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Meat and Fat Quality of Salem Black Goat meat Reared under Different Rearing Systems

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ABSTRACT

Background: The work was carried out to complementary contribution to the comprehensive study of the recently recognised promising Salem Black goat breed's meat quality raised under intensive and semi intensive systems at different age for both sexes.

Methods: The study was conducted on sixty four, three months old Salem Black goat kids (32 males and 32 females) by allotting randomly as16 kids in each group in a 2 X 2 factorial design.

Result: The pH value for meat was significantly (P<0.05) higher at 9 months male animals. Meat redness (a*) value increased and the lightness (L*) and yellowness (b*) values significantly (P<0.01) decreased with age. The shear force indicates that male had significantly (P<0.01) higher value. Meat at 6 months had significantly (P<0.01) higher sarcomere length. Hydroxyproline content was significantly (P<0.01) higher with lower muscle fibre diameter in intensively reared male kids meat. Acid insoluble ash, ether extract and PUFA contents were significantly (P<0.05) increased with age in meat. Intensively reared animals had significantly (P<0.05) low level of SFA and high level of PUFA, MUFA and PUFA/SFA ratio than semi-intensively reared animals. The intensively reared animal shows better meat quality, more nutritious than semi intensively reared animal meat.

Key words: Fatty acid profile, Goat meat, Goat rearing system, Physicochemical properties, Proximate composition.

INTRODUCTION

Goat meat is an important food source and widely consumed in the semiarid regions of developing countries (Upton, 2004). The production of goat meat steadily increased in recent years especially in the Southern India. The goat population in the country in 2019 was 148.88 million showing an increasing of 10.1 per cent over the previous census (Livestock Census, 2019). The country is largest exporter of sheep and goat meat to the world. The increased popularity for goat meat is because of its dietetic and the cultural tendency of consumers towards natural foods and the association of goat meat with religious activities (Debeuf *et al*., 2004). Besides its popularity, ruminants products often blamed for their high content of saturated fatty acids (SFA) and the low content of polyunsaturated fatty acids (PUFA) (Scollan *et al*., 2006). While the former are among those responsible for increasing risk of cardiovascular diseases, the later and specially n-3 fatty acids have been shown to exert favourable effects on human health (Simopoulos, 1999). To cope up with this crisis, it is necessary to adopt strategies which aim quality meat production. Use of different production systems and breeds has been shown to influence a number of changes in the meat characteristics (Miguel *et al*., 2008; Emre Sirin, 2018). There is little literature available on goat meat chemical composition at different age, sex and rearing systems and its impact on consumer's preference. Moreover, the wide spread distribution of this meat breed has wide scope for improvement in terms of its meat quality. Hence, the present work was carried out to study the carcass of the recently recognised promising Salem Black goat breed for its chemical composition and meat quality raised under intensive and semi intensive systems at different age for both sexes.

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MATERIALS AND METHODS

Goats were reared at Mecheri Sheep Research Station (MSRS), Tamil Nadu Veterinary and Animal Sciences University during the year 2017-18. Location of MSRS is at longitude of 77°56′E, latitude of 11°45′N and altitude of about 650 feet above MSL. The local climate of the area is generally hot, semi-arid and tropical with an average rainfall of 831.4 mm. At the end of the experiment animals were transported (two hours journey) to the experimental slaughter

house of Department of Livestock Products Technology (Meat Science), Veterinary College and Research Institute, Namakkal located 95 km from the research station to study the meat quality.

Experimental animals

Sixty four, three months old Salem Black kids (32 males and 32 females) with an average body weight of 9.39±0.09 kg for male and 8.75±0.05 kg for female were selected for the study (Males are not castrated). The kids were randomly allotted to an experimental group; 16 kids in each group in a 2 X 2 factorial design; 32 kids in intensive system and 32 kids in semi-intensive system to two treatments (Male and female). Animals were housed in a pen with individual feeding and watering facility. The animals under the intensive system and semi-intensive system were fed concentrate feed at the rate of 1 per cent of the body weight and *ad libitum* of fodder (Guinea grass, hybrid Bajra napier) and tree leaves Subabul(*Leucaena leucocephala*), Glyricidia (*Gliricidia maculate*), Neem (*Azardirechta indica*), Babul (*Acacia nolitica*), Agathi (*Sesbania grandiflora*), Kodukapuli (*Pithecellobium dulce*), Mango (*Magnifera indica*), Guava (*Psidium guajava*) and Kapok (*Ceiba pentadra*) leaves during the experimental period. In addition, animals in semi-intensive system were allowed for grazing between 9.00 AM and 5.00 PM for 8 hours.

