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NUTRITIONAL AND FATTY ACID PROFILING OF MURRAH BUFFALO, SAHIWAL AND HARIANA COW'S MILK

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ABTRACT

Nutritional and fatty acid profiling of Murrah Buffalo, Sahiwal and Hariana Cow's milk was conducted at DUVASU, an instructional livestock farm complex. In which milk samples from ten animals of each Hariana and Sahiwal cows and Murrah buffalo were collected at monthly interval. These samples were then separately analyzed for nutritional and fatty acid components. On comparison with Hariana and Sahiwal, Sahiwal was showing higher fat and casein components than Hariana. Murrah buffalo milk was having greater quantity of fat, casein, lactalbumin, total solids, SNF and lactose as compared to cow milk. Major Fatty acids recorded were butyric, Caproic, capric, lauric, Myristic, palmitic, stearic, oleic, linoleic, linolenic etc. Oleic acid was recorded 24.63% in Sahiwal, 23.24% in Hariana and 30.58% in Murrah. Linolenic acid was higher in buffalo than cow milk. Lauric and Myristic fatty acids were less in summer while Palmitic was higher in summer. Stearic acid varies throughout the year. CLA was recorded 0.34 g/100 g in buffalo milk while Sahiwal milk showed 0.62 g/100 g and Hariana 0.51 g/100 g.

Keywords: *Bubalus bubalis*, buffaloes, milk, Sahiwal, Hariana, Murrah, Nutritional Components, fatty acids

INTRODUCTION

Milk and milk products are well balanced nutritious food and play a very important role in human diet. The nutritional quality of dairy products is highly correlated with its components, their proportions and technological properties (Heck *et al*., 2009). The composition of milk may change over a period of time, seasons and interactional effects of several factors like breeding program and feeding strategy. The variations in cows' and buffalo milk composition are strongly correlated with the manufacturing conditions, sensory quality, and nutritional properties of dairy products (Han *et al*., 2012). Inherently cow milk is yellowish in color due to the presence of carotene which is not present in buffalo milk giving it white color.

The nutritional aspects of food are much more concerned now than in earlier days. Components which are functional in nature and have nutritional potential for human health

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are now expected in the foods. Besides overall nutrients present in milk, fat is highly correlated with milk quality due to fat soluble vitamins and n-3 fatty acids and conjugated linoleic acids (CLA) (Markiewicz-Kęszycka *et al*., 2013). Fat also plays an important role in processing raw material and is a carrier of taste and aroma. So, the analysis of these aspects has begun to receive an increasing attention, especially the short-chained ones, polyunsaturated, *cis* and *trans*. Conjugated fatty acids are potentially involved in human health and are much more concern to the consumers (Wolff,1995). Higher CLA content is evident in foods derived from ruminants than non-ruminants due to the ability of ruminants to biohydrogenate dietary unsaturated fatty acids with the help of bacteria present in the rumen (Khanal *et al*., 2004). All the animals are considerably variable with regard tothe principal components in milk (Islam *et al*. 2014). But Murrah buffalo, Sahiwal and Hariana cows have special role in Indian milk industry and are called the backbone of Indian dairy industry. So, the study was confined to the milk produced by these species and breeds. The aim of the study was to explore the variability and peculiarity of the milk components in various months of the calendar year. So, the planning of breeding, feeding, management and technological interventions can be done.

MATERIALS AND METHODS

Source of raw materials

Three different kinds of milch animals of similar age group and lactation of Instructional Livestock Farm Complex of DUVASU, Mathura were selected for sample collection. A total of ten animals of each Murrah Buffalo, Sahiwal and Hariana cows were selected, and 100 samples of each breed/species were collected three times in a month on 1st, 15th and 30th day.

Physico-chemical and nutritional assessment

Milkwasinitiallyanalyzedbasedonsensory attributes like Colour and appearance, Flavour and taste using human senses. THI was calculated using the method adopted by (Bianca, 1962). Then it was analyzed for physical characteristics like specific gravity byusing the lactometer following the method of Mahoney (1998), heat stability by Singh (2004), and titrable acidity by Barry (2014). Oxidation-Reduction Potential and pH by using combination electrode according to Bradley *et al*. (1992). Chemical analysis of milk samples for moisture, fat, lactose, protein, total solids and solid-not-fat was performed usingstandard AOAC procedures suggested by Bradley *et al*. (1992). To extract the total lipid amount, from the material studied we used the classic method (Folch *et al*., 1957). The compositional analysis of fatty acids was made by gas chromatography which implies their transformation in methyl esters or other volatile derivatives.

