ChemSearch Journal 9(1): 43 – 50, June, 2018
Publication of Chemical Society of Nigeria, Kano Chapter

Received: 15/12/2017 Accepted: 12/03/2018

Seasonal Variation on the Fatty Acids Profile, Thrombogenic and Athrogenic Indices of Raw Milk Samples from Cow and Sheep Breeds from Kano State, Nigeria

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ABSTRACT

This study was aimed to compare the fatty acids profile, thrombogenic and atherogenic health indices of the raw milk from local cow and sheep breeds raised among Fulani herdsmen managed under semi-intensive husbandry system in Challawa industrial area within Kano metropolitan of Kano State, North West Nigeria. Fatty acids were derivatized following the Official Methods of the American Oil Chemists' Society with modifications. Raw milk of cow breeds contained higher percentage composition of $C_{14:0}$ and $C_{16:0}$, while raw milk from sheep breed contained higher percentage composition of $C_{4:0}$, $C_{18:0}$, and $C_{18:3.}$ The percentage compositions were highest during rainy season (RS) in comparison to dry season (DS) in all the breeds. Raw milk of cow breeds showed that $C_{14:0}$, $C_{16:0}$ and $C_{18:3}$ were significantly highest in Red Bororo cow (RBC) and lowest in White Fulani cow (WFC). However, $C_{4:0}$, $C_{6:0}$, $C_{10:0}$, $C_{12:0}$, $C_{18:0}$, $C_{18:1}$ and $C_{18:2}$ were significantly highest in WFC and lowest in sokoto Gudali cow (SGC). Total saturated fatty acid (TSFA) was highest during RS (62.70 – 66.83%) and lowest during DS (59.59 – 63.55%). Result of the analysis of the percentage fatty acids composition of the raw milk of sheep breeds showed that $C_{4:0}$, $C_{6:0,}$ $C_{8:0,}$ $C_{10:0,}$ $C_{12:0,}$ $C_{18:0,}$ $C_{18:1.}$ $C_{18:2}$ and $C_{18:3}$ were significantly ($P < 0.05$) highest in Balami sheep (BS) and lowest in Yankasa sheep (YS). However, $C_{14:0}$ and $C_{16:0}$ were significantly ($P < 0.05$) highest in YS and lowest in US. The percentage TSFA of the raw milk ranged from 62.65 to 68.30% during RS and 59.93 to 64.18% during DS, in which the lowest percentage was recorded in the raw milk of Yankasa sheep (US), while highest in the raw milk of BS. Fatty acids sums in all the breeds decreased in the order of SFA > MUFA > PUFA. The ratio of n-6/n-3 of cow and sheep breeds were (1.31 – 2.19), (1.78 – 2.31) and (1.78 – 2.31), similarly the value of AI and TI for cow and sheep breeds in the present study were within the recommended level for health safety except for sheep breeds which is higher. Raw milk from WFC and BS had the highest percentage fatty acid composition and higher value of health indices which indicate that WFC and BS had higher risk of 'lifestyle diseases' such as coronary heart disease and cancer.

Keywords: breeds, fatty acid, thrombogenity, atherogenity

INTRODUCTION

Dietary factors were recognized to have a role in changing the percentage fatty acid in the milk of cows (Moloney *et al.,* 2011) and ewes (Elgersma *et al.,* 2006; Chen *et al.,* 2014). Individual fatty acids (FA) produced determines the lipid fraction's health impact (Kholif *et al.,* 2012; Mills *et al.,* 2011; Kuczyoska *et al.,* 2012). Studies have shown that there is a link between the fatty acids composition and the chronic disorders such as cardiovascular diseases and diabetes (Oliver *et al.,* 2009. Nevertheless, research indicates that only few individual fatty acids have negative consequences on consumer health (Ndubeze *et al.,* 2006). Dietary that is rich in individual fatty acids, like lauric ($C_{12:0}$), myristic ($C_{14:0}$) and palmitic acids ($C_{16:0}$), are connected to an increased risk of coronary heart diseases, obesity and atherosclerosis Olafadehan *et al.,* (2010); Ferlay *et al.,* (2006) The 'healthy fats' are the unsaturated fatty acids (UFAs), due to their impact on the level of cholesterol in blood (Olafadehan *et al.,* 2010; Ferlay *et al.,* 2006). Conjugated linoleic acid (CLA) ($C_{18:2cis9trans11}$), α-linolenic (LNA, $_{18:3n-3}$) and oleic acids ($C_{18:1cis9}$), could be improved in milk through pasture feeding (Ndubeze *et al.,* 2006; Kuczyoska *et al.,* 2012). The health benefits of Conjugated Linoleic acid include the lowering of cholesterol content, anti-carcinogenic, antidiabetic and immunomodulation effects in the blood (Knowles *et al.,* 2006). n–3 fatty acid has a benefit of preventing of heart disease and improved immune response (Gomez-Cortes *et al.,* 2014). The cholesterol content is less in polyunsaturated fatty acids compared to monounsaturated fatty acids ((Oliver *et al.,* 2009), while Oleic acid and linolenic acid have antiatherogenic and anticancer properties ((Oliver *et al.,* 2009; Ferlay *et al.,* 2006).

