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Comparative Studies on Free Fatty Acid Profile of Deccani and Madgyal Sheep Milk.

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ABSTRACT

This study assessed the fatty acid profile and estimated the lipid quality indices of raw milk from two indigenous sheep breed. Sheep raw milk were found to contain high proportions of short and medium chain fatty acids,which are of value for a healthy diet.The results showed that all parameter related to fatty acid profile attributes of tested milk samples were within the recommended nutritional levels.Differences in fatty acid profile composition of milk across the species, breed and season, or differences based on diet, provides us with the ability to choose the right breed, diet to obtain milk and dairy products with improved nutritional quality and more valuable fat composition. Consuming milk with a more valuable composition should positively influence consumer health.

Keywords: Free Fatty Acid Profile, Deccani and Madgyal sheep, Milk

I. INTRODUCTION

Milk fat provides energy, fat soluble nutrients and bioactive lipids, such as triacylglycerides, diocylglyerides, saturated and polyunsaturated fatty acids and phospholipids (German and Dillard, 2006). Milk fat is one of the most complex natural fats that consist of approximately 400-500 fatty acids. Milk fat biosynthesis is a complex process, which requires coordinated control of many cellular processes and metabolic pathways that occur at various stages of development and functioning of the mammary gland. Polyunsaturated fatty acids consumed by ruminants are microbially dehydrogenated in the rumen. In cow, sheep, and goat, milk EPA and DHA are found in trace amounts. In cow, goat, and sheep, milk PUFAs account for as little as ~3% of all fatty acids. However, (Strzałkowska et al., 2009 and Mayer and Fiechter, 2012) found more than 4% of PUFA in goat milk, and (Cieślak et al., 2010) found even more than 21% of PUFAs in milk of sheep fed rapeseeds.

The predominant n-3 FA in milk fat of the majority of mammals is α-linolenic acid. Milk of sheep and goats usually has a smaller value of n-6/n-3 ratio and greater concentration of ALA compared to cow's milk.The milk fat consists mainly of triglycerides, approximately 98 per cent, while other milk lipids are diacylglycerol (about 2 % of the lipid fraction), cholesterol (about 0.3 %), phospholipids (about 1 %) and free fatty acids (about 0.1 %) (Jensen et al.,1995).

Lipids in sheep and goat milk have higher physical characteristics than in cow milk, but there are variations between different reports (Anifantakis, 1986 and Park, 2006). Compared to cow milk, sheep milk contains more fat, more proteins and the dry matter content increases naturally with these values. Sheep's milk contains about twice the fat of cow's milk,but this also means twice the healthy fats (monounsaturated and polyunsaturated, including Omega 3and 6).The same goes for the goats milk. The body needs healthy fats for many bodily functions, like absorbing vitamins. Monounsaturated fats lower total cholesterol and LDL cholesterol (the bad cholesterol) while increasing HDL cholesterol (the good cholesterol). Polyunsaturated fats also lower total cholesterol and LDL cholesterol. Omega 3 and 6 fatty acids belong to this group. Sheep milk is also rich in medium chain fatty acids or triglycerides (MCTs)-about 25% of the fat content. MCTs can benefit weight control by promoting fullness, reducing fat deposits, increasing energy expenditure and being more easily metabolised (turned into energy in the body).

The fat globules in sheep milk are smaller than those in either cow or goat milk so the milk is more homogenous. The smaller fat globules are often more easily digested and less likely to cause high cholesterol. Milk obtained from indigenous Romanian sheep breeds is used primarily to make traditional cheeses such as "telemea" and 'branza de burduf", which are highly appreciated by

consumers and have a high market value. The remarkable quality of traditional cheeses is linked to milk fat content and fatty acid profile, as the number of volatile compounds that result from their degradation during maturation give specific aromas and savour (McSweneey, 2004, Mele et al., 2007). No previous data on the FA composition of milk fat of Spanca and Turcana breeds were found in the literature.