Statistical analysis

The data obtained in the study on various parameters were statistically analyzed on 'SPSS-19.0' software package using standard methods of Snedecor and Cochran (1994). Data was subjected to one way analysis of variance, homogeneity test and Duncan's Multiple Range Test (DMRT) for comparing the means to find out the significant differences in the values obtained among various milk types.

RESULTS AND DISCUSSIONS

Temperature humidity index

Temperature humidity index is the indication of comfort level to the milch animals. In whole of the year comfort level of milch animals was not up to the standards (<72 THI). It might be due to adverse climatic conditions of the Brij region of Uttar Pradesh. So certain measures are to be adopted to provide comfort to the milch animals. It is utmost important to get the maximum yield and nutrients from these animals.

Physical appearance

The apparent physical characteristics of Hariana, Sahiwal cows and Murrah buffalo were recorded throughout the year. Overall, with slight variation in intensity, the cow's milk showed yellowish white colour and buffalo was white color. The color difference between cow and buffalo milk was probably due to the presence of carotene in cow's milk and absence of carotene in buffalo milk. The slight variations in colour and appearance were due to variations in food and fodder and climatic changes in different months of the year. Ahmad *et al*. (2013) also reported the very white and beautifully smooth color of buffalo milk.

The flavor of all types of milk was in general faint. However, variations in milk were due to the feed availability and feeding to the animals in various months of the year. The taste of the milk of these breeds was sweet and the intensity of sweetness was higher in buffalo than cow's milk due to the presence of lactose quantity in respective breeds. As we collected the fresh milk from the animals directly the heat stability of all types of milk showed negative results. It was the indication of goodness of milk for processing.

Physical characteristics

pH: Physical characteristics of Hariana and Sahiwal cows and Murrah buffalo were assessed in terms of pH, oxidation reduction potential, specific gravity and titrable acidity and depicted in Table 1. The range of pH in milk of Hariana cows was 6.27^{b}±0.07 in October to 6.99±0.01 in May months. Similar pattern was observed in same months in Sahiwal milk that was 6.35^{b}±0.02lowest to highest 7.07±0.05. The normal pH of cow milk reported is 6.4 to 6.6. Most of the values of pH in cow's milk were in this range, however the highest range was beyond this which might be due to adverse climatic conditions in the month of May in study area. The Murrah milk showed lowest pH 6.54^{a}±0.02 in February month and highest 7.13±0.07 in May month. However, Ahmad *et al*. (2013) reported the pH of buffalo milk in the range of 6.57 to 6.84 and is not influenced by month, lactation number, or season of calving, but correlated with solid-not-fat (SNF) and lactose contents. Obviously overall higher pH was recorded in buffalo milk than cow's milk which might be due to higher SNF and lactose in buffalo milk.

Oxidation reduction potential

Oxidation-reduction potential or redox denoted as E_h indicates the ability of a chemical/ biochemical system to oxidize or reduce. The E_h of milk at 25°C is usually in a range from +250 to +350 mV. The most of Eh values in the study were in this range and overall buffalo milk showed higher Eh than cow's milk which could be due to greater species' affinity for electrons. Test is also important to know susceptibility of milk to oxidation, but its routine measurement has limitations due to the separation between hydrophobic and hydrophilic phases (Larsen *et al*., 2015).

Specific gravity

Specific gravity is the overall impression of all the components present in it because every component of milk shows special specific gravity. Overall the specific gravity of buffalo milk was higher than cow milk which might be due to higher milk solids and lactose. The specific gravity of cows and buffaloes were very well in the range as specified by various scientistsi.e Fangmeier *et al.* (2018).

Titrable acidity

The titrable acidity is usually expressed as a ‘percentage of lactic acid. The titrable acidity in the study was very well below the range as specified by various scientists. It indicated that milk of all species/ breeds was very good in quality and could be processed well. It is because acidity of more than 0.18% lactic acid would result in curdling during heat processing (Melia *et al*., 2018). Ahmad *et al.* (2013) also reported the acidity values of buffalo milk in the range of 0.05% to 0.20%.