The Fatty acids of raw milk is important for the nutritional quality of dairy products. The health lipid indices (e.g. atherogenic and thrombogenic indices) are used in evaluating the nutritional value of milk fat. Diets used in the herd plays an important role in determining the variation in milk fatty acid composition, and the variability in fatty acid composition is genetically determined (Adesina, 2013). Researchers have addressed the issue of breed and genotypic effects on milk fatty acids composition (Mills *et al.*, 2011; Kuczyoska *et al.,* 2012). Breeds differences from several independent investigations are ambiguous for most of the fatty acid profiles (Muchenje *et al.,* 2009). Few studies evaluated the fatty acids profiles health indices and nutritional quality of raw milk from different breeds under semi-intensive husbandry system (Haug *et al.,* 2007; Oliver *et al.*, 2009). Thus, this study was aimed to compare the fatty acids profile and health indices of the raw milk from local cow and sheep breeds raised among Fulani herdsmen managed under semi-intensive husbandry system in Challawa industrial area within Kano metropolitan of Kano State, North West Nigeria.

MATERIALS AND METHODS

Animals Management:

The animals used for this study were local cow and sheep breeds and owned by pastoralists and managed under semi intensive husbandry system. The animals are headed to the fields in the morning after milking to feed on natural forages and crop residues and returned in the evening and kept during the night in the open field, near the homestead. The cows and sheep were randomly selected from the experimental sites. The animals feed on any available food they come across and routine grazing was carried out two times daily (i.e. morning and evening) they were fed on natural pasture comprising mainly guinea grass and other forages. Cow, sheep and goat breeds were milked manually by the owner before morning grazing into the collecting containers.

Milk sampling and Analysis:

Hand-milking was done by the herdsmen in the farm in the morning between 06.00—07.30am. Milk samples for analysis were collected in hygienic conditions from breeds of each cow. Raw milk samples were collected from each breed in the morning before grazing into clean, white plastic container of 120cm³ capacities. The nipples were sterilized with ethanol before milking. Samples were transported to the laboratory in an ice cold box for analysis. All analysis was done in triplicate.

Fatty acids determination

Fatty acids were derivatized following the Official Methods of the American Oil Chemists' Society (AOAC, 2005) with modifications. Individual fatty acids were determined by gas chromatography, using the Varian CP 3800 system with a split/splitless injector and a flame-ionization detector (FID). Samples (1μl) of fatty acid methyl esters were placed on a CP-Sil 88 capillary column (length: 100 m, inner diameter: 0.25 mm). Fatty acids were identified by comparing their retention times with those of commercially available reference standards purchased from Supelco, Inc. Analyses of samples and reference standards were performed under identical conditions, i.e. carrier gas - helium, injector temperature 260°C, detector temperature 260°C, initial oven temperature 110°C, raised to 249°C. The ratio of n-6/n-3, atherogenic (AI) and thrombogenic (TI) health indices were evaluated. All percentage fatty acids compositions were obtained in triplicate. The values are reported in MEAN±S.D.

Statistical Analysis

Values represented are the means and standard deviations for three replicates. Statistical analysis was carried out by student t-test using SPSS Version 11.0 software package (SPSS Inc., Chicago Illinois, USA) and ANOVA using SAS system Version 8e. Fatty acid composition values were processed to compute the content of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). AI (atherogenic index) and TI (thrombogenic index) were calculated based on the formula by (Ulbricht and Southgate 1991). All percentage proximate content fatty acids n-6/n-3, AI and TI were obtained in triplicate. The values were reported in MEAN±S.D.

