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EFFECT OF GOAT BREEDS ON THE MILK COMPOSITION UNDER CLIMATIC CONDITIONS OF DAUSA TEHSIL OF DAUSA DISTRICT RAJASTHAN

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Abstract: Milk is rightly described often as near complete food in nature. It contains all five major nutrients: fat, protein, lactose (milk sugar), vitamins and minerals (salts). The aim of this study was to project the importance and significance of goat milk with special reference to Indian field and farm rearing conditions. The research was conducted at the Rukmani Devi College of agriculture, Dausa district of Rajasthan during 2021-23. The specific gravity of Jamunapari goat breed's milk was greater than that of Jakhrana animals. The overall fat per cent in the both breeds during 2021-23 of all the 1200 samples was found to be 4.68±0.021, Solids Not Fat (SNF) 8.45±0.030 per cent and total solids percentage was found to be 13.32 ± 0.035. The protein per cent during 2021-22 conditions was significantly ($p < 0.01$) greater than that of farm rearing goat milk in both the breeds. The statistical analysis also revealed that the lactose content in 2021 – 22 has significantly higher than that of 2022 -23 in Jakhrana as well as Jamunapari goat breeds at $p < 0.05$. The overall average ash content in both breed's milk during 2021-23 of all samples was found to be 0.815±0.007 per cent. Breed had conspicuous effects on the milk composition of goats.

Keywords: Goat breeds, milk composition, Dausa, Rajasthan.

INTRODUCTION

India today stands first in the area of milk production at the world level, with an annual growth rate of about 4%. The country's milk production in 2010 was estimated to be 110 million tons. A large quantity of milk produced in the country, amounting to over 46%, is being consumed as liquid milk. The production and use of animal products in the use of

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human diet is receiving tremendous attention. (Singh et al., 2012). The productive improvements among dairy animals can be made through proper management, feeding, handling, etc., which may influence the expression of productive characters as per their heritability nature. Before identifying the animals for breeding and production purposes, screening of animals shall be performed on the basis of physical traits (Singh et al., 2013). The goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling, and other environmental conditions that will influence the expression of characters, but a limit of which is set by the heredity of the individual (Singh et al., 2013b).