While the high saturated fat content of sheep milk may suggest that we should eat less to reduce the risk of heart disease, the high proportion of healthy fats may well reduce or eliminate this risk. At present there is not enough research to know either way. It is clear that cultures with diets high in sheep milk, such as the famously healthy 'Mediterranean diet', do enjoy lower rates of heart disease which suggests sheep milk is not a risk factor.

It has been determined that the main triglycerides in the sheep milk fat consisted predominantly of three fatty acids (FA). (C14, C16 a C18:1) in combination with C4 and C6 short chain fatty acids (De la Fuente et al., 2013). Most fatty acid, from acetic(C2:0) to arachidic acid (C20:0),contain an even number of carbon atoms. Five fatty acids (C10:0, C14:0, C16:0, C18:0 and C18:1) account for > 75 % of total fatty acid in goat and sheep milk. Levels of the metabolically valuable short and medium chain fatty acid, caproic (C6:0) (2.9, 2.4, 1.6 %), caprylic (C8:0) (2.6, 2.7, 1.3 %), capric (C10:0) (7.8, 10.0, 3.0 %) and lauric (C12:0) (4.4, 5.0, 3.1 %) are significantly higher in sheep and goat than in cow milk, respectively (Alonso et al., 1999, Goudjil et al., 2004). These fatty acid are associated with the characteristic flavours of cheese and can also be used to detect admixtures of milk from different species.

The studies conducted since 2000 have contradicted the thesis that the consumption of milk and dairy products would increase the synthesis of LDL and the risk of coronary disease. At present, it is believed that the increased LDL blood concentration is attributable to lauric C12:0, myristic C14:0, and palmitic C16:0 acids, while the other saturated fatty acids found in milk neutralise their effect since they increase HDL level.

The specific characteristics of fatty acid profile of cow, goat, and sheep milk with an emphasis on health benefits for human organism, as well as milk fat modification methods enhancing content of unsaturated fatty acids in raw material. Cardiovascular disease, cancer, obesity, and diabetes are collectively responsible for more than 80 per cent of the disease-related mortality in the United States. Lipids play a critical role in all of these diseases, and the relative amounts and types of dietary lipids consumed are believed to be of a critical importance.

Diet is the most important factor affecting ruminant's milk composition, particularly fatty acid composition. Appropriate feeding systems were implemented to increase the content of beneficial fatty acids (Biondi et al.2006).

The milk composition of the grazing ewes is believed to be relatively healthy due to their richness in polyunsaturated fatty acids, mainly α-linolenic acid (ALA) and conjugated linoleic acid (CLA)compared to milk of ewes fed indoors with total mixed rations (Morand-Fehr et al.2007).

In several studies carried out to determine the milk fatty acid profile in various ovine breeds, the ewes were maintained on different farms and their diet was pasture-based during the duration of the experiments. Such feeding practices do not ensure results that can be compared, at least between breeds, because recent studies have shown that differences in pasture management, in the botanical composition of pastures and in the vegetative stages of plants, can affect the fatty acid composition of ewe milk fat (Cabiddu et al., 2003).

Monounsaturated fatty acids do not cause accumulation of cholesterol as saturated fats do, and do not turn rancid as readily as polyunsaturated fatty acids. Moreover, they have a positive effect on the concentration of high density lipoproteins (HDL), transporting cholesterol from blood vessel walls to the liver, where it is degraded by bile acids, which are afterwards excreted from the organism. At the same time, monounsaturated fats reduce the concentration of low density lipoproteins (LDL), which when circulating over the entire organism are deposited in blood vessels.

