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Comparative study on nutritive properties and composition of milk of Sangamneri Goat, Nimari Cow and Surti Buffalo

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Abstract
Milk is the essential component of our daily diet, especially for young ones. So the present research paper studies contents and nutritive properties of milk of livestock. For this study physico-chemical analysis applied. Milk samples of Surti Buffalo had higher pH, titratable acidity, total solids, solid not-fat (SNF), ash, fat, protein, lactose, total Nitrogen and some selected minerals viz., Calcium, Phosphorous and Chloride content than Nimari cow and Sangamneri goat. Whereas Sangamneri goat milk samples were having higher water and magnesium content than that of milk samples collected from Nimari cow and Surti buffalo. Milk of Surti buffalo was rich source of macro nutrients (fat, protein, lactose and selected minerals than that of Nimari cow milk. Surti buffalo milk was more energetic, than that of milk of Nimari cow and Sangamneri goat.

Key Words: *pH, S.N.F, goat milk, titratable acidity, macro nutrients*

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I. Introduction

Overview of Jalgaon District in Maharashtra-Jalgaon district is located in the north-west region (N latitudes 20°15' and 21°25' and E longitudes 74°55' and 76°28) of the state of Maharashtra and is bounded by Satpuda mountain ranges in the north, Ajanta Mountain ranges in the south. Jalgaon district is having area of 11757 sq. kms. With 15 tehsils (Figure1.2). Jalgaon district is bounded by Madhya Pradesh state to the north, and by the districts of Buldhana to the east, Jalna to the southeast, Aurangabad to the south, Nashik to the southwest, and Dhule to the west. Fifteen tehsils are included in Jalgaon districts namely 1. Jalgaon, 2. Jamner, 3. Erandol, 4. Dharangaon, 5. Bhusawal, 6. Bodwad, 7. Yawal, 8. Raver, 9. Muktainagar, 10. Amalner, 11. Chopda, 12. Parola, 13. Pachora, 14. Chalisgaon, and 15. Bhadgaon.

Jalgaon district is known for its advances in horticulture. The soil which is found in Jalgaon district is well suited for cotton production. Its production of bananas and cotton, especially by resorting to drip irrigation, has created a role model for cultivators in other parts of India. The district is very famous for the production of Banana's in the country also known as banana capital of the country. Bananas grown in the district are exported outside the State and to other countries. Jalgaon is also famous for gold. It is a major business center for tea, gold, pulses, cotton and bananas due to which the city is developing rapidly. The famous, Jain irrigation systems producing solar product is situated in Jalgaon. The other different types of industries like coal products, chemical products, metal products and parts, food products, dairy products, gold and silver, silk, sugar, cotton, irrigation instruments, pipes and many more are helping in the development of the city. There are total 63 large scale 128 medium scale and 3303 small scale industries in Jalgaon. There are local farmers, Kathiyawadi people and Animal Farm Houses in Jalgaon district are having cattle raised for milk and meat.

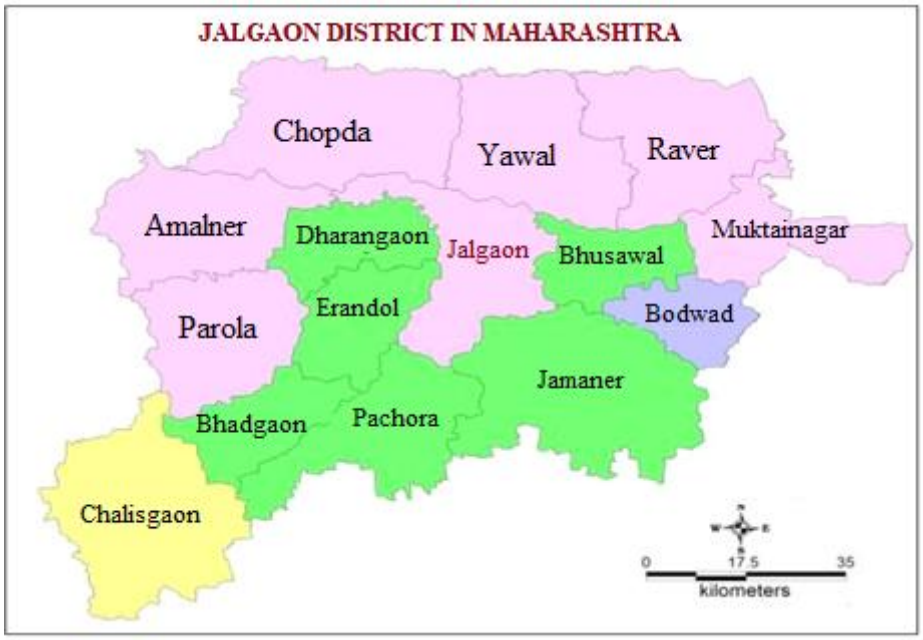

Figure 1.2. Map of Jalgaon district showing 15 Tehsils and adjoining boundaries. (Source: www.mapsofindia.com)

Milk is considered as nearly complete human food and it is considered as the first food for the newlyborn offspring. Milk is an almost ideal food having high nutritive value. It supplies body building proteins, bone forming minerals and furnishes energy giving lactose and milk fat. Besides supplying certain essential fatty acids, it contains the above nutrients in an easily digestible and assimilable form (Vishweshwar and Krishnaiah, 2005).

World milk production derives from cows, buffaloes, goats, sheep, and camels, with buffalo milk being the second most consumed type after cow's milk. Both buffalo and cow's milk are highly nutritious and provide a great amount of vitamins and minerals, but buffalo milk packs more nutrients and calories per serving. Buffalo milk is extremely rich in calcium, and is a good source of minerals like magnesium, potassium, and phosphorus. It contains less cholesterol, more fat, and more calories. It is good for healthy bones, dental health, cardiovascular health, and weight gain. It has 100% more fat content than cow's milk and can be preserved for longer. Whereas cow's milk has lower in fat than buffalo milk and preserved for less time. Cow's milk is rich in a variety of minerals, vitamins, and proteins, it is also an excellent source of calcium. More cholesterol, less fat, fewer calories. It is beneficial for healthy bones, dental health, reducing obesity in children, protection from thyroid diseases, and cardiovascular health (Sahin et al,2014; Navale and Gupta (2016).

There are nearly 500 breeds of goats in the world; however, only a half dozen are generally raised for their milk purpose and about 600-700 million of dairy goats are present in the world (Kris, 2008). Goat is one of the oldest domesticated animals. In ancient times also goat milk was valued the most. Goat milk still plays an important role in human nutrition. All over the world riding on high profile or big budget campaign cow milk has been made very popular, however it doesn't mean that cow milk is the best with better quality than the goat milk. Goat milk offers a wide variety of health benefits such as better digestibility (Desjeux, 1993), more alkalinity (Saini and Gill, 1991), less αs1 casein than cow's milk and is, therefore, less allergenic (Merin et al, 1988). Goat milk also has antioxidant, antimicrobial, and medicinal property (Lopez et al, 1985; Rincon et al, 1994). Goat milk contains a higher carotene (pro-vitamin A) having cancer-preventing properties. It is also useful in the treatment of ulcers due to its more effective acid buffering capacity (Boros, 1989). Goat milk has a stronger flavour due to the liberation of short-chain fatty acids during rough handling, which gives off a goaty smell (Babayan, 1981; Haenlein, 1993). In fact 65% of the milk consumption worldwide is from goat milk and is superior to cow milk in many aspects. (Mahmood and Usman, 2010; Kumar and Sharma, 2016).