RESULTS AND DISCUSSION

Variation in raw milk fatty acids (FAs) of cow and sheep breeds during rainy (RS) and dry seasons (DS) is shown in Table 1 to 2 below. Season is considered a substantial source of variation in fatty acids composition of milk (Frelich *et al.*, 2012; Adler *et al.*, 2013). There was a trend of increasing percentage composition of fatty acids in the RS in comparison to the DS. This is similar to the report of Toyes *et al.,* (2014), who found out that composition of fatty acids increased in RS compared to DS. Seasonal variation has been reported at the farm level (Lock and Garmsworthy, 2003; Ellis *et al.,* 2006; Rego *et al.,* 2008) and in milk collected at processing plants or commercial dairies (Collomb *et al.,* 2008), and is well recognized as a factor influencing milk fat composition (Jensen, 2002; Walker *et al.,* 2004; Elgersma *et al.,* 2006). Raw milk of cow breeds contained higher percentage composition of $C_{14:0}$ and $C_{16:0}$, while, sheep breeds contained higher percentage composition of $C_{4:0}$, $C_{18:0}$, and $C_{18:3}$. The percentage compositions were higher during RS in comparison to DS in all the breeds of cow and sheep.

Table 1 Percentage (%) fatty acid composition of the raw milk of cow breed during RS and DS

	RBC		SGC		WFC	
Fatty acids	**RS**	**DS**	**RS**	**DS**	**RS**	**DS**
Butaric ($C_{4:0}$)	2.59±0.06	2.01±0.05	2.18±0.02	1.71±0.10	2.84±0.05	2.27±0.03
Caproic ($C_{6:0}$)	1.93±0.05	1.24±0.04	1.61±0.08	1.36±0.04	2.01±0.05	1.38±0.04
Caprylic ($C_{8:0}$)	1.45±0.04	1.12±0.05	1.11±0.04	0.81±0.02	1.88±0.06	1.39±0.02
Capric ($C_{10:0}$)	4.54±0.05	4.25±0.04	3.78±0.04	3.38±0.03	4.98±0.05	4.28±0.05
Lauric ($C_{12:0}$)	4.02±0.04	3.82±0.03	3.03±0.03	3.01±0.04	4.23±0.05	4.02±0.06
Myristic ($C_{14:0}$)	14.02±0.50	13.72±0.60	13.98±0.20	13.38±0.20	13.66±0.30	13.18±0.20
Palmitic ($C_{16:0}$)	28.38±1.12	28.09±2.30	28.04±1.10	27.79±1.10	27.09±1.10	26.79±1.10
Stearic ($C_{18:0}$)	9.90±0.19	9.29±0.16	8.97±0.13	8.15±0.14	10.10±0.16	9.92±0.11
Oleic ($C_{18:1}$)	13.96±0.23	12.94±0.24	12.18±0.20	12.08±0.18	14.89±0.23	14.27±0.25
Linoleic ($C_{18:2}$)	1.81±0.06	1.73±0.05	1.48±0.03	1.08±0.02	2.46±0.07	2.06±0.06
Linolenic($C_{18:3}$)	1.38±0.03	1.08±0.02	1.05±0.03	1.01±0.02	1.25±0.04	1.01±0.07
TSFA	66.83±2.12	63.55±2.02	62.70±2.01	59.59±1.87	66.79±2.21	63.23±2.09
TUFA	17.15±0.56	15.75±0.47	14.71±0.48	14.17±0.41	18.60±0.62	17.34±0.55
TFA	83.98±3.02	79.39±2.62	77.41±2.87	73.76±2.52	85.39±3.21	80.57±2.83
MUFA	14.96±0.23	13.94±0.24	12.18±0.20	12.88±0.18	15.89±0.23	15.27±0.25
PUFA	3.19±0.04	2.81±0.03	2.53±0.03	2.09±0.02	3.71±0.05	3.07±0.04
n-6/n-3	0.76±0.02	0.62±0.04	0.71±0.05	0.94±0.07	0.51±0.07	0.49±0.10
AI	3.85±0.05	2.99±0.03	3.24±0.04	2.54±0.03	4.23±0.07	3.37±0.06
TI	2.84±0.07	2.20±0.05	2.40±0.05	1.87±0.03	3.11±0.08	2.98±0.07

RBC = Red Bororo cow, SGC = Sokoto Gudali cow, WFC = White Fulani cow, RS = Rainy season, DS = Dry season

