

**“COMPARATIVE STUDY OF PHYSICO-CHEMICAL PROPERTIES OF MILK OF DIFFERENT DOMESTICATED COW, BUFFALO AND GOAT BREEDS FROM SOUTH-WEST PART OF KARJAT TEHSIL, AHMEDNAGAR DISTRICT, M.S., INDIA”**

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**ABSTRACT:**

The milk is a nutrient rich liquid food produced by mammals in their mammary glands. The milk serves as a primary food for the young ones and as a food supplement for the adults. In human beings, the use of milk had found nearly about 9000 BC to 7000 BC. The first milk used was of cattle, goat and sheep. In India, the first reared cattle were supposed to be of Zebu breed almost 8000 years ago. It was completely domesticated for obtaining milk. The milk quality can be assessed by measuring its different parameters like pH, water %, fat, SnF, total proteins, specific gravity, somatic cell count, casein protein, lactose content, ash content, minerals and other vitamins content, etc. These parameters vary with the habitat, food and feeding habits, type of barn, no. of calving, milking period, etc. In the present study, different physico-chemical parameters (temperature, pH, fat, SnF, total protein and specific gravity) of milk of buffalo, cow and goat (2 breeds each) was tested to assess the differences within themselves. Present study was carried out from March 2022 to April 2022 to compare the various physico-chemical parameters of milk. The selected sampling sites for milk collection were Karjat (S1), Kuldharan (S2), Rashin (S3) and Khed (S4). These sites show much variation in overall climate, domestication methods and food material hence the physico-chemical parameters show changes among them.

**Keywords:** Milk, Karjat Tehsil, Khillar, Protein Casein, Buffalo.

**I. INTRODUCTION:**

Karjat Tehsil is situated in southern part of Ahmednagar district. This is drought prone Tehsil, lies between 18°33'04'' to 18°82'96'' latitude and 74°91'95'' to 75°21'83'' longitude. It has an area of about 1503.61 sq. km. with average height 594 m from mean sea level. Climatically Karjat Tehsil is hot and dry in general. The maximum temperature recorded in the month of May rises to about 40° C while the lowest temperature recorded in the month of January goes down to 12°C. The district is

receives an annual average rainfall of about 700 mm. Since human civilization, humans are succeeded to keep or domesticate the animals that are useful for mankind. Their byproducts like milk, meat, coat, fat, horns, etc. are useful in day to day life since its use had determined. The most common animals that are reared by humans are cow, buffalo, sheep, goat and their variant species.

India has lots of genetic variation and diversity among the cattle breeds (Shah *et al.*, 2012) that are adapted to the environment in which they survive. The buffalo that mostly domesticated in India is Asian river water buffalo. Asian water buffalo was the main milk source among Indian peoples for many years (N.G. Hegde 2019). India has nearly 34 well recognized goat breeds that are reared for meat, milk and skin purposes (Singh *et al.*, 2019). Operation Flood, initiated in India on 13 January 1970, was the world's largest dairy development program and a pioneer in the history of India's National Dairy Development Board. The program led India from 50<sup>th</sup> to the largest producer of milk in the world in just a couple of decades. To increase the milk production, various cross breeds like Holstein Frisian and Jersey were introduced meant for milk. The breeds of cow that are popular at Karjat Tehsil are Gir, Sehwal, Khillari, Holstein Friesian and Jersey. Similarly in buffalo; Murrah and Pandharpuri and in goat: Beetal, Osmanabadi, Surti, Kathiyawadi, Jamanpari and Boer.

The milk is very rich in various nutrients that are needed for animals, including humans for the normal body function (Gakkhar *et al.*, 2015). Goat milk is rich in various nutritional factors like proteins, vitamins (E and C), flavonoids and carotenoids having antioxidant properties. Hence goat milk helps to protect consumers from exposure to oxidative stress, which occurs in many acute and chronic diseases (Dalle *et al.*, 2006; Valko *et al.*, 2007). Due to short shelf life, the milk is converted to its processed products like cheese, whey which has higher nutritional value important for normal physiological activities of human body like blood pressure, immunity, inflammatory actions (Athira *et al.*, 2015).