Milk of different species contains the same kind of constituents but in varying in amount. Within a given species, genetic factors, environmental conditions and stage of lactation influence the composition of milk (Kanwal *et al*, 2004). Pertaining to available literature, comparative study between the nutritive quality and composition of milk collected from Sangamneri Goat, Nimari Cow and Surti Buffalo raised in Jalgaon district is not available. Hence present investigation was carried out to compare the milk samples of goat, cow and buffalo from the point of view of its composition and nutritional values.

II. Materials And Methods

Equipment/Apparatus

Hot Air Oven

Hot air oven (BST/HAO-1128, Bionics Scientific Technologies (P). Ltd**.** India) was used to evaporate the moisture content of milk samples.

Analytical Balance

Analytical balance (Smith Model: MO00440007) was used to weigh the milk samples and reagents.

Centrifuge Machine

Centrifuge machine (Tanco CEN-16, Medico Centrifuge, India) was used to centrifuge the milk samples during determination of fat content of milk samples.

Micro Kjeldhal Digestion and Distillation Unit

Micro Kjeldhal digestion unit (BST/KDU-6**,** Bionics Scientific Technologies (P). Ltd. India) was used to digest the samples during determination of protein content of milk.

Titration Kit

Titration kits were used to titrate the samples after distillation during determination of protein content of milk.

Muffle Furnace

Muffle furnace (Biolinx Labsystems Pvt Ltd, Mumbai)) was used to ignite the milk samples during the determination of ash content of milk.

Butyrometer -Borosilicate Glass Butter Butyrometer (Hindustan Thermostat, India) were used to measure fat content of the milk samples.

pH meter -SELTIX pH Test Meter ± 0.1pH was used to measure the pH of milk samples

Pcynometer -Specific gravity of milk samples were measured using Pcynometer (Thomas Scientific, USA)

COLLECTION OF MILK SAMPLES

Fresh milk samples form Sangamneri Goat, Nimari Cow and Surti Buffalo were used (each type four samples). All these samples were collected from local famers, animal farm houses and Kathiyawadi people who have lactating cattle in Jalgaon district of Maharashtra. The samples were kept refrigerated at 4°C and transported to the laboratory within 24 hours, prior to refrigeration. All the milk samples were stored at -20°C until analysis.

PHYSICO-CHEMICAL ANALYSIS OF MILK SMAPLES

Specific gravity

The specific gravity of the milk is measured using a Lactometer and the temperature deviation of milk is taken into considerationand correction applied, the lactometer is called CorrectLactometer Reading (CLR) with the formula. Specific gravity of milk can be calculated by the following formula:

$$\text{Sp. Gr.} = \frac{\text{CLR}}{1000} + 1$$

Corrected lactometer reading (CLR) = LR + CF

Where CF for Quevenne lactometer

CF (+) = 0.1 x difference in temperature above 60^0F

CF (-) = 0.1 x difference in temperature below 60^0F

Titratable acidity

Titratable acidity is the amount of alkali required to bring the pH to neutrality. This property of milk is used to determine bacterial growth during fermentations, such as cheese and yogurt making as well as compliance with cleanliness standards. Naturally, there is no lactic acid in fresh cattle milk, however, lactic acid can be produced by bacterial contamination, but this is not common. The titratable acidity is due to the casein and phosphates.

Titratable Acidity of Milk The alkaline range of the titration curve is important because of the widespread use of titratable acidity to characterize milk. The titratable acidity is the buffering capacity of milk between its own pH (6.6) and pH 8.3 (the phenolphthalein end point). The measurement of titratable acidity (usually expressed, somewhat arbitrarily, as percentage lactic acid) is useful for determining the freshness of milk and for controlling the manufacture of fermented dairy products. Thetitratable acidity of fresh milk seldom falls outside the range 0.14–0.16% **(**McCarthy, 2002).

- **Total Solids Content**

Total solids content (TS) was observed according to the method of Association of Official Analytical Chemists (AOAC, 2000). The milk sample (5g) was taken in a pre-weighed flat bottom dish. The dish was placed in hot air oven at101±1^{o}C for 3 hrs and transferred to desiccator having a silica gel as desiccant. After 1 hr, the dish was weighed.The drying and desiccating were repeated till achieving the constant weight and calculation was made as per following formula.

$$\text{Total solids content (\%)} = \frac{\text{Wt. of dried sample (c-a)} \times 100}{\text{Wt of sample taken (b-a)}}$$

Where,
a = weight of empty dish
b = weight of sample + dish
c = weight of dried sample + dish

Solids Not Fat (SNF)

Solid not-fat is an important criterion of milk selection for further processing. Milk solids non-fat would include the nitrogenoussubstances, milk sugar and mineral matter. Whole fluid milk contains a minimum 8.25 percent SNF. The determination of solidnon-fat is done by taking lactometer reading at 40°C. Solids-not-fat (SNF) content was determined by the following formula (HarrisandBachman, 2003).

SNF content (%) = TS (%) – Fat (%)

Fat Content

Fat content was determined by Gerber method as described by James (1995). Milk sample (11 ml) was mixed with 90 % sulfuric acid (10 ml) and amyl alcohol (1 ml) in butyrometer and closed with rubber cork. The butyrometer was placed in a Gerber centrifuge machine and centrifuge for 5 min at 1100 rotation per minute (r.p.m). The fat percentage was noted on the butyrometer scale.

Protein Content

Protein content was determined according to the method of British Standards Institution (BSI, 1990). The sample (5g) was digested using Micro Kjeldhal digester in the presence of catalyst (0.2 g of copper sulfate and 2 g of sodiumsulfate) where sulfuric acid (30 ml) was used as an oxidizing agent. The digested sample was diluted with distilled water (250 ml). Then 5 ml portion from the diluted sample was distilled with NaOH (40 %) using Micro-Kjeldhal distillationunit, where steam was distilled over 2 % boric acid (5 ml) containing an indicator for 3 minutes. The ammonia trapped in boric acid was determined by titrating with 0.1N HCl. The nitrogen percentage was calculated using following formula:

$$N\% = \frac{1.4\,(V_1-V_2) \times \text{Normality of HCl} \times 250}{\text{Wt. of sample} \times \text{Vol. of diluted sample}}$$

Where,
V1 = Titrated value of milk sample
V2 = Titrated value of Blank sample

While protein content was calculate from the N% by multiplying with conversion factor i.e. 6.38 as reported by James (1995).

Lactose Content

Lactose content was determined by subtracting the sum of total percent of fat, protein and ash contents from thatof total solids content of milk.

Ash Content

Ash percentage was determined by Gravimetric method as described by AOAC (2000) using muffle furnace. The milk sample (5g) was taken in pre-weighed crucible, and transferred to muffle furnace (550^{o}C) for 4±1 h. Ignitedsample was transferred to desiccator having silica gel as desiccant. After 1 hr. the crucible was weighed and the content wascalculated by following formula:

$$\text{Ash (\%)} = \frac{\text{Wt. of ignited sample} \times 100}{\text{Wt. of sample taken}}$$

Calorific Values of milk samples

Calorific/energy values were calculated from the proximate analysis results using the following generalized equation:

Kcal 100g-1 = (% protein × 4) + (% fat × 9) + (% lactose × 4)

Selected minerals content

Calcium and magnesium were determined simultaneously in milk by complexometric method of Davies and White (1962) using disodium salt of ethylenediaminetetraacetic acid.

