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COMPARATIVE STUDY OF CASEIN CONTENTS FROM MILK OF DIFFERENT COW BREEDS OF AMRAVATI, MAHARASHTRA, IN CORRELATION WITH SEASONS

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ABSTRACT:

The nutritional composition of cattle milk, including casein, is significantly influenced by seasonal variation and the stage of lactation. Casein, a major milk protein, crucial for nutritional quality and dairy processing (cheese production), tends to fluctuate due to environmental conditions, feed intake, and physiological changes in the cow. A study was conducted to evaluate these variations in Gir, Nagori and Gaolao cattle, a dual-purpose Indian breed known for its adaptability. The study was divided into two main periods: Period I (November to January) – representing the winter season, and Period II (February to April) – covering the early to mid-summer months. From November 2024 to April 2025 showed continuous increase in casein contents from winter (-1.7862) to onset of Summer in April (+2.2258) from +10.29% to -12.04% in Nagori and in the same duration Gaolao showed the change in casein contents from -0.0778 % to -12.2663%. Casein contents of Nagori and Gaolao breeds are maximum in the winter season and gradually declines in the summer seasons.

Keywords:- Gir, Nagori, Gaolao, casein contents, Seasonal change.

INTRODUCTION:

Cow milk has 3-4 times more protein and 5-7 times more minerals than human milk. Milk is a complete food, containing valuable dietary components like water (87.4%) and milk solids (12.6%) which includes protein, fats, carbohydrates, vitamins and minerals. Cows' milk contains about 4.8% lactose. Milk lipids are mainly triacylglycerols or fatty acid esters with glycerol. Casein and whey protein, both of which are considered as a complete proteins, being they contain all nine essential amino acids that the body needs. The breed of an animal significantly influences both the composition and yield of its milk. Sahiwal's milk has the highest content of milk protein. The protein fraction includes casein (80%) and whey proteins (20% such as lactalbumin, lactoglobulin) and it is of interest, not only from the nutritional point of view, but also from dairy processing.

Milk fat and protein content changes in relation to change in food availability and weather conditions. During spring, due to low contents of fibres which affects the lipid composition of milk. The increase in temperature and other climatic factors also affects the milk composition (Boro *et al.*, 2018).

Several cow breeds are known for high milk production, both globally and particularly in India. Globally, Holstein-Friesian and Jersey are popular choices. In India, Sahiwal, Gir, and Rathi are among the top milk-producing breeds. Ca, Mg, P, K, Na S, Fe, Cu Zn etc are minerals found in milk also vary according to the food consumption.

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Gir:

Fig. 1. Gir cow breed

Gir is one of the most renowned milk-producing breed in India, is also called, Kathiawari and Sorthi. It is originated from Gir hills and forests of Kathiawar, covering the districts of Junagadh, Bhavnagar, Rajkot, and Amreli in Gujarat. It has a large hump on the shoulders, short horns, large drooping ears, and a prominent dewlap. Gir adult cows have average weight 313 kg and height 120 cm at the withers (Gaur *et al.,* 2003). Udder well-developed, round, yield about 2,063 liters per lactation period. Being behavior is gentle and has docile nature, mainly used for dairy management. It is more resistant to heat and diseases.

Fig. 2. Nagori cow breed

The Nagori breed originates from the Nagaur district of Rajasthan, with its breeding tract extending into the adjoining districts of Jodhpur and Bikaner (Nokha tehsil). These cattle are white in color, alert, agile, and resemble horses in facial features. Nagori cattle likely evolved from a mix of Hariana and Kankrej breeds due to geographical proximity. They are large, strong, and docile animals with well-developed frames, straight backs. Characteristic features are long, narrow face, flat forehead, small bright eyes, large pendulous ears, and moderate horns curving inward at the tips. Nagori has strong physical conformation, which is essential for endurance in harsh environments (Sukanya *et al.,* 2025).

Though primarily draught animals, produce an average of 900 kg of milk per lactation.

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Fig 3. Gaolao cow breed

It is a dual purpose breed, native to India. The breed is mainly located in Nagpur (M.S.), Chindwara (M.P.), and Wardha (M.S.). It is a medium sized animal which has white to grey color body with long head, medium size ears and short horns. The cow gives an average of 470-725 litre milk per lactation period. Adult males generally show body length about 147.28 cm; height 147.78 cm; chest girth172.85 cm and weight 405.40 kg compared to females (Sukanya *et al.*, 2025).

