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REVIEW ARTICLE **OPEN ACCESS**

A Review on Chemical Composition and Nutritional Properties of Goat Milk

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ABSTRACT

Generally, goats are used as a meat and also it is a source of milk. Goat is also called as "Cow of poor man". Goat milk is the commonly consumed type of dairy in the world. Many authors found that the chemical and functional properties of the goat milk along with cow and sheep milk. Goat milk is one of the important nutraceutical health drinks. It is rich in mineral and vitamin content. Goat milk has creamy texture. It has better digestibility as compared to the cow milk.

Keywords: Goat milk, Protein, Allergy, Digestible fat, Immunity booster, Anti-inflammatory

Introduction

The goat was the first domesticated animal to produce for the consumer. The presence of the goat in all sectors of ancient time has been continued to the present, particularly in economy, religion and nutrition. Goat farming is the important in many countries from the economy point of the view. Both global and regional approaches to livestock farming of goat are important from the economic point of view of developed and developing countries. Goat farming is well organized in many countries such as France, Spain, Italy, and Greece (Park and Haenlein, 2006). Goat milk is the commonly consumed type of dairy in the world. In fact, globally 65% to 72% of all dairy consumed is goat milk. Goats have been used as a source of milk for thousands of years (Boyazoglu *et al.,* 2005). Industrialization of the goat milk is not well successes because of its poor and insufficient volume. There is increase in the production of the goat milk, still there is lack of marketing of goat milk. A goat is universally called as "cow of poor man" (Iqbal *et al.,* 2008). Goat milk is also considered as an ideal food for all the ages' groups because it contains essential vitamin and minerals. Goat milk is considered better for its digestibility, buffer capacity, alkalinity and therapeutic values. Goat milk has higher physical properties such as specific gravity, viscosity and surface tension than the cow milk. It is one of the important nutraceutical health drinks. It is rich in mineral and vitamin content. Goat milk has creamy texture. Goat milk is better as compared to the cow milk because of its easy digestibility.

Composition of goat milk

Composition of goat milk is different as compared to the cow, human milk. Goat milk contains 3.8% fat, 4.1% lactose, 3.4% protein, 0.8% ash, 8.9 % SNF (Park et al., 2007) and 87% water (Iqbal *et al.,* 2008). Composition of the goat milk and human milk are varied from changes in diet, breed, species, individuals, season, feeding managements, environmental conditions, stage of the lactation etc. Goat milk is considered better for digestibility, buffer capacity, alkalinity and therapeutic values as compared to the cow and human milk. Goat milk fat has higher physical properties such as specific gravity, surface tension and viscosity as compared to cow milk (Park *et al.,* 2007).

Milk fat:

The fat is present in milk as an "oil-in-water" type emulsion. Fat globules (FG) size of goat milk is

almost similar to cow milk composition and properties but goat milk is lacks of agglutinin (Jenness, 1980). Goat milk appears a specific distinction in comparison to cow's milk; cow's milk typically contains 14 to 17 mg cholesterol per 100 g milk (Auld et al., 2000). Fat content up to 99 % of triglycerides. The average size of diameter of globules in goat's milk is approx. 1.5-2 µm as compared to cow milk of 2.5-3.5 µm diameter (Le Jaouen, 1981 and Kalantzopoulos, 1993). Average size of the fat globules (FG) is smaller in goat milk are less than 3 µm as compared to that of the cow milk (Park *et al.,* 2007). Due to the lesser fat globule size present in goat milk, so it is considered as "self-homogenized" milk. Goat milk has higher values of free lipids than the cow milk (Cerbulis *et al.,* 1982). Goat milk has three fatty acids (C8, C10, and C12) higher as compared to that of cow milk (Juarez and Ramos, 2011). Medium chain triglycerides (MCTs) are provided energy without being deposited in the fatty tissue of the body and it also play a role in decreasing cholesterol levels in human body. Medium chain triglycerides (MCT) are also used for treating the food absorption disorders such as diarrhoea, liver disease, steatorrhea and digestion problems due to partial surgical removal of stomach or intestine.

Milk proteins

Two distinct types of milk proteins are casein as an unstable micellar phase and whey protein as a soluble phase. Goat milk contains lesser amounts of the άs-casein, but it contains higher concentration of the β-casein and almost equal concentration of the k-casein fractions as compared to the cow milk. The major protein in cow milk contains is άs1-casein but goat milk contains β-casein. Goat milk also contains almost equal amount of αs1-casein, but genetic variants differ between goat populations (Diaz-Castro *et al.,* 2010). The casein micelles in goat milk differ from cow milk in having greater β-casein solubilisation, more calcium and phosphorus and lower the heat stability (Horackoval *et al.,* 2014). Goat milk contains lower level of αs-1 casein, a major allergen in bovine milk (Lara-Villoslada *et al.,* 2004).