The quality of milk sample can be checked by measuring its physical properties like specific gravity, temperature and pH and chemical composition like protein casein, fat, SnF, lactose, water percentage, somatic cell count etc. using automated milk scan machines like Milkoscan and various other manual techniques (Balbin *et al.*, 2019). The focus of this study is to assess and compare some of the physicochemical properties of milk samples obtained from mostly reared species of buffalo, cow and goat from Karjat Tehsil, MH, India.

Murrah buffalo is breed of water buffalo having origin at Haryana and Punjab, India. They are purely black in color, sometimes having white haired patch on face, legs. They typically show short and tightly curved horns. Pandharpuri buffalo is also a breed of water buffalo from Solapur, Satara, Sangli and Kolhapur, India. The name it got comes from the city Pandharpur in Solapur district from where it was originated. This buffalo shows characteristic very long horns almost about the half of the length of the animal, sometimes more. They are also black in colour.

Khillar cow is a breed of *Bos indicus* native to Satara, Kolhapur and Sangli district of Maharashtra, India. Its variants are also found native of Vijapur, Dharwad and Belagavi districts of Karnataka, India. The characteristic features include tall, tight, stout legs. They are slimmer than other milking cow breeds. They are mostly white but some variants are pure black in color. Horns are straight, long, sometimes make a characteristic bow shape and originate on narrow forehead. Holstein Friesian is a cattle breed native to North Holland and Friesland. This breed is dominant in worldwide dairy industries. Coat is typical black-white showing piebald fashion. Rarely it exhibits red-white or red-black coat also. This coat color shows co-dominance. Hf cow shows horns. There is a trend of de-horning these cattle. they are short and curvy making bow.

Osmanabadi goat is native to Maharashtra. They mainly found in Osmanabad, Ahmednagar, Latur, Parbhani, Solapur and other areas of Maharashtra, India. Besides that Andhra Pradesh, Telangana and Karnataka states of India also has well known population of this breed. Most of the times the goat has black coat but it also shows white, brown, spotted coat. The horns are straight, short and curved or bowed. This breed is famous for its good taste of milk as well as meat. Beetal goat is native to Punjab, India. It is also parallel and famous as Osmanabadi Goat for milk and meat. The characteristic long ears are hanging like pendulums and the nasal bones are sturdy, showing a typical curve called roman nose. The horns are very close to back side of forehead and curved backwards. They are distinctly tall. The coat or skin is famous for leather quality.

## **II. MATERIALS AND METHODS:**

### **Study Area:**

The milk samples were collected from four sampling sites, abbreviated as S1 (Karjat), S2 (Kuldharan), S3 (Rashin) and S4 (Khed) for two months i.e. March and April of the year 2022. The geographical coordinates were S1 (18.5522° N, 75.0101° E), S2 (18.5362° N, 74.8646° E), S3 (18.4377° N, 74.9238° E) and S4 (18.3814° N, 74.8171° E).

Sterilized bottles were used to collect the fresh milk samples from two species each of Buffalo, Cow and Goat (Mahmood *et al.*, 2010). The different physico-chemical parameters of collected milk samples were depicted by using various methodologies (Kumbhar and Mhaske 2019) Table:1.

## **III. RESULTS AND DISCUSSION:**

**Temperature** of the milk samples was taken just after it was withdrawn from mammary. The observed values ranges between 33<sup>0</sup>C to 35<sup>0</sup>C for buffalo breeds; 33<sup>0</sup>C to 38<sup>0</sup>C for cow breeds and 26<sup>0</sup>C to 34<sup>0</sup>C for goat breeds. The minimum temperature 26<sup>0</sup>C for Beetal goat breed was recorded at Khed (S4) (Table: 2, Fig.2). The maximum temperature was found for the HfX breed i.e.38<sup>0</sup>C at Karjat (S1) (Table: 2, Fig.2). The mean temperature of milk samples during entire study period was observed as 33.95<sup>0</sup>C ± 0.69282 for buffalo breeds, 34.85<sup>0</sup>C ± 1.899624 for cow breeds and 30.4125<sup>0</sup>C ± 3.449405 for goat breeds. It was observed that, milk temperature was slightly lower than normal body temperature in all selected breeds.