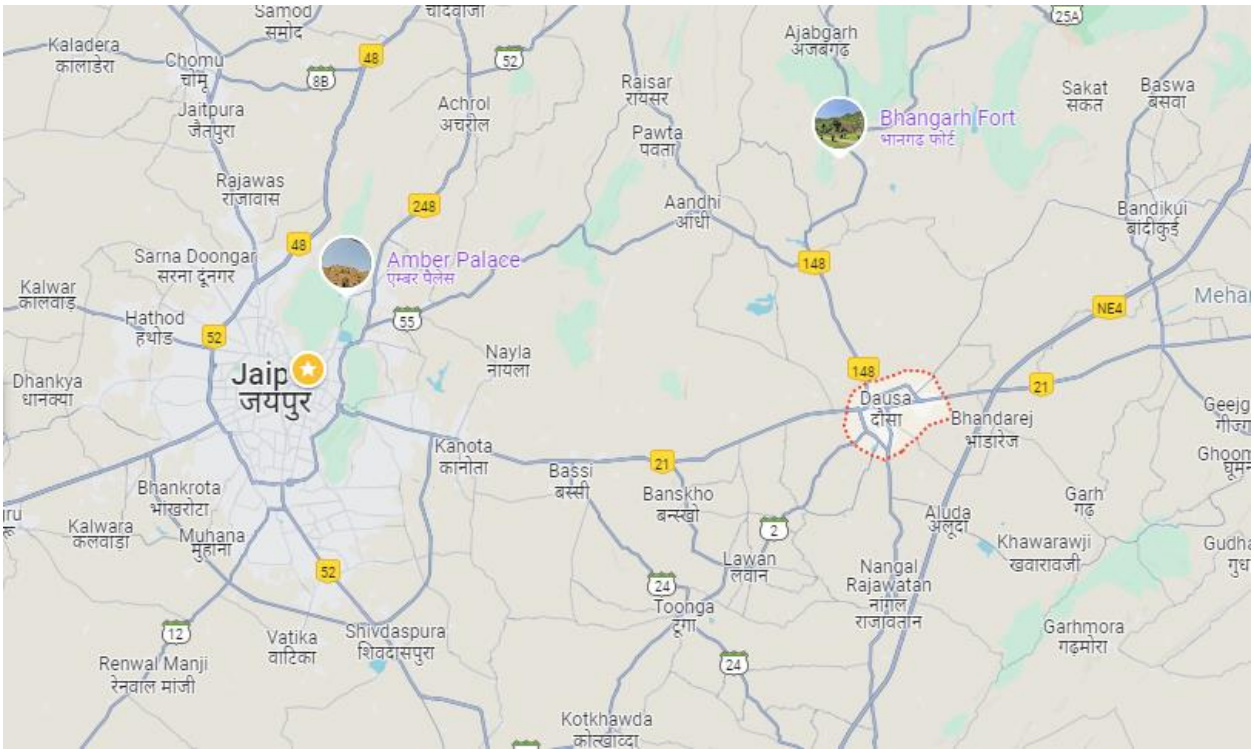

Fig. 1: Map sowing Ramgarh Pachwara tehsil of Dausa district Rajasthan

Goats are an integral part of livestock production and play a vital role in the socio-economic structure of the rural poor. There are adverse ecological and physiological constraints in the Indian system of goat farming. The goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2014). Various government and non-government organizations have also recognized the importance of dairy farming as an employment-generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh

environments (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries. Asia is home to about 60% of the total world goat population and has the largest goat breed share of 26%. Goats play a vital socioeconomic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et al., 2014c). Goats are more often poorly managed, and this is attributed to their ability to survive under harsh conditions and also because most people in rural areas rear goats for their subsistence purposes to support their families. This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et al., 2014d). Goat milk contains less lactose than cow's milk, so it is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin. The milk also has a more similar makeup (percentage of fats, etc.) to human milk than cow's milk. For these reasons, goat milk may be recommended for infants and people who have difficulty digesting cow's milk (Singh et al., 2014e). Goat meat, being a high-quality protein source, is the choicest meat in the domestic market. It is leaner than other red meats, and its fat has desirable fatty acids. The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et al., 2014f). The major population of India is primarily dependent on an agricultural-based system for their daily life, including goat keeping, that constitutes an important rural business of small marginal farmers and landless laborers (Singh et al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving, first gestation length, etc. However, this study is limited to studying the reproductive management in terms of the age of the animal at first calving (Singh et al., 2014h). Goats, which were known as "wet nurses of infants" in the United Kingdom and "poor man's cow" in India, were the first animals to be domesticated. Goat milk contains less lactose than cow's milk, so it is less likely to trigger lactose intolerance (Singh and Sharma, 2015). Goat meat, being a high-quality protein source, is the choicest meat in the domestic market. It is leaner than other red meats, and its fat has desirable fatty acids. The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia. It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Pearl millet was recognized as a main source of energy for livestock and is fed at critical times, such as during lactation, illness, and for weight gain. Farmers felt that grass is more useful to fill the animals' stomachs and would therefore come

before crop stover as a feed. Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). This explains why goat farmers seldom consider the possibilities of increasing production through either crossbreeding or artificial insemination. A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Goats, being a multipurpose animal, produce meat, milk, skin, fiber, and manure. The country is endowed with a large and biologically diverse population of goats. (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season, etc. Goat milk has more calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), and chloride (Cl) and less sodium (Na) and sulfur (S) content than cow milk (Singh and Sharma, 2016b). Livestock production is the backbone of Indian agriculture, contributing 7% to national GDP and being a source of employment and livelihood for 70% of the population in rural areas. India ranks first in terms of milk production (129.7 million tonnes); however, the productivity is quite low, mainly because of the scarcity of feeds and fodders (Singh et al. 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et al. 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries. This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh and Sharma, 2017b). Jamnapari (or Jamunapari) is a breed of goat originating from the Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goats, and their mixture with a local goat called "PE," *peranakan Etawa*, or Etawa mix), where they have been a great success. It is bred for both milk and meat. The name is derived from the rivers Yamuna, Jamuna (West Bengal), and Jamuna (Bangladesh) of India and Bangladesh. There is a great variation in coat color, but the typical coat is white with small tan patches on the head and neck. The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et al. 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types. These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people

living in harsh environments. Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide. Asia contributes approximately 59% to world goat milk production (Singh et al. 2018). There is a large commercial chicken industry that provides us with eggs and meat. Over recent decades the industry has made tremendous adjustments to meet the increasing demand for an inexpensive and safe supply of meat and eggs (Singh, G. 2019). India is endowed with a significant share of the world's livestock population, growing steadily and continuously. Buffalo are predominantly animals of poor countries with a very high density of livestock and human population and with poor feed resources. In tropical and subtropical regions, dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs. Severe acute cases can be fatal, but even in cows that recover, there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security. The dairy livestock owners who raise cattle and buffaloes are yet ignorant of scientific management practices (Singh and Somvanshi, 2020a).

