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Goat Milk: Miracle for human – A Review

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Abstract

Milk has been an important source of food for man since the dawn of civilization and regarded as an ideal food from nutritional point of view milk is nature's the most nearly perfect food. It provides all the nutrient elements, essential for the human nourishment, it contains high quality proteins, lactose, and flavor enriching fat, essential fatty acids, vitally essential amino acids, mineral, and vitamins in well balanced form in an easily digestible and assailable form. Transforming the milk into milk products have been developed from prehistoric times and practiced even today. The non-bovine annual milk production including the caprine stands at 133 million tons, representing more than 17% of total milk output worldwide. Goat milk is the most significant contributor in terms of production with 13.5% of the total output. Besides many beneficial effects of goat milk, the advantages of breeding goats, such as the lower cost of animals, the need for less feed and water, and often not requiring the specialized housing that larger livestock need, are reasons to promote the improvement of goat milk production worldwide. Goat milk do possess unique biologically active properties, such as high digestibility, distinct alkalinity, high buffering capacity, and certain therapeutic values in medicine and human nutrition. Goat milk has been highly recommended as an substitute for cow milk, suffering from the allergy by the later. Goat milk has high amounts of conjugated linoleic acids playing important roles in immune stimulation, growth promotion, and disease prevention.

Keyword: caprine, nourishment, allergy, immune stimulation

Introduction

Milk is one of the important commodities among the animal products, which is predominantly the domain of landless laborers and small/marginal farmers in our country, who generally keep 1-2 milch animals under mixed farming system. The small holder has about 70% of the milch animals, small and

marginal farmers own almost 78% of total land holdings. The dairy sector provides 70 million farm families the triple benefit of nutritive food supplementary income and productive employment for family labor, mainly women **(Gandhi. 2005).**

In India, 46 percent of total milk produced is consumed as fluid milk while the remaining 54 percent is transformed into various milk products (Hemlatha and Reddy, 2001). Dieticians and nutrition scientists have recommended minimum level of milk and milk product to be included in the items of dairy consumption.

Today's Indian consumer is more receptive to new ideas, more concerned with health and nutrition and desires higher-quality more convenient food items. Milk and milk products are in high demand due to population expansion, changes in demographics, socioeconomic level, income distribution and people's tastes and preferences. The domestic sector consumes the most milk and milk products, since a large number of Indian's are vegetarians and milk is an integral part of their diet.

The goat has been known as the oldest domesticated animal in mankind's history as a source of milk and different dairy products, required for survival as well as fulfilling the need for a nutritious and balanced diet. It although contribute around 2% production supply of the world's total milk, their significance in the economic up liftment and nutritional well-being (Park YW., 2017).

According to the Food and Agriculture Organization (FAO), developing countries are home to more than 90% of the world's goat population; Asia has the largest proportion of the world's goat population, followed by Africa.

Comparison with other milk sources

Goat milk has various effects on human health considering the total solid, fat, protein, lactose, mineral, and vitamin contents. In addition to positive effects on physical and sensory characteristics of dairy products, lipids of goat milk provide better digestibility with small fat globule size and high short- and medium-chain fatty acids content. The most important effect of goat milk proteins is their healing effect on cow milk allergy, the most common food allergy, which causes many deaths in infants. In addition, the β-casein/α_{s1}-casein ratio (70%/30%) of goat milk proteins is similar to human milk, which results in more digestibility compared to the cow milk in relation to higher sensitivity of β-casein to the protease enzymes. Lactose is the main carbohydrate of all species of milk, and its content in goat milk is lower than the others. In contrast, goat milk rich in oligosaccharides is important in its protective function of intestinal flora against pathogens and in brain and nervous system development. In addition to higher amounts of some minerals, more importantly the bioavailability of minerals in goat milk is

higher than of minerals in cow milk. Considering the millions of child deaths every year caused by Vitamin A deficiency, The higher Vitamin A content may be the most important difference among the other vitamins in goat milk compared to cow milk. It is regarded as the distinct source of providing a high amount of animal derived essential nutrients supply to the individual in the country having the vegetarian diet dependency in their diet.

