Comparative Study of Casein Protein Content from Milk of Different Domesticated Cow, Buffalo and Goat Breeds in Jabalpur Division using Isoelectric Precipitation Method

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***Abstract* —** *This study examined casein content in milk from various milch animals in Jabalpur District, including cows, buffaloes, and goats. Casein, which makes up about 80% of milk proteins, was isolated using isoelectric precipitation by adjusting the pH to 4.8 with 2% hydrochloric acid. Milk samples were collected from four locations. The findings revealed significant variation in casein content among species, highlighting differences in protein composition. These results offer valuable insights for dairy product formulation and nutrition, aiding in optimizing dairy processing and enhancing protein-rich diets.*

Keywords — Iso- Electric Precipitation, Casein, Milk Protein, Milch animals, Jabalpur

I. INTRODUCTION

Jabalpur is a district in Madhya Pradesh with a good climate. Commonly raised animals here include cows, buffaloes, and goats, which have many breeds. India has a wide variety of cattle due to genetic diversity and environmental adaptation. The Asian river water buffalo was historically the main milk source for Indians [1]. In this region, popular cow, buffalo, and goat breeds include Gir, HYBRID Gir, Desi cow, Haryanvi cow, Murrah Buffalo, Sahiwal, Jersey, Beetal Goat, Jamunapari Goat, Sangamneri Goat, and Black Bengal Goat.

Milk is a vital part of the human diet and is highly nutritious. It contains about 80% protein, mainly casein, along with 2-8% lactose (milk fat) and whey protein, which is a byproduct of cheese and casein production. Casein and whey are the two main proteins in milk, both essential for human growth and metabolism.

Milk proteins like lactoferrin and lactoperoxidase help boost immunity [2]. Casein makes up the largest part of milk protein and is rich in essential amino acids needed for healthy growth [3]. Casein accounts for almost 80% of total milk protein.

The casein is proved to be the major constituent of the milk and it is almost found 80 % of total milk protein [4] the essential amino acids present are like Leucine, Isoleucine, Lysine, Valine, Phenylalanine, Threonine, Methionine and Tryptophan. The various functional peptides from protein casein have many beneficial roles in human health; e.g. antimicrobial peptides help in immune system and antithrombotic peptides works in cardiovascular system [3]. The contents of various food supplements might be seen playing key role in maintaining net protein and amino acid balance of body [11].

Milk composition vary from specie to specie e.g., buffalo milk contains 58% and 40% more calcium and protein while 43% less cholesterol as compared to cow milk [1]. Besides, cow milk is considered as a good source of essential amino acids that are very close to the amino acid requirement of human body [5]. Goat milk has more digestibility as compared to other bovine milk. It is rich in various nutritional factors like proteins, vitamins (E and C), flavonoids and carotenoids having antioxidant properties. Hence goat milk help to protect consumers from exposure to oxidative stress, which occurs in many acute and chronic diseases [6; 7]. Due to short shelf life, the milk is converted to its processed products like cheese,

Whereas camel milk has similar composition to cow milk with few distinctions such as lower in lactose and higher in minerals, e.g., iron, potassium, magnesium, sodium, zinc and copper. Sheep milk is considered more supportive to human digestive system [8]. Proteins such as lactoferrin, proteose peptone, calmodulin, prolactin, and folate binding proteins are also found in milk and considered as minor proteins [9]. Whey which has higher nutritional value important for normal physiological activities of human body like blood pressure, immunity, inflammatory actions [10].

By knowing the importance of casein, the aim of this paper was to estimate the amount of casein in various cow, buffalo,

and goat breeds and to compare casein content in the composition and nutritional profile of milk of different milk samples.

II. MATERIALS AND METHODS

- **Study Area**

Milk samples were collected from four sampling sites, (A) Dayodaya Gaushala, Tilwara, (B) Ramayan Mandir Gaushala, (C) Neeraj Dairy, (D) Sadar, Jabalpur

18 Different Milk Samples Were Collected from Various Different Places of Jabalpur District given in Table 1.

Sample	Species	Correct Scientific Name	Sample Site
1A, 2A	Gir Cow	*Bos indicus*	Tilwara Gaushala
3A	Gir Hybrid	*Bos indicus*	Tilwara Gaushala
4A, 5A	Desi Cow	*Bos indicus*	Tilwara Gaushala
6A, 7A	Haryanvi (Lactating)	*Bos indicus* (Hariana breed)	Tilwara Gaushala
1B, 2B	Murrah Buffalo (Haryanvi)	*Bubalus bubalis*	Neeraj Dairy
2C	Berrari Goat	*Capra aegagrus hircus*	NA
1D, 2D	Sahiwal	*Bos indicus*	Garha, Jabalpur
1E, 2E	Jersey	*Bos taurus*	Ramayan Mandir Gaushala
1F	Beetal Goat	*Capra aegagrus hircus*	Sadar, Jabalpur
2F	Jamunapari Goat	*Capra aegagrus hircus*	Sadar, Jabalpur
3F	Sangamneri Goat	*Capra aegagrus hircus*	Sadar, Jabalpur
4F	Black Bengal Goat	*Capra aegagrus hircus*	Sadar, Jabalpur

Table 1: Different Milk Samples Were Collected from Various Different Places of Jabalpur District

Fig. 1. Location map for sample selection sites of Jabalpur district.