Phosphorous was determined by the colorimetric method of Fiske and Subbarow (1925).

The chloride content of all the milk sample of milk was determined by Hammer and Bailey (1917) using $AgNO_3$.

Statistical Analysis

A computerized statistical package of GraphPad Prism (Analytical software, San Diego, CA 92108) was used to analyse the data. The data so obtained was tabulated and analysed with statistical procedure of summary statistics, under which descriptive statistics and frequency distribution test, were applied to observe the

variability within same character of milk among different samples and their frequencies. The data were further analysed through statistical procedure of analysis of variance (ANOVA) to observe the significant differences among the variables and in case of significant difference exist, the mean were further computed using least significant difference (LSD) at 5 % level of probability.

OBSERVATIONS

Based on the survey of dairy farms and analysis of milk samples collected in Jalgaon district (Figure 1.6) the following obervations were noted.

Table 1.1: Phenotypic Characters of Sangamneri goat

1	Colour	PredominantlyWhite
2	Ears	Pendulous, in some goats horizontal & erectears
3	Horns	Average 8-12% are polled and remaining arehorned. Horns are curved (69.35%) or straight (30.65%)
4	Forehead	The Sangamneri goats had convex (87.75%),straight (10.14%)& concave (2.10 %) forehead.
2. Weights		
1	Wt.at birth	Male 2.43+0.11 kg Female2.08+0.092 kg
2	Wt.of full grown Female	23.72+0.71kg
3	Wt.of full grown Female	24.21+037kg
3.Reproductive Characters		
1	Age at Maturity	245.19+7.42 Days
2	Age at 1st pregnancy	287.09+10.16 Days
3	Age at 1st kidding	432.18+12.77 Days

III. Results And Discussion

pH of the milk samples: Milk has acidic properties inside of mammals due to the presence dissolved carbon dioxide. But the milk has alkaline properties outside of the mammals because of losing carbon dioxide to the air.The negative log of hydrogen ion concentration (pH) of the milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo is summarized in table 1.2. The pH of the milk was measured at the time of sampling using portable pH meter. The results showed that pH values were in the range of 6.48 to 6.65 in goat milk, 6.54 to 6.71 in cow milk and 6.52 to 6.95 in buffalo milk. The pH of buffalo milk were significantly ($p<0.05$) higher than that of cow and goat. Whereas, the pH of cow and goat were not significantly different form each other ($p>0.05$). The pH value of buffalo found the present investigation is in agreement of the findings of Kanwal et al (2004). Cow and goat milk shown pH in accordance with pH reported by Abay and Kebede (2016).

Table 1.2: The pH values of milk samples of goat, cow and buffalo

	pH value			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	6.48	6.65	6.56	0.06
Nimari cow	6.54	6.71	6.62	0.05
Surti Buffalo	6.62	6.98	6.73	0.08
Significance				
Goat milk v/s Cow milk	n.s			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = $p < 0.001$, *= $p < 0.05$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

Specific gravity of milk samples:

Fat present in the milk causes the specific gravity slightly higher than the water. Alteration in the composition of milk can reflect in change in the specific gravity of milk. If the fat is removed form milk, its specific gravity can be increased because ofthe weight of fat is much lower than the water. Milk adulterated with water converts milk into less nutritive and its quality becomes substandard. The lactometers are normally standardized at a particular temperature (say 60°F or 15.6° C). If the temperature is above or below the standard temperature of 60°F, the lactometer reading should be corrected by adding 0.1 to the lactometer reading or

0.0001 to the specific gravity for each °F above 60°F and vice versa for lower temperatures (Aware and Kshirsagar, 2017).

Table 1.3 represents the LR and specific gravity of milk samples taken from Sangamneri goat, Nimari cow and Surti buffalo. Results showed in the present study that Nimari cow's milk has highest specific gravity and LR i.e.29.9 and 1.03 respectively. These figures are followed by Sangamneri goat and lowest specific gravity and LR were noted for the milk sample of Surti buffalo. The results obtained during this study were resembling the findings of Getaneh et al (2016). Values of Mean LR and Mean specific gravity of goat and buffalo were no significantly differ from each other while these figure significantly with that of cow's milk. Normal milk rarely has the specific gravity at (60^0F) less than 1.03 (LR=30), hence lower LR may be due to adulteration of milk.

Table 1.3: Lactometer reading (LR) and Specific gravities of goat, cow and buffalo milk samples

Source	LR (Range)	LR (Mean)	Sp.Gravities (Range)	Sp. Gravities (Mean)
Goat	27-29	28.7	1.02- 1.03	1.02
Cow	28-33	29.9	1.02- 1.03	1.03
Buffalo	26-29	28.3	1.02- 1.02	1.02

Mean having same figures are statistically not significantly differ from each other ($P<0.05$).

Titrable acidity:

Table 1.4 shows the values of titratable acidity (%) of milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo. The results indicated the titratable acidity were fluctuated between 0.14 to 0.19% in goat milk, 0.14 to 0.17% in cow milk and 0.15 to 0.20% in buffalo milk.The mean value of titratable acidity (%) of buffalo milk were higher than that of goat milk and it showed highly significant differences at $p<0.001$ level. Whereas, it was observed that differences in mean values of titratable acidity (%) of goat milk and cow milk as well as of the cow milk and buffalo milk were significant ($p<0.05$).

Table 1.4: Values of titratable acidity (%) of milk samples of goat, cow and Surti buffalo.

	Titratable acidity (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	0.14	0.17	0.155	0.02
Nimari cow	0.14	0.19	0.165	0.01
Surti Buffalo	0.15	0.20	0.175	0.03
Significance				
Goat milk v/s Cow milk	*			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = $p < 0.001$, *= $p < 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The mean value of the titratable acidity (%) in Sangamneri goat was in accordance with results of Kumar and Sharma (2016). Whereas the milk of Nimari cow showed resembling figure of titratable acidity with that of Mahboba and Zubeir (2007).The Surti buffalo milk was similar as reported by Sahin et al (2014).

Total Solids (TS) in milk samples:

Total solids are measured to ensure the quality of milk samples. The total solids in milk can be determined from the specific gravity and fat content from lactometer reading. Besides carrying out the total solids percentage from the indirect method of using lactometer reading, a direct method of gravimetric analysis can also be useful. This method involves accurately weighing a few grams of the material and subjecting it to heat until all moisture has been driven off on a water bath. The dry residue is weighed, its percentage calculated as total dry solids. TS of milk samples were measured as per the method of AOAC (2000) and give in table 1.5.

Table 1.5: Concentration of total solids in milk samples collected form goat, cow and buffalo.

Total solids (%)				
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	12.86	13.65	13.25	0.62
Nimari cow	11.46	14.65	13.05	0.56
Surti Buffalo	15.59	19.44	17.52	0.85
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The results illustrated that the concentration of total solids were fluctuated in the range of 12.86 to 13.65% in the milk samples of Sangamneri goat, 11.46 to 14.65% in milk samples of Nimari cow and 15.59 to 19.44% in the milk samples of Surti buffalo. The concentration of total solids in buffalo milk was higher than that of the values noted in milk samples of cow and goat and showed highly significant differences at $p<0.001$ level. Whereas, TS values in goat and cow milk samples were not significantly differ from each other ($p>0.05$).

Solid not fat (SNF)

Results regarding solid not-fat (SNF) in milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo are shown in table 1.6. Statistical analysis indicated that source of milk has significant ($p < 0.05$) influence on SNF content. The SNF of milk samples were in the range of 6.97 % (Sangamneri goat) to 8.93 % (Surti Buffalo).