Milk carbohydrate

Lactose contains in goat milk as a major carbohydrate but cow milk contains slightly lower carbohydrate. Lactose is a disaccharide sugar and synthesized from glucose and galactose in the mammary gland (Kunz *et al.,* 2000). Goat milk also contains small amounts of inositol. Lactose gives a valuable nutrient, because it favours intestinal absorption of calcium, magnesium and phosphorous and the utilization of vitamin D. It also is of major importance during milk synthesis and during secretion of milk into the duct system of the udder. Other carbohydrates also found in goat milk such as oligosaccharides, glycopeptides, glycoproteins and nucleotides in small amounts. Goat milk is significantly rich in lactose-derived oligosaccharides as compared to cow milk. Milk oligosaccharides are thought to be beneficial to human nutrition because of their prebiotic and anti-infective properties (Lara Villoslada *et al.,* 2004). Goat milk contains a lower concentration of oligosaccharides as comparison to human milk. The oligosaccharide sugar identified in goat milk is almost similar to the human milk.

Milk vitamins

Goat milk contains almost similar amount of vitamin A as compared to human milk. Goat milk has a higher fat-soluble vitamin A content than cow milk because goats convert all β-carotene from foods into vitamin A in the milk (Conesa *et al.,* 2008). Goat milk is always whiter than the cow milk. Cow and goat milk have lower concentrations of vitamin B6 and vitamin D, which are important during infancy (Juarez *et al.,* 2011). Goat milk is also a good source of vitamins D, vitamin E, riboflavin, thiamine and niacin. Goat milk contains 25% more vitamin B6, 47% more vitamin A than cow's milk (Bruhn CM, 1999). Water soluble vitamin C is found in greater amounts in goat milk than in cow milk. Vitamin C has affected the many aspects of the immune system as a regulation of immunity via antiviral and anti-oxidant properties. Goat's milk contains low levels of folic acid (Park, 2006).

Milk mineral

Milk of each species has individual pattern of minerals, which may be a responsible for the nutritional importance. Goat milk has higher content of calcium, potassium, chloride, phosphorus, selenium, zinc and copper than the cow milk (Krstanovic et al., 2010; Lopez-Aliaga et al., 2005). But in case of cow milk, it has lower concentration of sodium, phosphorus, copper, zinc

and manganese than the goat and human milk. In human nutrition, goat milk is to be considered higher content of minerals as compared to cow milk.

Functional properties of goat milk

Goat milk plays important role in medicinal and therapeutic value. The soft curd of goat milk has an advantage for adult humans suffering from gastrointestinal problem and ulcers. Goat milk is also important for prevention of cancer, cardiovascular disease, allergy and used for stimulation of immunity. Goat milk is considered as an ideal food for all the ages as it contains essential vitamin and minerals. It is one of the healthy foods. Goat milk contains low lactose level, high protein, high calcium, and high proportion of digestible fatty acids as compared to cow milk (Safdar *et al.,* 2021; Zhao *et al.,* 2019).

Easily digestible fats

The size of the fat globules (FG) of the goat milk is smaller than the cow milk, so it is easy to digest. The qualities of fat of goat milk are very significant at differentiating the special health qualities of goat milk. These are the fat globule size, and the percentages of medium chain fatty acids. Fat globules in goat milk are smaller than that of cow's milk. This smaller fat globule size, combined with the lack of agglutinin, a protein that causes fat molecules to clump together, and which is present in cow's milk, has several implications. It also contributes to the higher digestibility of goat milk, and the better tolerance of it for individuals with certain digestive disorders.

Easily digestible proteins

The composition of protein of goat milk considered to softer curd which helps to digestive health. Caprine casein micelles contain more inorganic calcium and phosphorous, are less heat stable, are less solvated and lose β-casein more quickly than bovine casein micelle. Goat milk contains less αs-casein and has more protein αs2 than αs1-casein was observed by Mora Gutierrez *et al.,* 1991. Goat milk contains more β-casein and K-casein than the cow milk, so weak gel is obtained which is beneficial for the better digestibility but there are disadvantage for reduced cheese yield.