Sample collection and chemical analysis

Animals were slaughtered at the age of 6 and 9 months for both the sex, eight animals in each category by humane method in the experimental slaughter house. Meat was deboned and stored at -20°C for further analysis.

Physiochemical parameters

The pH of goat meat was determined by the method of AOAC (1995). The pH of the homogenate was recorded by immersing combined glass electrode and temperature probe of the digital pH meter (Model 361, Systronics, India).

Colour of LD muscles of goat meat was tested using Hunter Lab Mini Scan XE plus separate colorimeter (Model No. 45/0-L, Reston Virginia, USA) with geometry of diffuse/ 80 (sphere- 8mm view) and an illuminant of D65/10deg. The instrument was calibrated with black and white tile (L*=94, a*=1.10 and b*=0.6) every time before the colour was expressed as L* (brightness), a* (redness) and b* (yellowness). Average value for each colour parameter was determined by taking observation from five different places from each goat meat.

Fibre diameter of the meat sample was measured as per the method of Jeremiah and Martin (1982) and expressed in micrometres.

Sarcomere length was measured as per the method outlined by Cross *et al.* (1981) with certain modifications. The sarcomere length of twenty myofibrils was measured randomly and the average was calculated and expressed in micrometres.

Warner- Bratzler shear force analysis was carried out using a Warner- Bratzler shear (G.R. Electric Manufacturing Company, Manhatten, USA, Model 3000). Three shear values per core (kg/cm^2) obtained were (anterior, middle and posterior) averaged to get the mean shear force.

The amino acid hydroxyproline was determined as described by Woessner (1961). The Hydroxyproline content was converted to total collagen using a factor of 7.57 (Baker *et al.,* 1954).

Proximate composition

The proximate analysis of meat was done as per AOAC (1997). The gross energy (GE) content was estimated using an adiabatic bomb calorimeter.

Fatty acid composition

For the analysis of the fatty acid profile, the meat was thawed at 5°C for 12 hours followed by lipid extraction (Folch *et al.,* 1957). The fatty acid profile was determined according to Hartman and Lago (1973) using gas chromatography. The oven was maintained at 70°C for 4 min and then the temperature was increased at the rate of 13°C/min to 175°C, which was maintained for 27 min and then increased at the rate of 4°C/min to 215°C, which was maintained for 9 min and then increased at the rate of 7°C to 230°C, which was maintained for 5 min. The injector temperature was 250°C and the detector temperature 300°C.

Statistical analysis

The data were subjected to analysis of variance in a factorial design to observe the effect of systems of management, sex, age source and their interaction. All the statistical procedures were carried out as per the procedures of Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Physiochemical parameters

The physicochemical properties of Salem black goat meat are presented in Table 1. The pH values for *longissimus dorsi* muscle were higher at 9 months slaughter compared to 6 months. Male animals had slightly higher pH values than females and the system of management did not influence these values. These values were similar to previous reports of Hussin *et al.* (2000) and Werdi Pratiwi *et al*. (2004a). In agreement with Enfalt *et al*. (1997), the trend of higher the pH lesser in extract release volume and more in water holding capacity of meat was observed in the present study.

Fresh meat colour is an important criterion for judging freshness and quality by consumers. Muscle colour is darker red, (a* values) for muscle taken from kids slaughtered at 9 months compared to 6 months. Lightness (L*) and yellowness (b*) values decreased as the animals got older and heavier in the present study. The results confirm the reports of Werdi Pratiwi *et al*. (2004a) who observed that the colour of *longissimus dorsi* muscle become darker red with age, as muscle pigment concentration increases. This

Table 1: Mean (±) SE of Physico- chemical meat quality parameter of Salem Black goat meat at different age, sex and management systems.

