

Physiochemical Composition, Nutritional Value, and Health Benefits of Mithun Milk

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Abstract

Since antiquity, milk has been considered an important source of food. Milk is a biological fluid obtained from the healthy mammary glands of dairy animals. It is rich in several macronutrients and micronutrients essential for maintaining good health. Mithun (*Bos frontalis*), a rare semi-domesticated bovine species, is found in mountainous regions, mainly in the Northeastern Hills of India, Bhutan, China, Bangladesh, and Myanmar. It holds significant promise as a nutrient-rich food source with potential health benefits. The total population of mithun in India was estimated as 0.29 million in 2012. Compared to conventional bovine milk, mithun milk exhibits higher levels of protein, fat, solids-not-fat (SNF), calcium, and essential nutrients like calcium, phosphorus, and vitamins A, D, and E, making it a valuable source of nutrients for bone health, tissue repair, and immune function. Mithun milk also contains bioactive compounds like lactoferrin and conjugated linoleic acid (CLA), which confer antimicrobial, anti-inflammatory, and antioxidant properties. These compounds further enhance the health-promoting potential of mithun milk. Although milk of mithun has a lower yield, raising awareness and promoting its consumption could yield significant benefits for public health and rural economies. This review examines mithun milk's chemical composition, nutritional value, and health benefits, emphasizing its significance for rural communities and consumers seeking nutrient-rich foods.

Keywords

Bovine species, Chemical composition, Health benefit, Mithun, Mithun milk, Nutritive value

1. Introduction

Milk has been recognized as an excellent source of nutrition for both sexes and all age groups. Though cow's milk is globally consumed, the milk obtained from several other species of domesticated animals, such as buffaloes, goats, camels, donkeys, yak, Mithun, and sheep is also used in several parts of the world. Mithun (*Bos frontalis*) is found in South Asian countries namely India, Bhutan, China, Myanmar, and Bangladesh [1, 2]. In India, mithun is reared in some of the States, such as Manipur, Arunachal Pradesh, Mizoram, and Nagaland [2]. It is primarily kept by the tribal community as a meat animal [2]. Mithun is crucial for the social, cultural, and nutritional facets of rural life in these regions [3]. A nutrient-rich liquid such as milk is essential for maintaining human health. Because of its nutritional benefits, which aid in bone growth and development in children and treat calcium deficiency, it is widely consumed worldwide. El-Hatmi and co-investigators [4] reported that menopausal women who run the risk of developing osteoporosis should pay particular attention to this, and must consume milk as it is an excellent source of calcium.

Mithun milk, in addition to its meat, is reported to be superior in quality compared to the milk of other bovines. Though mithun milk is suitable for human consumption, it produces small quantities ranging between 1.0-1.5 kg/day/animal [2]. However, mithun milk is nutritionally superior to any other domesticated species [5]. Scientific studies comparing Mithun

milk with other livestock species. It contains higher fat, protein, and solids-not-fat (SNF) than cattle, sheep, goat, and buffalo milk [1-3, 6]. An antibacterial component called lactoferrin has promising medicinal value, and it is also reported that mithun milk contains double the quantity of total energy value than traditional cow milk [2].

The nutritional profile of mithun milk underscores its potential significance, boasting high levels of protein and amino acids and likely providing essential nutrients such as calcium, phosphorus, and vitamins A, D, and E, which are vital for bone health and overall well-being [6]. Furthermore, mithun milk may possess bioactive compounds and antioxidants that offer additional health benefits beyond basic nutrition [3]. While mithun milk is not as widely consumed or researched as other livestock milk, research into its composition and potential health benefits could provide valuable insights. Additionally, efforts to raise awareness and promote Mithun milk consumption could enhance its utilization, benefiting rural communities and consumers seeking alternative sources of nutrient-rich foods. Therefore, the present paper describes the chemical composition, nutritional value, and potential health benefits of mithun milk.

2. Physiochemical composition and nutritive value of mithun milk

Mithun milk presents a nutrient composition that aligns closely with other domestic animal milk varieties and possesses unique characteristics that set it apart. Mithun milk has a pleasant, fragrant flavor and is colored white to creamy white. Tamang and Perkins [7] reported that the density (g/ml) and pH lactometer reading at 15.5°C of mithun milk is 1.023, 36.03, and 7.09, respectively. In comparison to cow milk, these values are higher. Mithun milk has a higher specific gravity and relative viscosity than milk from cows and buffalo, which could be attributed to its higher total solid (TS) content [2]. Concerning mithun, the average lactation length was found to be 340 ± 2 days and the quantity of milk was less (0.87-1.46 kg/day) compared to indigenous cattle and buffalo; however, it was considered superior to cattle or buffalo milk in nutritive value [5, 8]. Several studies indicated that mithun milk contains higher total protein, fat, total solids, and solid-not-fat than cow, buffalo, sheep, and goat milk. These properties make mithun milk a more nutritious option for home consumption in hilly areas.

In addition to its nutrient richness, mithun milk contains lactose, a type of sugar providing energy, akin to other mammalian milk varieties. However, its lactose concentration may exhibit slight variations compared to milk from other bovine species [6, 8-10]. Detailed variations in milk composition, encompassing total solid, fat, total protein, solid-not-fat (SNF), lactose, and ash contents across different species, are presented in Table 1.

Mithun milk contains a significant proportion of essential amino acids, such as threonine, isoleucine, phenylalanine, lysine, and tyrosine, which are crucial for various physiological functions in the body [11]. The mineral composition of mithun milk contributes to its nutritional value, with notable levels of essential minerals such as calcium (Ca) and phosphorus (P). Notably, mithun milk's calcium levels surpass those of cattle, buffalo, sheep, goat, camel, and yak [3, 6]. Moreover, mithun milk stands out for its rich vitamin content, particularly featuring higher concentrations of vitamins A, D, and E compared to other species. Multiple studies have documented these findings, emphasizing the nutritional superiority of mithun milk [3, 6, 12].