Lower in lactose

Goat milk contains slightly lower lactose than cow milk. Lactose intolerance is cause of the deficiency of lactase enzymes which digests milk sugar (lactose). Patients suffering from lactose intolerance, it has unhydrolyzed lactose passes to the large intestine. In large intestine, this unhydrolyzed lactose is fermented by the microbes leading to gas formation and also release free fatty acids (FFA) which causes gastrointestinal disorders such as diarrhea, abdominal pain and flatulence (Russell et al., 2011). Goat milk is easy to digest because of soft curd formation. Casein contents of goat milk allow lactose to pass through large intestine more fastly and it is responsible to prevent the symptoms of lactose intolerance (Robinson, 2011). Some of the authors found that the better digestibility of goat milk is responsible for lactose intolerance patient. Haeilein *et al.,* (2004) found that treatment with goat milk cure 30 to 40 % problem cases of childhood cow milk allergy, which can be higher in some.

Less allergic proteins

Allergy is defined as an abnormal tissue reaction following exposure to foreign antigen (McCullough, 2003). Proteins are essentials for the body functioning like growth, development and repair the body. Proteins are the most common antigens. Infants are most commonly sensitive to proteins (Lara-Villoslada *et al.,* 2004). The level of άs-1 casein of goat milk is 89 % lower than that of cow milk. So, goat milk is less allergic. Goat milk has the properties to improvements in colic, digestive disorders, asthma and eczema over the cow milk (McCullough, 2003). Cow milk significantly increased markers of inflammation such as including cytokine interleukin-4 and antigen-specific immunoglobulin G1, hypersensitivity reactions as compared to goat milk. IgG1 binds to mast cells and promotes degranulation, causing an increase in histamine levels and the resulting allergic symptoms. This reaction to the cow milk did not induce an allergic response in contrast to goat milk. Goat milk has anti-allergy benefits upon drinking when a similar trial in children with the cow milk protein allergies was taken. Drinking of cow milk had significantly higher levels of the inflammatory marker tumour necrosis factor-α (TNF-α) than those who consumed the goat milk.

Anti-inflammatory properties

Cow milk is responsible for the allergens because of protein fractions are present, while goat milk is not allergens. On other hand, cow milk contains high content of fat than goat milk which may increase mucous buildup. Goat milk not causes the irritation in the gut, because the size of the fat globules (FG) of the goat milk. Goat milk plays a important role in almost all biological reactions and it exerts antioxidant and anti-inflammatory effects in the body. Some other factors like maintenance of a healthy intestinal micro flora with the help of probiotics and prebiotics are essential for protecting against the negative effects of pathogenic infection allergy (Shea et al., 2004).

Improvement of heart

Cholesterol is responsible for human health. Low-density lipoprotein (LDL) is transports cholesterol from the liver to the blood vessels and is called "The bad cholesterol". The "good" cholesterol is called the high-density lipoprotein (HDL) which transports cholesterol from the vessels to the oxidative modification of LDL plays a essential role in atherosclerosis progression. This implies that antioxidants, which could inhibit the LDL oxidation, it should be effective in suppressing atherosclerosis (Lindqvist, 2008). Goat milk protein are important source of the antihypertensive peptide, angiotensin converting enzyme (ACE) and inhibitory peptides. They are responsible to control microbial infection and also provide disease defence. Non-protein nitrogen (NPN) of human milk and goat milk is higher than that of the cow milk. Taurine in the goat milk which is derived from the sulphur-containing amino acid has important metabolic functions as does carnitine – important nutrient for neonate. The mineral and vitamin content of goat milk are mostly higher as compared to the cow milk (Park et al., 2007). Goat milk higher polyunsaturated fatty acids (PUFA), monounsaturated fatty acids (MUFA) and medium chain triglycerides (MCT) than that of cow milk. These are beneficial for cardiovascular disease. Goat milk has lower level of the cholesterol than that of cow milk (Haenlein, 2004). High potassium content of goat milk reduces the blood pressure. Goat milk exerts hypocholesterolemic effect. Consumption of goat milk reduces plasma triglyceride and it had positive effect on lipid metabolism (Lopez-Aliaga et al., 2005). Goat milk reduce the total cholesterol level and also maintain adequate triglycerides and transaminases. This makes goat milk to prevent coronary heart diseases.

Immunity booster of goat milk

Selenium is the major component for the immune system. Cow milk contains small amount of the selenium, but significant amount of the selenium is found in goat milk. Therefore, goat milk are acts as immunity booster and able to protect an individual from illness. Many types of cells are involved in the innate and adaptive immune response such as Tlymphocytes and Natural Killer cells as the main players. Therefore, immunoglobulin (Ig) are similar in structure, minor differences within the main immunological classes such as IgG, IgM, IgA, IgD and IgE are connected with a variety of biological properties. A number of factors influence our immune health and nutrition in particular is main determinant of the body's immune response. The effects of goat milk on human blood cells in terms of nitric oxide and cytokine release, the results demonstrated that goat milk was able to activate nitric oxide release from blood cells with triggering of cytokine production.