	Intensive system (n=32)		Pooled	Semi-intensive system (n=32)		Pooled	SEM	P-value		
	6 Month	9 Month		6 Month	9 Month			System	Sex	Age
pH										
Male	6.44±0.037	6.60±0.032	6.52±0.031	6.35±0.030	6.54±0.037	6.45±0.034				
Female	6.36±0.030	6.51±0.032	6.44±0.029	6.38±0.046	6.49±0.028	6.44±0.030	0.009	0.111	0.066	0.001
Pooled	6.40±0.025^{X}	6.56±0.024^{Y}	6.48±0.022	6.36±0.027^{X}	6.52±0.023^{Y}	6.44±0.022				
Colour L*										
Male	48.09±0.791^{a}	42.28±1.306$_{a}$	45.18±1.052	51.10±1.463^{a}	43.51±0.977^{a}	47.31±1.297				
Female	51.95±1.806^{b}	45.82±0.791^{b}	48.88±1.239	53.04±1.477^{b}	46.80±0.513^{b}	49.92±1.105	11.761	0.070	0.001	0.0001
Pooled	50.02±1.075^{X}	44.05±0.868^{Y}	47.03±0.866	52.07±1.035^{X}	45.15±0.682^{Y}	48.61±0.870				
a*										
Male	11.60±0.307^{a}	14.33±0.656^{a}	12.96±0.470	10.82±0.419^{a}	13.99±0.836^{a}	12.41±0.610				
Female	10.77±0.526^{b}	12.24±0.514^{b}	11.50±0.403	10.09±0.339^{b}	12.27±0.615^{b}	11.18±0.453	2.368	0.260	0.001	0.0001
Pooled	11.18±0.313^{X}	13.28±0.457^{Y}	12.23±0.332	10.46±0.277^{X}	13.13±0.558^{Y}	11.79±0.389				
b*										
Male	15.76±0.751	13.72±0.336	14.74±0.477	15.53±0.566	13.42±0.488	14.48±0.453				
Female	15.86±0.814	13.66±0.469	14.76±0.535	16.13±0.753	14.60±0.402	15.36±0.457	2.847	0.688	0.283	0.0001
Pooled	15.81±0.535^{X}	13.69±0.279^{Y}	14.75±0.353	15.83±0.462^{X}	14.01±0.342^{Y}	14.92±0.326				
Muscle fibre diameter (µm)										
Male	33.76±0.575	36.60±0.302	35.18±0.482	33.80±0.281	38.54±0.828	36.17±0.743				
Female	33.51±0.491	36.73±0.425	35.12±0.521	34.91±0.413	36.94±0.419	35.92±0.386	1.953	0.013	0.667	0.001
Pooled	33.64±0.367^{X}	36.67±0.250^{Y}	35.15±0.349^{A}	34.35±0.281^{X}	37.74±0.493^{Y}	36.04±0.413^{B}				
Sarcomere length (µm)										
Male	1.75±0.052	1.53±0.010	1.64±0.038	1.81±0.026	1.55±0.022	1.68±0.037				
Female	1.81±0.041	1.53±0.028	1.67±0.043	1.79±0.033	1.57±0.012	1.68±0.033	0.008	0.250	0.559	0.001
Pooled	1.78±0.033^{X}	1.53±0.014^{Y}	1.65±0.028	1.80±0.020^{X}	1.56±0.012^{Y}	1.68±0.024				
Sheare force value (kg/cm^{2})										
Male	6.51±0.236^{a}	7.36±0.022^{a}	6.94±0.191	5.70±0.224^{a}	7.10±0.124^{a}	6.40±0.219				
Female	5.30±0.264^{b}	7.11±0.079^{b}	2.21±0.269	5.53±0.255^{b}	7.11±0.130^{b}	6..32±0.247	0328	0.144	0.006	0.001
Pooled	5.91±0.232^{X}	7.24±0.118^{Y}	6.57±0.175	5.61±0.166^{X}	7.11±0.087^{Y}	6.36±0.163				
Hydroxyproline (mg/g)										
Male	3.10±0.068^{a}	3.10±0.071^{a}	3.10±0.048	3.10±0.092^{a}	2.62±0.084^{a}	2.86±0.086				
Female	3.10±0.092^{b}	2.60±0.072^{b}	2.85±0.086	2.64±0.064^{b}	2.67±0.112^{b}	2.65±0.062	0.055	0.001	0.001	0.001
Pooled	3.10±0.055^{X}	2.85±0.080^{Y}	2.97±0.053^{A}	2.87±0.081^{X}	2.65±0.068^{Y}	2.76±0.056^{B}				