Table 1. Variations in the milk chemical composition of different domestic animals

Milk Composition	Mithun	Camel	Cow	Sheep	Goat	Buffalo
Total solids (TS)%	20.94-22.62 41.60 7.72-10.25	3.37-4.22	13.43-4.34	17.48-19.50	12.60-15.17	12.73-15.90
Fat%	2.05 3.4-17 6.31-6.78	1.2-5.4	4.0-5.0	8.0-9.6	3.9-5.7	4.0-6.5
Total Protein%	38.51 4.4-9.8 13.40-13.70	3.37-4.22	4.46-5.75	5.32-7.74	1.10-3.18	3.12-4.12
solid-not-fat (SNF)%	6.8-22.2 10.28% 4.36-4.60		8.43-10.14	9.48-10.1 6.8-7.5	8.53-9.47	8.28-9.40
Lactose%	1.04 5.57	2.4-5.8	3.0-4.6	3.0-4.2	4.0-5.5	3.28-4.80
Ash%	0.9-0.93	0.6-0.9				
Source	[6, 8-10, 13]	[14, 15]	[10]	[10, 16]	[10]	[10]

3. Health benefits of mithun milk

Milk is universally recognized as a valuable source of essential nutrients for mammals, encompassing proteins, fats, carbohydrates, vitamins, and minerals vital for maintaining good health [17]. Within milk, proteins play a crucial role, harboring significant amounts of bioactive peptides (BAPs) with various health-promoting properties such as antioxidative, antithrombotic, antimicrobial, and immune-modulatory activities [18]. Mithun milk, in particular, stands out for its myriad health benefits for human consumption, attributed to its rich nutrient profile and abundance of bioactive compounds [19]. Research suggests that mithun milk consumption and its products in the human diet can lead to a decline in the frequency of metabolic disorders [19].

Another noteworthy feature is the amount of important amino acids found in mithun milk. Since the body cannot naturally make lysine, one of the essential amino acids, it must be supplemented through diet. Mithun milk is a valuable source of these nutrients [6]. One of the vital amino acids in mithun milk, lysine, is essential because it helps make collagen and absorb calcium. Collagen is essential for maintaining connective tissue integrity, wound healing, and supporting the immune system. The presence of lysine in mithun milk contributes to its potential health benefits in promoting bone health, tissue repair, and immune function [6]. Additionally, mithun milk is rich in branched-chain amino acids (BCAAs) such as isoleucine, which is essential for muscle tissue growth, repair, and recovery. These BCAAs play a crucial role in supporting muscle health and preventing muscle breakdown, particularly during periods of exercise or physical exertion [20].

Mithun milk is known for its high levels of vitamins A, D, and E [6, 12], as well as calcium, compared to other species of dairy animals [3, 6]. Calcium is essential for maintaining healthy bones, muscle function, and nerve transmission. Additionally, vitamins play a significant role in various physiological processes such as vision, bone health, immune function, and antioxidant protection. Moreover, mithun milk is likely to contain conjugated linoleic acid (CLA), a bioactive lipid known for its anti-allergic and anti-inflammatory properties. CLA can decrease the production of cytokines, prostaglandins, and immunoglobulins linked to conditions like atherosclerosis, cancer, and irritable bowel disease [21].

Devi and co-authors [6] suggested that mithun milk typically contains around 88 mg/100 g of calcium and 147 mg/100 g of phosphorus. Notably, Mithun milk possesses a significantly higher proportion of lactoferrin compared to cattle milk, with studies indicating ampicillin and kanamycin in that it reduces the development of dangerous bacteria such as *E. coli* and *S. aureus* by 28 and 53%, respectively [2, 22].

It is important to mention that milk produced in an unsanitary environment may act as a vehicle for many microbes including the spoilage-producing and pathogenic ones that cause infections to the susceptible individuals [23]. Pal [23] isolated some important food-borne pathogens, such as *Staphylococcus aureus*, *Listeria monocytogenes*, *Escherichia coli*, and *Campylobacter jejuni* from the raw bovine milk. These pathogens are known to produce serious infections in human beings [24]. It is advised that raw milk should not be taken as it poses a hazard to the consumers. Hence, hygienic processing of milk is very imperative from a food safety point of view [25].

4. Conclusion and recommendations

Mithun milk, obtained from a unique semi-domesticated bovine species, offers significant nutritional value and potential health benefits compared to other livestock milk varieties. Its rich composition of protein, fat, essential amino acids, vitamins, and minerals, including calcium and vitamins A, D, and E, positions it as a valuable dietary resource for promoting bone health, tissue repair, and immune function. Moreover, bioactive compounds, such as lactoferrin and conjugated linoleic acid (CLA) enhance its health-promoting properties, conferring antimicrobial, anti-inflammatory, and antioxidant effects.

Based on the above conclusion, the following recommendations further increase the benefits of mithun milk:

- Intensified efforts to raise awareness about the nutritional superiority and health benefits of Mithun milk are essential.
- Further studies should be conducted on the chemical composition and health benefits of Mithun milk, including clinical studies to explore its effects on human health outcomes.
- Strategies to promote the integration of Mithun milk into dietary practices should be devised, particularly in regions where Mithun is found.
- Priority should be given to investigating the medicinal value of Mithun milk in areas like Asia, which has a high potential for the Mithun population.
- It is emphasized to undertake studies to elucidate the potential of Mithun as a dairy animal.

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