Casein: Casein constitutes upto 80% of the true proteins and remaining 20 % is of whey protins approximately while Nonprotein nitrogen (NPN) is represented by urea accounting for approximately 50 % of total NPN (Wolf schoon-Pombo and Klostermeyer, 1981). It is the most abundant protein family in milk, composed of several fractions: αS1-casein, αS2-casein, β-casein, and *κappa*-casein. These fractions after aggregation forms casein micelles ((de Kruif and Holt, 2003). Each casein protein has both hydrophobic as well as hydrophilic domains influencing their functional behavior in milk (Horne, 2020; Latnikova *et al.,* 2008). Caseins show unique flexibility and thermal stability, compared to other proteins in milk (Huppertz *et al.*, (2018).

REVIEW OF LITERATURE:

Although this research field is relatively recent, the data accumulated over the past few years provide valuable insights and a clearer understanding. According to Barłowska *et al.,* (2011) proteins contributes the main fraction of the milk, significantly influencing its nutritional value. Milk proteins are in the form of casein complexes and whey proteins. Among these, casein is the predominant protein compared to meagre presence of whey proteins.

The composition of milk varies significantly during the lactation period and is also influenced by seasonal changes. Tsioulpas *et al.,* (2007) used milk including colostrum obtained in early lactation, to assess compositional differences and found that there was a notable decrease in pH and as per the advancement of the lactation period it gradually increases. Protein concentration showed a gradual decline until about 30 days postpartum.

Malacarne *et al.,* (2000) identified and characterized κ-casein in mare's milk. The overall proportion of κ-casein in mare's milk which was lower than that found in ruminant and human milks.

Biochemical similarities of bovine and human κ-casein including the presence of carbohydrate moieties and susceptibility to hydrolysis by chymosin group II enzymes studied by Iametti *et al.*, (2001); Egito *et al.,* (2002). Holt *et al.*, 1978 studied the magnitude of micelle dimensions influenced by agricultural and environmental factors such as cow's diet and seasonal variations.

Yadav *et al.* (2013) conducted a study and reported significant variations in milk yield and composition over the course of lactation. The milk yield ranged from 4.3 kg to 9.5 kg, fat content from 7.19 ± 0.04% to 8.63 ± 0.07%, protein

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content from 3.46 ± 0.01% to 3.56%, and lactose content from 4.36% to 4.60%.

Environmental factors such as breed, genetic variations, health, seasonal factors, diet, age, level of lactation has a significant influence on milk protein concentration (Davies *et al.*, 1983; Ng-Kwai-Hang *et al.,* 1982, 1985; Rogers and Stewart, 1982). At the beginning of lactation, colostrum has double casein content and whey proteins along with rich contents of immunoglobulins, later the protein contents fall down during the transition to normal milk and reach a minimum about 5 to 10 weeks into lactation (Murgiano *et al.,* 2009).

This research work was conducted in the laboratory of the Department of Zoology, Sant Gadge Baba Amravati University, Amravati.

a) Collection of Samples: To isolate and compare casein content among different cow breeds, milk samples were collected from Shri Gaurakshan Sanstha, Amravati M.S. (20.9320° N, 77.7523° E) from Nov 2024 to April 2025 in each week.

Approximately 50 ml of milk was aseptically collected per sample using sterile Falcon tubes and brought to the laboratory within 30 to 60 minutes. The samples underwent a series of processing steps, including heating, treatment with acid solutions, isolation of casein, drying till its weight come constant, and measurement. All samples were processed for the isolation of casein protein (*https://www.scribd.com/document/368739156/Experiment2#:~:text=It%20(%20The%20document%20)%20outlines%20objectives,pH%2C%20then%20performing%20acid%20and%20base%20hydrolysis*).

OBSERVATIONS AND RESULT:

Seasonal variations significantly affects cattle milk's nutritional profile, mainly due to variations in environmental factors like temperature, humidity, quality of food, and lactation phases consequently changes quality and quantity of milk. The present study was conducted in two seasons: Winter (November 2024 to January 2025), typically cooler and drier, and Summer (February 2025 to April 2025), generally warmer and hot. Results from the study indicate that there were significant changes in milk protein content during the two seasons.

