

Comparison of Fat fractions and Nutrients in bovine milk from 2 different geographical regions in South India.

1. SIVA TEJA GADEPALLI, Department of Food Science, Nutrition and Dietetics, Acharya Nagarjuna University, Guntur, India.
2. BABITHA BOBBA, Department of Food Science, Nutrition and Dietetics, Acharya Nagarjuna University, Guntur, India .
3. NAGA HIMAKUND MALLAMPALLI, Excelra Knowledge Solutions Pvt Ltd, Hyderabad, India .

***Corresponding Author-** Department of Food Science, Nutrition and Dietetics, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, Andhra Pradesh- 522510, India

Abstract:

The study aims to compare the milk fat fractions and nutrients (Calcium, Protein, SNF, ASH, Vitamin-D, and Vitamin-A) in cows and buffaloes of 2 different regions. Milk was collected from 8 bovine animals each from Attili and Venigandla villages which are 2 different geographical locations in Andhra Pradesh, India. Milk samples were analyzed for calcium, protein, SNF, Ash, Vitamin-D, Vitamin-A, and fat contents, and comparison was done between cows and buffaloes of both the regions using the Student's T-test, and a significant difference was observed for calcium, ash, Vitamin-A and fat fractions whereas no significant difference was found for protein, SNF and Vitamin-D. The comparison was also made between Attili buffalo and cow, Venigandla buffalo and cow, and between cows and buffaloes irrespective of regions using Welch's T-test, and a significant difference was observed for calcium, protein, Vitamin-D, Vitamin-A, and fat fractions. Considering various comparisons between the bovine milk nutrient compositions in both the regions, the Attili region has shown significance over the Venigandla region in most of the milk nutrient aspects. Irrespective of region, buffalo milk has shown significance over cow's milk regarding nutrient aspect. Soil has a strong impact on bovine milk nutritional quality in which phosphorus plays a key role in maintaining the soil-fodder-bovine milk relation, which is one of the aspects towards Attili regional bovines showing significant milk nutrient status over that of Venigandla.

Keywords: Bovine, Milk, Fat fractions, Milk Nutrients, Geographical variation in milk, Cow, Buffalo.

Introduction:

India is the world's largest milk producing country accounting for 22% in the world's milk share. India is also largest producer of buffalo milk followed by Pakistan. Buffalo milk is a rich source of calcium, protein, fat, magnesium, potassium, sodium than that of cow's milk. Because of its high fat content, buffalo milk is used in the preparation of mozzarella cheese. The world famous Murrah breed buffalo is originated from Punjab region of India.

The differences in bovine milk nutritional quality has been observed in various studies which includes expression of particular fatty acids and it may be the result of variation in nutrient content of soil or fodder or the cattle breed(Hussien et al., 2013), (Hossain et al., 2017) and (Varricchio et al., 2007). Geographical location also plays a crucial role in determining the nutritional quality of cattle milk(Rutkowska et al., 2015), (Alonso et al., 2004), (Collomb et al., 2002), (Yang et al., 2013) and (Liang et al., 2018). Even though the world's population majorly depends on cow milk, few studies have shown that nutrient content in buffalo milk is far much denser than cow's milk(Mahmood & Usman, 2010), (Soliman, n.d.), (Rafiq et al., 2015), (Zou et al., 2013), .

Materials and Methods:**Study Design and Sampling:**

The current study is a cross sectional observational study. Milk was collected from 8 bovine animals (3 cows and 5 buffaloes) each from Attili and Venigandla regions of Andhra Pradesh and the research work was done during April- 2016 to May-2021. Other details regarding parity, breed, milk yield per day, fodder details were taken from the corresponding bovine farmers in both the regions.

Description of the sampled regions:

Attili is a village located in West Godavari District of Andhra Pradesh with clay type of soil. Paddy is the versatile crop in this region. Average rainfall being 1000 mm.

Venigandla is a village located in Guntur district of Andhra Pradesh with sandy clay loam type of soil. Paddy being the highest grown crop followed by cotton and maize. Average rainfall being 700 mm.

Feed and Fodder:

Cows and buffaloes in Attili were fed Hay, Pasture (Napier, Hybrid Napier, Paragrass), rice bran, husk, concentrate (Andhra sugars mineral mixture) along with outdoor pasture feeding. Whereas

buffaloes in Venigandla were fed Hay, Pasture (Napier, Hybrid Napier, Paragrass, maize, bajra), coconut oil cake, rice bran, concentrate (SGP mineral mixture) along with outdoor pasture feeding. Cows were restricted to indoor feeding and were fed with Pasture (Napier, Hybrid Napier, Paragrass, maize, bajra) and concentrate (chelated ultraforamin, HG and HD mineral mixture).