Result of the analysis of the percentage fatty acids composition of the raw milk of cow breed showed that $C_{14:0}$, $C_{16:0}$ and $C_{18:3}$ were higher in RBC compared to SGC and WFC. However, $C_{4:0}$, $C_{6:0}$, $C_{10:0}$, $C_{12:0}$, $C_{18:0}$, $C_{18:1}$ and $C_{18:2}$ were higher in WFC and lowest in SGC. Total saturated fatty acid (TSFA) was highest during RS (62.70 – 66.83%) and lowest during DS (59.59 – 63.55%), in which highest percentage was recorded in the raw milk of WFC (63.55 – 66.83%) and lowest in the raw milk of SGC (59.59 – 62.70%). Soraj *et al.*, (2012), reported percentage TSFA of 56 – 67% during wet and 49 – 59% during dry in Sahiwal and crossbred cow, which is almost within the range of the present study. SCFAs ($C_{4:0}$ and $C_{6:0}$) for the raw milk of cow breed during RS ranged from (2.18 – 2.84%) and (1.61 – 2.01%) which decreased to (1.71 – 2.27%) and (1.16 – 1.36%) during DS, with SGC (1.71 – 2.18%) and (1.16 – 1.61%) and WFC (2.27 – 2.84%) and (1.36 – 2.01%) having the lowest and highest composition. The present result is much lower than (19.0 – 19.1%) and (13.7 – 15.0%) reported by Butler *et al.*, (2010) for Jersey cow breeds during wet and dry season. Similarly, MCFAs ($C_{8:0}$ – $C_{12:0}$) had the highest composition during RS and the values ranged from (1.11 – 1.88%), (3.78 – 4.98%) and (3.03 – 4.23%), while lowest during DS and ranged from (0.81 – 1.39%), (3.38 – 4.28%) and (3.01 – 4.02%) for $C_{8:0}$, $C_{10:0}$ and $C_{12:0}$. The values were higher in the raw milk of WFC (0.81 – 1.11), 3.38 – 3.78%) and 3.01 – 3.03%) and lowest in SGC (1.39 – 1.88), (4.28 – 4.98%) and 4.02 – 4.23%) for the DS and RS. Butler *et al.*, (2010) reported the value of MCFAs for Jersey cow breeds of (9.40 – 10.10%), (26.40 – 27.20%) and (33.60 – 33.80%) which is much higher than the current study. On the other hand, LCFAs ($C_{14:0}$ – $C_{18:0}$) ranged from (13.66 – 14.02%), (27.09 – 28.38%) and (8.97 – 10.10%) during RS, which decreased to (13.18 – 13.72%), (26.79 – 28.09%) and (8.15 – 9.92%) during DS. The value was highest in RBC and lowest in WFC for $C_{14:0}$ and $C_{16:0}$, while for $C_{18:0}$ the value was highest in WFC and lowest in SGC. Among the individual SFAs $C_{16:0}$, $C_{14:0}$ and $C_{18:0}$ were the major SFAs. Toyes *et al.*, (2014) and Soraj *et al.*, (2017) reported that $C_{14:0}$, $C_{16:0}$ and $C_{18:0}$ were the major SFA in the raw milk of cow breeds. Similarly, Rodriguez-Alcala *et al.*, (2009) and Talpur *et al.*, (2009), reported $C_{14:0}$, $C_{16:0}$ and $C_{18:0}$ SFA in cow breeds as main FA and accounted about 67% to 75% of TFA, which is similar to the report of the present study.

Total unsaturated fatty acid (TUFA) was highest during RS (14.71 – 18.60%) and lowest during DS (14.17 – 17.34%), the highest percentage was recorded in WFC (18.60%) and lowest in SGC (14.71%). The result of TUFA of the present study is lower than (34.35%) for wet season and (31.78%) for dry season reported by Hanus *et al.*, (2016) for cow breeds milk. The percentage composition of $C_{18:1}$ in the raw milk among the breed for RS was (12.18 – 14.89%) of TUFA and DS (12.08 – 14.27%) of TUFA, with SGC (12.18 and 12.08%) and WFC (14.89 and 14.27%) having lowest and highest percentage. The results of the present study is lower than (26.15 – 26.73%) and (23.91 – 24.50%) reported by Hanus *et al.*, (2016) for wet and dry seasons for cow milk. Concerning $C_{18:2}$ and $C_{18:3}$ UFAs their percentage compositions were higher during RS (1.48 – 2.46%) and (1.05 – 1.38%) and lowest during DS (1.08 – 2.06%) and (1.01 – 1.08%) respectively, with WFC (2.46%) and SGC (1.48%) having the highest and lowest composition for $C_{18:2}$, while for $C_{18:3}$ RBC (1.38%) and SGC (1.05%) had the highest and lowest composition.