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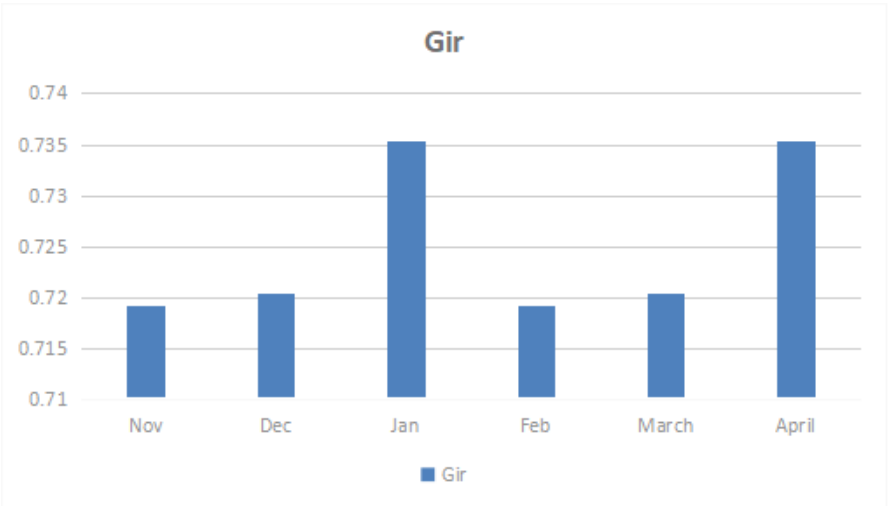
Table 1: Percent change in casein content of selected breeds from November 2024 to April 2025

	Nov	Dec	Jan	Feb	March	April
Gir	0.7192	0.7204	0.7354	0.7192	0.7204	0.7354
% change		-1.7862	2.2258	0	0.1668	2.2258
SD		0.0015	0.0256	0.0278	0.0053	0.0095
Nagori	0.8034	0.8861	0.8278	0.781	0.7378	0.7066
% change		10.29	3.037	-2.788	-8.1652	-12.04
SD		0.0135	0.002	0.0118	0.0069	0.0467
Gaolao	0.7704	0.7698	0.7494	0.7251	0.6822	0.6759
% change		-0.0778	-2.7258	-5.88	-11.448	-12.266
SD		0.0024	0.012	0.0066	0.0057	0.004

In table 1 all depicted values are the average casein content estimated per week in the given month. Casein content of the different breeds of cows show variable values. Nagori breed showed highest contents of casein out of three selected breeds, which is followed by than that of Gaolao and Gir. During winter season to summer season it was found that Gir breed continuously increased casein contents from month of December 2024 (-1.7862) to April 2025 (+2.2258). In Nagori during winter season's initially in the month of December percent changes in casein contents are increased (+10.29) which later continuously declined upto the month of April (-12.04) while in Gaolao, from the month of December (-0.0778) it continuously decreased upto the month of April (-12.266). The most significant decrease was depicted by Gaolao than Nagori.



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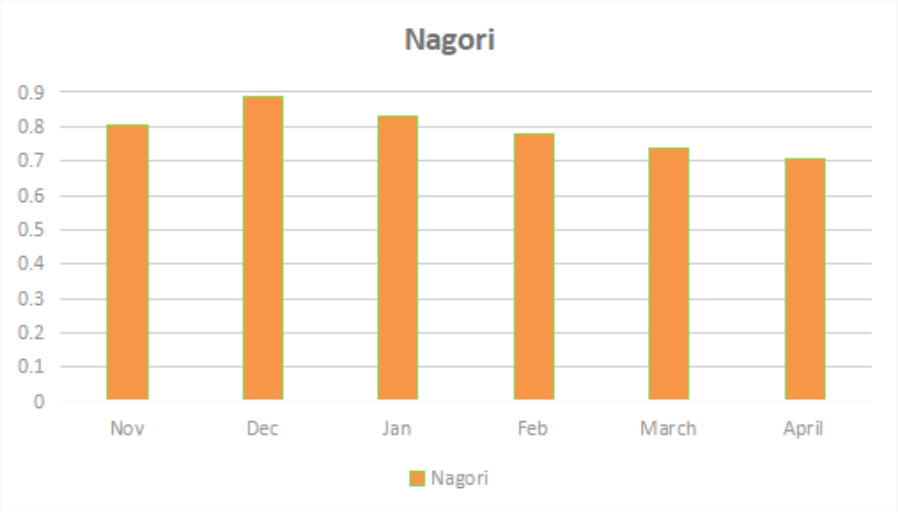