The differences in percentage of SNF in goat and buffalo milk samples as well as in cow and buffalo milk samples were highly significant ($p < 0.001$) whereas SNF% in goat milk sample and cow milk sample were not significantly differ from each other at $p>0.05$. Rasheed et al (2016) reported similar results of SNF% in the milk samples of various sources of milk.

Table 1.6: The percentage of SNF in milk samples of goat, cow and buffalo.

Solid Not Fat (%)				
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	6.97	7.05	7.01	0.04
Nimari cow	7.24	7.98	7.61	0.07
Surti Buffalo	8.23	8.93	8.58	0.12
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

On the other hand, results reported by Pandya and Ghodke (2007) were slightly different and this might be due to the variation in breed, diet and animal health and environmental conditions (Zicarelli, 2004; Ahmad et al. 2008). Hence, concluded that SNF content not only depends on source of milk but also depends on various factors such as breeds, animal feed and season.

Ash-Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence ofoxidizing agents, which provides a measure of the total amount of minerals within a food. Analytical techniques for providinginformation about the total mineral content are based on the fact that the minerals can be distinguished from all the othercomponents within a food in some measurable way. The most widely used methods are based on the fact that minerals are notdestroyed by heating and that they have a low volatility compared to other food components. The main analytical techniquesused to determine the ash content of foods are based on this principle: dry ashing, wet ashing and low temperature plasma dryashing. By dry ashing method its percentage in the milk samples were calculated.

The percentage of ash content in the milk samples of Sangamneri goat, Nimari cow and Surti buffalo are given in table 1.7.

Table 1.7: Ash content in the milk samples collected from goat, cow and buffalo

	Ash (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	0.57	0.98	0.77	0.11
Nimari cow	0.38	0.79	0.58	0.08
Surti Buffalo	0.70	0.97	0.83	0.09
Significance				
Goat milk v/s Cow milk	***			
Goat milk v/s Buffalo milk	n.s.			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s.= $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The milk samples from Surti buffalo shown the highest ash content (0.83%) and its values were fluctuated between 0.70 to 0.97%, followed by goat milk (0.77%) in which its values showed range between 0.57 to 0.98% and the lowest ash content (0.58%) was noted in milk samples collected form Nimari cow, where in the values fluctuated between 0.38 to 0.79%. The differences in values of ash content in goat milk and cow milk samples as well as in cow milk and buffalo milk samples were highly significant ($p<0.001$), whereas there were non-significant ($p>0.05$) difference between values of ash content in milk samples collected form goat and buffalo.

The amount of ash content in Surti buffalo milk samples were similar to that were reported by Imran et al (2008). There was resembling reports noted by Bhosale et al (2009) so far the ash content values in milk samples of collected form Sangamneri goat were concerned. The percentage of ash content in milk sample of Nimari cow were in accordance with results obtained by Javaid et al (2009) and Sreedhar et al (2009).

Fat content

The results related to fat content in milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo are shown in table 1.8.The results related to fat content (%) indicated that maximum mean value (7.5) was noted in milk samples of Surti buffalo, followed by Nimari cow (4.59). Whereas milk sample taken from Sangamneri cow showed lowest percentage of fat (3.86).

Table 1.8: Fat content (%) in milk samples of goat, cow and buffalo

	Fat (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	3.45	4.27	3.86	0.48
Nimari cow	3.98	5.21	4.59	0.53
Surti Buffalo	6.89	8.12	7.50	0.42
Significance				
Goat milk v/s Cow milk	**			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, ** = $p <0.01$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

There were highly significant differences ($p<0.001$) between goat and buffalo milk samples as well as in in cow and buffalo milk samples. The differences in fat content (%) between goat and cow milk were significantly differ ($p<0.01$).Mean fat content 5.25% in buffalo milk and 4.04% in cow milk were noted by Salman et al (2014).

Fats in milk are called butterfat and occur as suspended globules, which are easily seen through low power microscopes. Cattle milk derives many of its most distinctive properties from its lipid fraction. The average total fat content in the milk is similar to that found in other ruminant species, despite reports that the

percentage of fat in goat's milk exceeds that of the cow (Getaneh et al, 2016). Such a controversy most likely derived from the fact that the average percentage of milk fat, as with cow's milk fat, is a variable component, often ranging between 3.0 and 6.0 percent. There are also distinct breed differences in fat composition. It should be remembered, however, the quality and quantity of feeds, genetics season, stage of lactation, etc. all influence the average percentage of goat milk fat. According to analytical results obtained by Garry et al (2000) in terms of cholesterol, goat's milk appears to offer a specific distinction in comparison to cow's milk, cow's milk typically contains about 14 to 17 mg cholesterol per 100 g milk, while goat's milk is more usually recorded at 11 to 25 mg per 100 gram of milk.

Protein content

Milk protein is mainly in the form of casein, lactoalbumins and lactoglobulins. About 82 percent of the protein in milk is casein and the remaining proteins are whey proteins, which are lactoalbumin and lactoglobulin. Casein binds with calcium in milk and forms the calcium caseinate complex, which is present in the colloidal form. Acid, rennet, alcohol and heat can precipitate this complex. The protein content (%) in the milk samples collected from Sangamneri goat, Nimari cow and Surti buffalo are shown in table 1.9.

The results indicated that the value of mean protein in Surti buffalo milk was highest (4.46%) as compared to that of cow milk (3.44%) and goat milk (3.02%). The values of protein content of buffalo milk with that of goat milk and cow milk were differ highly significant ($p<0.001$) whereas differences in protein content in goat milk and cow milk were not significant ($p>0.05$).

Table 1.9: Protein content (%) in milk samples of goat, cow and buffalo

	Protein (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	2.49	3.55	3.02	0.24
Nimari cow	2.93	3.96	3.44	0.28
Surti Buffalo	4.11	4.82	4.46	0.22
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	***			

Significance: *** = $p < 0.001$, n.s. = $p > 0.05$

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The proteins in milk contain all the essential amino acids, and elements that our bodies cannot produce. It is important to remember that proteins are the building blocks of all living tissue. Milk proteins have roughlythe same composition as the egg protein, except for the amounts of methionine and cysteine, significantly lower. Indeed, thesulphur amino acids are the limiting factors in milk. Casein and, even more, the complex milk protein contains good proportionof all amino acids essential for growth and maintenance (Ghada, 2005). The amino acids present in the milk can be precipitated by acid, rennet or alcohol. The denomination crude protein (CP) includes protein (TP) andnon-protein nitrogen (including urea). The protein content is an important feature of the milk (Arora et al, 2013).

Lactose-Chemically lactose is disaccharide made up of glucose and Galactose. It is main component of milk. Except for the milk of mammals, lactose is rarely found in other whole, unprocessed foods. Infants use it as an important energy source during their first year of life (Silanikove et al., 2015). It also supports the development of probiotic bacteria in gastrointestinal tract, which helps protect them from infections (Fassio et al., 2018).In cows, lactose is synthesized in the mammary gland from about 20% of the glucose in the bloodstream. It makes up an estimated 4.7% of the total nutrient content in a cow's milk, typically more by weight than even fat or protein (Costa et al., 2019).

Lactose content in the milk samples collected fromSangamneri goat, Nimari cow and Surti buffalo are given in table 1.10.

