



Effect of Seasonal Variation on the Composition of Goat Milk Raised in Amber Tehsil of Jaipur District

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Abstract

Goats represent an important component of livestock production and contribute significantly to the socio-economic livelihood of rural communities, particularly among economically weaker sections. This study aimed to highlight the importance and value of goat milk under Indian rearing conditions. In India, more than 46% of the total milk produced is consumed in liquid form. The goat is considered one of the earliest domesticated ruminants and, except for the dog, has the widest adaptability across different ecological zones. The study was carried out at Shri Vinayak College of Agriculture, Nayla, Kanota, Jaipur district, Rajasthan, during the period 2022–2024. A total of 1200 milk samples collected from goats reared in Amber tehsil under different seasonal conditions were analyzed. The overall mean values for specific gravity, fat, protein, lactose, ash, total solids, and solids-not-fat were found to be 1.0399 ± 0.0009 , $4.70 \pm 0.048\%$, $3.79 \pm 0.029\%$, $4.81 \pm 0.024\%$, $0.88 \pm 0.009\%$, $13.09 \pm 0.039\%$, and $8.15 \pm 0.051\%$, respectively. Significant seasonal variations were observed in milk composition, particularly in parameters such as specific gravity, fat, calcium, phosphorus, potassium, magnesium, and chloride content in Jakhrana and Sirohi goat breeds. The findings clearly indicate that seasonal conditions have a marked influence on the quality and composition of goat milk.

Keywords: Goat milk, seasonal variation, milk composition, Jakhrana breed, Sirohi breed, Amber tehsil, Rajasthan, physicochemical properties, livestock production, dairy quality.

Introduction

Animals reared under intensive production systems consume substantial amounts of protein and other nitrogen-rich components in their diets. Small ruminants play a significant role in the economy and food security of populations in tropical and subtropical regions. However, their contribution is often underreported in official statistics due to informal marketing and slaughter practices. The Indian goat production system is affected by several ecological and physiological limitations. Globally, the goat population is estimated at about 921 million, with more than 90% located in developing countries. Asia alone accounts for nearly 60% of the world's goat population and holds a major share of about 26% of recognized goat breeds. Non-cattle milk contributes nearly 15% of global human milk consumption. Archaeological evidence suggests that goats were domesticated as early as 6–7 BC in Western Asia.

In India, a large proportion of the population depends on agriculture-based livelihoods, where goat rearing serves as an important occupation for small and marginal farmers as well as landless laborers. Increasing attention is being given to the production and utilization of animal products in human diets. Productivity in dairy animals can be improved through appropriate management practices such as feeding, housing, and handling, which influence the expression of productive traits based on their genetic potential. Therefore,

proper selection of animals for breeding and production should be based on systematic evaluation of physical and productive traits.

The goat population in India has shown a steady increase, rising from 47.14 million in 1951 to 124.5 million in 2005. Among indigenous breeds, the Jakhrana goat is native to the north-western arid and semi-arid regions of Rajasthan, particularly the Alwar district, where it is considered to be in its purest form. These animals are relatively large in size with a predominantly black coat and characteristic white markings on the ears. They have a straight facial profile, narrow forehead, medium-sized ears, and a well-developed udder with conical teats. Jakhrana goats are primarily maintained for milk production.

Goat reproduction is influenced by several parameters such as age at first conception, age at first kidding, and gestation length; however, this study focuses mainly on age-related reproductive aspects. Originating in Asia, goats have now spread across all continents and are found in nearly all climatic zones, ranging from the Arctic regions to the equator.