Table 2 Percentage (%) fatty acid composition of the raw milk of sheep breed during RS and DS

	BS		US		YS	
Fatty acids	**RS**	**DS**	**RS**	**DS**	**RS**	**DS**
Butaric ($C_{4:0}$)	3.78±0.05	3.19±0.02	3.31±0.06	3.09±0.06	2.98±0.06	3.01±0.06
Caproic ($C_{6:0}$)	3.01±0.06	2.71±0.06	2.46±0.04	2.18±0.02	2.16±0.08	2.04±0.04
Caprylic ($C_{8:0}$)	2.37±0.03	2.09±0.01	2.29±0.02	2.01±0.05	2.11±0.06	2.01±0.04
Capric ($C_{10:0}$)	4.77±0.03	4.19±0.02	4.68±0.03	4.09±0.02	4.28±0.02	4.09±0.06
Lauric ($C_{12:0}$)	4.87±0.05	4.28±0.03	4.34±0.05	4.01±0.06	4.02±0.05	3.31±0.06
Myristic ($C_{14:0}$)	11.45±0.14	11.03±0.12	10.23±0.13	10.04±0.12	12.68±0.15	12.06±0.13
Palmitic ($C_{16:0}$)	26.97±1.02	26.28±1.03	24.56±1.05	24.13±1.05	27.11±1.05	27.03±1.06
Stearic ($C_{18:0}$)	11.08±0.08	10.41±0.10	10.78±0.30	10.38±0.60	10.48±0.60	10.16±0.40
Oleic ($C_{18:1}$)	16.71±0.50	16.08±0.70	16.07±0.20	15.72±0.60	15.45±0.80	14.72±0.70
Linoleic ($C_{18:2}$)	1.66±0.05	1.27±0.02	1.28±0.04	1.10±0.05	1.08±0.05	1.01±0.05
Linolenic($C_{18:3}$)	2.11±0.07	1.81±0.01	1.57±0.03	1.21±0.01	1.41±0.02	1.11±0.01
TSFA	68.30±2.05	64.18±1.90	62.65±2.20	59.93±2.00	65.83±2.10	63.71±2.10
TUFA	20.48±0.60	19.16±0.60	18.92±0.80	18.02±0.70	17.94±0.80	16.84±0.70
TFA	88.78±3.06	83.34±2.80	81.57±3.30	77.96±3.10	83.76±3.10	80.55±2.90
MUFA	16.71±0.50	16.08±0.70	16.07±0.90	15.72±0.90	15.45±0.80	14.72±0.70
PUFA	3.77±0.05	3.88±0.04	2.85±0.06	2.31±0.04	2.49±0.07	2.12±0.05
n-6/n-3	1.27±0.05	1.45±0.06	1.23±0.04	1.10±0.05	1.31±0.05	1.10±0.06
AI	5.61±0.08	4.74±0.06	4.92±0.06	4.59±0.05	4.43±0.05	4.47±0.04
TI	4.41±0.04	3.50±0.03	3.63±0.03	3.39±0.02	3.27±0.03	3.30±0.03

BS = Balami sheep, US = Uda sheep, YS = Yankasa sheep. RS = Rainy season, DS = Dry season