Table 1.10: Lactose content in milk samples of goat, cow and buffalo

	Lactose (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	3.76	4.42	4.09	0.28
Nimari cow	4.44	5.32	4.88	0.31

Surti Buffalo	4.68	5.37	5.02	0.44
Significance				
Goat milk v/s Cow milk	*			
Goat milk v/s Buffalo milk	***			
Cow milk v/s Buffalo milk	*			

Significance: *** = p < 0.001, * = p <0.05

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

The results of the present investigation reveals that lactose (%) is highest in milk samples of Surti buffalo, in which values ranged between 4.68 to 5.37%. It then followed by milk samples of Nimari cow, in which the percentage of lactose were lower (4.88%) than Surti buffalo and higher than that of Sangamneri goat. Lactose content in goat milk fluctuated between 4.44 to 5.32%. The lowest lactose content were noted in milk of Sangamneri goat (4.09%), where the values showed the range between 3.76 to 4.42%. The differences in values of lactose content between milk samples of goat and cow as well as in cow milk and buffalo milk were moderately significant from each other at p<0.05 level. While, differences in values of lactose content in milk samples of goat and buffalo were highly significant at p<0.001 level.

Pertaining to the results obtained, it important to mention that Kapadiya et al (2016) reported resembling values of lactose content during their studies on the gross composition, nitrogen distribution, and selected mineral content ingoat milk, and its comparison was made between cow and buffalo milk. The resembling results were also noted by Imran et al (2008) and Bhosale et al (2009).Variationin lactose content might be due to the differencesin the breed, feeding and environmental conditions (Pandya and Ghodke, 2007; Ahmad et al, 2008).

Water content -Water content of milk samples of Sangamneri goat, Nimari cow and Surti buffalois givenin table 1.11. Results illustrated that average water contentof goat, cow and buffalo milk samples were 88.3, 87.2, and 84.3 %, respectively. Statisticalanalysis showed a significant (P < 0.05) differencebetween the water content of goal and buffalo as well as in milk samples of cow and buffalo.

Maximum water content was observed for goat milk (88.3 %), while minimum value was recorded in buffalo milk (84.3 %). Abdelgawad et al (2014) and Rasheed et al (2016) observed higher water content in case ofgoat and cow milk. Cow milk contains a considerable amount of water that ranged from 87.2 to 87.4% (Abay and Kebede, 2018). Health of animal, stage of lactation, breed and somehow animal age has significant influence on water content of milk (Park, 2007).

Table 1.11: Water content in milk samples of goat, cow and buffalo

	Water content (%)			
Source of milk	**Min.**	**Max.**	**Mean**	**SD (±)**
Sangamneri goat	87.7	88.9	88.3	0.11
Nimari cow	86.7	87.8	87.2	0.09
Surti Buffalo	83.9	84.8	84.3	0.08
Significance				
Goat milk v/s Cow milk	n.s.			
Goat milk v/s Buffalo milk	*			
Cow milk v/s Buffalo milk	*			

Significance: * = p <0.05

Min.=Minimum, Max.= Maximum, SD = Standard Deviation

Nitrogen distribution

Total nitrogen (TN) content of all the milk samples of Sangamneri goat, Nimari cow and Surti buffalo determined using the micro Kjeldahlmethod of nitrogen estimation as described in BIS handbook and given in table 1.12.

Table 1.12: Nitrogen distribution in milk samples of goat, cow and buffalo

Types of milk	**Parameters (%)**		
	TN	**NCN**	**NPM**
Goat	0.536±0.021[a] (0.498-0.548)	0.153±0.015[a] (0.132-0.167)	0.029±0.007[a] (0.019-0.036)
Cow	0.547±0.028[a] (0.499-0.568)	0.124±0.013[b] (0.103-0.136)	0.054±0.014[a] (0.036-0.074)
Buffalo	0.702±0.046[b] (0.644-0.743)	0.140±0.020[c] (0.118-0.157)	0.051±0.024[a] (0.023-0.082)
SEM	0.015	0.007	0.007
CD	0.05	0.022	-
Test	*	*	NS
CV%	5.62	11.64	37.003

[a-c] Values with different letters within a column are significantly different at 5% level of significant (i.e., $p<0.05$). SEM=Standard error of mean, CD=Critical difference, CV=Coefficient of variance, NS=Not significant, TN=Total nitrogen, NCN=Non-casein nitrogen, NPM=Non-protein nitrogen

Non-casein nitrogen (NCN) contentand non-protein content of all the milk samples were determined using Rowland's analytical scheme for nitrogen fractions of milk as described in a laboratory manual on chemical analysis of milk protein byKumar et al, 2012.

Selected mineral content of milk

The selected mineral content of Sangamneri goat, Nimari cow, and Surti buffalo milk is mentioned in Table 1.13. The values of calcium content ranged between125.2 to 138.5 mg/100 ml with a mean value of131.8 mg/100 ml in milk samples of Sangamneri goat. Similarly, in Nimari cowmilk, range of calcium was 112.5 to 134.8 mg/100 ml with a mean value of 123.6 mg/100 ml. Onthe other hand, calcium content ranged between164.8 to 182.7 mg/100 ml with a mean value of173.7 mg/100 ml in Surti buffalo milk. The calcium contentof buffalo milk was statistically higher than that of the goat milk as well as cow milk. The differences in calcium content in milk samples of goat and buffalo as well as in milk samples of cow and buffalo were highly significant ($p<0.001$) while calcium content values of goat and cow milk differ from each other at $p<0.05$.

Table 1.13: Calcium, Magnesium, Phosphorous and Chloride content in milk samples of goat, cow and buffalo.

Milk source	Calcium (mg/100ml)	Magnesium (mg/100ml)	Phosphorous (mg/100ml)	Chloride (%)
Goat (G)	131.8 ± 8.32 (125.2 to 138.5)	18.72 ± 1.56 (17.27 to 20.18)	94.85 ± 11.32 (80.21 to 109.5)	0.11± 0.04 (0.09 to 0.13)
Cow (C)	123.6 ± 5.68 (112.5 to 134.8)	13.41 ± 2.14 (11.58 to 15.24)	87.26 ± 9.02 (75.96 to 98.57)	0.12 ± 0.02 (0.10 to 0.14)
Buffalo (B)	173.7 ± 6.89 (164.8 to 182.7)	17.79 ± 1.94 (15.47 to 20.12)	106.9 ± 9.02 (92.33 + 121.5)	0.12 ± 0.03 (0.11 to 0.13)
Significance				
G v/s C milk	*	**	*	*
G v/s B milk	***	n.s.	**	*
C v/s B milk	***	**	***	n.s.
Significance: *** p<0.001 **= p<0.01 * p<0.05 n.s. p>0.05				
Each figure is Mean ± Standard Deviation of 6 observations. n.s. =non-significant. Figures in bracket are range of parameters.				

The magnesium contents in milk samples of Sangamneri goat fluctuated between 164.8 to 182.7 mg/100 ml with a mean value of 18.72 mg/100 ml. Similarly, in Nimari cow milk, range of magnesium was 164.8 to 182.7 mg/100 ml with a mean valueof 13.41 mg/100 ml. On the other hand, magnesium content fluctuated between 15.47 to 20.12 mg/100 mlwith a mean value of 17.79 mg/100 ml in buffalomilk. These results are in accordance with Kapadiya et al (2016). The magnesium content of goat milk was significantly higher than that of the Nimari cow and Surti buffalo milk.The differences in magnesium content in milk samples of goat and cow as well as cow and buffalo milk were significant at $p<0.01$ level, while there no significant different in calcium content values of goat and buffalo milk samples ($p>0.05$).