Basic Processing methods involved for the conversion of goat milk

The processing techniques involved in the processing of fluid goat milk are similar to that of cow milk. Due to the small fat globule size as compared to the cow, goat milk is commonlynot required to be homogenized, results in a naturally homogenized consistency. After the milk is collected from an individual animal, a bulk tank, or a milk transportation truck,it is filtered to remove unwanted elements like sediments, udder body cells, and certain bacteria (Moatsou G. 2017). Depending upon the time and temperature relation, pasteurization can be achieved with the time tempearture combination viz, Low-temperature long time (65^0 C, 30 min); high-temperature short time (72–75^0 C for 25 s); Ultra-high temperature (125 ± 5^0 C for 4s or 135 ± 5^0 C, 4s). (chen 2019; cole 2020). Pasteurization is critical to overcome the disease brucellosis in human, which is frequently transmitted via unpasteurized goat milk and its cheese (Botta 2009). with the chilling and bottling of the milk, which is distributed in refrigeration van. The process of separation with the objective of cream separation is to standardize milk fat and produce butter, ice cream, and other dairy products. cream in goat milk is optional, as goat milk cream is rarely found in commercial markets. (Moatsou G. 2017). In brief, the processes involved for the conversion includes the following:

1. Pasteurization
2. PEF
3. Microfiltration
4. Ultrafiltration
5. HPP
6. Ultrasound

Milk Products Origin from Goat Milk

a. Cheese: cheese making is obtaining high quality goat milk that is free from visible impurities, abnormal odor or taste, foreign substances, pathogenic microorganisms, and should possess desirable acidity (pH 6.2–6.55). Also, the cheese starter culture bacteria must survive and multiply after being added to the milk (park 2006).

b. Milk Yogurt

c. MilkPowder: It involves the condensation of steam or vapor toward one end of a metalsurface in heat exchangers, forcing the liquid on another endto develop into vapour.

d. Fermented milk

e. Curd

f. Ice cream

A variety of other milk products such as yoghurt, butter, cheese, cream, butter oil, ice cream, condensed milk, dry whole milk flavoredmilk, Paneer, Channa, Srikhand etc. are manufactured fromthe milk of dairy animals including goat. (Nayik G. A. *et al* (2021), Loewenstein *et al*.,1980; Agnihotri and Prasad,1993; Yangilar, 2013; Pal,2014).

Health benefits of goat milk

Milk is a source of nutrition for newborn mammals, as well as children and adults, and it is used for growth and sustenance. It is frequently regarded as a functional food because it exhibits potential bioactive compounds, such as whey proteins and casein, which are discovered to be highly significant for biochemical and physiological functions with a profound influence on human health and metabolism (Turkmen et al.2017). In the current scenario, there is an increase in the importance of goat milk due to its unique composition and thus it is utilized as a superior raw material for the production of food for infants and the elderly, as well as for some segments of the population with special dietary requirements (Hodgkinson et al (2018; Prosser et al 2021). Because of its nutritional richness, digestibility, dietary and therapeutic potential, goatmilk is becoming an indispensable part of the human diet (Verruck et al. 2019). In addition to the presence of high-quality protein, goat milk comprises unsaturated fatty acids, vitamins, hormones, cytokines, enzymes, growth factors, and bioactive peptides, all of which assist to nourish and protect infants (Lou et al.2018; Sun et al. 2019; Li et al. 2018). Besides nutritional benefits of milk components, additional components such as antibodies, glycoproteins, and oligosaccharides can protect infants by preventing pathogen infections and supportingthe growth of the intestinal epithelium (Parc 2014).

Goat milk has been known for its therapeutic and hypoallergenic characteristics in human health and nutrition and include metabolically activeand bioactive components that are specific to this species' milk. This concept has gained the interest of goat milkconsumers and producers worldwide, particularly in developed nations in recent years (Park 2017). In a study, goat milk treatment cured a large population of children suffering from cow milk allergies; and in another allergy case study, 49 of 55 treated children benefited from goat milk treatment (Park et al 2009). The various Physicochemical functions of the Goat milk constituents are represented in the table 1. (Nayik G. J. *et al.* 2021)

Table -1: Physicochemical functions of the Goat milk constituents

1.	Casein	Anti-viral property	According to preliminary data, the process is non-specific and is mediated by a casein fraction component. This fraction is most likely comprised of one or more distinct components that interact with the capsid receptors or membrane of different viruses, therefore preventing cell entry and replication of pseudo virus SARS-CoV-2, Coxsackievirus A9, and HSV-1 viruses
		Anti-diabetic	Casein hydrolysates present in goat milk have the potential to improvise insulin resistance and treatment of type-2 diabetes
		Anti-hypertensive and immuno-stimulating	Caprine milk β-Casein can generate immune-stimulating and anti-hypertensive peptides
		Angiotensin-converting enzyme inhibitors (ACE inhibitors)	Identification of β-Casein f58–65 and αs2-Casein f182–187 in caprine milk have the potential in producing ACE-inhibitory peptides
		Anticariogenic effects	Calcium-binding Casein phosphopeptides (CPP) present possess anticariogenic properties via preventing caries lesions by recalcification of the tooth enamel, as well as competing for calcium from dental plaque-forming bacteria
		Antioxidant property	Peptides produced from αs-casein exhibit free radical-scavenging action and prevent both non-enzymatic and enzymatic lipid peroxidation
		Antagonistic or agonistic activity	The peptides present in β- and α-casein are known to function as opioid peptides, exhibiting antagonistic, or agonistic effects
		Cytomodulatory effect	Caseinophosphopeptides (CPPs) have been shown to have cytomodulatory properties by suppressing the development of cancer cells or promote the function of immunocompetent cells
2	Casein and whey protein	Immunomodulatory effect	Immunomodulatory effects of peptides and protein hydrolysates obtained from major whey proteins and milk caseins include the proliferation of lymphocytes, production of antibodies, and cytokine modulation
3	Whey protein	Antioxidant property	Whey protein processed at low temperature includes a relatively increased number of certain dipeptides (glutamylcysteine), which can increase glutathione production, an essential antioxidant essential in cellular protection and repair activities
		Anti-appetizing effect	The total content of whey protein present in the diet has been related to decreased LDL cholesterol and increased production of cholecystokinin (appetite-suppressing hormone)
		ACE inhibitors	The hydrolysate of caprine (β-Lg) produced with termolisin yielded four novel ACE-inhibitory peptides

