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# Intramuscular fatty acid profile of longissimus dorsi and semitendinosus muscle from Pateri goats fed under traditional feeding system of Sindh, Pakistan

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ABSTRACT

The present study was undertaken to assess the intramuscular fatty acid composition of different muscles taken from male Pateri ($n = 15$) goats, reared on naturally grown grasses, leaves and pods of *Acacia nilotica* and crushed cereal, under traditional way of feeding. Goats were slaughtered with an average weight of 68 ± 7 kg and age 12 ± 1 month. The samples were taken from longissimus dorsi region (between the 12th and 13th rib) and distal region of semitendinosus muscle. Results of total fat content and fatty acids composition does not show significant ($P > 0.05$) variation among muscles investigated. The fatty acid composition of muscles studied were primarily composed of oleic (31.50–33.38%), followed by palmitic acid (19.84–22.05%) and stearic acid (22.25–24.91%) respectively. Muscle tissue in general contained an average 51.13% of saturated fatty acids and 48.87% of unsaturated fatty acids. The mean conjugated linoleic acid was found 0.41%, 0.43% and 0.47% in ribeye and loin portion of longissimus dorsi muscle and distal region of semitendinosus muscle, respectively.



## 1. Introduction

Interest in the study of fatty acids, particularly the total quantity of saturated and poly unsaturated fatty acids in muscle and adipose tissue, is mainly aimed at understanding their role in affecting human health (Banskalieva, Sahlu, & Goetsch, 2000). Information gained indicates that excessive consumption of polyunsaturated fatty acid fats can increase the formation of oxygen radicals and aldehydes, which are thought to be partly responsible for carcinogenesis and tissue ageing (Russo, Preziuso, Casarosa, Campodoni, & Cianci, 1999). On the other hand a low intake of saturated fat and increased polyunsaturated (PUFA) to saturated fatty acids (SFA) ratio are associated with a lower risk of human coronary heart disease (Hu et al., 1999). Other studies have investigated fatty acids, not from a health perspective, but because the amount of fatty acid saturation can affect the degree of fat firmness which influences the value and acceptability of meat products (Perry, Nicholls, & Thompson, 1998).

The proportion of SFA in ruminant muscle lipids are often high (Bas and Morand-fehr, 2000), and the PUFA/SFA ratio is lower because dietary unsaturated fat is hydrogenated in the rumen (Jenkins, Wallace, Moate, & Mosley, 2008). The difference in FA composition between various tissues including intra- and intermuscular, as well as abdominal (e.g. Perirenal, omental) and subcutaneous adipose tissues for beef cattle has been well documented (Talpur, Bhanger, & Khuhawar, 2007; Webb, De Smet, Van, Martens, & Dremeyer, 1998). However, due to the diversity of production system, meat from ruminants is also characterized by variations in fat composition, either quantitatively or quantitatively (Geay, Bauchart, Hocquette, & Culioli, 2001).

Over the past few years, meat from goats has gained acceptance around the world mainly because it is leaner than beef and mutton (Mahgoub et al., 2002) and has low cholesterol content (Naudé & Hofmeyer, 1981). Adrizzo (1999) has reported fatty acid composition of goat meat with low levels of lauric, myristic and palmitic acids, which are associated with the biosynthesis and deposition of cholesterol. Goats have also been reported to be efficient converters of low quality feed into a valuable animal protein by Rao, Kowale, and Verma (2003). Regardless of the importance of goats as a source of lean meat, the nutritive value of goat meat has received little attention and consequently there are only few reports on the fatty acid composition of meat and adipose tissues from different goat breeds. These studies are mostly from young goats slaughtered at lighter body weights (up to 30 kg) (Mahgoub et al., 2002; Park & Washington, 1993). More recently Werdi Pratiwi, Murray, Taylor, and Zhang (2006) have reported difference in fatty acids composition from *longissimus throracic* muscle among Boer and Australian feral goats at different slaughter weights (up to 60 kg).

In Pakistan goats are reared mostly for meat and wool purposes, while milking is a secondary purpose for rearing these small ruminants, which is an extra source of income for poor farmers. In spite

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of the role of Pateri goats (found in many districts of Sindh including Nawabshah, Sanghar, Hyderabad and Khairpur) in fulfilling the demand of goat meat for Sindh, Pakistan markets, published information related to the quality and nutritive value of meat from this breed of goat is inadequate. In the present work the fatty acid composition of different muscles from these Pateri goats of Pakistan, feed traditionally was studied.

## 2. Material and methods

### 2.1. Animals management and diet

Twenty winter born Pateri male goat kids from the animal herd in Dadu region Sindh, were selected for study. The animals were reared with their mothers, and they were kept suckling and grazing until the weaning age of 2–3 months. After weaning, bucks grazed wild bushes, grass and babuol (*Acacia nilotica*) pods and leaves ad libitum, they were never given concentrates. Goats were grown until the average weight of 60 kg and mean age of 9 months, and then they were fed additionally crushed cereals for 95 days of experimental period, in order to fatten them. During that period bucks were grazed as a group (stocking rate 2.5 bucks per ha) on natural grown grass and herbs, from 0800–1200 h and then housed in free-stall bran, consecutively to safe them from hot weather (temperature ranges to 38–43 °C). Goats were then again allowed grazing from 1500 to 1700 h. Then they were housed together and fed crushed cereals (3:1, 1/2 kg per day). Botanical composition of grass was approximately 40% natural grown lawn grass (*Cynodon dactylon* L. pers), 20% Purslane (*Portulaca oleracealinn*), 10% Bind weeds (*Convolulus arvensis Linn*) and 10% babuol tree (*Acacia nilotica*) pods and leaves.