In relation to range of phosphorous content in the milk samples of Sangamneri goat were 80.21 to 109.5mg/100 ml with a mean value of94.85 mg/100 ml. While in milk samples of Nimari cow, phosphorous content fluctuated between 75.96 to 98.57mg/100 ml witha mean value of 106/9 mg/100 ml in Surti buffalo milk.The mean value of phosphorous content in Surti buffalo milk was significantlyhigher than that of the Sangamneri goat and Nimari cowmilk. The differences in phosphorous content in milk samples of goat and cow

were significant at $p<0.05$ level, in milk samples goat and buffalo were significant at $p<0.01$ and in milk samples of cow and buffalo were highly significant at $p>0.001$.

The values of chloride content in the milk samples of Sangamneri goat were fluctuated between0.09 to 0.13% with a mean value of 0.11% in goatmilk. Similarly, in Nimari cow milk, range of chloride was0.10 to 0.14% with a mean value of 0.12%. On the otherhand, chloride content ranged between 0.10% and0.12% with a mean value of 0.12% in Surti buffalo milk.The chloride content of goat milk samples were significantly higher ($p<0.05$) than that of the cow and buffalo milk samples, while there in no significant difference ($p>0.05$) in chloride content of cow and buffalo milk samples. These results differed from the findings of Kapadiya et al (2016), which might be due to differences in species and environmental conditions including physiochemical parameters of water used for cattle (Guzeler et al., 2010). Asif and Usman (2010) compared the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep and recorded higher levels of physicochemical parameters in buffalo and sheep milk than cow and goat. They noted comparatively higher values of specific gravity, titratable acidity, ash and protein content in sheep than that in buffalo milk but the estimated values of pH, total solids, fat and lactose in sheep milk were lower than that in milk samples of buffalo in addition to findings that all tested parameters were similar in cow and goat milk except ash which was higher in milk samples of goat under study.

IV. Conclusion

Milk samples of Surti Buffalo had higher pH, titratable acidity, total solids, solid not-fat (SNF), ash, fat, protein, lactose, total Nitrogen and some selected minerals viz., Calcium, Phosphorous and Chloride content than Nimari cow and Sangamneri goat. Whereas Sangamneri goat milk samples were having higher water and magnesium content than that of milk samples collected from Nimari cow and Surti buffalo.

The results of the present part of investigation help to conclude that milk of Surti buffalo was rich source of macro nutrients (fat, protein, lactose and selected minerals than that of Nimari cow milk. Surti buffalo milk was more energetic, than that of milk of Nimari cow and Sangamneri goat.

References

[1]. A.P.H.A. Standard Methods for the Examinations of Dairy Products, 12t h Ed. American Public Health Association. Inc.1967. N.Y., USA

[2]. Abdelgawad, A.R., B. Guamis & M. Castillo. Using a fiber optic sensor for cutting time prediction in cheese manufacture from a mixture of cow, sheep and goat milk. *Journal of Food Engineering* 2014.125: 157-158 (2014).

[3]. Ahmad, I.S. Gaucher, F. Rousseau, E. Beaucher,M. Piot, J.F. Grongnet & F. Gaucheronl. Effects of acidification on physico-chemical characteristics of buffalo milk: a comparison with cow's milk. *Food Chemistry*.2008.106: 11-17.

[4]. AOAC, Official Methods of Analysis International, 17th Ed. 2000..AOAC, Washington, DC

[5]. Arora R., N. Bhojak and R. Joshi. Comparative Aspects of Goat and Cow Milk. 2013.Vol. 2 Issue 1,p.07-10

[6]. Asif Mahmood and Sumaira Usman. A comparative study on physicochemical parameters of milk samples collected form buffalo, cow, goat and sheep of Gujrat, Pakistan. P.J.of Nutrition.2010.9 (12) 1192-1197.

[7]. Aware A.M. and U.A. Kshirsagar (Belorkar) Design of Milkotester for Fat and CLR Measurement using Arduino Microcontroller. 2017 .Vol. 4, Issue 5.1-5.

[8]. Babayan, V.K. Medium chain length fatty acid esters and their medical and nutritional application. *J. Am. Oil Chem. Soc*., 1981. 59: 49-51

[9]. BAHS, Basic Animal Husbandry Statistics. *Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India*. 2014

[10]. Bhatia, A; Bhojak, N. and Gakkhar, N. Comparative Study on Physicochemical Properties of Various Milk Samples. Intern'l J.of Recent Sci. Res. 2015. (6) pp: 4436-4439

[11]. Bhosale S.S., P.A.Kahate, K.Kamble, V.M.Thakare and S.G.Gubbawar. Effect of lactation on physico-chemical properties of local goat milk. Vet.World, 2009. 2:17-19.

[12]. Boros, V., Herian, K. and Krcal, Z. Variations in mineral content of goat milk during lactation. *Prum. Potravin* 1989. 40: 312-314.

[13]. Buffington D.E, Collazo-Arochu A, Canton H.H, Pritt D, Thatcher W.W, Collier R.J. Black globe-humidity index (BGHI) as comfort equation for cows. *Trans. Am. Soc. Agric. Eng.* 1981, 34:711.

[14]. Chand R. and S.S. Raju. Livestock Sector Composition and Factors Affecting Its Growt.Ind. Jn. of Agri. Econ.2008. Vol. 63,198-210

[15]. Chander Mahesh, Triveni Dutt, R K Ravikumar and B Subrahmanyeswari. Livestock technology transfer service in India: A review. Indian J of Animal Sci. 2010 Vol 80 (11): 1115–25.

[16]. Costa, A., Lopez-Villalobos, N., Sneddon, N.W., Shalloo, L., Franzoi, M., De Marchi, M., & Penasa M. Invited review: Milk lactose – Current status and future challenges in dairy cattle. *Journal of Dairy Science*, 2019 *102*, 5883-5898.

[17]. Dadasaheb Navale, Shelley Gupta Comparative Study of Buffalo Milk and Cow Milk Samples Containing Reducing Sugar and Solid Not Fat 2016. *Intern'l J of Latest Tech in Engineering*, Manag't & App Sci. 2016 Volume V, Issue V, Page 36

[18]. Dash S, Chakravarty A.K, Sah V, Jamuna V, Behera R, Kashyap N, Deshmukh B. Influence of temperature and humidity on pregnancy rate of Murrah buffaloes. *Asian-Aust. J. Anim. Sci.* 2015; 28(7):943–950.

[19]. Dash S. *Genetic evaluation of fertility traits in relation to heat stress in Murrah buffaloes.* Karnal, Haryana, India: M.V.Sc. Thesis, ICAR-NDRI (Deemed University); 2013.

[20]. Dash S., A. K. Chakravarty, A.Singh, A.Upadhyay, M. Singh and S. Yousuf. Effect of heat stress on reproductive performances of dairy cattle and buffaloes: A review. 2016 Veterinary World, EISSN: 2231-0916 Vol.9. P.234-244.

[21]. Davies, D.T. and White, J.C.D. The determination ofcalcium and magnesium in milk and milk diffusate. *J. Dairy Res.*, 1962.29: 285-296.

[22]. Delgado C. Rising demand for meat and milk in developing countries: implications for grasslands-based livestock production. In *Grassland: a global resource* (ed. McGilloway D. A.), 2005. pp. 29–39 The Netherlands: Wageningen Academic Publishers.

[23]. Desjeux, T.F. Nutritional value of goat's milk. *Lait*, 1993.73(5): 573-580.