From Table 2, result of the analysis of the percentage fatty acids composition of the raw milk of sheep breed showed that $C_{4:0}$, $C_{6:0}$, $C_{8:0}$, $C_{10:0}$, $C_{12:0}$, $C_{18:0}$, $C_{18:1}$. $C_{18:2}$ and $C_{18:3}$ were higher in the raw milk of BS (1.66 – 16.71%) and lowest in the raw milk of YS (1.28 – 16.07%). However, $C_{14:0}$ and $C_{16:0}$ were higher in the raw milk of YS (12.68 – 27.11%) and lowest in the raw milk of US (10.23 – 24.56%). The percentage TSFA of the raw milk ranged from 62.65 to 68.30% during RS and 59.93 to 64.18% during DS, in which the lowest percentage was recorded in the raw milk of US (59.93 – 62.65), while highest in the raw milk of BS (64.18 – 68.30). The result of the present study is lower than the report of Rodriguez-Alcala *et al.*, (2009) and Talpur *et al.*, (2009), who reported TSFA as main FA and accounted about 67% to 75% of TFA, but higher than 56.53±0.52 and 49.52±0.17% reported by Soraj *et al.*, (2017), for wet and dry season for sheep milk. Similarly, SCFAs ($C_{4:0}$ and $C_{6:0}$) for the raw milk was highest during RS (2.16 – 3.78%) and lowest during DS (2.04 – 3.19%). SCFAs during RS ranged from (2.98 – 3.78%) and (2.16 – 3.01%) which decreased to (2.01 – 3.19%) and (2.04 – 2.71%) during DS, with the raw milk of YS (2.01 – 2.98%) and BS (2.071– 3.78%) having the lowest and highest composition. For the MCFA ($C_{8:0}$ – $C_{12:0}$) their compositions during RS were (2.11 – 2.37%), (4.28 – 4.77%) and (4.02 – 4.87%), while during DS the values ranged from (2.01 – 2.09%), (4.09 – 4.19%) and (3.31 – 4.28%). YS (2.01 – 2.04% and 2.04 – 2.71%) and BS (2.01 – 2.04% and 2.04 – 2.71%) had the lowest and highest composition for the RS and DS. On the other hand, LCFAs ($C_{14:0}$ – $C_{18:0}$) ranged from (11.48 – 12.68%), (24.56 – 27.11%) and (10.48 – 11.08%) during RS, which decreased to (10.04 – 12.06%), (24.13 – 27.03%) and (10.16 – 10.41%) during DS. Their compositions were higher in the raw milk of BS and lowest in YS. Among the individual SFAs, $C_{14:0}$, $C_{16:0}$ and $C_{18:0}$ were the major SFAs and accounted for (27.09 – 28.38%), (13.66 – 14.02%) and (8.97 – 10.10%) during RS, while their percentage composition during DS were (24.13 – 27.03%), (10.04 – 12.06%) and (10.16 – 10.41%). The results of the present study agrees with the report of Soraj *et al.,* (2017), who reported higher percentage composition of SCFA, MCFA and LCFA in sheep milk during wet season than dry season.

The percentage TUFA of the raw milk ranged from 17.74 to 20.48% during RS and 16.84 to 19.16% during DS, in which the lowest percentage was recorded YS, while highest in BS for the RS and DS. Soraj *et al.,* (2017) reported 23.49±0.43% and 28.19±0.56% for dry and wet season which is higher than the result of the present study. $C_{18:1}$ in the raw milk of sheep breeds during RS was (15.45 – 16.71%) of TUFA and DS was (14.72 – 16.08%) of TUFA, with YS and BS having lower and higher percentage during RS and DS. Results of the present study is lower than 19.74±0.27% and 22.84±0.21% reported by Soraj *et al.,* (2017) for wet and dry seasons of sheep milk.

TSFA of the raw milk across the breeds was higher during RS (68.30±2.05%) in the raw milk of BS sheep breed and lowest during DS (59.59±1.87%) in the raw milk of SGC cow breed. Soraj *et al.,* (2017) reported higher TSFAs in cow breed during wet season (61.53±0.41%) and lowest in sheep breed during dry season (49.52±0.17%). Raw milk contained less short chain fatty acids (SCFA) and higher percentage of long chain fatty acids (LCFA) in all the breeds. The order of the percentage composition of the saturated fatty acids among cow and sheep breeds were SCFA < MCFA < LCFA. SFA contributes major part of TFA in all the breeds of the selected ruminants. In general, cow and sheep raw milk contains less SCFA and higher percentage of LCFA. These results were similar to the finding of Ahamad *et al.,* (2013). The difference in short chain (SCFA) and medium chain FA in milk among may be due to distinct activity of mammary enzyme (steroyl coenzyme A desaturase) (Medrano *et al.*1999) which oxidises medium chain fatty acid in to its corresponding unsaturated FAs. White *et al.,* (2001) and Capp *et al.*, (1999) reported similar results by feeding same diet to different breeds of cows. The percentage composition of TUFA of the raw milk across the breeds of the cow and sheep was higher during RS (20.48±0.60%) in the raw milk of BS sheep breeds and lowest during DS (12.53±0.27%) in the raw milk of SGC cow breed. Soraj *et al.,* (2017) reported highest percentage composition of TUFA during wet and dry season in sheep breed compared to cow breed. Among the individual UFA in cow and sheep breeds, $C_{18:1}$ had the highest compositions, while $C_{18:3}$ was the lowest. The finding of the present report is similar with the report of Haenlein and Wendorff (2006). PUFA ($C_{18:2}$ and $C_{18:3}$) accounted for 2 to 4% of TUFA in the raw milk of cow and sheep breeds for the RS and DS. MUFA for cow and sheep breeds ranged from 12 to 17% during RS and DS. Similar to present study, Peterson *et al.,* (2000) reported alikeness in total MUFA content between buffalo and cow milk. Talpur *et al.,* (2009) reported higher MUFA in RS than DS which could be attributed to feed resources and feeding pattern.

