

Importance of Goat Milk

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Goats are important component of livestock industry having adaptability to harsh climates which make them suitable for landless and marginal farmers. The contribution of goats in supplying milk and milk products is high and it has significant role in rural economy and health. Goat milk contains higher amount of Ca, Mg and P than cow and human milk. Medium Chain Triglycerides (MCT) which are more in goat milk have been recognized as unique lipid with unique health benefits. The soft curd of goat milk may be an advantage for adult humans suffering from gastrointestinal disturbances and ulcers. Goat milk is recommended for infants, old and convalescent people. The consumer acceptance of goat milk and its products is reported to be excellent. Goat cheese production in Nepal is coming up in a big way which will prove to be a boon to Nepalese cheese industry. Despite this fact, goat has remained neglected in research and development. Universally recognized as 'poor man's cow', goat now has to be fully exploited to get maximum benefits, particularly meat, milk and milk products having medicinal values.

Keywords: Goat milk, Medicinal value, Marketing, Nepal

Introduction

Due to rapidly increasing human population, the demand for milk and milk products is on the rise in the tropical developing countries. The increased demand can be met by increasing ruminant livestock population as suggested by Devendra and McLeroy (1982). The contribution of small ruminants in general and goats in particular in meeting this demand will be very high. Goats are important milk producers in several parts of the tropics and contribute significantly to human nutrition in many developing countries (Devendra, 1999). A goat is universally called as "Poor man's cow" (Iqbal *et al.*, 2008). Developing countries raise 775 million of the 809 million goats in the world and 86 percent of them are in low-income countries with a food deficit. Sixty-five per cent of the global goat population is maintained in the developing countries of Asia and 29 percent in Africa (Singh *et al.*, 2006). Goat's population is increasing in Nepal each year and according to FAOSTAT, 2010 it is around 8.8 million. These statistics are a strong indication of the importance of goats in the livelihoods of people in developing and under-developed countries, especially in Asia (Singh *et al.*, 2006). Asia alone produces about 80 % goat milk (Iqbal *et al.*, 2008). In this regard main countries include India, China, Bangladesh, Iran, Pakistan and Turkey (Khan *et al.*, 2003).

Why goat?

In Nepal, the goats are an important livestock species uniquely adapted to the temperate environment. Goats can survive under environmental conditions that are difficult for other domestic livestock species. According to Devendra (1999), goats have small land and initial investment requirements, and their adaptability to harsh climates makes them suitable for landless and marginal farmers. Goat milk is very nutritious and is an acceptable food in several parts of the tropics (Devendra, 1999). Daily milk yield varies from 0.9 L to 4.5 L as reported by different researchers (Iqbal *et al.*, 2008). Goats are prolific breeders and achieve sexual maturity at an early age of 10-12 months; gestation period in goats is short and it starts giving milk at the age of 16-17 months (Mangurkar, 2007).

Composition of goat milk

Compositions of goat milk vary with diet, breed, individuals, parity, season, feeding, management, environmental conditions, locality, stage of lactation, and health status of the udder (Park *et al.*, 2007) which also affects taste of goat milk. Comparison between composition of goat milk with of cow and human milk is given in Table 1.

General characteristics of goat milk

Goat milk contains 3.8% fat, 3.4% protein, 4.1% lactose, 0.8% ash, 8.9 % SNF (Park *et al.*, 2007) and 87% water (Iqbal *et al.*, 2008). Goat milk differs from cow or human milk in having better digestibility, alkalinity, buffering capacity and certain therapeutic values in medicine and human nutrition (Haenlein and Caccese, 1984; Park and Chukwu, 1989; Park, 1994). Density of goat milk is comparable to that of cow milk, while it has higher specific gravity, viscosity, titratable acidity, but lower refractive index and freezing point than cow milk (Parkash and Jenness, 1968; Haenlein and Wendorff, 2006). The freezing point of goat milk is about -0.580°C , viscosity 13.4 mP at 27°C , titratable acidity as lactic acid ranges from 0.11 to 0.18 per cent (Roy and Vadodaria, 2006). Surface tension of goat milk is within the range of cow milk (Ju'arez and Ramos, 1986). The mean pH value ranges from 6.5 to 6.9. The curd tension of goat milk is much lower than that of cow milk. The average value with pepsin-HCL test was 36 (Roy and Vadodaria, 2006).

Physico-chemical properties of goat milk constituents

Lipids in goat milk have higher physical characteristics, than in cow milk, but there are variations between different reports (Anifantakis, 1986; Park, 2006a). Lipids in goat milk have generally higher physical characteristics than in cow milk (Anifantakis, 1986; Park, 2006a). The unsaponifiable matter of milk fat and acid values are not different between goat and cow milk, but goat milk has lower iodine values, which reflects its greater amount on lower and unsaturated fatty acids (Park, 2006a).