[24]. Emanuelson Ulf, Karin Sjöström and Nils Fall.Biosecurity and animal disease management in organic and conventional Swedish dairy herds: a questionnaire study. *Acta Vet Scand*.2018. 60:23.

[25]. FAO 2010: Food and agriculture organization of the United Nations statistical databases.

[26]. Fassio, F., Facioni, M.S., & Guagnini, F. Lactose maldigestion, malabsorption, and intolerance: A comprehensive review with a focus on current management and future perspectives. *Nutrients*, 2018.*10*, 1599-1610.

[27]. Fiske, C.H. and Subbarow, Y. The colorimetric determination of phosphorous. *J. Biol. Chem.*, 1925. 66(2): 375-400.

[28]. Garcia-Ispierto I, Lopez-Gatius F, Bech-Sabat G, Santolaria P, Yaniz J.L, Nogareda C, De Rensis F, Lopez-Bejar M. Climate factors affecting conception rate of high producing dairy cows in northeastern Spain. *Theriogenology*. 2007;67:1379–1385.

[29]. Garry AW, Chritine M, Bruhn JM Reported adoption of dietary fat and finer recommendations among consumers. *J Ame Dietetic Assoc*. 2000.100: 52-8.

[30]. Gaughan J.B, Mader T.L, Holt S.M, Lisle A. A new heat load index for feedlot cattle. *J. Anim. Sci*. 2008; 86:226–234.

[31]. Getaneh G, Mebrat A, Wubie A and Kendie H Review on Goat Milk Composition and its Nutritive Value.*J. of Nutrition and Health Sci*. 2016.Vol.3 (4), p.1-10.

[32]. Ghada Z. A. Soliman Comparison of Chemical and Mineral Content Of Milk from Human, Cow, Buffalo, Camel and Goat in Egypt. 2005. Vol., 21: 116 – 130.

[33]. Gudev D, S. Popova-Ralcheva, P. Moneva, Y. Aleksiev, T. Peeva, Y. Ilieva, P. Penchev. Effect of heat-stress on some physiological and biochemical parameters in buffaloes.2007. *Italian Journal of Animal Science*, 6:sup2, 1325-1328.

[34]. Guzeler, N., Say, D. and Kaçar, A. Compositionalchanges of Saanen X Kilis goats' milk during lactation. 2010. *GIDA*, 35(5): 325-330.

[35]. Habeeb, A. A. M., A. E. Gad, A. A. EL-Tarabany and M. A. A. Atta. Negative Effects of Heat Stress on Growth and Milk Production of Farm Animals.Journal of Animal Husbandry and Dairy Science 2018. Vol.2, Issue 1, PP 1-12.

[36]. Haenlein, G.F. Producing quality goat milk. *Int. J. Anim. Sci.*, 1993.8: 79-84.

[37]. Hahn G.L, Mader T.L, Eigenberg R.A. Perspectives on development of thermal indices for animal studies and management. *Proceeding Symposium. Interactions between Climate and Animal Production. EAAP Technical Series No. 7*. 2003:31–44.

[38]. Hahn, G.L., Mader, T.L. and Eigenberg, R.A. Perspectives on development of thermal indices for animal studies and management. In: Proceeding Symposium. Interactions between Climate and Animal Production. EAAP Technical Series No. 7; 2003.p31-44.

[39]. Hammer, B.W. and Bailey, D.E. A rapid volumetric method for approximate estimation of chloride in milk. Research Bulletin No. 41. 1917. Agricultural Experiment Station Iowa State College of Agriculture and Mechanic Arts.

[40]. Harris B. and K.C. Bachman Nutritional and Management Factors Affecting Solids-Not-Fat, Acidity and Freezing Point of Milk. Original publication. University of Florida.1988. Reviewed June 2003.DS25, 1-5.

[41]. Imran M., Khan H.,Hassan S.S. and R.Khan. Physiochemcial characteristis of various milk samples available in Pakistan. 2008. J.Zhejiang Uni.Sci.B, 9:546-551.

[42]. Indu S.and Pareek A. A Review: Growth and Physiological Adaptability of Sheep to Heat Stress under Semi –Arid Environment. 2015 *Intern' J of Emerging Trends in Sci and Tech*.Vol 2 (9)p.3188-3196

[43]. James, C.S. Determination of fat content of dairy products by the Gerber method. Analytical chemistry of food. Blacki Academic and Professionals, an imprint of Champan and Hall, Glasgow, UK. 1995.Pp: 93-95.

[44]. Javaid SB, Gadahi JA, Khaskeli M, Bhutto MB, Kumbher S, Panhwar AH. Physical and chemical quality of market milk sold at healthline .Tandojam, Pakistan. 2009 Vet. J. 29(1): 27-31.

[45]. Kanwal Rashida, Toqeer Ahmed, Bushra Mirza. Comparative Analysis of Quality of Milk Collected from Buffalo, Cow, Goat and Sheep of Rawalpindi/Islamabad Region in Pakistan. 2004. *Asian Journal of Plant Sciences* ISSN : 1812-5697

[46]. Kanwal, R, T. Ahmad and B. Mirza. Comparative analysis of quality of milk collected from buffalo, cow, goat and sheep of Rawalpindi/Islamabad region in Pakistan. *Asian J. Plant Sci*. 2004.3(3):300-305.

[47]. Kapadiya D. B. Darshna B. P., Amit K. Jain, Bhavbhuti M. M. Comparison of Surti goat milk with cow and buffalo milk for gross composition, nitrogen distribution, and selected minerals content. 2016. *Veterinary World*, EISSN: 2231-0916 Vol.9.p.710-716.

[48]. Khan F.A, Prasad S, Gupta H.P. Effect of heat stress on pregnancy rates of crossbred dairy cattle in Terai region of Uttarakhand, India. *Asian Pac. J. Reprod*. 2013; 2(4):277–279.

[49]. Kris H.K. The history of domestication of goats. *J Archaeolo Sci* 2008.28: 61-79.

[50]. Kumar A. and Ambika Sharma Nutritional and Medicinal Superiority of Goat Milk over Cow Milk in Infants. *International Journal of Pediatric Nursing* 2016 .Vol 2 Number 1, 47-50

[51]. Kumar R., Sangwan, R.and Mann,B. ALaboratory Manual on Chemical Analysis of Milk Protein. National Dairy Research Institute, Karnal, India.2012.p27-29.

[52]. Liesel Laubscher and Louwrens Hoffman An Overview of Disease-Free Buffalo Breeding Projects with Reference to the Different Systems Used in South Africa. *Sustainability*, 2012.4, 3124-3140

[53]. Lopez, A., Collins, W.F. and Williams, H.L. Essential elements, cadmium and lead in raw and pasteurized cow and goat milk. *J. Dairy Sci.*, 1985.68(8): 1878-1886.

[54]. Maddison *The world economy: historical statistics*. 2003 Paris, France.

[55]. Mahboba I.A.A. and I.E.M. El Zubeir. The compositional quality of raw milk produced by some dairy cow's farms in Khartoum state, Sudan.2007.*Res.J.Agri.Bio.Sci*. 3, 902-906.

[56]. Mahmood, A. and Usman, S. A comparative study on the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep of Gujarat, Pakistan. *Pak. J. Nutr*., 2010. 9(12): 1192-1197.