Chemical Analysis:

Protein: Determination of crude protein content in the given milk sample was done by using Macro Kjeldahl Method as mentioned in (Barbano et al., 1990).

SNF: The SNF content of milk sample was determined using Lactometer as mentioned in (*IS 10083 (1982): Method of Test for Determination of SNF(Solids Not Fat) in Milk by the Use of Lactometers*, n.d.)

Ash: Total ash content of the given milk sample was determined on dry basis of the dried milk as mentioned in (*IS 1165 (2002): Milk Powder Specification (Determination of Total Ash (on dry basis))*)).

Calcium: The calcium content in the given milk sample was measured using flame photometry as mentioned in (Keirs & Speck, 1950).

Vitamin-A: The Vitamin-A content of milk sample was estimated using the retinylpalmitate content of the milk by HPLC method as mentioned in (Thompson et al., 1980).

Vitamin-D: The Vitamin-D (cholecalciferol) content in milk sample was estimated using HPLC method as mentioned in (Mattila et al., 1995).

Fat: Lipids from milk samples were separated using FSSAI MANUAL METHODS FOR FOOD ANALYSIS, and derivatization of milk fat as mentioned by (Christopherson & Glass, n.d.). The gas chromatography method for milk fatty acid analysis was done as mentioned by (Contarini et al., 2013).

Statistical Analysis:

The bovine milk parameters between both the regions were tested using Student's T-test whereas the milk parameters between bovine animals of the same region were tested using Welch's T-test. Both the significance tests were run using statistical software R studio.

Results and Discussion:

The comparison of nutritional parameters of milk was made between bovine animals of Attili&Venigandla, Attili buffalo &Venigandla buffalo and Attili cow &Venigandla cow in table 1. In relation to comparison between Attili&Venigandlabovines, among 11 nutritional parameters only 3 i.e., ash, Vitamin-A and PUFA showed significant differences. Whereas comparison between Attili&Venigandla buffaloes showed that 6 nutritional parameters, which are calcium, fat, Vitamin-A, fat, unsaturated fat and PUFA were significant. Among the six significant parameters, Vitamin-A showed high level of significance. There is no significance between Attili and Venigandla cow parameters.

	Attili Bovines vsVenigandla Bovines	Attili Buffalo vsVenigandla Buffalo	Attili Cow vsVenigandla Cow
Calcium	0.15	0.04*	0.99
Protein	0.21	0.2	0.52
SNF	0.33	0.09	0.72
Ash	0.03*	0.01*	0.75
Vitamin-A	0.03*	0.004**	0.12
Vitamin-D	0.7	0.19	0.55
Fat	0.23	0.01*	0.1
Saturated Fat	0.25	0.06	0.1
Unsaturated Fat	0.19	0.03*	0.12
MUFA	0.27	0.66	0.12
PUFA	0.03*	0.01*	0.37

Table-1: Significance of bovine milk parameters between both the regions were tested using Student's T-test

Level of Significance: * significant

** highly significant

*** very highly significant

Milk constituents when compared between different geographical regions showed significant differences (Nam et al., 2009), (Kędzierska-Matysek et al., 2011). Milk fatty acids have shown significant differences when compared between different geographical regions (Yang et al., 2013), (Liang et al., 2018), (Collomb et al., 2002), (Alonso et al., 2004), (Rutkowska et al., 2015).

The milk nutritional parameters in table-2 denotes the comparison between Attili buffalo & cow, Venigandla buffalo & cow and the final comparison between the buffaloes & cows irrespective of the region. The comparison between Attili buffalo & cow shows that Vitamin-A and PUFA were significant, whereas the former showed a high level of significance. Between the comparison of Venigandla buffalo and cow, Vitamin-A, fat, saturated fat, unsaturated fat and MUFA showed a very high level of significance. The final comparison between both buffalo & cow irrespective of regions shows that except SNF and ash all other parameters were significant. Among 9 significant parameters fat and saturated fat showed high level of significance, whereas Vitamin-A exhibited a very high level of significance.

