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A REVIEW ON PHYSICO-CHEMICAL PROPERTIES OF GOAT MILK

Binod Kumar Bharti, A.K. Jha and B.K. Singh[1*]

Sanjay Gandhi Institute of Dairy Technology (Bihar Agricultural University) Patna, Bihar

**Corresponding author (B.K. Singh) Email : bipinsgidt@gmail.com*

ABSTRACT

Goats are domestic animals. Goat are maintained them either as a source of the income. Goats are maintained as a source of the milk. Goat is considered as the "cow of poor man". The chemical composition of goat milk is varied with the different factors such as changes in diet, individuals, bread, season, species, feeding, environmental conditions, stage of the lactation, locality and condition of the udder. Many researchers are focused on the chemical properties of the goat milk along with cow milk, human milk and sheep milk. Goat milk have high nutritional value and dietary characteristics.

Goat farming is the important part in many countries from the economy point of the view; particularly in the Mediterranean and Middle East region. Goat farming very well organized in many countries such as France, Italy, Spain and Greece (Park and Haenlein, 2006). But industrial point of view, goat milk is not well successes because of its poor and insufficient production. In 1981, world goat's milk production was 7236 tons contributed only 1.6% to all world milk production (Le-Jaouen 1981). After the year 1990, many farmers are interested in the goat milk production, production was increased about 10 million MT (1990) to 15.2 million MT (2008). After the increase in the production of goat milk, there are also facing lack of marketing of goat milk (Mahmoud, 2010). A goat is universally called as "cow of poor man" (Iqbal *et al*., 2008). Dairy product of goat and sheep farming are a important part of the national economy in many countries, especially in the Mediterranean and Middle East region and are particularly well organized in Italy, France, Spain and Greece (Chiafalo *et al*., 2004) presently, India produces 126 million goats which contribute 14.5% of the world (FAO, 2009). Goat milk has many advantages health and nutraceutical health drink. Goat milk is rich in mineral as well as vitamin content and it has also creamy texture. Goat milk is considered as quite better as compared to cow milk because of its easy digestibility.

Chemical composition of goat milk : Goat milks have different chemical composition as compared to cow milk. The chemical composition of goat milk is varied with the different factors such as changes in diet, individuals, bread, season, species, feeding, environmental conditions, stage of the lactation, locality and condition of the udder. Park *et al*., (2007) reported that goat milk contains 3.8% fat, 8.9 % SNF, 4.1% lactose, 3.4% protein and 0.8% ash. Goat milk differs from other milk like cow and human milk. Goat milk having better digestibility, buffer capacity and therapeutic values. Goat milk fat content have higher physical properties such as surface tension, viscosity and specific gravity with comparison to cow milk (Park *et al*., 2007).

Milk fat : Compositionally fat content up to 99 % glycerides. The fat is present in the milk as "oil-in-water" type of emulsion phage. Jenness, (1980) was observed that the fat globules of goat milk are similar to the cow milk in lipids chemical composition and properties but goat milk lacks of agglutinin. The average diameter of globules in goat milk is nearby 1.5-2 µm as compared to 2.5-3.5 µm for cow milk and the percentage of globules of less than 1.5µm is 28% for goat milk as compared to 10% cow milk (Le Jaouen, 1981 and Kalantzopoulos, 1993). It was observed that the average fat globules size is smaller in goat milk as compared to the cow milk (Park *et al*., 2007). Because of the lower content of size of fat globule, goat milk is considered as "self homogenized" milk. Goat milk has higher values of free lipids than the cow milk (Cerbulis *et al*., 1982). Goat milk contents three fatty acids higher as compared to the cow milk such as C8, C10, and C12 (Juarez and Ramos, 1984). Medium chain fatty acid are able to provide energy without being deposited in the fatty tissue of the body and it play a role in decreasing cholesterol levels in the body. Medium chain fatty acid of goat milk is used for "milky urine" and chylothorax (lung conditions). Medium chain triglycerides are also used for treating the food absorption disorders such as diarrhea, steatorrhea (fat indigestion), cealic disease, liver disease and digestion problems due to partial surgical removal of stomach (gasterctomy) or intestine.

Milk proteins : Milk protein are possessed two distinct phases composed of casein and whey proteins. Goat

Table-1 : Fatty acids composition of goat milk reported by various authors.

Fatty acid	Goat milk			
	Boccignone et al., 1981	Sawaya et al., 1994	Martin Hernandez et al., 1986	Hellin et al., 1998
C 4:0	1.81	3.0	1.8-2.8	3
C 6:0	2.03	2.0	2.2-3.4	6.3
C 8:0	2.68	2.0	2.4-3.9	2.9
C 10:0	8.45	6.1	8.8-13.4	10.4
C 12:0	5.21	2.9	3.8-5.5	5.6
C 14:0	10.52	9.5	8.5-11.6	12.38
C 16:0	24.33	28.6	23.3-32.1	34.8
C 18:0	9.49	10.3	4.3-11.2	6.8
C 18:1	23.96	26.3	16.2-26.6	13.3
C 18:2	1.68	2.6	1.2-2.5	3.9

Table-2 : Vitamin content of Goat milk and human milk (Park et al., 2007).