**pH** of milk samples was measured as soon as the sample collected. The pH values ranges between 6.35 to 6.86 for breeds of buffalo; 6.33 to 6.77 for breeds of cow and 6.40 to 6.59 for breeds of goat. The minimum pH 6.33 was recorded for milk of cow breed HfX at Khed (S4) (Table: 2, Fig.2). The maximum pH i.e. 6.86 was recorded for buffalo breed Murrah milk at Kuldharan (S2) (Table: 2, Fig.2). The average values of pH observed were  $6.62875 \pm 0.191269$  for buffalo milk,  $6.58125 \pm 0.128779$  for cow milk and  $6.51125 \pm 0.066427$  for goat milk. The results are in much resemblance with findings of Mahmood and Usman (2010). The results obtained were in line with Braun and Stefanie (2008). The pH values of cow and goat breeds shows accordance with the pH values of goat and cow milk found out by Legesse *et al.*, (2017). The pH values found out by Imran *et al.*, (2008) corresponds with the respective range of pH findings. pH values of cow are commensurate with findings of Kanwal *et al.*, (2004) and Enb *et al.*, (2009) and Elbagermi *et al.*, (2014).

**Fat** of milk samples was measured in lab using Indifoss Milkoscreen in lab. The values for buffalo breeds ranges between 4.30% to 9.87% for Buffalo breeds; 3.09% to 6.20% for cow breeds and 1.46% to 8.39% for goat breeds. The recorded readings clearly indicate the % of fat for Pandharpuri buffalo was relatively more as compared to % of fat for Murrah buffalo. Similarly the % of fat for Khillar cow breed was relatively more than % of fat for Hf crossbreeds. The % of fat was lower in Beetal goat than in Osmanabadi goat. The minimum % of fat was seen for the Beetal goat milk i.e. 1.46% at Karjat (S1) (Table: 2, Fig.2). The maximum % of fat i.e. 9.87% was recorded for the milk of Pandharpuri buffalo at Kuldharan (S2) (Table: 2, Fig.2). The mean value for % of fat observed during current research study was  $6.64875 \pm 1.703026$  for milk of buffalo,  $4.2325 \pm 1.068373$  for cow milk and  $4.88375 \pm 2.494748$  for milk of goat. The fat content of buffalo milk was found much higher than cow and goat milk; the same was found out by Mahmood and Usman (2010). The % of fat for cow was found higher than above range by Elbagermi *et al.*, (2014). The values recorded were in line with Kanwal *et al.*, (2004). The % of fat was found much similar for cow and buffalo by Kapadiya *et al.*, (2016); similar results were obtained by Ibrahim *et al.*, (2018).

**SnF** i.e. solid no fat of milk samples was measured by using Indifoss Milkoscreen in lab. The values for buffalo breeds ranges between 7.65% to 10.21%; 7.34% to 9.64% for cow breeds and 8.22% to 10.99% for goat breeds. The lowest reading of % of SnF was found for HfX milk (7.34%) at Karjat (S1) (Table: 2, Fig.2). The highest reading of % of SnF was found for the milk of Osmanabadi goat i.e. 10.99% at Karjat (S1) (Table: 2, Fig.2). The mean values of SnF recorded during the study period was  $8.975 \pm 1.0632431$  for milk of buffalo,  $8.6725 \pm 0.716714$  for cow milk and  $9.015 \pm 0.933381$  for milk of goat breeds. The SnF values of Osmanabadi goat milk was found better than Beetal goat. The values obtained from present research work were within the range recorded by Daniela *et al.* (2008) in raw milk. Similar readings were recorded by Kapadiya *et al.*, (2016) in cow, goat and buffalo milk, Kanwal *et al.*, (2004). The mean values of % of SnF obtained by Hamiroune *et al.*, (2019) were higher for cow and similar for goat.

