age on fatty acid profile (% of total fatty acid) of Barbari goat meat

Parameter	Intact 12	Castrate 12	Intact 15	Castrate 15
C14: 0	1.76±0.10b^{c}	1.58±0.20^{c}	2.12±0.12^{ab}	2.43±0.16^{a}
C16: 0	20.74±0.58^{b}	20.76±0.91^{b}	22.87±0.33^{a}	24.10±0.56^{a}
C16: 1	2.42±0.29^{a}	1.60±0.24^{b}	0.50±0.05^{c}	0.61±0.18^{c}
C17: 1	4.52±0.45^{a}	2.46±0.62^{b}	1.88±0.18^{b}	1.85±0.11^{b}
C18: 0	14.63±0.62^{a}	11.81±0.92^{b}	9.13±0.42^{c}	7.57±0.86^{c}
C18: 1	44.54±1.28^{c}	49.53±1.83^{b}	45.57±0.87^{bc}	55.92±1.51^{a}
C18: 2	6.20±0.91^{b}	4.18±0.68^{c}	10.03±0.44^{a}	3.75±0.18^{c}
C18: 3	0.44±0.04b	ND	0.62±0.05^{a}	0.74±0.06^{a}
C22: 0	1.71±0.85^{b}	5.32±0.59^{a}	0.65±0.08^{b}	0.20±0.02^{b}
C20: 3	1.81±0.35^{b}	ND	4.04±0.30^{a}	1.58±0.19^{b}
ΣSFA	40.07±0.67^{a}	40.19±1.05^{a}	34.91±0.41^{b}	34.55±1.27^{b}
ΣMUFA	51.48±1.08^{c}	55.63±0.97^{b}	50.22±0.80^{c}	59.31±1.41^{a}
ΣPUFA	8.45±1.14^{b}	4.18±0.68^{c}	14.70±0.69^{a}	6.07±0.31^{c}

Means bearing different superscripts in a row differ significantly (P<0.05); ND, not detected.

slaughter age, effect of castration on SEP was non-significant. SEP are the key determinants for various functionality while meat products processing. Based upon results of the present study, it can be said that meat from 12 months old intact and castrated goat will be more suitable for product processing with respect to the meat from 15 months old goats. Total extractable proteins as obtained by summing up the WEP and SEP were significantly higher in meat from younger intact animal while at 15 months ages TEP was significantly higher in meat castrated animals.

Hunter colour parameter and texture profile analysis: The effects of castration and slaughter age on Hunter colour parameters and textural properties of goat meat are presented in Table 4. Hunter colour lightness value for goat meat was significantly increased (P<0.05) by castration though the value decreased with increase in the slaughter age. Intramuscular fat content can be responsible for part of the differences in meat lightness found between castrated and intact goats. Fat is lighter in colour than muscle and therefore its presence could contribute to an increased lightness value (Priolo *et al*. 2001). Slaughter age significantly decreased (P<0.05) the Hunter colour redness value. No significant effect (P>0.05) of castration on redness value of goat meat was observed. Hunter colour yellowness value of goat meat remained unaffected by castration and slaughter age. Meat from castrated goats had significantly lower (P<0.05) shear force value and work of shear as compared to meat from intact goats. Slaughter age significantly increased the shear force value of meat from castrated goats. In pork, intramuscular fat (IMF) accounted for 47% of the differences in Warner-Bratzler shear (WBS) force, and the relationship was linear; WBS decreased as IMF increased (Van Laack *et al*. 2001).

Fatty acid profile: Fatty acid profile of meat from 12 and 15 months old intact and castrated goat is presented in Table 5. Amount of palmitic acid was significantly increased (P<0.05) by slaughter age, however, no significant effect of castration was observed. Both castration and slaughter age significantly decreased (P<0.05) the stearic acid content in goat meat. Contrary to this, amount of oleic acid significantly improved (P<0.05) due to castration and age at slaughter. In the present study, amount of oleic acid in intact goat meat was similar to the value reported by Madruga *et al*. (2001); however, for the meat from castrated goats, oleic acid content was much higher. Park *et al*. (1990) reported oleic acid as the major component in the fatty acid profile of goat meat.The fatty acid content of the longissimus thoracic muscles from goat were primarily composed of oleic acid (43.3–53.8%), followed by palmitic acid (22.5–27.9%) and stearic acid (10.7–18.1%) (WerdiPratiwi *et al*. 2006). Oleic and palmitic acids increased while stearic acid decreased with an increase in slaughter weight as reported by these workers. Linoleic acid content was significantly lower in meat from castrated goats of both age groups. As regard to the saturated fatty acids (SFA), these were significantly decreased (P<0.05) with increasing the age at slaughter. Similar results were also reported by Bas and Morand-Fehr (2000) and Todaro *et al*. (2002). The percentage of stearic, linoleic and total saturated fatty acids were lower in muscle taken from the castrated animals (WerdiPratiwi *et al*. 2006). Monounsaturated fatty acids (MUFA) were significantly higher in meat from castrated goats; however, no significant effect of age at slaughter on MUFA content was seen. Increasing the age at slaughter increased the amount of polyunsaturated fatty acids (PUFA).

The results of the present study showed that though live weight, carcass weight was affected by age at slaughter, dressing per cent remained similar in all groups of goats. Castration and slaughter age affected different carcass and non-carcass traits as well as carcass composition and fat distribution. Amount of meat was higher in intact goats while castrated goats had more fat. As regard to the proximate composition, both castration and age affected moisture and fat contents while protein and ash contents were affected by slaughter age. Meat from older goats had more WHC while younger goat meat contained higher salt extractable proteins. Young goat meat had more lightness

(castrates) and redness values. Castrated goat meat was tenderer as depicted by lower shear force value and work of shear. Saturation of fatty acids decreased as slaughter age of goats increased.

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