^{AB}Pooled mean bearing different superscript in a row differ significantly for system of management.

^{XY}Pooled mean bearing different superscript in a row differ significantly for age within the system of management.

^{ab}Mean bearing different superscript in a column differ significantly for sex within the age and system of management.

is because muscle colour is greatly influenced by the concentration and chemical nature of haemoprotein present in the muscle (Kannan *et al.,* 2001). System of management and sex of the animal did not influence the colour of the meat.

Mean fibre diameter of Salem Black goat meat ranged from 33.51 to 38.54 µm. Higher muscle fibre diameter was observed in semi-intensive system compared to intensive system of management in the present study might be due to exercise by extensive movement during grazing. Furthermore, it was evident that with the increase in the age, the mean fibre diameter value also increased, which was in concurrence with the result of Ilavarasan *et al*. (2018). The muscle fibre diameter can be positively correlated with shear force value and negatively with tenderness and sarcomere length (Kandeepan *et al*., 2009). The measured fibre diameter for Salem Black goat was higher than two and half year old Black Bengal goats (29.94 µm) and Garole sheep (26.64 µm) (Kesava Rao *et al*., 1984) and comparable with Sudan desert sheep (32.5µm) (Gaili and Ali 1985a) and, Muzaffarnagari rams (37.91µm) (Kesava Rao *et al*, 1998).

Sarcomere length plays a key role in the development of meat tenderness and it may provide useful information for economic production of farm animals to produce high quality meat. The result of the present experiment showed that sarcomere length significantly (P<0.01) decreases with advancing age. The variation in sarcomere length and their interaction with proteins released during collagen proteolysis directly determines the tenderness of individual muscle (Wheeler and Koohmaraie, 1999).

Devine *et al*. (1993) reported that the tender meat will have the SFV varied from 5.53 to 7.24 kg/cm^2. In accordance with earlier study, male goats and slaughtered at 9 months old age produced significantly (P<0.05) tender meat compared to female and 6 months groups. Variations found in the SFV can be attributed to differences in nutrition, age and final meat pH (Devine *et al*., 1993).

Collagen content was significantly (P<0.01) higher in meat for intensively reared animal compared to semi-intensively reared animal. Similarly, the sex and age of the animal significantly influences the collagen content of the meat. Male kid meat had higher collagen than female. The collagen content was increased with increasing age in the present study. The higher collagen content can be attributed due to the age of the animals, greater amount of soluble, less stable collagen with fewer covalent cross- links between the collagen (Argüello *et al*., 2005).

Proximate composition

The meat from kids reared under intensive system of management had significantly (P<0.05) lower moisture, higher ether extract and energy as compared to semi-intensively reared kids in both the age groups (6 and 9 months) (Table 2) which were in accordance with the findings of Pal *et al*. (1997) and Dass *et al.* (2008) in Muzaffarnagari lambs. The higher feed intake, better nutrient utilization and restricted movement might have lead to more fat deposition resulting higher ether extract and energy values in meat of intensively reared kids compared to semi-intensively reared kids in the present study. Higher fat content decreased the moisture content in meat as fat accumulation in muscle tissue replaces water under adequate feeding (Dass *et al*., 2008, Rajkumar and Agnihotri, 2005). The ether extract and gross energy content of the *longissimus dorsi* muscle were lower than those found by Babiker *et al*. (1990) for goats slaughtered at 35 kg live weight and maintained under complete diet.