**Total Protein** of milk samples was measured by using Indifoss Milkoscreen in lab. The values of % of protein for buffalo breeds ranges between 2.71% to 4.54%; similarly for cow breeds it was 2.40% to 3.99% and 3.10% to 5.99% for goat breeds. The minimum % of total protein was found

2.40% for the milk of HfX at Karjat (S1) (Table: 2, Fig.2); whereas, maximum total protein was recorded 5.99% for the milk of Osmanabadi goat at Karjat (S1) (Table: 2, Fig.2). The obtained results reflects that the % of protein was somewhat higher in goat milk (especially Osmanabadi breed) than in cow and buffalo. Also, Osmanabadi goat shows higher % of total protein than Beetal goat and Khillar cow shows higher % of total protein than Hf cow. Similar values of protein % were obtained by Jaafar *et al.* (2018) but for different goat breeds. The mean values of % of total protein observed during the research work was  $3.61375 \pm 0.698119$  for buffalo milk,  $3.19875 \pm 0.590289$  for cow milk and  $4.11375 \pm 0.935413$  for goat milk. Mean values of % of total protein obtained by Mahmood and Usman (2010) were found similar to the findings of present research work. The results obtained were in line with Elbagermi *et al.* (2014) for goat and cow milk. The results were also in agreement with the findings of Imran *et al.* (2008), Strzalkowska *et al.* (2009) and Aneja *et al.* (2002).

**Specific Gravity** of milk samples was measured at 39°C temperature (Watson 1957) by using formula i.e.  $sp.gr. = (CLR/1000) + 1$ ; where CLR= corrected lactometer reading. The specific gravity of milk of buffalo breeds ranges between 1.0239 to 1.0337; 1.0251 to 1.0324 for milk of cow breeds and 1.0286 to 1.0354 for milk of goat breeds. The minimum reading of specific gravity was recorded 1.0239 for the milk of Pandharpuri buffalo at Karjat (S1) (Table: 2, Fig.2). The maximum reading of specific gravity was 1.0354 recorded for the milk of Osmanabadi goat at Karjat (S1) (Table: 2, Fig.2). The mean values of specific gravity of milk samples observed during the research work was  $1.028825 \pm 0.003649$  for buffalo milk,  $1.02965 \pm 0.002447$  for cow milk and  $1.030488 \pm 0.002215$  for goat milk. The observed differences based on different animal breeds at different sampling sites. Also, it was mostly observed that, the value of specific gravity was more for the milk sample having high value of SnF (Mahmood and Usman, 2010). The results obtained were in line with Mahmood and Usman (2010), Franciscis *et al.*, (1988). Jenness *et al.* (1974) and Jaurez and Ramos (1986).

#### **IV.CONCLUSION:**

The present study was aimed to study the physico-chemical parameters (temperature, pH, fat, SnF, total protein, casein protein and specific gravity) of milk samples from buffalo (Murrah and Pandharpuri), cow (HfX and Khillar) and goat (Osmanabadi and Beetal). It is found that temperature of the milk just withdrawn from the mammary is slightly lower than the average normal body temperature. There is slight change in pH according to the breed and change in site of collection of milk. The fat % of buffalo milk is much higher than milk of cow and goat. The Snf % is little higher in goat and buffalo milk than cow milk. The Osmanabadi goat milk has higher total protein than Beetal goat milk and other cow and buffalo milk. The specific gravity is different for different animal related with the SnF of the milk. This data could be useful for crossbreeding program so as to achieve the highly sustainable breed having good quality of milk and meat. Also these parameters directly indicate the quality of milk and are related with the diet which is provided to the milking animals.