Anti-carcinogenic

Goat milk is used to decrease or to maintaining the body weight. The cow or goat mike has the ability to extract potential anticarcinogenic agents such as beta-carotene, beta ionone and gossypol from its feed and then transfer to milk. Goat milk contains high content of conjugated linoleic acid (CLA) (Jirillo *et al.,* 2010). Anticarcinogenic properties of conjugated linoleic acid have been reported against mammary and colon cancer (Liew et al., 1995) in animal models, as well as in vitro models of human melanoma (Shultz et al., 1992) colorectal and breast cancer. The conjugated linoleic acid has the properties to inhibit tumor development, anti-oxidative effects and disturbance of the receptor mediated actions of estrogen, although all have been suggested by fermented goat milk (Jirillo *et al.,* 2010).

Conclusion

In the design and performance evaluation of heat exchangers and evaporators, the models of thermo-physical properties and rheological properties are important, which can be selected as per requirement and parameters of operations. The physical, thermal and rheological models are summarized for utilization in performance evaluation and design problems. The effects on heat induced changes such as effects on heat stability of cow and buffalo milk, denaturation of whey proteins and effects on casein micelles of milk are described in brief to understand the effects on quality of processed products.

Recently, goat milk consumption increases globally as people recognize the advantage of goat milk over the cow and human milk especially in the developed nations. It is well known that goat milk has high nutritional value than the other species of animals. Goat has the ability to produce high quality milk of good composition and for human consumption. These compositions of milk are fat, lactose, protein, vitamin, ash and enzymes. Goat milk have high nutritional value and composition, various factors including breed, udder size and shape, body weight and litter size affect the composition and the other contents of the milk. Different influencing factors that cause variation to the milk content are genetics, size, season, stage of lactation, type of diet, physiological status, udder health and physiological behaviour. Moreover, goat milk also has medicinal value for human being and is healthy alternative to cow's milk that may be more easily digested than regular cow's milk, especially to children. There is limitation in goat milk, it lacks folic acid so it does not recommend for infants under one year because it can cause anaemia. So, goat milk is better option to consume over the other species of milk. It may be concluded that, goat milk has not only high nutritional value but also have a therapeutic value and dietary characteristics.

References

Auld G.W., Bruhn C.M., McNulty J., Bock M.A., Gabel K., Lauritzen G., Medeiros D., Newman R., Nitzke S., Ortiz M., Read M., Schutz H. and Sheehan E.T. (2000). Reported adoption of dietary fat and fiber recommendations among consumers. *J Am Diet Assoc*. 100(1):52-58.

BoyazogluI J., Hatziminaoglou P. and Morand-Fehr (2005). The role of the goat in society: Past, present and perspectives for the future. *Small Ruminant Research*. 60(1):13-23.

Bruhn C.M. (1999). Consumer Food Safety Knowledge and Practices. *Journal of Food Safety*. 19:73-87.

Cerbulis O J., ParksHarold W., Farrell M., Jr. Harold M. and Farrell, Jr. (1982). Composition and Distribution of Lipids of Goats' Milk. *Journal of Dairy Science*. 65(12):2301-2307.

Conesa C., Sanchez L., Rota C., Perez M., Calvo M. and Farnoud S. (2008). Isolation of lactoferrin from milk of different species; calorimetric and antimicrobial studies. *Comp Biochem. Physiol*. 150: 131-139.

Diaz-Castro J., Hijano S., Alferez M.J.M., Lopez-Aliaga I. and Nestares T. (2010). Goat milk consumption protects DNA against damage induced by chronic iron overload in anaemic rats. *Int Dairy, J.* 20: 495-499.

Haelein G.F.W. (2004). Goat milk in human nutrition. *Small Rumin. Res*. 51: 154-163.

Haenlein G. F. W. (2001). The Nutritive Value of Sheep Milk. *Inter. J. Anim. Sci.* 160(2): 253-268

Horackoval S., Sedlackova1 P., Slukovaand M. and Milada P. (2014). Influence of Whey, Whey Component and Malt on the Growth and Acids Production of Lactobacilli in Milk. *Czech J. Food Sci.* 32: 526-531.

Iqbal A., Khan B.B., Tariq M. and Mirza M.A. (2008). Goat-A Potential Dairy Animal: Present and Future Prospects. *Pak. J. Agri. Sci.* 45(2): 227-230.

Jenness R. (1980). Composition and characteristics of goat milk: Review. *J. Dairy Sci.* 63: 1605-1630.