4	Milk protein	Anti-thrombotic activity	Caprine κ-CMP and its hydrolysates with trypsin inhibited the aggregation of human platelet
5	Lactoferrin	Anti-microbial activity	A peptide derived from lactoferrin (Lactoferricins) has anti-microbial action against a variety of Gram-negative and positive- bacteria, fungi, and yeast
6	Fatty acids	Hypocholesterolaemia	Fatty acids present are known to exhibit a hypocholesterolemic effect on blood and tissue through inhibition of dissolution and deposition of cholesterol in gallstones
7	Phospholipid	–	Phospholipids aid in fat absorption by forming a barrier around the fat globules, which keeps them finely distributed. Through their lipotropic action, phospholipids aid in the transfer of fat from the liver
8	Medium-chain triglyceride (fat)	Energy providing effect	Because MCT is a readily accessible energy substrate, goat milk has a substantial influence on supplying energy, particularly in developing youngsters
9	Cholesterol	–	It is considered a metabolic precursor of bile acid and vitamin D. It is essential for metabolic processes involved in DNA synthesis, transportation of lipid, and cell division
10	Oligosaccharide	Cell protection activity	They help in the protection of intestinal mucosa cells against infections by encouraging the development of *Lactobacillus bifidus* in the digestive tract, particularly in infants
		Anti-inflammation	They help in decreasing intestinal inflammation and aid in the repair of damaged colonic mucosa in rat studies
		Prebiotic anti-pathogenic effect	The oligosaccharides present in goat milk help in exhibiting anti-pathogenic and prebiotic effects, associated with enhancement of central nervous system and can be used in supplementation of milk formulation as an alternative to other milk
11	Minerals	Enhanced mineral uptake	In rats, a goat milk-based diet boosted iron deposition in target organs while decreasing anemia
		Increase mineral bioavailability	The consumption of goat milk in rats resulted in increased bioavailability of selenium, zinc, and copper than cow milk-fed rats
12	–	Increase in overall nutrition	Rats fed GM thrived substantially better, had greater liver weights, enhancement in hemoglobin iron content, and its absorption
13	–	Allergy	Goat milk delivery and feeding alleviated gastrointestinal allergies in some infants
14	–	Promotion of growth factors	GM contains a significantly greater concentration of growth factors, and a human epidermal growth factor (hEGF) polyclonal antibody was used to detect the existence of EGF in caprine milk
15	–	Antioxidant property	GM fermented with Lactobacillus fermentum (M4) had remarkable antioxidant activities

Source : **(Nayik G. J. *et***

Summary

Goat milk could be considered as a significant option for consumption in nearly all age groups, compared to other milk obtained from different animal species. Apart from imparting various nutritional benefits, goat milk promotes a wide range of health benefits in humans. Bioactive peptides present in goat milk- based products have tremendous therapeutic potential by regulating the physiological and metabolic functions of the body. Goat milk and milk-based products exhibit excellent cholesterol properties by improving cholesterol mobilization and controlling its storage in the blood. Functional and nutraceutical properties of goat milk could be attributed to its strong bioactive potential and hence could be considered for future applications in the development of functional foods for the treatment of certain chronic diseases. Exploiting the use of novel technologies in the processing of goat milk and its product could pave way for new horizons in the development of functional foods based on goat milk attributed to its significant bioactive potential.

Goat milk can be utilized for the formulation of numerous common dairy ingredients such as ice cream, butter, etc. as well as for the development of novel dairy products. It can also be used to develop different infant-based foods, and will surely be a game- changer in infant foods if more and more detailed research is carried out. Goat milk is rich in bioactive compounds and functional ingredients, so its potential could be explored for the development of dairy based functional foods and nutraceuticals. (*Gulzar Ahmad Nayik et al .2021)*

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