The share of monounsaturated fatty acids (MUFA) is similar in sheep, cow, and goat milk fat and may range from about 20 per cent to about 35 per cent. Among the MUFA group, the oleic acid (C18:1) is characterised by the highest content, which is typical for milk of the majority of mammals. Cow's milk is the richest source of oleic acid (24%), while its content in goat and sheep milk is on average 18 per cent of all fatty acids. However, some authors reported its higher concentration (more than 20 % of all fatty acids) in sheep and goat milk. In ruminant's milk, there are also relatively small but significant contributions from other MUFA such as 14:1 (about 1 %), 16:1 (about 1.5 %) and very desirable vaccenic acid, which is a precursor of CLA in human organism (1.5 - 5 %).

Taking into account a negative role of the C12:0, C14:0, and C16:0 acids, Ulbricht and

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Southgat proposed atherogenic indices (AI) and thrombogenic indices (TI). Based on AI and TI values conclusions may be drawn concerning fat quality from the point of view of human diet. The results for AI and TI for goat, sheep, and cow milk are similar and depend on breed, stage of lactation, and diet; however, the lowest values of these indices were for sheep milk, which is favourable in a health perspective. The values of AI and TI of ruminant milk can be improved by the administration of either olive cake, rapeseed oil, linseed oil or camelina sativa cake to the diet.

II. MATERIALS AND METHODS

Fresh composite milk samples of each breed was collected from Sheep project at 7 days interval and preserved in deep freeze till the analysis completed. At a time, 200 ml milk samples each were collected from farm site of Mahatma Phule Krishi Vidyapeeth and near the village place to Rahuri. Milk was analyzed for different free fatty acid profile of milk for both breeds by using Spectra Alyzer (Sample and Reference). The experiments were arranged in Completely Randomised Design (CRD) with two treatments and seven replications for each parameter.

III. RESULT AND DISCUSSION

The result pertaining to FreeFatty Acid Profile of Deccani and Madgyal sheep milk are tabulated (Table.1 to 13) and discussed as follows:

Saturated fatty acid

Butyric acid (C4:0)

Table1. Butyric acid (C4:0) content content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Butyric Acid (C4:0) Per cent
1.	Deccani	3.74
2.	Madgyal	3.06
	S.E+.	0.21
	CD at 5 %	0.66
	CV	16.7
	CF	162

Each value is a mean of seven replications

The data in respect of Butyric acid (C4:0) content of milk showed that overall mean of Butyric acid content of Deccani and Madgyal Sheep milk was 3.74 per cent and 3.06 per cent respectively. The Butyric acid (C4:0) content of milk was significantly affected due to breed.

Caproic acid (C6:0)

Table2. Caproic acid (C6:0) content content of Deccani and Madgyal sheep milk at (27^0C) as affected by breed

Sr. No.	Strain of Sheep	Caproic acid (%)
1.	Deccani	2.65
2.	Madgyal	2.53
	S.E+.	0.02
	CD at 5 %	0.08
	CV	2.76
	CF	94.01

Each value is a mean of seven replications

The data in respect of Caproic acid (C6:0) content of milk showed that overall mean of Caproic acid content of Deccani and Madgyal Sheep milk was 2.65 per cent and 2.53 per cent respectively.The highest Caproic acid (C6:0) content 2.65 per cent was recorded in the Deccani sheep milk.The Caproic acid (C6:0) content of milk was significantly affected due to breed.

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Caprylic acid (C8:0)

Table 3. Caprylic acid (C8:0) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Caprylic Acid (%)
1.	Deccani	3.10
2.	Madgyal	3.05
	S.E+.	0.01
	CD at 5 %	0.03
	CV	0.90
	CF	132

Each value is a mean of seven replications

The data in respect of Caprylic acid (C8:0) content of milk showed that overall mean of Caprylic acid content of Deccani and Madgyal Sheep milk was 3.10 per cent and 3.05 per cent respectively. The highest Caprylic acid (C8:0) content 3.10 per cent was recorded in the Deccani sheep milk.The Caprylic acid (C8:0) content of milk was significantly affected due to breed.