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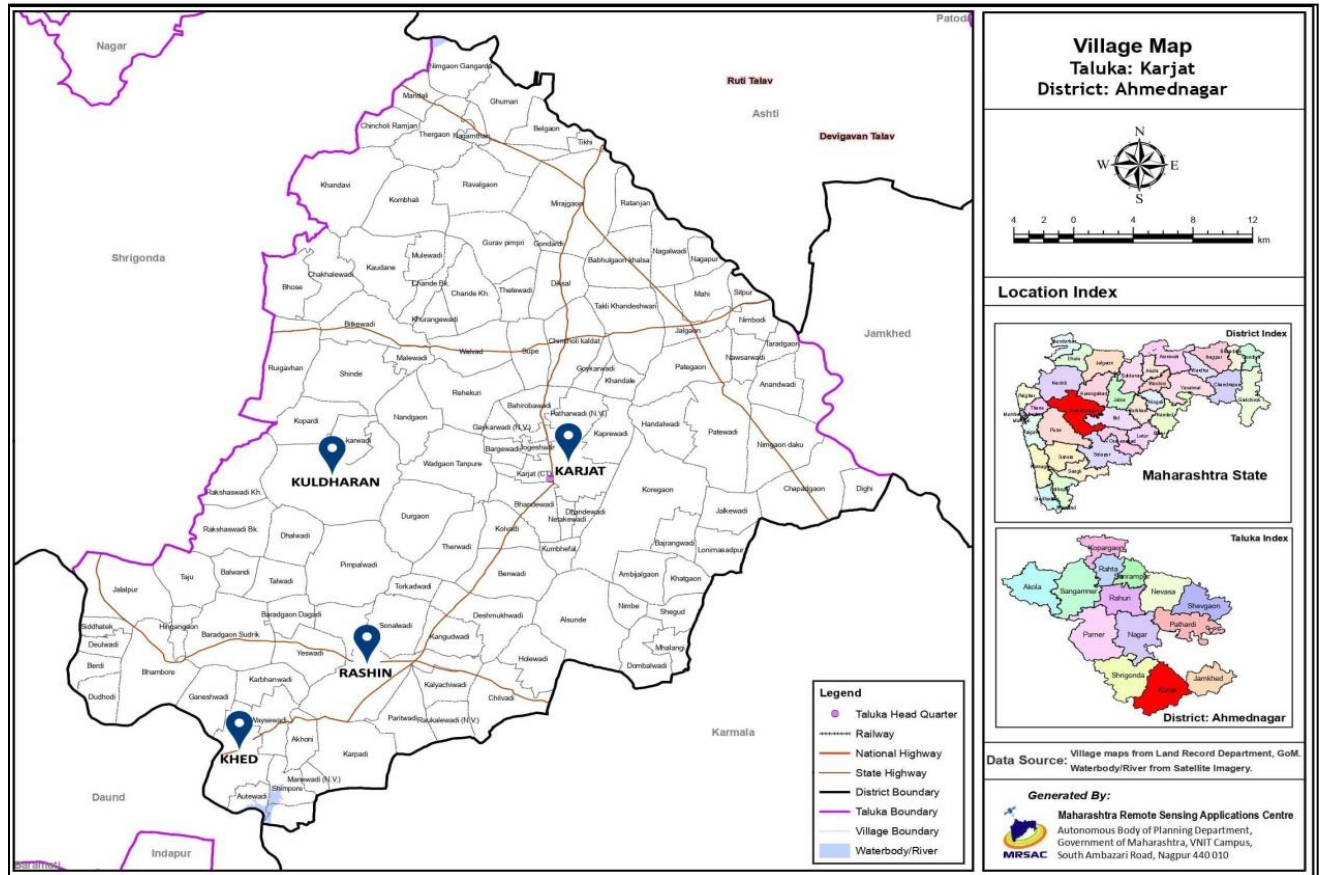
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**Fig. 1** - Location map for selected sampling sites of south-west Karjat Tehsil.

**Table 1:** Methodology used for analysis of physico-chemical parameters of milk.

Sr.No.	Parameter	Unit of measurement	Method/Instrument
1	Temperature	°Fahrenheit	Mercury Thermometer (on site)
2	pH	-	HI96107 Hanna Instruments pH meter (on site)
3	Fat	%	Indifoss Milkoscreen 60057884 (in lab)
4	SnF	%	
5	Total Protein	%	
6	Specific Gravity	-	Lactometer (in lab)

**Table 2:** Variations in physico-chemical parameters of milk samples. (**Temp.:**Temperature, **SnF:** Solid not Fat, **T. Protein:** Total Protein, **Sp. Grav.:** Specific Gravity, **SD:** Standard Deviation).