Fig. 2 Jakhrana and Sirohi Goat

Fig. 3 Electronic Milk Analyzer

The goat is thought to have been the earliest domesticated ruminant and, of all the species of domesticated animals except the dog, has the widest ecological range. Originating in Asia, goats have spread over all the continents and inhabit almost all climatic zones from the Arctic Circle to the equator (Singh, G., 2024). Man, animal, and nature are in a symbiotic relationship for their survival and sustenance. The balance maintained among the three for several millennia has been disturbed by the overexploitation of natural resources to meet the demands of the increasing population of men and animals (Singh et al., 2024a). The

nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, and season. Goat milk has more calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), and chloride (Cl), and less sodium (Na) and sulfur (S) compared to cow milk (Singh et al. 2024b). Minerals are required by dairy animals for their metabolic functions, growth, milk production, reproduction, and health. Animals cannot synthesize minerals inside their bodies, and usually, feeds and fodders fed to the dairy animals do not provide all the minerals in the required quantity (Singh et al. 2024c). The goat is thought to have been the earliest domesticated ruminant and, of all the species of domesticated animals except the dog, has the widest ecological range (Singh et al. 2024d).

The productive improvements among dairy animals can be made through proper management, feeding, handling, etc., which may influence the expression of productive characters as per their heritability nature. (Singh et al. 2024e). The production and use of animal products in the use of human diet is receiving tremendous attention. (Singh et al. 2025).

MATERIALS AND METHODS

The research has conducted at the Rukmani Devi College of agriculture, Dausa district of Rajasthan with broad objective, as ‘Effect of goat breeds on the milk composition under climatic conditions of Dausa tehsil of Dausa district Rajasthan during 2021-23. 05 milk samples of Jamunapari Goat and 05 milk samples were collected from Jakhrana goat breed during the lactation at different villages of dausa tehsil of dausa district throughout two years. Total 1200 (600 samples collected from Jaumnapari and 600 samples from Jakhrana) samples collected from both goat breed of dausa tehsil. All samples were analyzed by electronic milk analyzer. Data were analyzed using the ANOVA procedure of RBD (at 5% and 1% significance levels) for the statistical analysis of all milk samples.

RESULTS AND DISCUSSION

1. Effect of Goat breeds on Specific gravity:-

The data obtained on specific gravity in the present study of Jakhrana and Jamunapari goat breed milk are presented in Table 1.

Table 1 - Effect of Goat breeds on Specific gravity of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	Jakhrana	1.0223±0.0003	1.0232±0.0003	1.022±0.0003	3.51^{+}	1.540 2.145
2.	Jamunapari	1.0296±0.0002	1.0263±0.0003	1.0279±0.0002	3.20^{+}	
	Overall mean	1.0259±0.0002	1.0247±0.0002	1.0340±0.0002		

Note: + = Significant at 5% level of significance

It is observed from Table 1. that the specific gravity of Jakhrana and Jamunapari goat breeds has found to be 1.0223±0.0003 and 1.0296±0.0002, respectively with an average of 1.0259±0.0002. It is observed from above table that specific gravity of Jamunapari goat breed's milk has greater than that of Jakhrana animals.

2. Effect of Goat breeds on Fat %:-

The result obtained for the fat percentage of milk of Jakhrana and Jamunapari goat breed are presented in Table 2.

Table 2 - Effect of Goat breeds on Fat % of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	Jakhrana	4.43±0.034	4.71±0.033	4.57±0.032	2.987^{+}	1.547 2.321
2.	Jamunapari	4.81±0.087	4.80±0.023	4.805±0.011	2.354^{++}	
	Overall mean	4.62±0.060	4.75±0.046	4.68±0.021		

Note: + = Significant at $p < 0.05$
++=Significant at $p < 0.01$

The average percentage of fat in the milk of Jakhrana and Jamunapari goat breeds has found to be 4.43±0.034 and 44.81±0.087 respectively with an average value of 4.62±0.060 per cent during 2021 - 22 Similarly, fat content in 2022 - 23 of Jakhrana and Jamunapari goat breeds has found to be 4.71±0.033 and 4.80±0.023, respectively with an average value of 4.75±0.046 per cent. The overall fat per cent in the both breeds during 2021- 23 of all the 1200 samples has found to be 4.68±0.021. The results of the present investigation on fat content of Jakhrana and Jamunapari goat breeds are in consonance with the observation of Singh and Sharma (2015), Prasad et. al. (2005) have, however, reported higher value for fat percentage of goat milk. Lower values have been reported by Agnihotri et. al. (2002).