Cow milk has a higher saponification value and slightly greater refractive index than goat milk, which relates to the

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Table 1. Composition of goat milk in comparison with cow and human milk

Particulars	Per 100 gram		
	Goat	Cow	Human
Total solid (%)	12.97	12.01	12.5
Energy kilo calorie	69	61	70
Protein (%)	3.56	3.29	1.03
Lipid (%)	4.14	3.34	4.38
Carbohydrates (%)	4.45	4.6	6.89
Ash (%)	0.82	0.72	0.2
Calcium (mg)	134	119	32
Iron (mg)	0.05	0.05	0.03
Magnesium (mg)	14	13	3
Phosphorus (mg)	111	93	14
Potassium (mg)	204	152	51
Sodium (mg)	50	49	17
Zinc (mg)	0.3	0.38	0.17
Ascorbic acid (mg)	1.29	0.94	5
Thiamin (mcg)	40	40	20
Riboflavin (mg)	0.138	0.162	0.036
Niacin (mg)	0.277	0.084	0.177
Panthothenic acid (mg)	0.13	0.314	0.223
Vitamin B ₆ (mcg)	60	60	10
Folacin (mcg)	1	6	5
Vitamin B ₁₂ (mcg)	0.065	0.0357	0.045
Vitamin A RE (mcg)	44	52	58
Vitamin D (mcg)	0.11	0.03	0.04
Vitamin E (mg)	0.03	0.09	0.34
Vitamin C (mg)	1	1	4

Source: Haenlein, (2001)

longer carbon chains and saturation of the fatty acids (Park, 2006a). Goat milk may have lower Reichert Meissl and higher Polenske values than cow milk, suggesting that goat milk fat contains less soluble and more insoluble volatile fatty acids than cow milk fat (Park, 2006a).

Remeuf and Lenoir (1986) reported that the relative proportions of the major *casein* components of goat milk are quite different from those in cow milk. Goat milk contains less α_s -casein, and often has more α_{s2} than α_{s1} -casein. The latter is present in highly variable amounts depending on individual goats (Mora-Gutierrez *et al.*, 1991). Proportions of κ -casein and especially β -casein are higher in goat than in cow milk. Casein contents in goat milk range from 16 to 26 g/L, the proportions of NPN of the total nitrogen content are between

3% and 13%, the ionized calcium levels between 0.07 and 0.19 g/L, the total inorganic phosphorus between 0.45 and 1.0 g/L (Remeuf and Lenoir, 1986), depending on individuals, lactation period, and sample differences (Parkash and Jenness, 1968). The relative compositions of *essential amino acids* are given in Table 2. The *vitamins* in goat milk are comparable with those of cow and human milk (Roy and Vadodaria, 2006). The *mineral* contents of goat milk have already been presented in Table 1. Goat milk contains more calcium, phosphorus and potassium than cow and human milk.

Dietary and medical significance of goat milk

Goat milk is adequate for human infant in vitamin A and niacin and supplies generous excesses of thiamin, riboflavin and pantotheanate (Jenness, 1980; Haenlein, 2004). It is, however,

Table 2. Relative composition of essential amino acids in goat and cow milk taking human milk as standard

Particulars	Goat	Cow
Arginine	277	277
Histidine	387	387
Isoleucine	370	355
Leucine	330	339
Lysine	426	384
Methionine	381	395
Phenylalanine	337	346
Threonine	354	324
Tryptophan	259	270
Valine	381	349

Source: Haenlein, (2001)

deficient in vitamins C, D, B₁₂, pyridoxine and folic acid (Park, 1994). Thus, when used for infant feeding, goat milk must be corrected by appropriate fortification.

One of the most important contributions of goat milk to human nutrition is the calcium and phosphate that it supplies. Goat milk contains about 1.2 g calcium and 1 g phosphate per litre; these concentrations are similar to those in cow milk (Jenness, 1980). Human milk contains much less of these minerals with only one-fourth as much calcium and one-sixth as much phosphate. Thus goat milk provides a great excess of Ca and P in relation to energy to human infant, both calcium and phosphorus of goat milk are absorbed by the human infant (Jenness, 1980).

The soft curd of goat milk may be an advantage for adult humans suffering from gastrointestinal disturbances and ulcers (Haenlein, 2004). High buffering capacity of goat milk appears to be useful for treatment of gastric ulcers (Park, 1994). Goat milk has been recommended as a substitute for patients allergic to cow milk. Between 40-100% of patients allergic to cow milk proteins tolerate goat milk (Park, 1994). Medium chain length fatty acid or Medium Chain Triglycerides (MCT) which are more in goat milk have been recognized as unique lipid with unique health benefits in mal-absorption syndromes, chyluria, steatorrhea, hyperlipoproteinemia, and in cases of intestinal resection, coronary bypass, premature infant feeding, childhood epilepsy, cystic fibrosis and gallstones. MCT also inhibits or limits cholesterol deposition, dissolve cholesterol gallstones and contributes to normal growth of infants (Roy and Vadodaria, 2006).