Jirillo F., Martemucci G.D., Alessandro A.G., Panaro M.A., Cianciulli A., Superbo M. and Magrone T. (2010). Ability of goat milk to modulate healthy human peripheral blood lymphomonocyte and polymorpho nuclear cell function: In vitro effects and clinical implications. *Curr. Pharmaceutical Design*. 16:870-876.

Juarez M., Martin-Hernandez M.C. and Ramos M. (2011). Biochemical characteristic of three

types of goat cheese. *J. Dairy Sci.* 75: 1747-1752.

Kalantzopoulos. G. C. (1993). Cheese from ewes' and goats' milk. In P. F. Fox (Ed.). Cheese: Chemistry, physics and microbiology, Vol. 2. Major cheese groups (2nd), *London: Chapman & Hall*. 507-553.

Krstanovic, V., Slacanac V., Bozanic R., Hardi J., Rezessyne J. and Lucan M.. (2010). Nutritional and therapeutic value of fermented caprine milk. *Int. J. Dairy Technol*. 63: 171-189.

Kunz C., Rudloff S., Baier W., Klein N. and Strobel S. (2000). Oligosaccharides in human milk: structural, functional and metabolic aspects. *Annu Rev. Nutr.* 20: 699-722.

Lara-Villoslada F., Olivares M., Jimenez J., Boza J. and Xaus J. (2004). Goat milk is less immunogenic than cow milk in a murine model of atopy. *J. Pediatric Gastroenterol*. 39: 354-360.

Le-Jaouen J. C. (1981). Milking and the Technology of Milk and Milk Products. In "Goat Production" *Ed. by Gall, G. Academ. Press, London Ltd. Chap*. 11:345-377.

Liew C., Schut H.A., Chin S.F., Pariza M.W. and Dashwood R.H. (1995). Protection of conjugated linoleic acids against 2-mino-3-methylimidazo-4, 5-quinoline-induced colon carcinogenesis in the F344 rat inhibitory mechanisms. Carcinogenesis. 16:3037-3043.

Lindqvist H. (2008). In:Influence of herring (Clupeaharengus) intake on risk, Department of chemical and biological engineering. *Goteborg: Chalmers University of Technology.*

Lopez-Aliaga I., Alferez M.J., Nestares M.T., Ros P.B., Barrionuevo M. and Campos M.S. (2005). Goat milk feeding causes an increase in biliary secretion of cholesterol and a decrease in plasma cholesterol levels in rats. *J. Dairy Sci.* 88: 102-141.

McCullough F. (2003). Nutritional evaluation of goat's milk. *Health Food J.* 105: 239-251.

Mora-Gutierrez A., Kumosinski T., and Farrell H. (1991). Quantification of αs1-Casein in Goat Milk from French-Alpine and Anglo-Nubian Breeds Using Reversed-Phase High Performance Liquid Chromatography. *Journal of Dairy Science.* 74 (10):3303-3307.

Park Y.W and Haenlein. (2006). Goat Milk- Chemistry and Nutrition. In: Handbook of Milk of Non-Bovine Mammals. Y.W. Park and G.F.W Haenlein, eds. Blackwell Publishers. *Ames, Iowa and Oxford, England.* 34-58.

Park Y.W., Juárez M., Ramos M., and Haenlein G.F.W. (2007). Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Res.* 68: 88-113.

Robinson F. (2011). Goats milk – a suitable hypoallergenic alternative. *British Food J.* 108: 192-208.

Russell D., Ross R., Fitzgerald G., Stanton C. (2011). Metabolic activities and probiotic potential of Bifidobacteria. *Int. J. Food Microbiol.* 149: 88-105.

Safdara Afifa, Khairunnuur Fairuz Azmana, Rahimah Zakariaa Che BadariahAb Aziza Usman Rashid (2011). *Journal of Traditional and Complementary Medicine.* 11(2): 117-122.

Shea O., Bassaganya M., Riera J. and Mohede I.C.M. (2004). Immunomodulatory properties of conjugated linoleic acid. American Society for Clin. *Nutrition.* 79: 1199-1206.

Shultz T.D., Chew B.P., Seaman W.R. and Luedecke L.O. (1992). Inhibitory effect of conjugated dienoic derivatives of linoleic acid and β-carotene on the in-vitro growth of human cancer cells. *Cancer Lett.* 63:125-133.

Zhao Xuan, Cheng Ming and Zhang Xuexi (2119). The effect of heat treatment on the microstructure and functional properties of whey protein from goat milk. *Journal of Dairy Science.* 103(2): 17221-17229.

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