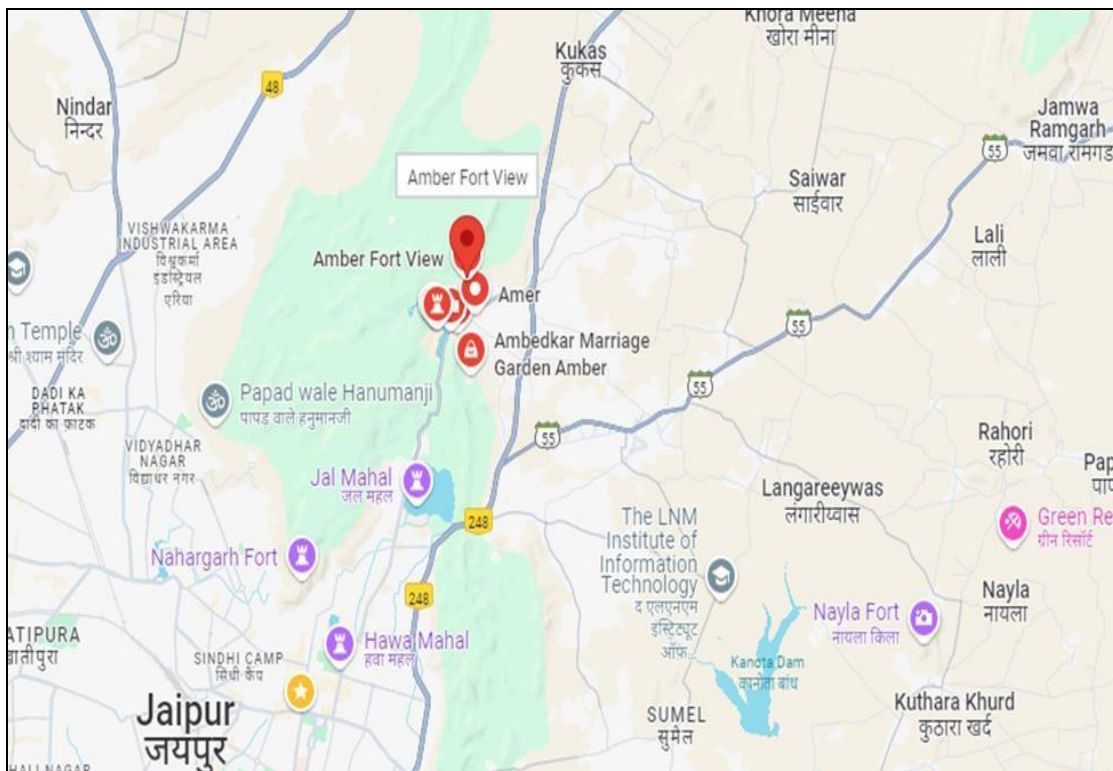


Figure 1 map showing location of amber teshils of jaipure district

Integral part of every business and it includes the activities of setting goals, identifying course of action, framing plans and implementation through coordination of skilled and unskilled labour to achieve service organization (Sharma, K. 2019) Along with the economic development, knowledge workers as a carrier of intellectual capital, become indispensable key people for enterprises to build and maintain a competitive advantage (Sharma and Mehta, 2020a) Environmental sustainability is propagated by favorable decision and making strategies which safeguard the interest of our surroundings and nature to ensure protection of natural vegetation with more emphasis on protecting the natural support system essential for existence of human life (Sharma, *et al.* 2020b) 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) he 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) 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.



Jakhrana



Sirohi Goat



Electronic Milk Analyzer

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, 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) Human Resource Management facilitates implementing of various HR functions like recruitment, induction, training, performance appraisal, etc. and engulfs planning & development of employees or preservation of knowledge capital (Sharma and Agrawal, 2020c) Environmental sustainability refers to preserving the environment for future generations and support human life. It is an action that involves decision making that protects the natural world and realise the full impact of business organizations on the environment (Sharma and Agrawal, 2021) The changing circumstances and the zeal to learn have eradicated the hassles and barriers of teaching from remote destinations and owing to the growing importance of lifelong learning, online learning has become a popular tool for learning in adverse conditions (Sharma and Choudhary, 2020d) Digital education is a priority task of government of India and is crucial to impart education to the disinterested students of rural school (Sharma and Choudhary, 2020e) Organization have grown interest in strategies which address environmental aspects and pursue new opportunities for sustainability creating a competitive landscape to comeback the effect of environmental destruction and take into consideration organization practices for initiating environment protection (Sharma and Agrawal, 2019a) Education system in historical times was sound enough to impart knowledge through practical training and building a strong relationship between Guru and Shishya (Sharma, *et al.* 2020f) Health care Services are the primary need and is very crucial for an economy like India where a large population to serve the increasing demand for high quality health care services (Sharma and Jain, 2021a) The competitive business environment around the globe has made advertisement an important tool for every organization to create a buzz in the society (Sharma and Gupta, 2017) Advertisements to spread information regarding social issues are known as social advertisements. In recent times, many commercial organizations have initiated advertising their brands accompanying with a social message which was earlier done only by government and non-government organizations with an objective of social welfare (Sharma and Gupta, 2020g) 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) and (Singh *et al.*, 2025a) 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.

The production and use of animal products in the use of human diet is receiving tremendous attention.

Materials and Methods

The study was conducted at the Shri Vinayak College of Agriculture, Nayla, Kanota, Jaipur district of Rajasthan during 2022-24. 05 milk samples of Sirohi goat and 05 milk samples were collected from the Jakhrana goat breed during the lactation at different villages of Amber tehsil of the Jaipur district throughout two years. A total of 1200 milk samples were collected from both goat breeds in Amber tehsil, with 600 milk samples from Sirohi goats and 600 milk samples from Sirohi goats. All samples were analyzed by an 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 Effect of seasons on Specific gravity

The results on specific gravity of milk of Jakhrana and Sirohi goat breed reared under conditions of Amber tehsil in different seasons are presented in Table 1. It indicated that the specific gravity of milk of Jakhrana breed's reared under conditions of Amber tehsil in different seasons i.e. summer, rainy and winter was 1.0399 ± 0.0009 , 1.0287 ± 0.0003 and 1.0399 ± 0.0009 , and 1.0290 ± 0.0003 and 1.0308 ± 0.00038 , respectively. Similarly, in case of Sirohi breed's milk reared under conditions of Amber tehsil in summer, rainy and winter seasons it was 1.0292 ± 0.0004 and 1.0302 ± 0.00038 , 1.0282 ± 0.00038 and 1.0280 ± 0.00038 and 1.0284 ± 0.00039 , and 1.0399 ± 0.0009 , respectively. The overall average specific gravity of goat breeds reared under conditions of Amber tehsil in different seasons of all 1200 samples was 1.0399 ± 0.0009 . These data suggested that the specific gravity was higher in summer seasons and lower in rainy seasons in both breeds of goat reared under conditions of Amber tehsil. Our results on specific gravity in different seasons in the milk of Jakhrana and Sirohi goat breed are in fair agreement with the findings of (Singh *et al.*, 2014b) [20] for the result of seasons.