Chemical characteristics

Milk is a complex mixture containing number of chemical components i.e. water, fat, protein, lactose, ash, vitamins tec. All the components naturally present in milk are same in all species but they vary in quantity of composition and is subjected to change in response of genetics, breeding, feeding, number and stage of lactation and health status of the animal (Misra *et al*., 2008; Islam *et al*., 2014). Therefore, s study was undertaken to know how about the presence and quantity and pattern of moisture, fat, casein, lactalbumen, total solids, SNF, lactose etc. in different months of the year and the values are shown in Table 2. The average values of total solids, fat, lactose and proteins of buffalo milk were similar as reported by Han *et al*. (2012) during study of water buffalo milk of Northeastern region of the United States. Overall buffalomilk reported higher fat, total solids, caseins andlactose contents than cow milk and similar findings were also given by Han *et al.* (2012). In some of the months (May, June, February and March) buffalo milk was nearly twice as rich in fat as compared to cow milk and the most important fraction is responsible for its high energetic and nutritive value. These findings are in similar fashion as reported by Varrichio *et al.* (2007); Tonhati *et al.* (2011).

Water

The water content in buffalo milk was comparatively lower in buffalo milk than cow’s milk which indicates the proportional values of other components were higher in buffalo milk than cow’s milk. However, no significant differences were observed in various months of the year in water content.

Fat

The fat content of Murrah buffalo was significantly higher than cow milk. In comparison of cow milk, Hariana milk comparatively contains less fat than Sahiwal milk in most months of the year.

Casein and lactalbumen

Caseinand lactalbumen are important proteins found in milk. Both proteins showed higher quantity in buffalo milk than cow’s milk. However, no significant differences were observed in Hariana and Sahiwal milk in caseinand lactalbumen contents which might be related to the same species and variable breeds. It could be due to inherent property in buffalo and cow milk. During the year lowest values recorded in April

month while highest in November and December month.

Total solids and SNF

Total solids and SNF both showed higher quantity in buffalo milk than cow's milk. However, no significant differences were observed in Hariana and Sahiwal milk in these contents which might be related to the same species and variable breeds. It could be due to inherent property in buffalo and cow milk. During the year lowest values recorded in April month while highest in November and December month.

Lactose

lactose is a typical sugar found in milk and composed of galactose and glucose subunits.It was in the range of $4.38^{b}\pm0.08$ to $5.88^{a}\pm0.11$ in Hariana milk (HM), $4.32^{b}\pm0.19$ to $5.33^{b}\pm0.02$ in Sahiwal milk (SM) and $5.77^{a}\pm0.10$ to $6.84^{a}\pm0.12$ in Murrah Buffalo milk (MBM). The significantly ($P<0.05$) higher T values were in MBM while no significant differences were observed in HM and SM milk.

Fatty acid profile

Nowadays consumers are very much concerned about the health providing components. Fat is the most important and disputed component of milk. So, the fatty acid profiling of the milk fat was done and values obtained were shown in Table 3 to 6. The major fatty acids recorded were butyric, Caproic, capric, My stalagmitic, stearic, oleic, linoleic, linolenic etc. Overall oleic acid was recorded 24.63% in Sahiwal, 23.24% in Hariana and 30.58% in Murrah. The similar findings were reported by Mihaiu *et al.* (2010) during comparative study of buffalo milk and cow milk samples collected from the north and center region of Transylvania.Linolenic acid was higher in buffalo than cow milk and is in the same fashion as suggested by Mihaiu *et al.* (2010) during comparative study of buffalo milk and cow milk samples collected from the north and center region of Transylvania.Lauric and Myristic were less in summer than winters while Palmitic was higher in summer than winters. Stearic acid varies throughout the year. The major health providing fatty acid popularly known as CLA was recorded 0.34 g/100 g in buffalo milk while Sahiwal milk showing 0.62 g/10g and Hariana 0.51 g/100 g. Mihaiu *et al.* (2010) also suggested the higher CLA values in cow milk than buffalo milk during comparative study of buffalo milk and cow milk samples collected from the north and center region of Transylvania.

CONCLUSIONS

It was evident from the results that buffalo milk is white in colour while cow's milk was yellowish white in colour. All milks showed faint flavour, sweet taste and negative heat stability values with slight variations in different months of the year. The physical characteristics like pH, oxidation reduction potential, specific gravity and titrable acidity values were very well in the range and milk showed good for processing. Chemical characteristics of these milk overall showed higher values for MBM than HM and SM except water content which was lower in MBM than HM and SM. Overall oleic acid value was highest in MBM than HM and SM while CLA was recorded highest in SM followed by HM and MBM.