Goat milk and milk products

Traditionally, goat milk is produced in small farms. Fresh goat

milk is sold as pasteurized milk and in variety of packaging in super market chains and health food shops in many western countries. In fact, fresh milk obtained under sanitary conditions from properly fed and managed healthy goats is free from objectionable flavour and odour (Roy and Vadodaria, 2006). The consumer acceptance of goat milk and its products is reported to be excellent. Some of these as described by Roy and Vadodaria, (2006) are discussed as below:

Special beverage- The goat milk standardized to 2% fat and 10.5% SNF was fortified with Vitamin A and D to label it as protein fortified low fat goat milk.

Khoa mawa- Mawa made from goat milk is sticky, no release of fat occurs during preparation, yellowish colored with moist surface, hard body and smooth texture.

Paneer- Good quality paneer free from goaty odour and flavor can be prepared.

Chhana- Good quality chhana has been prepared from goat milk which has been used for preparing Sandesh and Rasagolla.

Ice-cream- A premium quality ice-cream can be prepared using goat milk.

Infant Foods- In USA and South Africa, goat milk is sold in evaporated or spray dried form for pediatric use.

Yoghurt- Literature says that goat milk yoghurt is available on most supermarket shelves.

The characteristic goaty flavour is completely masked in goat milk yoghurt. Another positive aspect is that it does not show 'whey off' at 4°C storage as in case of unhomogenized cow milk yoghurt.

Ghee- Goat milk, due to its relatively small fat globules pose a problem during separation and its typical flavour, for ghee manufacture. In addition, ghee from goat milk is greasy. Therefore, blending of goat milk with buffalo milk in 1:1 ratio yields good quality ghee.

Cheese- Soft and semi hard varieties of cheeses are made from goat milk. In European countries, these cheeses are marketed as 'Premium Cheese'. According to Pal *et al.*, 2011, Greece and France have the largest goat milk cheese production. In India, goat milk has been used for making hard cheese. Attempts have also been made to manufacture Mozzarella cheese from blends of cow, goat and/or buffalo milk.

Nepalese scenario of goat cheese making

Goat milk is the proprietary item for a few varieties of soft, hard and semi-hard cheeses. Cheese production in

Nepal is coming up in a big way. Recently, *Jamunapari* and *Saanen* goat milk has been used for making soft and hard cheeses in the country following the path of France. France contributed technology and other support for initiation of goat milk production in Nepal. The ripened goat cheeses have characteristic piquant and peppery sharp flavor (Personal Communication, 2012).

Functional benefits of goat cheese

Goat cheese, like goat milk, is easier on the human digestive system and lower in calories, cholesterol and fat than its bovine counterpart. In addition, goat milk cheese is rich in calcium, protein, vitamin A, vitamin K, phosphorus, niacin and thiamin. The fats found in goat milk products are high in middle chain fatty acids, which are easier for the body to process than those found in cow's milk (Anon., 2012).

Marketing potential of goat milk and cheese

Medicinal value of goat milk has been documented in Nepalese *Ayurveda* (Nepalese Traditional Medicine) (Bajracharya *et al.*, 2010), Indian *Ayurveda* and Bhavprakash and goat milk was recommended as an effective dietary item for the patients suffering from tuberculosis, dysentery, cough and cold and certain gynaecological disorders (Pal *et al.*, 2011). In recent years, there has been an increased interest for goat milk production and conversion to value added products. There is increasing demand for organic and healthy dairy food worldwide including Nepal. The marketing value of such products in developed countries is estimated around US \$14180 million and it is rapidly growing on an average of 10-12% annually. In some countries, the growth is expected to cross more than 30% (Rathinam, 2005). This trend of consumer interest in goat cheese in Nepal is increasing and the present demand of goat cheese is not fulfilled by supply (Personal Communication, 2012). Mostly cheese is consumed in pizza parlours and fast food chains and to meet the demand, industrial production of cheese is continuously growing (Bhattarai and Acharya, 2010). Goat milk can be used as a major raw material for development of soft, semi soft and hard cheeses in the country which will prove to be a boon to Nepalese cheese industry.

Conclusion

In conclusion, it can be said that the contribution of goats in supplying milk and milk products is high and it has significant role in rural economy and health especially for developing countries like Nepal. Despite this fact, goat has remained neglected in research and development. Universally recognized as 'poor man's cow', goat has to be fully exploited to get maximum benefits, particularly meat, milk and milk products having medicinal values. This could be a greatest advantage for industrialization of a country.

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