



# Why Does Goat Milk Matter? - A Review



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## Abstract

The worldwide distribution of goats was discussed leading to the justifiable assumption that more people drink goat milk or eat their products than any other milk after weaning from human nursing. Goats have had a superior growth rate in numbers compared to other milk producing domestic animals, especially in the developing countries with large population increases and high rates of undernutrition and malnutrition. Goat farming, especially with milking goats can be quite profitable regardless of country, if intensive types of management are practiced, leading to the prospect that for the increasing people populations there are increasing numbers of milk producing goats available to fight undernutrition and malnutrition. The choice for goat milk has at least three reasons,

- A. They are more adapted to severe climate and geological conditions than any other domestic milk producing mammal.
- B. They are easier and cheaper kept, especially by women and children than any other domestic milk producing mammal.
- C. Their milk has superior nutritional and health qualities compared to the milk of the other domestic milk producing mammals. Thus it can seriously be asked why does goat milk matter?.

**Keywords:** Dairy goats; Cow milk allergy; Alpha-s-2 casein; Medium chain fatty acids; Conjugated linoleic acid (CLA)

## Introduction

Globally considered goats are found on each continent except in the Antarctic, and they are giving milk to man on each continent except in the Antarctic. This is in contrast to other animals producing milk for human consumption, which when ranked by numbers globally are: dairy cows (*Bos taurus*), but they have difficulty living in desert and mountainous countries; then there are sheep, but they have been kept mainly for wool and meat production, water buffaloes are not found nor milked outside of India, Southeast Asia and Italy, Brahma-Zebu (*Bos indicus*) cattle milk production is limited to Brazil and Central America, Yak (*Bos grunniens*) are milked only in the high altitude mountains of Tibet and Mongolia, camels are only milked in desert countries, horses and donkeys have been milked in Mongolia, Bulgaria and on specialty farms in Europe, Egypt, Chile, moose are milked on a resort farm in Northern Russia, and reindeer produce milk for people in a few arctic regions of Siberia and Finland, while the South American camelids like llamas and Alpaca have never produced milk for man nor have any other mammalian species there before the time of Columbus, and which is a very strange situation, that people like the Incas, Mayas, Aztecs, who were very advanced technologically and apparently also very athletic, but lived

without any milk or dairy products in their diet, contrary to the belief of health authorities in Western countries stating that about 1,000 mg calcium is a daily dietary requirement of adult humans and which can be obtained best from three glasses of milk.

Worldwide goats have reached the 1 billion population size due to tremendous percentage increases of more than 50% more goats during the last 40 years, especially in Africa and Asia [1]. Their numbers are stagnant in the Americas while slightly decreasing in Europe but actually increasing in the Mediterranean region, which reflects dairy goat increases against the numbers around the world, which are more dual purpose, meat, brush and fiber goats.

The world statistics of goat milk production also shows a 62% increase from 1993 to 2013 or from 11 to 18 million metric tons, with France, Spain, Turkey and Greece leading in tonnage in that order. As the world people population size increased from 5.5 to 7.2 billion during that same period from 1993 to 2013, it is important and comfortable to know that the large goat number increases in Asia and Africa try to keep pace with the need to feed more people, and that more people actually are exposed to goat milk worldwide than to any other milk.

### Economics

Thus the question of economics of dairy goat farming, is it economical to produce goat milk in the face of dairy cows producing so much more milk per animal, this question enters the decision making process. A study of the management of 108 US dairy goat herds in 1978 [2] showed that within a range of 503 to 1,115 kg milk per goat per year an income over feed costs from \$117- to \$406.- per goat per year was reported, respectively.

Other studies have shown similarly the profitability of goat farming, especially when their management was of the intensive type, such as in the study in Greece [3], where the net return per goat per year was \$24.05 for the intensive management type and \$7.55 for the extensive type management. In a large study in India [4] the net income per goat per year ranged from \$1.80 to \$10.00 when milk production per goat per year ranged from 178 kg to 595 kg, respectively.

Under US conditions and Swiss goat production the break-even producer prices for goat milk were determined to be \$0.52 per kg milk at annual production level of 680 kg milk compared to \$0.26 per kg milk at 1,161 kg milk production level [5]. Comparing milk whole sale from the farm with retail sales from farm a study in France [6] showed net returns per goat per year of \$74.93, when the milk was sold as such from the farm, but \$112.00, when the goat milk was processed there into goat cheeses and sold as value added products from the farm, confirming the results of another similar study in Italy [7]. Goat cheeses have seen a great increase in popularity in recent years especially among the more affluent gourmet consumers. Added to the profitability of dairy goat farming per se comes their distinct advantage in areas with harsh climate like the desert in several African and Asian countries and the steep mountainous and high altitude conditions of countries like Greece or China.