	Attili Buffalo vs Cow	Venigandla Buffalo vs Cow	All Buffalo vs All Cow
Calcium	0.06	0.37	0.01*
Protein	0.17	0.12	0.02*
SNF	0.56	0.34	0.83
Ash	0.66	0.27	0.81
Vitamin-A	0.008**	0.0006***	0.0005***
Vitamin-D	0.07	0.2	0.01*
Fat	0.16	0.00001***	0.006**
Saturated Fat	0.13	0.000006***	0.002**
Unsaturated Fat			
Fat	0.28	0.0000003***	0.01*
MUFA	0.36	0.0000004***	0.02*
PUFA	0.02*	0.37	0.03*

Table-2: Significance of milk parameters between the bovines of same regions was tested using Welch's T-test

Level of Significance: * significant

** highly significant

*** very highly significant

Several studies have stated that buffalo milk has high nutritional value than cow's milk as reported in our current study. Here, except SNF and ash all other nutritional parameters of buffalo milk showed different levels of significance over cow's milk when calculated irrespective of region (Mahmood & Usman, 2010), (Soliman, n.d.), (Kapadiya et al., 2016) and (Rafiq et al., 2015).

The assessment of lipid fraction in the current study among buffalo and cow irrespective of region denotes that both saturated and unsaturated fats of buffalo were significant over cow's milk fat fractions, whereas (Zou et al., 2013) stated that saturated fat percentage was higher in cows rather than buffaloes. They also stated that MUFA and PUFA were high in buffaloes than cows and saturated fat fraction showed high level of significance than unsaturated fat.

It can be explained from table-3 that the soil type in Attili region is clayey soil, whereas from Venigandla region, it is sandy clay loam soil. The soil in Attili is slightly alkaline with a pH of 7.8, whereas soil in Venigandla is having a pH of 7.2. Attili soil has high salinity value being 2.84, whereas Venigandla soil is neutral with the salinity value 0.23. Organic carbon content in both Attili and Venigandla regions is 0.36 kg/hectare and 0.35 kg/hectare respectively, being on the lower side. Similarly, nitrogen content in both Attili and Venigandla regions is 100 kg/hectare and 125 kg/hectare respectively being on the lesser side. The availability of Phosphorus content in Attili region is 22 kg/hectare which is a good amount to be considered. Whereas, the phosphorus content in Venigandla region is 6 kg/hectare which can be considered to be too low. The potassium content in both the regions is high with 356 kg/hectare in Attili region and 303 kg/hectare in Venigandla region. The available sulphur content is also high with 123 ppm in Attili region and 116 ppm in Venigandla region.

	Attili	Guntur
Soil colour	Black	Reddish brown
Soil type	Clay	Sandy clay loam
pH	7.8	7.2
Salinity	2.84	0.23
Organic carbon (kg/hectare)	0.36	0.35
Nitrogen (kg/hectare)	100	125
Phosphorus (kg/hectare)	22	6
Potassium (kg/hectare)	356	303
Sulphur (ppm)	123	116

Table-3: Soil parameters of both the regions

A study which was conducted to know the mineral relations in soil-fodder-cattle serum showed that phosphorus and potassium didn't show significance at any given level, which shows the availability of these two macro minerals at different levels is negligible (Kumaresan et al., 2010). In another study 5 types of soils were examined by (Zheng et al., 2003), in which phosphorus content was higher in clay soil type and phosphorus content decreased when clay content decreased and sand content of soil increased. Organic and humic acids obstruct the surface assimilation of phosphorus in soils with poor clay content when compared to soils with rich clay content (Andrade, 2001).

Conclusion:

The comparison of bovine (cow and buffalo) milk between both Attili and Venigandla regions denotes that irrespective of type of bovine variety, Attili region showed significant differences in ash, Vitamin-A and PUFA over Venigandla region. Whereas corresponding to buffaloes of both the regions, Attili region showed significant differences in calcium, ash, Vitamin-A, fat, unsaturated fat and PUFA over Venigandla region. No significance was observed for cows of both the regions.

Soil has a certain impact in soil to fodder to bovine milk nutrition quality aspect as low levels of phosphorus in the soil of Venigandla region is one of the reasons for low milk quality in Venigandla buffaloes than that of Attili region. Cows of Venigandla region can be exempted from the above reason as major part of their diet are concentrate mixtures.

The overall comparison between milk of cows and buffaloes irrespective of region shows that buffaloes exhibit significant difference in calcium, protein, Vitamin-A, Vitamin-D, fat, unsaturated fat, saturated fat, MUFA and PUFA fractions over cow's counterpart fractions. This manifests that the nutrients in buffalo milk are in higher proportions than that of cow's milk.

Further research on micronutrient analysis should be done in the soil samples of various regions along with their impact on fodder quality and its ultimate effect on bovine milk to compare the milk nutritional parameters between bovines (cows and buffaloes) of various different regions. More studies are required to analyse the differences of energy utilization from fodder to milk between cows and buffaloes to clearly evaluate the nutritional parameters of milk.

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Disclosure of Interest:

The authors report no conflict of interest.

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