Sr.No.	Breeds	Site	Parameters					
			Temp. ( <sup>0</sup> C)	pH -	Fat (%)	SnF (%)	T.Protein (%)	Sp.Grav. -
1	<b>Murrah Buffalo</b>	<b>S1</b>	33 <sup>0</sup> C	6.84	4.30	7.65	2.71	1.0255
2		<b>S2</b>	34.3 <sup>0</sup> C	6.86	7.20	8.24	3.16	1.0254
3		<b>S3</b>	34.5 <sup>0</sup> C	6.65	7.38	9.97	4.34	1.0322
4		<b>S4</b>	35 <sup>0</sup> C	6.46	5.62	8.50	2.87	1.0278
5	<b>Pandharpuri Buffalo</b>	<b>S1</b>	34 <sup>0</sup> C	6.78	6.97	7.81	3.30	1.0239
6		<b>S2</b>	34 <sup>0</sup> C	6.46	9.87	10.18	4.17	1.0309
7		<b>S3</b>	33.8 <sup>0</sup> C	6.63	5.10	9.24	3.82	1.0312
8		<b>S4</b>	33 <sup>0</sup> C	6.35	6.75	10.21	4.54	1.0337
	<b>Mean</b>	-	33.95 <sup>0</sup> C	6.62875	6.64875	8.975	3.61375	1.028825
	<b>SD (±)</b>	-	0.69282	0.191269	1.703026	1.0632431	0.698119	0.003649
9	<b>Holstein Friesian X Cow</b>	<b>S1</b>	38 <sup>0</sup> C	6.65	3.33	7.34	2.40	1.0251
10		<b>S2</b>	33.8 <sup>0</sup> C	6.58	4.18	8.41	2.59	1.0286
11		<b>S3</b>	34 <sup>0</sup> C	6.55	3.19	8.17	2.82	1.0285
12		<b>S4</b>	36 <sup>0</sup> C	6.33	3.09	9.12	3.70	1.0324
13	<b>Khillar Cow</b>	<b>S1</b>	37 <sup>0</sup> C	6.77	4.83	8.56	3.16	1.0287
14		<b>S2</b>	33 <sup>0</sup> C	6.60	4.96	8.94	3.10	1.0301
15		<b>S3</b>	34 <sup>0</sup> C	6.66	6.20	9.64	3.83	1.0319
16		<b>S4</b>	33 <sup>0</sup> C	6.51	4.08	9.20	3.99	1.0319
	<b>Mean</b>	-	34.85 <sup>0</sup> C	6.58125	4.2325	8.6725	3.19875	1.02965
	<b>SD (±)</b>	-	1.899624	0.128779	1.068373	0.716714	0.590289	0.002447
17	<b>Osmanabadi Goat</b>	<b>S1</b>	33 <sup>0</sup> C	6.59	8.39	10.99	5.99	1.0354
18		<b>S2</b>	33.6 <sup>0</sup> C	6.49	7.97	9.21	4.50	1.0287
19		<b>S3</b>	33.7 <sup>0</sup> C	6.40	5.25	9.19	4.16	1.0309
20		<b>S4</b>	34 <sup>0</sup> C	6.58	5.92	9.44	4.61	1.0313
21	<b>Beetal Goat</b>	<b>S1</b>	28 <sup>0</sup> C	6.48	1.46	8.22	3.10	1.0302
22		<b>S2</b>	28 <sup>0</sup> C	6.57	3.87	8.45	3.69	1.0291
23		<b>S3</b>	27 <sup>0</sup> C	6.46	2.25	8.27	3.25	1.0297
24		<b>S4</b>	26 <sup>0</sup> C	6.52	3.96	8.35	3.61	1.0286
	<b>Mean</b>	-	30.4125 <sup>0</sup> C	6.51125	4.88375	9.015	4.11375	1.030488
	<b>SD (±)</b>	-	3.449405	0.066427	2.494748	0.933381	0.935413	0.002215