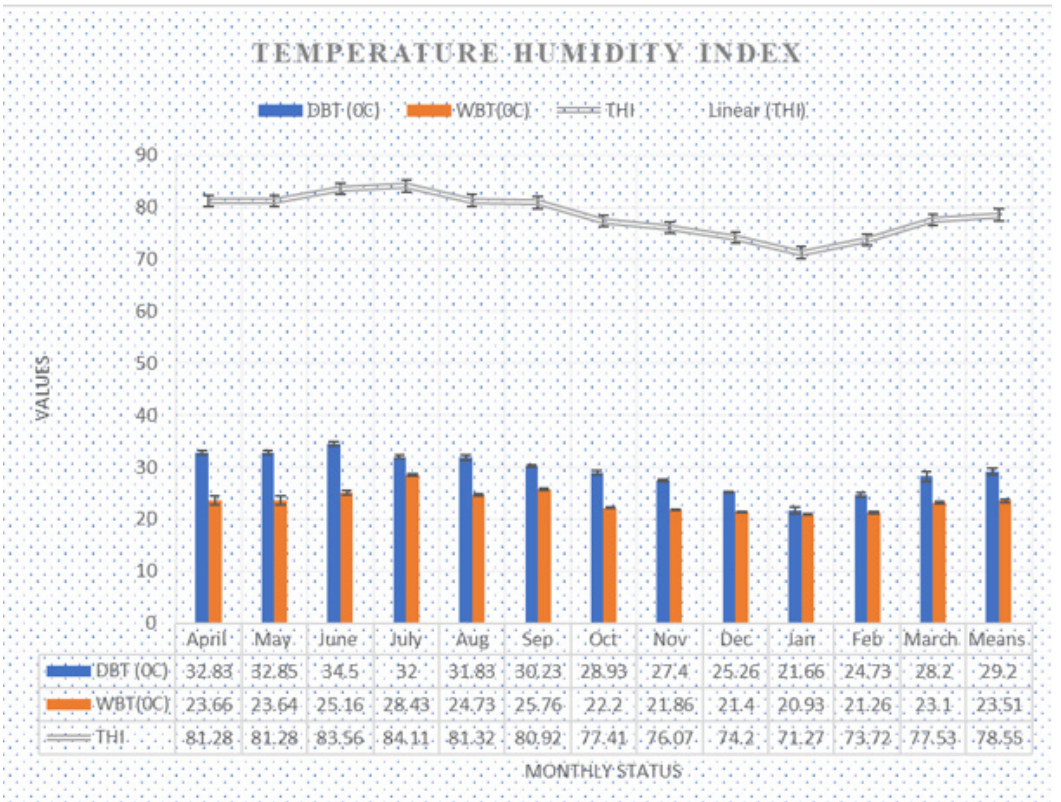

Figure 1. Temperature humidity index (mean±SE).

Table 1. Physical characteristics of Hariana, Sahiwal and Murrah milk (mean±SE).