Fig.5. Casein content of Nagori during winter and Summer seasons

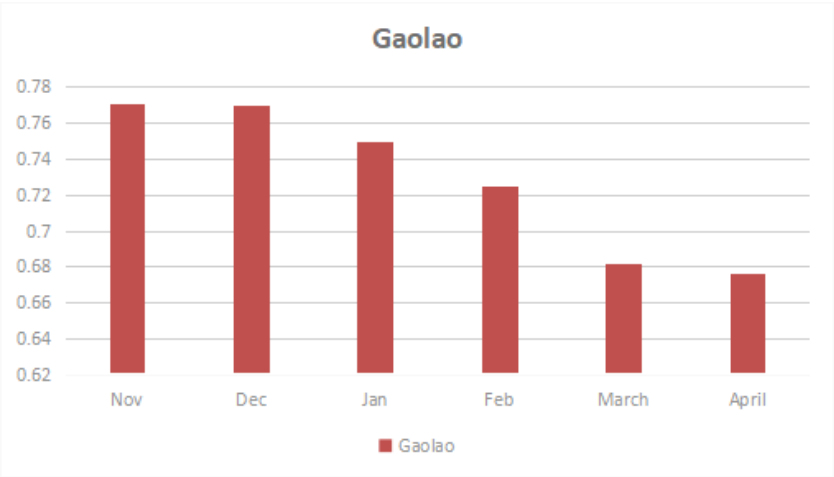

Fig.6. Casein content of Gaolao during winter and summer seasons

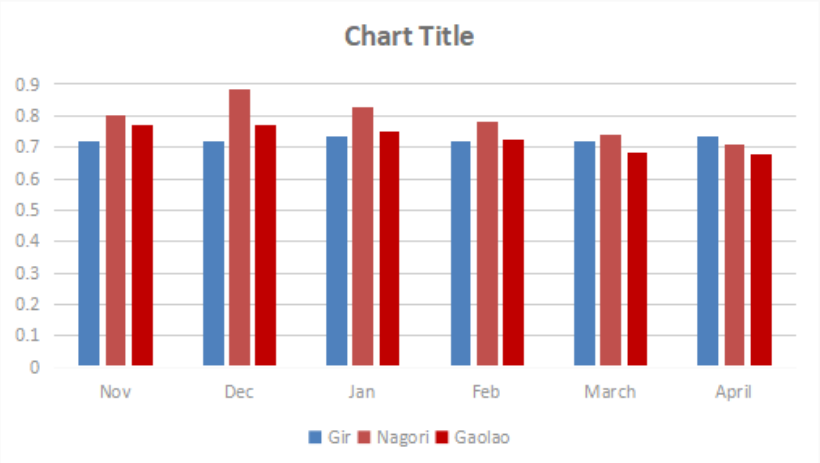

Fig:7. Comparative Casein content

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RESULT & DISCUSSUION :

Temperature, humidity, and feed availability between seasons can impact the physiological responses of cattle, thereby altering milk yield and composition. Period I (November to January), typically cooler and drier, and Period II (February to April), generally warmer. Changes occur in fat, protein, and lactose content between the two periods. Attributable factors to variations are feed intake, rate of metabolic activity and stress levels in animals due to climatic conditions.

The findings reveal that casein content in Gir, Nagori and Gaolao cattle milk is affected by seasonal changes. During winter (Period I), casein levels were generally high, likely due to favorable environmental conditions such as cooler temperatures, better feed intake, and reduced heat stress which leads to increase rate in protein synthesis.

During summer months, particularly in April, a decline in casein content was observed both in Nagori and Gaolao. Heat stress and lower feed consumption are the factors which might decline protein synthesis. During hot climatic conditions, less feed consumption leads towards insufficient supplement of required nutrients, which lowers protein synthesis, including casein (Ng-Kwai-Hang *et al.,* 1982) Milk protein percentage (Ng-Kwai-Hang *et al.,* 1982) are higher in winter than summer. However, stage of lactation and feeding practices may change milk protein concentrations (Rogers and Stewart, 1982). In Gir there is counter effects shown by continuous increase in casein content from Winter to Summer season is due to probably variation in genetics, feed intake, less stress level due to heat resistance capacity, level of milk production and age as well and not due to lactation phase being it is selected same for the present study. The work showed alignment with the work of Looper, (2012) who reported milk composition and component yields affected by genetics and environment, level of milk production, diseases, and age of cow.

CONCLUSION:

Nagori and Gaolao milk showed more protein in the winter, and less in the summer due to heat stress free conditions in addition to other ecological factors while in Gir continuous inclinity in protein contents depicts overriding phenomenon due to type of breed, age and other factors.

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