Capric acid (C10:0)

Table 4. Capric acid (C10:0) content content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Capric acid (%)
1.	Deccani	9.99
2.	Madgyal	9.94
	S.E+.	0.01
	CD at 5 %	0.04
	CV	0.368
	CF	1390.8

Each value is a mean of seven replications

The data in respect of Capric acid (C10:0) content of milk showed that overall mean of Capric acid content of Deccani and Madgyal Sheep milk was 9.99 per cent and 9.94 per cent respectively.The highest Capric acid (C10:0) content 9.99 per cent was recorded in the Deccani sheep milk.The capric acid (C10:0) content of milk was significantly affected due to breed.

Lauric acid (C12:0)

Table 5. Lauric acid (C12:0) content content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Lauric acid (%)
1.	Deccani	4.57
2.	Madgyal	4.52
	S.E+.	0.01
	CD at 5 %	0.04
	CV	0.87
	CF	289

Each value is a mean of seven replications

The data in respect of Lauric acid (C12:0) content of milk showed that overall mean of Lauric acid content of Deccani and Madgyal Sheep milk was 4.57 per cent and 4.52 per cent respectively.The highest Lauric acid (C12:0) content 4.57 per cent was recorded in the Deccani sheep milk.The Lauric acid (C12:0) content of milk was significantly affected due to breed.

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Myristic acid (C14:0)

Table 6. Myristic acid (C14:0) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Myristic acid (%)
1.	Deccani	10.9
2.	Madgyal	10.5
	S.E+.	0.49
	CD at 5 %	NS
	CV	12.1
	CF	1625

Each value is a mean of three replications

The data in respect of Myristic acid (C14:0) content of milk showed that overall mean of Myristic acid content of Deccani and Madgyal Sheep milk was 10.9 per cent and 10.5 per cent respectively.The highest Myristic acid (C14:0) content 10.9 per cent was recorded in the Deccani sheep milk.The Myristic acid (C14:0) content of milk was not significantly affected due to breed.

Palmitic acid (C16:0)

Table 7. Palmitic acid (C16:0) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Palmitic acid (%)
1.	Deccani	25.6
2.	Madgyal	24.5
	S.E+.	0.26
	CD at 5 %	0.81
	CV	2.76
	CF	8832

Each mean is sum of seven replication

The data in respect of Palmitic acid (C16:0) content of milk showed that overall mean of Palmitic acid content of Deccani and Madgyal Sheep milk was 25.6 per cent and 24.5 per cent respectively.The highest Palmitic acid (C16:0) content 25.6 per cent was recorded in the Deccani sheep milk.The Palmitic acid (C16:0) content of milk was significantly affected due to breed.

Stearic acid (C18:0)

Table 8. Stearic acid (C18:0) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Stearic Acid (%)
1.	Deccani	11.8
2.	Madgyal	11.3
	S.E+.	0.64
	CD at 5 %	NS
	CV	14.6
	CF	1883

Each value is a mean of seven replications

The data in respect of Stearic acid (C18:0) content of milk showed that overall mean of Stearic acid content of Deccani and Madgyal Sheep milk was 11.8 per cent and 11.3per cent respectively.The highest Stearic acid (C18:0) content 11.8 per cent was recorded in the Deccani sheep milk.The Stearic acid (C18:0) content of milk was not significantly affected due to breed.

Monounsaturated fatty acid

Myristoleic acid (C14:1)

Table 9. Myristoleic acid (C14:1) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Myristoleic acid (%)
1.	Deccani	0.34
2.	Madgyal	0.28

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	S.E+.	0.02
	CD at 5 %	NS
	CV	18.4
	CF	1.38

Each value is a mean of seven replications

The data in respect of Myristoleic acid (C14:1) content of milk showed that overall mean of Myristoleic acid content of Deccani and Madgyal Sheep milk was 0.34 per cent and 0.28 per cent respectively. The highest Myristoleic acid (C14:1) content 0.34 per cent was recorded in the Deccani sheep milk.The Myristoleic acid (C14:1) content of milk was not significantly affected due to breed.