Month	pH			Oxidation-reduction potential (mV at 25^{0}C)			Specific gravity			Titrable acidity (Percent lactic acid)		
	Hariana	Sahiwal	Murrah	Hariana	Sahiwal	Murrah	Hariana	Sahiwal	Murrah	Hariana	Sahiwal	Murrah
April	6.37^{b}±0.02	6.42^{b}±0.02	6.51^{a}±0.02	0.280±0.01	0.300±0.03	0.300±0.01	1.027^{b}±0.01	1.029^{ab}±0.02	1.030^{a}±0.01	0.11±0.01	0.12±0.01	0.12±0.01
May	6.99±0.01	7.07±0.05	7.13±0.07	0.290±0.02	0.280±0.02	0.300±0.01	1.028^{b}±0.01	1.028^{b}±0.01	1.030^{a}±0.01	0.14±0.01	0.13±0.01	0.14±0.01
June	6.35^{b}±0.08	6.60^{ab}±0.13	6.77^{a}±0.02	0.260±0.03	0.270±0.02	0.290±0.02	1.030^{a}±0.01	1.028^{b}±0.01	1.030^{a}±0.01	0.16±0.01	0.13±0.01	0.15±0.01
July	6.80±0.02	6.88±0.05	6.87±0.04	0.230±0.01	0.240±0.02	0.280±0.02	1.029^{ab}±0.01	1.028^{b}±0.01	1.030^{a}±0.01	0.17^{a}±0.01	0.13^{b}±0.01	0.14^{ab}±0.01
Aug	6.91^{a}±0.01	6.82^{ab}±0.03	6.70^{b}±0.08	0.240±0.02	0.270±0.04	0.370±0.07	1.028^{b}±0.01	1.027^{b}±0.01	1.030^{a}±0.01	0.12±0.01	0.10±0.01	0.12±0.01
Sep	6.65^{a}±0.03	6.49^{b}±0.02	6.68^{a}±0.02	0.280^{b}±0.01	0.280^{b}±0.01	0.320^{a}±0.01	1.028^{b}±0.01	1.028^{b}±0.01	1.031^{a}±0.01	0.14^{b}±0.01	0.14^{b}±0.01	0.15^{a}±0.01
Oct	6.27^{b}±0.07	6.35^{b}±0.02	6.64^{a}±0.01	0.270^{ab}±0.01	0.240^{b}±0.01	0.290^{a}±0.01	1.027^{c}±0.01	1.028^{b}±0.01	1.031^{a}±0.01	0.16±0.01	0.16±0.01	0.15±0.01
Nov	6.51^{b}±0.01	6.50^{b} ±0.01	6.75^{a}±0.01	0.300^{a} ±0.01	0.260^{b}±0.01	0.280^{a}±0.01	1.030^{b} ±0.01	1.030^{b} ±0.01	1.031^{a}±0.01	0.15^{b}±0.01	0.18^{a}±0.01	0.16^{ab}±0.01
Dec	6.56^{b}±0.01	6.51^{b} ±0.02	6.74^{a}±0.01	0.260±0.01	0.260±0.01	0.280±0.01	1.029^{c}±0.01	1.030^{b} ±0.01	1.031^{a}±0.01	0.14±0.01	0.14±0.01	0.14±0.01
Jan	6.38^{b}±0.03	6.50^{a} ±0.01	6.56^{a}±0.02	0.260±0.01	0.250±0.01	0.270±0.01	1.030±0.01	1.031 ±0.01	1.030±0.01	0.13±0.01	0.13±0.01	0.11±0.01
Feb	6.39^{b}±0.02	6.50^{a} ±0.01	6.54^{a}±0.02	0.230±0.01	0.250±0.01	0.260±0.01	1.030±0.01	1.030 ±0.01	1.031±0.01	0.12±0.01	0.12±0.01	0.11±0.01
March	6.42^{c}±0.01	6.53^{b}±0.01	6.62^{a}±0.01	0.23^{b}±0.01	0.25^{a}±0.01	0.26^{a}±0.01	1.031^{a} ±0.01	1.029^{b}±0.01	1.030^{a}±0.01	0.17±0.01	0.17±0.01	0.16±0.01

Table 2. Chemical characteristics of Hariana, Sahiwal and Murrah milk (mean±SE).