3. Effect of Goat breeds on Protein %:-

The data on Protein percentage in the present investigation of Jakhrana and Jamunapari goat breed's milk during 2021 - 23 are recorded in Table 3.

Table 3 - Effect of Goat breeds on Protein % of milk

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	**Jakhrana**	3.28±0.028	3.21±0.034	3.24±0.032	5.875^{++}	1.960 2.576
2.	**Jamunapari**	3.19±0.027	3.23±0.036	3.21±0.032	4.51^{++}	
	Overall mean	3.23±0.028	3.22±0.035	3.225±0.32		

Note: ++ = Significant at $p < 0.01$

It is observed from the Table 3 that the protein percentage in the Jakhrana and Jamunapari goat breeds during 20–21 has found to 3.28±0.028 and 3.21±0.034, respectively with an average of 3.23±0.028 per cent. The protein content of aforesaid breeds during 2022-23 found to be 3.21±0.034 and 3.23±0.036 per cent respectively with an average value of 3.22±0.035 per cent. It is clear from the above table that protein per cent during 2021 - 22 has significantly ($p < 0.01$) greater than that of 2022-23 goat milk in both the breeds. The statistical analysis revealed that protein content of Jakhrana goat breed has significantly higher than that of Jamunapari goat breed during 2021 - 22. The analysis of variance of these data (Table 3) reveled that protein content variation either Jakhrana or Jamunapari goat breeds had significant ($p < 0.05$) effect during 2021 - 23.

4. Effect of Goat breeds on Lactose %:-

The lactose per cent in the milk of Jakhrana and Jamunapari goat breeds during 2021 - 23 in the present investigation are presented in Table 4.

Table 4 - Effect of Goat breeds on Lactose % of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	**Jakhrana**	4.39 ±0.021	4.40±0.022	4.45±0.021	1.859^{+}	1.960 2.576
2.	**Jamunapari**	4.47 ±0.020	4.43±0.025	4.41±0.022	1.243^{+}	
	Overall mean	4.43±0.0205	4.415±0.0235	4.43±0.014		

Note: + = Significant at $p < 0.05$

It is clear from Table 4 that the lactose content in Jakhrana and Jamunapari goat breed's milk during 2021 – 22 has found 4.39 ±0.021 and 4.47 ±0.020 per cent, respectively. Similarly the lactose content in above both breed milk during 2022 – 23 has found 4.40±0.022 and 4.43±0.025 per cent, respectively. The overall average lactose per cent in Jakhrana and Jamunapari goat breed's milk during 2021 - 23 also calculated and found to be 4.43±0.014 for all 1200 samples. The statistical analysis also revealed that the lactose content

in 2021 – 22 has significantly higher than that of 2022 -23 in Jakhrana as well as Jamunapari goat breeds at $p < 0.05$. Our results on lactose percentage in above goat breed's milk are in fair agreement with those reported by Prasad et. al. (2002) and Agnihotri (2002) have reported higher values on it.

5. Effect of Goat breeds on Ash %:-

The results obtained for ash content of Jhakarana as well as Jamunapari goat milk during 2021-23 are presented in Table 5.

Table 5 - Effect of Goat breeds on Ash % of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	Jakhrana	0.80±0.008	0.82±0.007	0.81±0.008	3.879^{+}	1.960 2.576
2.	Jamunapari	0.82±0.008	0.84±0.005	0.82±0.006	3.654^{++}	
	Overall mean	0.81±0.008	0.82±0.006	0.815±0.007		

Note: + = Significant at $p < 0.05$ ++ = Significant at $p < 0.01$

The average percentage of ash during 2021–22 Jakhrana and Jamunapari goat breed's milk has found to be 0.80±0.008 and 0.82±0.008, respectively with an average value of 0.81±0.008 per cent. Similarly ash content in 2022 -23 of aforesaid breed's milk has found to be 0.82±0.007 and 0.84±0.005, per cent with an average of 0.82±0.006 per cent. The overall average ash content in both breed's milk during 2021 - 23 of all samples has found to be 0.815±0.007 per cent. It is also clear from the above table that ash content in the milk of Jakhrana or Jamunapari goat breed 2022-23 has significantly greater than that of 2021-22. The analysis of variance table showed that ash content of Jakhrana goat breed's milk during 2022- 23 has significantly more than that of Jamunapari goat breed milk. The results of present investigation on the level of ash in Jakhrana and Jamunapari goats' milk during 2021 - 23 are slightly higher by the findings (0.78 ± 0.01) of Agnihotri et. al. (2002) and Singh and Sharma (2015).