Vitamin content (Per 100gm)	Goat milk	Cow milk
Vitamin A (IU)	185	126
Vitamin D (IU)	2.3	2.0
Thiamine (mg)	0.068	0.045
Riboflavin (mg)	0.21	0.16
Niacin (mg)	0.27	0.08
Vitamin b6 (mg)	0.046	0.042
Vitamin B12 (µg)	0.065	0.357
Vitamin C (µg)	1.29	0.94

Table-3 : Mineral content of goat milk and human milk (Park et al., 2007).

Mineral (mg per 100 gm)	Goat milk	Cow milk
Ca	134	122
P	121	119
Mg	16	12
K	181	152
Na	41	58
Cl	150	100
S	28	32
Zn	0.56	0.53
Fe	0.07	0.08
Cu	0.05	0.06

milk contains slightly lower amounts of the s-casein, but contains higher amounts of -casein fractions and almost equal amounts of k-casein fractions as compared to cow milk. The major protein present in goat milk is casein. Goat milk also contains equal amount of s1-casein, but the amount and genetic variants differ between goat populations (Diaz-Castro et al., 2010). The casein micelles in goat milk having greater â-casein solubilisation, more calcium and phosphorus, it is differed from cow milk and lower heat stability (Horackoval et al., 2014). Lara-Villoslada et al., (2004) reported that the goat milk contains a significantly lower level of s-1 casein and having a major allergen in bovine milk. Goat milk contains 82.70% casein and 17.30% whey protein (Ceballos et al., 2009).

Milk carbohydrate : Lactose is a disaccharide carbohydrate. It is the major carbohydrate in goat milk. Lactose is synthesized from glucose and galactose in the mammary gland, where the milk protein -lactalbumin plays an important role (Kunz *et al*., 2000). It is a valuable nutrient, because it helps intestinal absorption of magnesium, calcium and phosphorous. Lactose is also importance during milk synthesis and during secretion of milk into the duct of the udder. Other carbohydrates also found in goat milk such as oligosaccharides, glycopeptides, glycoproteins

and nucleotides in small proportion. Bhosale *et al*. (2009) found that the lactation had significant increasing effect on lactose. Helmut and Fiechter (2012) showed that goats milk contain about 4.23% lactose. This data obtained from six dairy goats breeds in Austria. No recent further data are available for the lactose content of goat's milk. Goat milk is significantly present high in lactose-derived oligosaccharides as compared to cow milk. Milk oligosaccharides are to be beneficial to human nutrition because of their prebiotic and anti-infective activity (Lara Villoslada *et al*., 2006). Goat milk oligosaccharides have been shown to have anti-inflammatory effects in induced colitis (Daddaoua *et al*., 2006). These results could be useful in the management of inflammatory bowel disease (Robinson, 2001). Goat milk contains a lower concentration of oligosaccharides as comparison to human milk, This is significant for infant nutrition as human milk oligosaccharides are greatly beneficial for the infant due to their prebiotic and anti-infective properties.

Milk vitamins : Vitamin plays an important role in nutrition. Goat milk content higher vitamin A than cow milk because goats convert all -carotene from foods into vitamin A in the milk (Conesa *et al*., 2008). Due to present of â-carotene, goat milk is always whiter than cow milk. Both goat milk content low concentrations of vitamin B6 and vitamin D, which are important during infancy (Juarez *et al*., 2011). Goat milk contains almost similar amount of vitamin A as human milk. Vitamin C is water-soluble antioxidant that is found in largest amounts in goat milk as compared to cow milk. Vitamin C has been shown to affect many aspects of the immune system including the regulation of immunity via antiviral and anti-oxidant properties (Geissler and Powers, 2010). In 1981, Le-Jaouen reported that goat's milk has similar vitamins contents of human milk except lower content of folic acid, vit. C and inositol. Goat milk content low levels of foliate (Park, 2006). Goat milk is also a good source of vitamins D, vitamin E, thiamine, riboflavin and niacin.

Milk mineral : Mineral in milk is plays an important role in nutrition. Goat milk content higher amount of calcium, potassium, chloride, phosphorus, selenium, zinc and copper than cow milk (Krstanovic *et al*., 2010). From the nutrition view of point, goat milk is to be preferred to that from cow (Bunaji) due to present of higher content of most of the minerals. Hence goat milk, like cow milk cannot replace human milk in young children but could complement it. From the nutritional value of goat milk, it could promote its complementary effect in human diet, mostly if used highest mineral contents compared to that of cow milk (Belewu and Aiyegbusi, 2002).

Enzymes : Goats milk has lower activities of certain enzyme such as ribonuclase, alkaline phosphatase, lipase and xanthin oxidase than bovine milk. Lipase activity in goats milk significantly correlated with spontaneous lipolysis due to the particularities of the lipolysis system and plays a major in off-flavour development in milk (Jenness, 1980 and Kalantzopoulos, 1993).

Dietary and medical significance of goat milk : Goat milk is considered as an ideal food for all the ages as it also contains essential vitamin and minerals. It is one of the key healthy drinks. Functional food milk calcium and proteins along with the newly formed structures created by reaction of these are of great concern from the technological point of view. Milk and colostrum are rich in the bioactive components which are important to regulate weight and hypertension. It also influences digestion and health properties. As goat milk is rich in such components, we can call it as a functional and nutraceutical drink.

CONCLUSION

Goat milk has many health advantages and nutraceutical health drink. It is rich in mineral as well as vitamin content and it has also creamy texture. Goat milk is considered as quite better as compared to cow milk because of its easy digestibility. It is concluded that, goat milk have not only high nutritional value but also therapeutic value and dietary characteristics.

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