Month	Water			Fat			Casein			Lactalbumin		
	H	S	M	H	S	M	H	S	M	H	S	M
April	85.73^{a}±0.39	87.20^{a}±0.60	82.74^{b}±0.36	4.00^{b}±0.37	3.31^{b}±0.43	6.18^{a}±0.18	2.59^{b}±0.19	2.26^{b}±0.16	3.37^{a}±0.07	0.59^{b}±0.02	0.56^{b}±0.02	0.76^{a}±0.01
May	85.99^{a}±0.91	85.16^{a} ±0.23	81.68^{b}±0.12	4.17^{b}±0.15	4.24^{b}±0.25	8.52^{a}±0.21	2.54^{b}±0.06	2.57^{b}±0.16	4.30^{a}±0.08	0.63^{b}±0.01	0.61^{b}±0.01	0.89^{a}±0.01
June	85.99^{a}±0.91	85.10^{a}±0.31	81.54^{b}±0.15	3.03^{c}±0.19	4.42^{b}±0.25	7.21^{a}±0.25	2.11^{c}±0.07	2.66^{b}±0.10	3.78^{a}±0.10	0.57^{c}±0.01	0.62^{b}±0.01	0.81^{a}±0.01
July	85.99^{a}±0.91	86.14^{a}±0.22	81.70^{b}±0.15	4.38^{b}±0.20	4.47^{b}±0.17	7.38^{a}±0.65	2.64^{b}±0.08	2.68^{b}±0.07	3.85^{a}±0.26	0.64^{b}±0.01	0.63^{b}±0.01	0.82^{a}±0.03
Aug	85.57^{a}±0.61	85.72^{a}±0.32	81.89^{b}±0.10	4.20^{b}±0.19	4.55^{b}±0.18	6.78^{a}±0.41	2.58^{b}±0.07	2.72^{b}±0.07	3.61^{a}±0.16	0.61^{b}±0.01	0.61^{b}±0.01	0.77^{a}±0.02
Sep	85.73^{a}±0.64	85.41^{a}±0.37	81.70^{b}±0.12	5.23^{b}±0.29	4.96^{b}±0.21	8.51^{a}±0.37	2.99^{b}±0.11	2.86^{b}±0.09	4.26^{a}±0.16	0.66^{b}±0.01	0.65^{b}±0.01	0.88^{a}±0.01
Oct	85.73^{a}±0.64	85.71^{a}±0.32	81.52^{b}±0.08	5.62^{b}±0.19	5.12^{b}±0.14	7.77 ^{a}±0.06	3.14^{b}±0.07	2.94^{b}±0.05	4.01 ^{a}±0.02	0.67^{b}±0.01	0.63^{b}±0.01	0.79 ^{a}±0.01
Nov	84.11^{a} ±0.72	85.11^{a} ±0.32	81.67^{b} ±0.07	4.17^{b}±0.25	5.20^{b}±0.06	8.00 ^{a}±0.76	2.57^{b}±0.09	2.98^{b}±0.02	4.10^{a}±0.30	0.63^{b}±0.01	0.69^{b}±0.01	0.88 ^{a}±0.04
Dec	83.85^{a} ±0.72	85.11^{a} ±0.32	82.00^{b} ±0.03	6.55 ^{a}±0.36	4.78^{b}±0.16	6.50 ^{a}±0.33	3.52^{a} ±0.14	2.81^{b}±0.06	3.50 ^{a}±0.13	0.77 ^{a}±0.01	0.67^{b}±0.01	0.79 ^{a}±0.02
Jan	83.68^{b}±0.75	85.64^{a} ±0.19	81.82^{c} ±0.06	4.42^{b}±0.30	4.70^{b}±0.17	6.80 ^{a}±0.59	2.66^{b} ±0.12	2.78^{b}±0.07	3.62 ^{a}±0.23	0.65^{b}±0.01	0.67^{b}±0.01	0.79 ^{a}±0.03
Feb	83.59^{b}±0.61	85.58^{a}±0.16	81.82^{c}±0.06	3.20^{b}±0.04	4.11^{b}±0.24	7.56 ^{a}±0.63	2.42^{b}±0.12	2.83^{b}±0.06	3.62 ^{a}±0.23	0.59^{b}±0.01	0.63^{b}±0.01	0.86 ^{a}±0.03
March	83.55^{a}±0.59	84.93^{a} ±0.43	81.79^{b} ±0.07	3.77^{b}±0.13	4.05^{b}±0.14	7.46 ^{a}±0.60	2.40^{b} ±0.05	2.52^{b}±0.05	3.88 ^{a}±0.24	0.62^{b}±0.01	0.61^{b}±0.01	0.83 ^{a}±0.03

Table 2. Chemical characteristics of Hariana, Sahiwal and Murrah milk (mean±SE). (Continue).