Sex of the animal significantly (P<0.01) effected the ether extract and acid insoluble acid content of the meat. Females had higher percentage of ether extract in *longissimus dorsi* muscle than males. The result can be attributed to differences in the growth and development between females and males resulting from sexual hormone effects that influence growth speed and animal tissue components deposition (muscle, fat and bone). Moisture has shown an inverse relationship on the fat content of meat which is in agreement with findings of Sheridan *et al.* (2003) (Boer Goat Kids) and Santos *et al.* (2008) (Portuguese native breed).

The crude protein, ether extract, calcium, phosphorus salt, gross energy content of the muscle were significantly (P<0.01) higher in meat of 9 months old goats as compared to 6 months. The moisture percent was significantly (P<0.01) lower due to increased protein and fat percentage during growth period. This is similar to the findings of Dass *et al.* (2008). In Contrast, Sivakumar *et al.* (2013) reported no significant difference between the weight groups 12-15 and 15 -18 kg for proximate principles of the meat in Kanniadu. The variation might be due to the difference in age, feed and breed of the animals (Mahgoub *et al*., 2002).

Fatty acid composition

The Palmimic, Palmitolic, Linoleic, Stearic acid and DHA were significantly (P<0.01) higher in intensively reared kids meat compared to semi-intensively reared kids (Table 3). The greater concentration of these fatty acids observed in intensive system may be due to the greater consumption of nutrients (Lopes *et al*., 2014). Similarly, Jenkins *et al*. (2008) reported that the greater amount of starch consumed by goats fed *ad libitum* favours the development of protozoa which are an important source of PUFA and CLA in the meat. Sex of the animal did not significantly (P>0.05) influence the fatty acid composition of the meat in the present study. However, Johnson *et al.* (1995) and Matsuoka *et al.* (1997) reported lower total muscle lipids and greater PUFA: SFA ratio in male animals compared to female animals and similar concentrations of PUFA in Japanese Sannan goats between male and female. Literature review reveals that differences in fatty acid composition due to sex have been inconsistent. Studies of Terrel *et al.* (1968) with cattle have shown that sex effects were associated with the neutral rather than phospholipid fraction of fatty acids. The results of Matsuoka *et al.* (1997) for Japanese Jackson goats shows that sex difference in fatty acids composition are more

Table 2: Mean (±) SE of proximate composition of Salem Black goat meat at different age, sex and management systems.

	Intensive system (n=32)		Pooled	Semi-intensive system (n=32)		Pooled	SEM	P-value		
	6 Month	9 Month		6 Month	9 Month			System	Sex	Age
Moisture (%)										
Male	71.85±0.38^{a}	69.09±0.35^{a}	70.47±0.44	74.71±0.30^{a}	69.64±0.79^{a}	72.18±0.77	2.023	0.001	0.024	0.0001
Female	71.67±0.40^{b}	69.44±0.37^{b}	70.56±0.39	74.92±0.35^{b}	72.55±0.78^{b}	73.73±0.52				
Pooled	71.76±0.27^{X}	69.26±0.25^{Y}	70.51±0.29^{A}	74.81±0.23^{X}	71.10±0.66^{Y}	72.95±0.48^{B}				
Crude protein (%)										
Male	21.24±0.57	22.37±0.39	21.80±0.36	21.74±0.41	24.60±0.59	23.17±0.51				
Female	22.03±0.50	24.73±0.68	23.38±0.54	21.62±0.63	22.51±0.53	22.07±0.41	2.38	0.937	0.547	0.0001
Pooled	21.63±0.38^{X}	23.55±0.49^{Y}	22.59±0.35	21.68±0.36^{X}	23.55±0.47^{Y}	22.62±0.34				
Ether extract (%)										
Male	2.24±0.34^{a}	5.01±0.48^{a}	3.62±0.46	2.18±0.35^{a}	4.02±0.40^{a}	3.10±0.35				
Female	2.59±0.25^{b}	3.57±0.49^{b}	3.08±0.29	2.37±0.06^{b}	2.87±0.30^{b}	2.62±0.16	1.03	0.057	0.047	0.0001
Pooled	2.42±0.21^{X}	4.29±0.38^{Y}	3.35±0.27	2.28±0.17^{X}	3.45±0.28^{Y}	2.86±0.19				
Total ash (%)										
Male	1.41±0.15	1.00±0.07	1.21±0.09	1.36±0.15	1.12±0.06	1.24±0.09				
Female	1.01±0.08	1.23±0.01	1.12±0.05	1.27±0.08	1.17±0.03	1.22±0.04	0.07	0.306	0.410	0.057
Pooled	1.21±0.10	1.12±0.04	1.16±0.05	1.32±0.08	1.15±0.03	1.23±0.05				
Acid insoluble ash (%)										
Male	0.05±0.01^{a}	0.05±0.00^{a}	0.05±0.01	0.04±0.01^{a}	0.05±0.01^{a}	0.05±0.01				
Female	0.03±0.01^{b}	0.04±0.01^{b}	0.03±0.00	0.05±0.01^{b}	0.02±0.00^{b}	0.03±0.01	0.001	0.957	0.020	0.888
Pooled	0.04±0.01	0.05±0.00	0.04±0.00	0.04±0.01	0.04±0.01	0.04±0.01				
Energy (Kcal)										
Male	1462.2±31.20	1935.7±43.91	1698.9±66.45	1331.5±73.45	1713.8±17.95	1522.6±61.41				
Female	1435.8±19.76	1804.6±26.00	1620.2±50.15	1503.2±33.95	1828.1±37.94	1665.6±48.62	12276.72	0.022	0.251	0.0001
Pooled	1449.0±18.16^{X}	1870.1±29.9^{Y}	1659.5±41.55^{A}	1417.3±44.94^{X}	1771.0±21.07^{Y}	1594.1±40.61^{B}				