Twenty five hand plucked samples, per hectare of naturally grown grass and leaves and pods of *Acacia nilotica* was randomly taken over the last seven days of experimental period to obtain a composite sample. Approximate analysis of grasses, *Acacia nilotica* pods and leaves is shown in (Table 1). The samples of feed were analyzed for DM, crude protein (CP) and ether extract (EE) according to Association of Official Analytical Chemists. (1990). FA methyl esters of feed samples were prepared by the one-step extraction-methylation method as described by Sukhija and Palmquist (1988).

### 2.2. Meat sampling

After 95 days goats were slaughtered at an average weight of 68 ± 7 kg. All animals were slaughtered at a commercial slaughter house. Carcasses were stored at +4 °C for 24 h. Meat samples were taken from three different regions of carcass i.e. distal region of semitendinosus muscle, loin and ribeye portion of longissimus dorsi muscles (between the 12th and 13th rib). Muscle samples were packed in oxygen-impermeable polythene bags. All samples were immediately frozen at −20 °C until analyzed within the two following weeks.

**Table 1**
Proximate chemical composition of grass[a], leaves and pods of *Acacia nilotica* and crushed cereal[b] given to goats during experimental period

| Composition | Grass | Leaves and pods of *Acacia nilotica* | Crushed Cereal |
|---|---|---|---|
| Dry matter (%) | 87 | 92 | 89 |
| Crude protein (%) | 18 | 20 | 14 |
| Ether extract (%) | 3.00 | 1.5 | 2.3 |
| Ash (%) | 3.00 | 1.65 | 2.00 |
| NDF (%) | 22 | 17 | 12 |
| *Fatty acid content (g/100 g)* | | | |
| C14:0 | 1.10 | – | 0.40 |
| C16:0 | 16.90 | 20.12 | 17.50 |
| C16:1 | 1.50 | 1.72 | 0.50 |
| C18:0 | 3.00 | 4.20 | 3.50 |
| C18:1*n*−9 | 4.00 | 15.23 | 22.10 |
| C18:2*n*−6 | 14.2 | 17.25 | 51.80 |
| C18:3*n*−3 | 59.3 | 41.20 | 3.00 |

[a] Approximate composition of lawn grass (*Cynodon dactylon* L. pers), Purslane (*Portulaca oleracealinn*) and Bind weeds (*Convolulus arvensis Linn*).
[b] Crushed cereal is a mixture of wheat and maize crush (3:1 ratio).

### 2.3. Fat extraction and derivatization

Fat was extracted from meat samples by Official method of Analysis (Kenneth Helrich., 1990). Fatty acid methyl esters (FAME's) were prepared by standard IUPAC method (Paquot, 1979) and analyzed by Gas Chromatograph.

### 2.4. Gas chromatographic analysis

All FAME samples were analyzed on a Perkin Elmer gas chromatograph, model 8700, fitted with a non bonded biscynopropyl siloxane stationary-phase, polar capillary column SP-2340 (60 m × 0.25 mm), 0.2 μm film thickness and an FID. Oxygen-free nitrogen was used as a carrier gas at a flow rate of 3.5 ml/min. Quantitation was done as reported earlier by Talpur et al. (2007).

### 2.5. Statistical analysis

The effect of muscle on fatty acid profile was assessed by analysis of variance (ANOVA) using the General Linear Model of SPSS 10.0 (SPSS, 1990). Data Tables contain the least square mean (LSM) and the standard error of the mean (SEM). All statistical tests were performed for a significance level $P = 0.05$.

## 3. Results and discussion

The analysis of proximate composition of grass, crushed cereal, *Acacia nilotica* pods and leaves is depicted in Table 1. Among the fatty acids C18:3 content was higher in grass, while crushed cereal contained greater amounts of C 18:2 which comprise 50–60% of total fatty acids as expected and reported earlier (Gunstone, Harwood, & Padley, 1994). The results obtained for total Intramuscular fat and fatty acid composition *of* longissimus dorsi muscles (loin and ribye portion) and distal region of *semitendinosus* goat muscle (Table 2) do not show significant variations ($P \geqslant 0.05$) in mean fat and fatty acid contents within different region of muscle. The total intramuscular (IM) fat obtained in present study (1.94–2.16%) is comparable to earlier reported data for IM fat from longissimus dorsi muscle of Moroccan local goats (1.3–2.5%) raised in the Argan tree forest (Bas, Dahbi, El Aich, Morand-Fehr, & Arabia, 2005). However Lee, Kannan, and Kouakou (2006) have reported higher IM fat content (4.97%) for Boer goats feed on pasture with grain supplement. The differences are possibly due to different breed and feeding practices, as breed and diet are two major factors affecting IM fat content (Banskalieva et al., 2000). The fatty acid (FA) composition of muscles studied was primarily composed of oleic (31.50–33.38%), followed by palmitic (19.84–22.05%) and stearic acid (22.25–24.91%). These values are similar to those reported by Rao et al. (2003) on the muscle fatty acid content of Indian goats feed concentrate with water washed neem (*Azadirachta indica*) seed kernel cake. Muscle tissue of the Pateri goats contained an average 51.13 and 48.87% of SFA and unsaturated fatty acids (UFA), respectively (Table 2). These figures are in line with those reported elsewhere (Mahgoub et al., 2002) for Omani Jebel Akhdar goats. Potchoiba, Lu, Pinkerton, and Sahlu (1990) have also reported similar values of SFA (50.60%) and UFA (49.40%) for Alpine goats.