Table 1: Effect of seasons on Specific gravity of milk under field and farm rearing conditions.

Sl. No.	Breeds	Field	Farm	Overall average	Test significance	Table value (t) 5% 1%
1.	Jakhrana (i) Summer (ii) Rainy (iii) Winter	1.0399 ± 0.0009 1.0287 ± 0.0003 1.0290 ± 0.0003	1.0381 ± 0.00031 1.0399 ± 0.0009 1.0308 ± 0.00038	1.0308 ± 0.00041 1.0293 ± 0.00038 1.0294 ± 0.00038	1.441 ^{NS} 2.063 ⁺ 1.984 ⁺	1.960 2.576
2.	Sirohi (i) Summer (ii) Rainy (iii) Winter	1.0292 ± 0.0004 1.0399 ± 0.0009 1.0284 ± 0.00039	1.0302 ± 0.00038 1.0280 ± 0.00038 1.0399 ± 0.0009	1.0297 ± 0.00039 1.0399 ± 0.0009 1.0399 ± 0.0009	2.033 ⁺ 1.765 ^{NS} 2.107 ⁺	
	Overall mean	1.028 ± 0.00039	1.032 ± 0.000391	1.0399 ± 0.0009		

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

Table 2: Effect of seasons on Solids-Not-Fat % of milk under field and farm rearing conditions.

Sl. No.	Breeds	Field	Farm	Overall average	Test significance	Table value (t) 5% 1%
1.	Jakhrana (i) Summer (ii) Rainy (iii) Winter	4.32 ± 0.019 4.65 ± 0.045 4.61 ± 0.043	4.51 ± 0.047 4.88 ± 0.043 4.32 ± 0.019	4.46 ± 0.046 4.76 ± 0.044 4.65 ± 0.043	1.986 ⁺ 2.791 ⁺⁺ 2.034 ⁺	1.960 2.576
2.	Sirohi (i) Summer (ii) Rainy (iii) Winter	4.71 ± 0.050 4.95 ± 0.047 4.79 ± 0.042	4.87 ± 0.049 5.11 ± 0.055 4.99 ± 0.049	4.79 ± 0.050 5.02 ± 0.0465 4.89 ± 0.045	2.602 ⁺⁺ 2.596 ⁺⁺ 2.710 ⁺⁺	
	Overall mean	4.61 ± 0.066	4.86 ± 0.047	4.70 ± 0.048		

Table 3: Effect of seasons on Lactose % of milk under field and farm rearing conditions.

Sl. No.	Breeds	Field	Farm	Overall average	Test significance	of Table value (t) 5% 1%
1.	Jakhrana (i) Summer	4.81±0.024	4.35±0.014	4.36±0.014	2.734 ⁺⁺	1.960 2.576
	(ii) Rainy	4.48±0.017	4.40±0.010	4.44±0.014	4.316 ⁺⁺	
	(iii) Winter	4.62±0.013	4.51±0.011	4.57±0.012	5.103 ⁺⁺	
2.	Sirohi (i) Summer	4.39±0.018	4.33±0.008	4.36±0.014	2.063 ⁺	
	(ii) Rainy	4.43±0.014	4.81±0.024	4.40±0.014	3.628 ⁺⁺	
	(iii) Winter	4.50±0.015	4.44±0.009	4.47±0.013	3.021 ⁺⁺	
	Overall mean	4.47±0.017	4.41±0.012	4.81±0.024		

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

Table 4: Effect of seasons on Solids-Not-Fat % of milk under field and farm rearing conditions

Sl. No.	Breeds	Field	Farm	Overall average	Test significance	of Table value (t) 5% 1%
1.	Jakhrana (i) Summer	8.15±0.051	8.54±0.054	8.54±0.054	9.312 ⁺⁺	1.960 2.576
	(ii) Rainy	8.47±0.055	8.25±0.055	8.36±0.055	8.169 ⁺⁺	
	(iii) Winter	8.73±0.055	8.52±0.053	8.63±0.053	10.631 ⁺⁺	
2.	Sirohi (i) Summer	8.41±0.056	8.24±0.054	8.33±0.055	7.361 ⁺⁺	
	(ii) Rainy	8.25±0.058	8.00±0.053	8.12±0.056	11.260 ⁺⁺	
	(iii) Winter	8.52±0.056	8.28±0.050	8.40±0.054	10.093 ⁺⁺	
	Overall mean	8.15±0.051	8.27±0.052	8.15±0.051		

Conclusion

The specific gravity, fat, calcium, phosphorus, potassium, magnesium and chloride percentage in the milk of Jakhrana as well as Sirohi goat breeds under seasonal conditions was significantly differ. Season has conspicuous effects on milk quality of goats.

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