- **Methodology**

Sterilized 50ml Falcon tubes were used to collect the fresh milk samples from two species each of Buffalo, Cow and Goat Casein was isolated by **Iso - Electric Precipitation** (lowering the pH of milk to 4.6 by using 2% HCl) method, in which 100 ml of sample was centrifuged using REMI CH – 12 Plus Cooling Centrifuge at 20-25 min at room cream/fat was removed. Now this skim milk was transferred into 500ml glass beaker and distil water was added up to equal volume 2% HCL was taken in burette and added drop wise in the milk with constant stirring. The precipitated casein was filtered and air dried at Room temperature for 24 hours (till completely dried) and then dry weight of casein was measured with digital balance and taken out percentage yield [4; 11].

Estimation of Casein: Casein was isolated by fractional isolation precipitation method in which 100 ml of sample was centrifuged using REMI CH – 12 plus Cooling Centrifuge at 20-25 min at room cream/fat was removed. Now this skim milk was transferred into 500ml glass beaker and distil water was added up to equal volume 0.5 N HCL was taken in burette and added drop wise in the milk with constant stirring. It drops pH of milk to 4.8, so casein was easily separated and precipitated. This precipitation was allowed to settle down for 30min at room temp. Precipitated milk was filtered, washed dried and weight and taken out percentage yield. The percentage was calculated using formula given below:

Percentage yield of casein = weight of casein (g)/ weight of milk (g) x 100

III. RESULTS AND DISSCUSION

Sample	Zoological name	Casein (in grams)	Percentage yield of casein
1A Gir Cow	*Bos indicus*	1.382	1.3%
2 A Gir Cow	*Bos indicus*	1.274	1.2%
3A Gir HYBRID	*Bos indicus*	2.562	2.5%

4A Desi Cow	*Bos indicus*	1.359	1.3%
5A Desi cow	*Bos indicus*	1.369	1.3%
6A Haryanvi (Lactating)	*Bos indicus* (Hariana breed)	2.439	2.4%
7A Haryanvi (Lactating)	*Bos indicus* (Hariana breed)	2.418	2.4%
1B Murrah Buffalo (Haryanvi)	*Bubalus bubalis*	1.86	1.8%
2B Murrah Buffalo (Haryanvi)	*Bubalus bubalis*	1.815	1.8%
2C Berrari Goat	*Capra aegagrus hircus*	1.738	1.7%
1D Sahiwal	*Bos indicus*	1.373	1.3%
2D Sahiwal	*Bos indicus*	1.373	1.3%
1E Jersey	*Bos taurus*	1.117	1.1%
2E Jersey	*Bos taurus*	1.142	1.1%
1F Beetal Goat	*Capra aegagrus hircus*	1.415	1.4%
2F JamunaPari Goat	*Capra aegagrus hircus*	2.683	2.6%
3F Sangamneri Goat	*Capra aegagrus hircus*	1.058	1%
4F Black Bengal Goat	*Capra aegagrus hircus*	2.537	2.5%

Table 2: Casein Protein yield in grams and percentage

In this study, milk samples from different breeds of buffalo (Murrah), cow (Gir, Hybrid Gir, Desi, Haryanvi, Sahiwal, Jersey), and goat (Beetal, Jamunapari, Sangamneri, Black Bengal, Berrari) were collected from four different sites in Jabalpur district. The variation in casein protein content (g/100ml) was analyzed using the iso-electric precipitation method. The results indicate that goat milk yields a relatively higher amount of casein protein compared to buffalo and cow milk. Among the goat breeds, Jamunapari goat milk exhibited the highest casein content (2.68 g/100 ml), whereas Sangamneri goat milk showed the lowest (1.05 g/100 ml).

Similarly, among the cow breeds, Hybrid Gir and Haryanvi (Lactating) cows exhibited higher casein content (2.56 g/100 ml and 2.41 g/100 ml, respectively), whereas Jersey cow milk had the lowest casein content (1.11 g/100 ml). For buffalo milk, the average casein yield was around 1.8 g/100 ml. The casein values obtained in this study align with previous research findings, reinforcing the observed trends in casein distribution among different dairy species.

Given the importance of casein as a slow-digesting protein with significant nutritional and functional benefits, this study highlights its higher availability in goat milk, followed by buffalo and cow milk. Such findings are valuable for dietary recommendations, protein supplementation, and the dairy industry, especially for cheese and casein-based product manufacturing. The quantitative estimation of casein across different milk sources provides essential insights for optimizing casein extraction and utilization in dairy processing.

IV. CONCLUSION

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