Reviews have discussed all this in greater detail [8-10,11]. An updated review would be welcome, as the dairy goat has changed from its former despised reputation to a valued member of the world dairy industry during the last 40 years. FAO statistics [12] have shown in 2001 that goat milk makes up 55% of all milk in Bangladesh, 51% in Somalia, 24% in Iran, and 16% in Sudan, demonstrating the nutritional value of goat milk in underdeveloped countries with high numbers of undernutrition and malnutrition, e.g. in Bangladesh a person is supplied only 5 g protein per day from milk and meat, in Somalia 17 g, in Iran 16 g, and in Sudan 22 g, while the European standards are 60 g from milk and meat. Of course the productivity per goat in those countries needs very much improvement, as not all of their goats are being milked, Bangladesh 40 kg/goat/year, Somalia 31 kg, Iran 15 kg, and Sudan 31 kg, compared to Spain 121 kg and France 400 kg.

### Nutritional value

What then is the justification of producing goat milk, if cow milk and goat milk were the same for the nutrition of man? However, they are not in at least two major categories: proteins and lipids in goat milk are very different from those in cow milk. Milk proteins are of the same type in cow or goat milk, but their relative amounts differ greatly, which affects human digestion and cheese yield significantly. Alpha-s-1 casein is the major protein in cow milk but is only found in very low levels or not at all in goat milk, where the polymorphic variant alpha-s-2 casein dominates, which is responsible for a soft curd, easier digestion but also lower cheese yield [12].

Efforts are under way in France and USA to test goat bucks for the presence of the rare alpha-s-1 casein gene and breed selectively against it. Unfortunately this would eliminate one of the superior values of goat milk for human nutrition, just because cheese yield would be higher. Kappa casein has also been found to differ between cow and goat milk because of amino acid substitutions. Average amino acid composition of goat milk is higher in six of the ten essential acids: cysteine, tyrosine, lysine, valine, threonine and isoleucine. Due to these compositional differences some physical properties of goat milk also differ, such as the size and form of the casein micelle, solubilization, mineral contents and heat stability.

The other major category of differences between the two milks is the lipids. Their contents in milk can vary with different grazing and feeding management in addition to the genetic differences [12], which are principally the short and medium chain fatty acids, that in their higher levels are characteristic for goat milk and some are even named after goats, caproic (C6:0), caprylic (C8:0), capric (C10:0) (SCT). Overall goat milk is generally also higher in contents of medium chain (MCT), monounsaturated, polyunsaturated fatty acids and conjugated linoleic acid (CLA) which is important in human health because of their cardiovascular benefits. In addition the fat globules in goat milk are mostly much smaller than those in cow milk, which has given goat milk the name of being "naturally homogenized" and which is another digestive advantage in human nutrition.

### Health Benefits

SCT and MCT have been used as medical treatments in cases of gastro-intestinal and other disorders including intestinal resection, coronary bypass, gallstones, premature infant feeding, malabsorption syndrome and others, because of their unique ability to provide energy directly in human metabolism instead of being deposited in adipose tissue, while also lowering, limiting and inhibiting cholesterol [13-16], which is of significant benefit for cardiovascular health. This biomedical superiority of goat milk has not been used in marketing and promotion, but has great potential [17].

In a study in Madagascar [18] with 30 hospitalized children those on goat milk outgained the cow milk children by 9 % during the study period. In other studies in Spain [19] similar results were obtained besides a reduction of total cholesterol levels and the LDL fraction, which was due to the higher provision of MCT from goat milk. In an Algerian study [20] with 64 children with malabsorption syndromes, feeding goat milk caused significantly higher rates of fat absorption in the intestines.

Cow milk allergy in infants can be 8% according to one study [21] or as high as 20% according to another study [22] depending on country, but the use of goat milk is a cure in approximately at least 40% of all cow milk allergy cases [23] or more [24]. Many anecdotal reports [25] exist in support of the value of goat milk for cases with cow milk allergy. A preliminary report [26] of a nutritional study with 38 children drinking daily either 1 liter goat milk or 1 liter cow milk showed that 22% of the cow milk children were underweight.

The goat milk children were superior in skeletal mineralization, blood serum vitamin A, calcium, thiamin, riboflavin, niacin and hemoglobin levels. A study with rats [27] fed either goat or cow milk, showed the goat milk rats grew also significantly better, had higher liver weights, greater hemoglobin iron gain and higher iron absorption. The wide genetic diversity of milk proteins makes it difficult to identify which one is the responsible one in clinical cases of allergy, however studies with guinea pigs [28] have shown that they had allergic reactions when fed alpha-s-1 casein and not if they were fed alpha-s-2 casein. Since alpha-s-1 casein is the dominant protein in cow milk, this may now explain why goat milk is so often a cure for cow milk allergy, since the dominant protein in goat is not alpha-s-1 casein but alpha-s-2 casein and goat milk lacking alpha-s-1 casein is less allergenic.

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