Month	Total solid			SNF			Lactose		
	H	S	M	H	S	M	H	S	M
April	11.87^{b}±0.41	11.38^{b}±0.51	15.20^{a}±0.28	7.87^{b}±0.24	8.07^{b}±0.11	9.02^{a}±0.14	4.51^{b}±0.15	4.32^{b}±0.19	5.77^{a}±0.10
May	12.82^{b}±0.32	12.34^{b}±0.31	18.02^{a}±0.34	8.25^{b}±0.05	8.10^{b}±0.13	8.19^{a}±0.15	4.87^{b}±0.12	4.68^{b}±0.12	6.84^{a}±0.12
June	11.54^{b}±0.23	12.49^{b}±0.35	16.41^{a}±0.21	8.44^{b}±0.10	8.01^{b}±0.18	9.20^{a}±0.13	4.38^{b}±0.08	4.74^{b}±0.13	6.23^{a}±0.08
July	12.97^{b}±0.24	12.70^{b}±0.29	16.61^{a}±0.67	8.59^{b}±0.10	8.14^{b}±0.21	9.23^{a}±0.03	4.92^{b}±0.09	4.82^{b}±0.11	6.30^{a}±0.25
Aug	12.31^{b}±0.18	12.30^{b}±0.22	15.55^{a}±0.47	8.14^{b}±0.08	7.89^{b}±0.07	8.77^{a}±0.14	4.67^{b}±0.07	4.67^{b}±0.08	5.90^{a}±0.18
Sep	13.46^{b}±0.29	13.20^{b}±0.27	17.70^{a}±0.35	8.26^{b}±0.04	8.24^{b}±0.07	8.93^{a}±0.09	5.11^{b}±0.11	5.01^{b}±0.10	6.70^{a}±0.14
Oct	13.51^{b}±0.24	12.88^{b}±0.19	16.00 ^{a}±0.09	7.89±0.09	7.66±0.06	7.76±0.26	5.12^{b}±0.09	4.89^{b}±0.07	6.07 ^{a}±0.03
Nov	12.76^{b}±0.32	14.05^{b}±0.07	17.76 ±0.88	8.61^{b}±0.05	8.82^{b}±0.01	9.76 ^{a}±0.12	4.84^{b}±0.12	5.33^{b}±0.02	6.74 ^{a}±0.33
Dec	15.49 ^{a}±0.29	13.62^{b}±0.23	15.93 ^{a}±0.44	8.94 ^{b}±0.07	8.84^{b}±0.07	9.43 ^{a}±0.10	5.88^{a}±0.11	5.17 ^{b}±0.09	6.05 ^{a}±0.16
Jan	13.30^{b}±0.32	13.76^{b}±0.17	15.93 ^{a}±0.64	8.89 ^{b}±0.04	9.06^{ab}±0.01	9.13 ^{a}±0.08	5.05^{b}±0.12	5.22 ^{b}±0.06	6.04^{a}±0.24
Feb	12.02^{b}±0.13	12.84^{b}±0.18	17.28 ^{a}±0.77	8.71 ^{b}±0.12	8.73^{b}±0.07	9.71 ^{a}±0.16	4.56^{b}±0.05	4.87 ^{b}±0.07	6.56^{a}±0.29
March	12.49^{b}±0.13	12.45^{b}±0.13	16.85 ^{a}±0.64	8.72 ^{b}±0.09	8.40^{b}±0.09	9.40 ^{a}±0.04	4.74^{b}±0.04	4.72 ^{b}±0.05	6.40^{a}±0.24

Table 3. Fatty acid profile of Hariana, Sahiwal and Murrah milk (mean±SE).