Palmitoleic acid (C16:1)

Table 10. Palmitoleic acid (C16:1) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Palmitoleic acid (%)
1.	Deccani	1.67
2.	Madgyal	1.19
	S.E+.	0.27
	CD at 5 %	NS
	CV	50.3
	CF	28.8

Each value is a mean of seven replications

The data in respect of Palmitoleic acid (C16:1) content of milk showed that overall mean of Palmitoleic acid content of Deccani and Madgyal Sheep milk was 1.67 per cent and 1.19 per cent respectively. The highest Palmitoleic acid (C16:1) content 1.67 per cent was recorded in the Deccani sheep milk.The Palmitoleic acid (C16:1) content of milk was not significantly affected due to breed.

Oleic acid (C18:1)

Table 11. Oleic acid (C18:1 n-9 cis) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	Oleic acid (%)
1.	Deccani	20.92
2.	Madgyal	20.61
	S.E+.	0.10
	CD at 5 %	0.31
	CV	1.29
	CF	6040

Each value is a mean of seven replications

The oleic acid (C18:1) content in Deccani and Madgyal Sheep milk was 20.92 per cent and 20.61 per cent respectively.According to observation deccani sheep (20.92) milk contains more oleic acid (C18:0)as compared to madgyal sheep milk(20.61).The oleic acid (C18:1) content of milk was significantly affected due to breed.

Polyunsaturated fatty acid

Linoleic acid (C18:2)

Table 12. Linoleic acid (C18:2) content of Deccani and Madgyal sheep milk at (270 C) as affected by breed

Sr. No.	Strain of Sheep	Linoleic acid (%)
1.	Deccani	2.40
2.	Madgyal	2.37
	S.E+.	0.02
	CD at 5 %	NS
	CV	3.18

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	CF	79.9

Each value is a mean of seven replications.

The average minimum LA value in the milk was found among the breed Deccani and Madgyal was 2.40 and 2.37 % respectively.According to observations Deccani sheep milk(2.40) contains more linoleic acid (C18:2) as compared to madgyal sheep milk(2.37).It was also observed that the breed did not affect significantly the LA values in the milk.

Alfa -Linolenic acid (alfa C18:3)

Table 13. Alfa -Linolenic acid (alfa C18:3) content of Deccani and Madgyal sheep milk at (27^0 C) as affected by breed

Sr. No.	Strain of Sheep	α-Linolenic (%)
1.	Deccani	0.49
2.	Madgyal	0.46
	S.E+.	0.013
	CD at 5 %	NS
	CV	7.63
	CF	3.25

Each value is a mean of seven replications

The α-Linolenic acid content in Deccani and Madgyal sheep milk was 0.49 and 0.46 per cent respectively. Highest α-Linolenic acid content in the Deccani milk samples was observed under study. Further, it appeared that the breed not significantly affect much the a-Linolenic acid in the milk.

IV. CONCLUSION

On the basis of the overall results of the present investigations, it may be concluded that although apparently and at gross level the milk of Deccani and Madgyal sheep milk shows more or less similar free fatty acid profile to that of the other breeds.Deccani sheep milk is superior over Madgyal sheep milk in context of saturated fatty acid. Among saturated fatty acid C4:0, C8:0, C10:0, C12:0 and C16:0 was significantly affected due to the Deccani and Madgyal sheep breed milk. While C14:0 and C18:0 was not significantly affected due to sheep breed. Deccani sheep milk is superior over Madgyal sheep milk in context of monounsaturated fatty acid. Among monounsaturated fatty acid C18:1 was significantly affected due to the Deccani and Madgyal sheep breed. While C14:1 and C16:1 was not significantly affected due to the sheep breed. Among polyunsaturated fatty acid C18:2 and C18:3 both are not significantly affected due to the sheep breed. Deccani sheep milk is superior over madgyal sheep milk in context of polyunsaturated fatty acid.

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