^{AB}Pooled mean bearing different superscript in a row differ significantly for system of management.

^{XY}Pooled mean bearing different superscript in a row differ significantly for age within the system of management.

^{ab}Mean bearing different superscript in a column differ significantly for sex within the age and system of management.

Table 3: Mean (±) SE of fatty acid composition (per cent) of Salem Black goat meat at different age, sex and management systems.

	Intensive system (n=32)		Pooled	Semi-intensive system (n=32)		Pooled	SEM	P-value		
	6 Month	9 Month		6 Month	9 Month			System	Sex	Age
Myristic acid (C14:0)										
Male	2.77±0.28	3.20±0.51	2.99±0.29	2.03±0.16	2.53±0.32	2.28±0.19	0.823	0.262	0.685	0.891
Female	3.04±0.42	1.86±0.20	2.45±0.27	2.58±0.23	2.70±0.27	2.64±0.17				
Pooled	2.90±0.25	2.53±0.32	2.72±0.20	2.30±0.15	2.62±0.21	2.46±0.13				
Palmitic acid (C16:0)										
Male	20.85±0.67	20.98±0.61	20.91±0.44	18.45±0.82	21.56±0.70	20.00±0.66				
Female	19.47±0.72	21.39±0.43	20.43±0.47	20.63±0.31	17.79±0.49	19.21±0.46	3.016	0.017	0.147	0.187
Pooled	20.16±0.51	21.91±0.36	20.67±0.32^{A}	19.54±0.51	19.67±0.64	19.61±0.40^{B}				
Stearic acid (C18:0)										
Male	19.20±1.05	17.97±1.66	18.58±0.96	13.83±0.39	16.72±0.94	15.28±0.62				
Female	18.00±1.11	16.21±1.58	17.11±0.96	16.53±0.81	13.06±0.80	14.79±0.71	9.896	0.001	0.219	0.258
Pooled	18.60±0.75	17.09±1.13	17.84±0.68^{A}	15.18±0.56	14.89±0.76^{B}	15.03±0.46				
Oleic acid (C18:1)										
Male	35.26±1.30	41.31±0.78	38.29±1.07	33.47±1.57	41.63±0.73	37.55±1.34	15.577	0.094	0.244	0.0001
Female	38.86±2.20	41.91±0.85	40.39±1.20	35.31±1.30	40.23±1.75	37.77±1.23				
Pooled	37.06±1.32^{X}	41.61±0.56^{Y}	39.34±0.81	34.39±1.01^{X}	40.93±0.93^{Y}	37.66±0.90				
Linoleic acid (C18:2)										
Male	10.31±0.73	10.73±1.06	10.52±0.62	8.67±1.478	5.91±0.51	7.29±0.83				
Female	7.45±0.62	11.83±1.69	9.64±1.04	7.26±1.02	6.33±0.44	6.80±0.55	8.541	0.0001	0.351	0.704
Pooled	8.88±0.59	11.28±0.97	10.08±0.60^{A}	7.97±0.88	6.12±0.33	7.04±0.49^{B}				
Linolenic acid (C18:3)										