Fatty acid (g/100g)	Jan-March			April-June			July-Sep			Oct-Dec		
	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo
Saturated Fatty Acids (SFA)												
Butyric acid (C4:0)	1.79b±0.03	1.88^{ab}±0.03	1.98^{a}±0.04	1.32b±0.17	1.62b±0.03	2.57a±0.07	1.64b±0.01	2.63a±0.11	1.60b±0.04	1.45b±0.20	1.68b±0.04	2.60a±0.04
Caproic acid (C6:0)	1.40b±0.09	1.97^{a}±0.04	1.82^{a}±0.03	1.36b±0.12	2.03a±0.04	1.86a±0.04	1.39b±0.02	1.92a±0.07	2.10a±0.06	1.63b±0.16	2.13a±0.09	1.90ab±0.06
Caprylic acid (C8:0)	1.55b±0.02	1.73^{ab}±0.03	1.83^{a}±0.09	1.48b±0.04	1.67a±0.03	1.80a±0.04	1.58b±0.05	1.90a±0.04	1.79ab±0.09	1.65b±0.05	1.68ab±0.04	1.81a±0.03
Capric acid (C10:0)	2.98ab±.01	3.13^{a}±0.10	2.88^{b}±.06	2.90b±0.01	3.00a±0.02	2.82c±0.03	2.81ab±0.05	2.51b±0.18	2.93a±0.05	2.88±0.04	3.10±0.12	2.85±0.04
Lauric acid (C12:0)	3.56a±0.07	3.17^{ab}±0.35	2.35^{b}±0.07	3.17a±0.06	2.86a±0.30	2.13b±0.07	4.54a±0.01	3.45b±0.09	4.53a±0.01	3.52a±0.06	3.18a±0.34	2.36b±0.07
Myristic acid (C14:0)	2.71b±0.01	2.80^{b}±0.01	3.26^{a}±0.22	2.44b±0.01	2.52b±0.01	2.93a±0.34	2.44b±0.01	2.93a±0.20	2.52b±0.01	2.71b±0.01	2.81b±0.01	3.26a±0.22
Palmitic acid (C16:0)	8.75b±.09	9.03^{b}±0.22	10.87^{a}±0.06	10.70b±0.09	10.99b±0.21	13.25a±0.01	10.70b±0.09	13.25a±0.01	10.99b±0.21	8.80b±0.04	8.99b±0.24	10.71a±0.06
Stearic acid (C18:0)	10.51a±0.11	10.78^{a}±0.11	9.39^{b}±0.19	10.38a±0.14	10.68a±0.15	9.65b±0.12	10.58±0.02	9.98±0.29	10.48±0.09	10.48a±040	10.75a±0.14	9.32b±0.21
Arachidic acid (C20:0)	1.43b±0.11	1.41^{b}±0.05	1.73^{a}±0.03	1.33b±0.04	1.38b±0.06	1.71a±0.02	1.33b±0.04	1.71a±0.02	1.38b±0.06	1.53b±0.08	1.51b±0.06	1.81a±0.09
Behanic acid (C22:0)	1.83±0.08	1.78±0.03	1.79±0.05	1.70±0.01	1.75±0.02	1.72±0.02	1.70±0.01	1.72±0.02	1.75±0.02	1.77±0.07	1.78±0.06	1.82±0.09

Table 3. Fatty acid profile of Hariana, Sahiwal and Murrah milk (mean±SE). (Continue).

Fatty acid (g/100g)	Jan-March			April-June			July-Sep			Oct-Dec		
	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo	Hariana	Sahiwal	Buffalo
Unsaturated Fatty Acids (USFA)												
Myristoteic acid (C14:1 n-9-cis)	0.60^{b}±0.01	1.31^{a}±0.05	1.28^{a}±0.03	1.21a±0.01	1.21a±0.06	0.54b±0.04	1.21a±0.01	0.54b±0.04	1.21a±0.06	1.28a±0.06	1.27a±0.02	0.47b±0.03
Palmitoleic acid (C16:1 n-9-cis)	1.87^{a}±0.06	1.57^{b}±0.05	1.49^{b}±0.13	1.32c±0.04	1.47b±0.02	1.81a±0.01	1.32c±0.04	1.81a±0.01	1.47b±0.02	1.46b±0.09	1.53b±0.06	1.87a±0.06
Oleic acid (C18:1 n-9-cis)	30.59^{a}±0.30	23.39^{b}±0.09	22.72^{b}±0.49	22.46b±0.32	23.32b±0.09	30.56a±0.28	25.12c±0.01	30.56a±0.28	28.32b±0.09	22.69c±0.21	23.49b±0.07	30.62a±0.31
Lenoleic acid (C18:2 n-6-cis)	1.13±0.17	1.21±0.04	0.95± 0.12	0.95±0.12	1.21±0.04	1.07±0.10	2.26a±0.05	1.86b±0.02	2.30a±0.01	1.15±0.24	1.37±0.09	1.20±0.16
Linolenic acid (C18:3n3)	1.62^{a}±0.04	0.74^{b}±0.02	0.83^{b}±0.09	0.83b±0.09	0.74b±0.02	1.65a±0.01	0.83b±0.09	1.65a±0.01	0.74b±0.02	0.84b±0.09	0.74b±0.02	1.75a±0.06
Erucic acid (C22:1n-9-cis)	1.71±0.05	1.67±0.03	1.64±0.05	1.61b±0.02	1.64ab±0.01	1.68a±0.02	1.65±0.01	1.68±0.02	1.65±0.01	1.60b±0.02	1.64ab±0.01	1.69a±0.03
Octadecadienoic acid (C18:2 n-9-cis 11 trans) CLA	0.33±0.04	0.58±0.11	0.47±0.04	0.45ab±0.04	0.58a±0.17	0.19b±0.06	0.68±0.02	0.53±0.12	0.71±0.01	0.46b±0.04	0.62a±0.02	0.31b±0.06

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