[57]. Marta Hernández-Jover, Lynne Hayes, Robert Woodgate, Luzia Rast and Jenny-Ann L. M. L. Toribio Animal health management practices among smallholder livestock producers in Australia and their contribution to the surveillance system. *Front. Vet. Sci*., 2019. Vol 6 Article 191.p.1-14.

[58]. McCarthy O.J. Physical and Physico-Chemical Properties of Milk, Massey University, Palmerston North, New Zealand 2002 Elsevier Ltd.

[59]. McGowan M.R, Mayer D.G, Tranter W, Shaw M, Smith C, Davison T.M. Relationship between temperature humidity index and conception efficiency of dairy cattle in Queensland. *Proc. Aust. Soc. Anim. Prod*. 1996;21:454.

[60]. Merin, U., Rosenthal, I. and Maltz, E. The composition of goat milk as affected by nutritional parameters. *Milchwissenschaft*, 1988.43(6): 363-365.

[61]. Morton J.M, Tranter W.P, Mayer D.G, Jonsson N.N. Effect of environmental heat on conception rates in lactating dairy cows: Critical periods of exposure. *J. Dairy Sci.* 2007; 90:2271–2278.

[62]. Muhammad Salman, Muhammad Khaskheli, Israr-Ul-Haq, Aisha Rahman Talpur. Comparative studies on nutritive quality of buffalo and cow milk. *International Journal of Research in Applied, Natural and Social Sciences* Vol. 2, Issue 12, Dec 2014, 69-78

[63]. NDRI Vision 2030. Karnal, Haryana, India: National Dairy Research Institute;

[64]. Pandya, A.J. and K.M. Ghodke. Goat and sheep milk products other than cheeses and yoghurt. *Small Ruminant Research.* 2007. 68: 193-206.

[65]. Park, Y.W., M. Juarez, M. Ramosc & G.F.W. Haenlein. Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Research*. 2007. 68: 88-113.

[66]. Perry B. and Grace D. The impacts of livestock diseases and their control on growth and development processes that are pro-poor. *Phil. Trans. R. Soc*..B 2009. 364, 2643–2655.

[67]. Philip K. Thornton. Livestock production: recent trends, future prospects. *Phil. Trans. R. Soc*. B 2010. 365, 2853–2867

[68]. Purohit P.B., J. P. Gupta, J. D. Chaudhari, T. M. Bhatt, M. M. Pawar. Effect of Heat Stress on Production and Reproduction Potential of Dairy Animals Vis-À-Vis Buffaloes *International Journal of Livestock Research*. 2020. Vol 10(3) p.1-23.

[69]. Rasheed S., I. M. Qazi, I.Ahmed , Yasser D. and Z. Azmat Comparative Study of Cottage Cheese Prepared from Various Sources of Milk. Proceedings of the Pakistan Academy of Sciences: *Pakistan Academy of Sciences B. Life and Environmental Sciences*.2016. 53 (4): 269–282.

[70]. Ravagnolo O, Misztal I. Effect of heat stress on non return rate in Holsteins: Fixed-model analyses. *J. Dairy Sci.* 2002; 85:3101–3106.

[71]. Ravindra Kumar, Sushil Prasad and Pravin Kumar. Role of information technology in livestock development in India – an overview.*Progressive Research* 7 (Special).2012: 9-13.

[72]. Rincon, F., Moreno, R., Zurera, G. and Amaro, M. Mineral composition as a characteristic for the identification of animal origin of raw milk. *J. Dairy Res.*, 1994.61(1):151-154.

[73]. Rosegrant M. W. Looking into the future for agriculture and AKST (Agricultural Knowledge Science and Technology). In *Agriculture at a crossroads* (eds McIntyre B. D., Herren H. R., Wakhungu J., Watson R. T.), 2009.pp. 307–376 Washington, DC

[74]. Sahin A., A. Yildirim and Z. Ulutaş¸Some Physicochemical Characteristics of Raw Milk of Anatolian Buffaloes. *Italian. J. Food Sci*., 2014.vol. 26 –p.398-404.

[75]. Saini, A.L. and Gill, R.S. Goat milk: An attractive alternate. *Indian Dairyman*, 1991.42: 562-564.

[76]. Salman M, M.Khaskheli, Israr-Ul-Haq, A. R. Talpur,A. P. Khuhro, M. Rauf, H. Hamid and Atif A. Comparative Studies On Nutritive Quality Of Buffalo And Cow Milk. *International Journal of Research in Applied, Natural and Social Sciences*. 2014. Vol. 2, Issue 12, 69-78.

[77]. Schillings Juliette, Richard Bennett and David Christian Rose. Exploring the Potential of Precision Livestock Farming Technologies to Help Address Farm Animal Welfare. *Front. Anim. Sci.*, 2021.Vol 2.Article 639678 p. 1-17

[78]. Schuller L.K, Burfeind O, Heuwieser W. Impact of heat stress on conception rate of dairy cows in the moderate climate considering different temperature humidity index thresholds, periods relative to breeding, and heat load indices. *Theriogenology*. 2014; 81:1050–1057.

[79]. Serap Göncü and Cahit Güngör. The Innovative Techniques in Animal Husbandry, Animal Husbandry and Nutrition. 2018. *IntechOpen*, DOI: 10.5772/intechopen.72501.

[80]. Silanikove, N., Leitner, G., & Merin, U. The interrelationships between lactose intolerance and the modern dairy industry: Global perspectives in evolutional and historical backgrounds. *Nutrients*, 2015. *7*, 7312-7331.

[81]. Sreedhar S., Suresh Babu D. Milk Constituents and Microbial Analysis of Mixed Milk Samples in Rural Areas. *Ind J of Vet Research*.2009; 18(2):31-36.

[82]. Steinfeld H., Gerber P., Wassenaar T., Castel V., Rosales M., de Haan C.2006 *Livestock's long shadow: environmental issues and options.* Rome, Italy

[83]. The Food Safety and Standards Act, 2006 –Accessed from www.drugscontrol.org/ on 19 May, 2012

[84]. Thiruvenkadan A.K, Panneerselvam S, Rajendran R, Murali N. Analysis on the productive and reproductive traits of Murrah buffalo cows maintained in the coastal region of India. *Appl. Anim. Husb. Rural Dev.* 2010; 3:1–5.

[85]. Thom E.C. The discomfort index. *Weatherwise*. 1959; 12:57–59.

[86]. UNFPA (United Nations Population Fund) 2008 The State of World Population 2007: unleashing the potential of urban growth. United Nations Population Fund.

[87]. UNPD (United Nations Population Division) 2008 The 2006 revision and world urbanization prospects: the 2005 Revision. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects.

[88]. Van Vuuren D. P. Outlook on agricultural change and its drivers. In *Agriculture at a crossroads* (eds McIntyre B. D., Herren H. R., Wakhungu J., Watson R. T.), 2009.pp. 255–305 Washington, DC

[89]. Vishweshwar, S.K and N. Krishnaiah. Food and nutritive value of milk. Quality control of milk and processing, State Institute of Vocational Education Director of Intermediate Education Govt. of Andhra pradesh, India, 2005. p. 10.

[90]. World Bank. *Minding the stock: bringing public policy to bear on livestock sector development*. Washington, DC: 2009. Report no. 44010-GLB.

[91]. Zicarelli, L. Buffalo milk: its properties, dairy yield and mozzarella production. Veterinary Research Communications.2004. 28:127-135. 34.

Shubhi Mishra, et. al. "Comparative study on nutritive properties and composition of milk of Sangamneri Goat, Nimari Cow and Surti Buffalo." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 15(01), 2022, pp. 17-30.