6. Effect of Goat breeds on Total Solids %:-

The results obtained for total solids percentage in milk of Jakhrana and Jamunapari goat breed during 2021-23 are presented in Table 6.

Table 6 - Effect of Goat breeds on Total solids % of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	Jakhrana	13.03±0.030	13.16±0.035	13.09±0.032	1.21^{+}	1.960 2.576
2.	Jamunapari	13.23±0.036	13.87±0.039	13.55±0.037	1.985^{NS}	

	Overall mean	13.13±0.033	13.51±0.037	13.32 ± 0.035		

Note: NS = Non Significant + = Significant at $p < 0.05$

According to above Table 6, the average total solids percentage in milk of Jakhrana and Jamunapari goat breed during 2021 – 22 has found to be 13.03±0.030 and 13.23±0.036, respectively with an average value of 13.13±0.033. Similarly the total solids percentage in the milk of above goat breeds during 2022 – 23 has found to be 13.16±0.035 and 13.87±0.039, respectively with an average value of 13.13±0.037 per cent. The overall average total solids percentage of all 1200 samples has found to be 13.32 ± 0.035. It has observed from above table that Jakhrana goat breed's milk total solids were significantly ($p < 0.050$) higher in 2021-22 than 2022-23 whereas in case of Jamunapari goat breed an insignificant difference has observed in total solids content. The analysis of variance in the table revealed that the breed variation during 2021-22 has non-significant but it has significant during 2022-23 at 5% level of significance.

The level of total solids percentage in the milk of above goat's breeds as obtained in the present study, Compared favorably with the results of Pal et. al. (2011) and Agnihotri (2002). Prasad et. al. (2005) have, however, reported higher values of Singh and Sharma (2015).

7. Effect of Goat breeds on Solids-Not-Fat %:-

The data on solids-not-fat percentage in Jakhrana and Jamunapari goat breed's milk during 2021-23 are recorded in Table 7.

Table 7 - Effect of Goat breeds on Solids-Not-Fat % of milk.

Sl. No.	Breeds	2021 - 22	2022 -23	Overall average	Test of significance	Table value (t) 5% 1%
1.	**Jakhrana**	8.42±0.036	8.44±0.024	8.43±0.030	3.659^{++}	1.960 2.576
2.	**Jamunapari**	8.46±0.034	8.48±0.026	8.47±0.030	3.854^{++}	
	Overall mean	8.44±0.035	8.46±0.025	8.45±0.030		

Note: ++ = Significant at $p < 0.01$

It is observed from the Table 7 that the solids-not-fat percentage in the milk of Jakhrana and Jamunapari goat breeds during 2020–21 has found to be 8.42±0.036 and 8.46±0.034, respectively with an average value of 8.44±0.035 per cent. The solids-not-fat content of above breeds during 2022-23 samples has also calculated and found to be 8.44±0.024 and 8.48±0.026 per cent, respectively with an average of 8.46±0.025 per cent.

The overall average solids-not-fat percentage of above samples in 2021-22 and 2022-23 of all 1200 samples has 8.45±0.030 per cent. The statistical analysis showed that the solids-not-fat percentage has significantly ($p < 0.01$) higher in 2022-23 either Jakhrana or Jamunapari goat breed than that of 2021-22. It is due to higher fat percentage and lower percentage of protein, lactose and ash in 2022-23 of Jakhrana as well as Jamunapari goat breeds. The analysis of variance table on these data also revealed that significantly breed variation on solids-not-fat content has observed either 2021-22 or 2022-23. The results of the present investigation on solids-not-fat content of Jakhrana and Jamunapari goat breed's milk 2021-23 are in consonance with the observations of Singh and Sharma, (2015) reported slightly higher values.

CONCLUSION

The specific gravity and fat percentage in the milk of Jakhrana has significantly higher than milk of Jamunapari goat breeds. Breed had conspicuous effects on milk quality of goats under study.

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