Male	1.19±0.12	1.72±0.19	1.45±0.13	1.74±0.33	1.13±0.27	1.44±0.22				
Female	1.70±0.28	1.05±0.16	1.37±0.18	3.52±1.67	1.46±0.25	2.49±0.86	3.204	0.225	0.281	0.125
Pooled	1.44±0.16	1.38±0.15	1.41±0.11	2.63±0.86	1.29±0.18	1.96±0.45				
Arachitonic acid (C20:4)										
Male	0.77±0.07	0.74±0.08	0.76±0.05	0.46±0.08	1.02±0.15	0.74±0.11				
Female	0.84±0.26	0.69±0.11	0.77±0.14	0.87±0.31	0.77±0.16	0.82±0.17	0.246	0.884	0.703	0.568
Pooled	0.80±0.13	0.72±0.07	0.76±0.07	0.67±0.17	0.89±0.11	0.78±0.10				
Behenic acid (C22:0)										
Male	2.37±0.12	2.57±.0.28	2.47±0.15	1.74±0.14	1.65±0.31	1.69±0.17				
Female	2.20±0.25	1.61±0.27	1.90±0.19	2.06±0.30	1.95±0.33	2.00±0.22	0.541	0.071	0.490	0.425
Pooled	2.28±0.14	2.09±0.22	2.19±0.13	1.90±0.16	1.80±0.22	1.85±0.14				
Eicosapentanoic acid (C20:5)										
Male	0.54±0.07	1.08±0.07	0.81±0.08	0.54±0.07	1.07±0.21	0.81±0.13				
Female	0.68±0.07	0.83±0.13	0.15±0.07	0.54±0.07	1.04±0.28	0.79±0.16	0.167	0.848	0.740	0.0001
Pooled	0.61±0.05^{X}	0.95±0.08^{Y}	0.78±0.06	0.54±0.05^{X}	1.06±0.17^{Y}	0.80±0.10				

Table 3: Continue...

Table 3: Continue...

Docosahexonoic acid (C22:6)										
Male	0.94±0.06	1.04±0.16	0.99±0.08	0.53±0.08	0.92±0.14	0.73±0.09				
Female	0.73±0.11	1.07±0.16	0.90±0.10	0.59±0.08	0.59±0.14	0.59±0.08	0.117	0.001	0.195	0.019
Pooled	0.84±0.06^{X}	1.06±0.11^{Y}	0.95±0.07	0.56±0.05^{X}	0.75±0.10^{Y}	0.66±0.06				
Palmitoleic acid (C16:1)										
Male	4.00±0.22	2.67±0.28	3.33±0.24	2.48±0.48	2.54±0.23	2.51±0.26				
Female	3.01±0.39	3.62±0.23	3.31±0.23	3.41±0.41	2.77±0.26	3.09±0.25	0.849	0.026	0.228	0.162
Pooled	3.50±0.25	3.14±0.21	3.32±.017^{A}	2.94±0.33	2.65±0.17	2.80±0.18^{B}				
Others										
Male	2.21±0.36	2.06±0.41	2.13±0.27	0.86±0.33	1.49±0.28	1.17±0.22				
Female	1.95±0.27	0.19±0.06	1.07±0.26	1.43±0.49	1.69±0.51	1.56±0.34	1.067	0.364	0.195	0.324
Pooled	2.08±0.22	1.12±0.31	1.66±0.21	1.14±0.30	1.59±0.28	1.37±0.21				

^{AB}Pooled mean bearing different superscript in a row differ significantly for system of management.

^{XY}Pooled mean bearing different superscript in a row differ significantly for age within the system of management.