Result of the present study indicated that raw milk of sheep contained higher PUFA than cow and in both the seasons with oleic acid being the dominant among other UFA. The higher percentage of oleic acid in ruminant milk could be due to extensive biohydrogenation of PUFA from feeds in rumen and by the use of concentrates. Diet has major impact on the FA acid composition of milk (Palmquistand Jenkins 2003). Many workers reported highest content of PUFA in wet season and lowest during dry season in sheep milk (Chilliard *et al.*, 2007, De La Fuenteet *et al.*, 2009). The differences in botanical composition of grass may modify the bacterial population in rumen and thereby lipid mobilization and affects the proportion of different FA (Collomb *et al.,* 2008). Feeding of fresh grass to ruminants elevate the FA content of milk (Floris *et al.,* 2006). Thus grazing modifies the FA composition of ruminant milk towards more desirable components. Tyagi *et al.,* (2007) reported higher linoleic acid content in milk by green fodder feeding.

The value of n-6/n-3 ratio, atherogenity index (AI) and thrombogenity index (TI) are commonly used to assess the nutritional value and consumer health of intramuscular fat, it is an important determinant for reducing the risk of many chronic diseases (Simopoulos, 2008; Pilarczyk *et al.*, 2015). In general, a ratio of n-6/n-3 of 1.0 – 4.0 is required in the diet to combat lifestyle diseases such as coronary heart diseases and cancers (Simopoulos, 2002). In the present study the range of n-6/n-3 ratios of cow, and sheep breeds were (0.49 – 0.76) and (1.10 – 1.45) for the RS and DS. The values were within the recommended level of > 1.0, except for sheep breeds which is higher. The range of n-6/n-3 of the present study is lower than (2.76 – 6.41) reported by Aguilar *et al.,* (2014). Similarly the athrogenic index (AI) and thrombogenic index (TI) take into account the effects that single FAs might have on human health and, in practice, on the probability of increasing the incidence of pathogenic phenomena such as atheroma and/or thrombus formation (Pilarczyk et al., 2015). In general, AI and TI value of 1.0 – 4.0 is required in the milk, which improves human health because of the beneficial effect on the cardiovascular system. In the current study the AI of the raw milk of cow and sheep breeds were (2.54 – 4.23) and (4.43 – 5.61). On the other hand TI of the cow and sheep breeds were (1.87 – 3.11) and (3.27 – 4.41).

CONCLUSION

Raw milk of cow breeds contained highest percentage of $C_{14:0}$ and $C_{16:0}$, while raw milk from sheep breed contained higher $C_{4:0}$, $C_{18:0}$, and $C_{18:3}$. The percentage compositions were highest during RS in comparison to DS in all the breeds. Raw milk of cow breeds showed that $C_{14:0}$, $C_{16:0}$ and $C_{18:3}$ were highest in RBC and lowest in WFC. However, $C_{4:0}$, $C_{6:0}$, $C_{10:0}$, $C_{12:0}$, $C_{18:0}$, $C_{18:1}$ and $C_{18:2}$ were highest in the raw milk of WFC and lowest in the raw milk of SGC. Result of the analysis of the raw milk of sheep breeds showed that $C_{4:0}$, $C_{6:0,}$ $C_{8:0,}$ $C_{10:0,}$ $C_{12:0,}$ $C_{18:0,}$ $C_{18:1.}$ $C_{18:2}$ and $C_{18:3}$ were highest in the raw milk of BS and lowest in the raw mill of YS. However, $C_{14:0}$ and $C_{16:0}$ were significantly highest in the raw milk of YS and lowest in US. Raw milk from WFC and BS had highest percentage fatty acid composition and higher value of health indices which indicate that WFC and BS had higher risk of 'lifestyle diseases' such as coronary heart disease and cancer.

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