Table 4: Mean (±) SE of proportion of fatty acid composition of Salem Black goat meat at different age, sex and management systems.

	Intensive system (n=32)		Pooled	Semi-intensive system (n=32)		Pooled	SEM	P-value		
	6 Month	9 Month		6 Month	9 Month			System	Sex	Age
Saturated fatty acids (SFA)										
Male	37.41±0.31	44.06±0.54	40.74±0.30	43.81±0.61	43.13±.54	43.47±0.28	15.18	0.001	0.065	0.612
Female	42.40±0.24	34.31±0.52	38.35±0.33	42.11±0.31	42.25±0.65	42.18±0.25				
Pooled	39.91±0.21	39.18±0.41	39.54±0.16^{A}	42.96±0.24	42.69±0.29	42.82±0.13^{B}				
Monounsaturated fatty acids (MUFA)										
Male	45.31±0.28	37.93±0.50	41.62±0.31	44.11±0.40	36.00±0.58	40.05±0.36				
Female	44.92±0.24	42.48±0.73	43.70±0.28	43.64±0.65	48.07±0.47	40.86±0.33	16.57	0.034	0.162	0.001
Pooled	45.12±0.13^{X}	40.21±0.34^{Y}	42.66±0.15^{A}	43.87±0.26^{X}	37.04±0.26^{Y}	40.45±0.17^{B}				
Polyunsaturated fatty acids (PUFA)										
Male	13.74±0.27	15.31±0.46	14.52±0.19	11.94±0.47	10.05±0.33	11.00±0.21				
Female	11.40±0.30	15.47±0.46	13.43±0.23	12.78±0.79	10.20±0.23	11.49±0.29	12.69	0.003	0.738	0.748
Pooled	12.57±0.16	15.39±0.22	13.98±0.10^{A}	12.36±0.31	10.12±0.14	11.24±0.12^{B}				
PUFA/SFA										
Male	0.37±0.01	0.36±0.01	0.36±0.01	0.28±0.02	0.24±0.01	0.26±0.01				
Female	0.27±0.01	0.46±0.02	0.37±0.01	0.31±0.02	0.25±0.01	0.28±0.01	0.01	0.001	0.694	0.579
Pooled	0.32±0.01	0.41±0.01	0.37±0.01^{A}	0.30±0.01	0.24±0.01	0.27±0.01^{B}				

^{AB}Pooled mean bearing different superscript in a row differ significantly for system of management.

^{XY}Pooled mean bearing different superscript in a row differ significantly for age within the system of management.

pronounced in phospholipids than in neutral lipids. In accordance to Banskalieva *et al*. (2000), Salam Black goat meat contains lower concentration of other fatty acids (Eg. C20:0, C12:0, C15:0, C17:0, C20:1, C20:3, C22:0, C24:0, C22:4 and C22:6).

Management system significantly (P<0.01) influences the SFA, MUFA, PUFA and PUFA: SFA ratios and age of the animal influence the MUFA content of the muscle were observed in the present study (Table 4).

The intensively reared kids had significantly (P<0.01) lower concentrations of SFA, greater concentrations of MUFA and PUFA and PUFA: SFA ratio compared to other rearing system. It may be attributed due to high plan of nutrition which produced more fatty acids through de novo synthesis (mainly oleic acid) (Lopes *et al.,* 2014) and the increased intramuscular fat content in the *longissimus dorsi* muscle (De Smet *et al*., 2004). However, meat from 6 months slaughter had significantly higher (P<0.05) MUFA level compared to 9 month slaughter others did not differ related to age of the animal. *Longissimus dorsi* muscle from Salem Black goat contain higher unsaturated, monounsaturated and polyunsaturated fatty acids and which are considered desirable fatty acids that have either a neutral or cholesterol lowering effect.

CONCLUSION

It can be concluded that the meat from intensively reared goat kids develop better meat quality and contains higher levels of PUFA and MUFA than the semi intensively reared goat kid meat. The meat quality, nutrient content and fatty acid profile was better at 9 months of age in comparison to 6 months. Meat from male goats had superior carcass traits with darker colour and higher ether extract.

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