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Chemical Composition of Goat Milk: Revisión Bibliográfica

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Developing.

Goat's milk contains all the components necessary for human consumption: proteins, lipids, sugars, mineral salts, vitamins, enzymes and water. It is one of the most complete foods for people, given the characteristics of its components, such as proteins that contain a large number of essential amino acids for food (Paz et al, 2007). However, the chemical composition of milk may vary according to individual characteristics such as race, food composition, time of lactation, management, climate and the region where the animals are found (Vega et al, 2005).

The fundamental objective of knowing the chemical composition of milk is given by the importance of goat's milk not only as pure food, but for the elaboration of secondary productions: powdered milk, cheeses, cream cheese, cottage cheese, sweets, ice cream, butter, dairy serums, yogurt and beauty products such as soaps and facial creams. From a technological point of view, the composition of milk determines its nutritional quality, its properties and its value as raw material to manufacture these food and beauty products.

The principal interest in knowing these indicators lies in the potentials that these productions have that can be consumed by users, as well as providing a dynamic effect on the economy of the place where they are made. The management of the facilities and the hygienic conditions of the animals, directly influence the quantity and quality of milk produced and therefore the profitability of any company, where it's organoleptic, physical and chemical characteristics play a fundamental role.

Organoleptic analysis of milk.

Organoleptic analysis is the qualitative assessment that is performed on milk. This analysis includes a visual phase, an olfactory phase and a gustatory phase (Frau et al, 2007).

In the visual phase of the milk its appearance is observed (viscosity, cleanliness, brilliance and color). Goat's milk is a very white, clean-looking, lump-free matte color since its fat does not contain β-carotenes. It is whiter than cow, because these are the ones that yellow milk. Carotenes are each of the unsaturated hydrocarbons, of vegetable origin and red, orange or yellow color found in tomatoes, carrots, egg yolks, etc., and in animals they are transformed into vitamin A. It is more viscous than that of a cow, the size of its fatty globules is smaller than that of a cow and sheep and its number is larger. The blue-white color could indicate skim or watery, the possible red color presence of colostrum or pathological problems of the animal.

In the olfactory phase, we capture the smell that milk produces. The smell of freshly milked goat's milk is quite neutral although sometimes the milk at the end of the lactation period has a characteristic odor due to the capric acid that is associated with the animal. It has a strong odor, as a result of the absorption of aromatic compounds during handling, generally inadequate, with the presence of males in the milking sites, poor hygiene of the stables to which the milk is exposed, delay in filtering and cooling after He ordered; taste and smell that on the other hand, can be eliminated in large part by a simple vacuum deodorization treatment (Borras, 1968). If stored

at low temperatures, it acquires its own smell (goat aroma). The smell should be of fresh milk but there may be presence of foreign substances or possible acidification when it is thick or cut.

The taste phase contemplates the sensation in the mouth that produces the tasting of milk based on the flavors: acid, sweet, salty, bitter. Goat milk has a sweet taste, a pleasant sensation on the palate and very characteristic.

Physicochemical characteristics.

We can define milk as a colloidal suspension of particles in a dispersing aqueous medium. The particles are of two types: some have a globular shape: 1.5 to 0 microns in diameter and consist of lipids; the others are smaller: 0.1 microns in diameter and correspond to protein micelles that have mineral salts attached.

Goat's milk is an equilibrium mixture of proteins, fats, carbohydrates, salts and other components. The composition of the milk determines its nutritional quality and its value as raw material for manufacturing food products. It has a constant qualitative composition, but quantitatively varies depending on different factors such as the breed of the animal, the time of lactation, the number of births, the time of the year and the climate of the region (Capra, 2004).

By leaving the milk at rest or when subjected to a light centrifugation, a fatty fraction, the cream, can be separated more or less yellowish. If after resting it boils, the agglutination of the fat is favored and a semi-solid film is formed on the surface: the cream. In the event that proteins are coagulated, a more friable mass will be obtained or less whitish, the curd and a more or less cloudy liquid residue that corresponds to the water-soluble fraction with the dissolved lactose, the serum.

Density at 15°C:	1,027-1,040
pH:	6,5-6,7
Specific heat:	0,93
Freezing point	-0,55°C

Source: Capra, 2004.

Table 1: *Main physical-chemical characteristics of milk.*

Other authors define goat's milk as a substance composed of 77 to 80% water, that is, it must contain 20 to 23% of total solids. These total solids are normally composed between 3 and 3.5% fat, 3 to 3.5% protein and 4 to 6% carbohydrates such as lactose and minerals as important as calcium (Salvador et al, 2006)

Some authors point out different values in their composition, comparing them with cow's and human's milk.

	Human	Cow	Goat
Protein (g)	1,2	3,3	3,3
Casein (g)	0,4	2,8	2,5
Lactoalbumin (g)	0,3	0,4	0,4
Fat (g)	3,8	3,7	4,1
Lactose (g)	7.0	4,8	3,8
Caloric value (Kcal)	71	69	76

Source: CAPRAHISPANA, 2011.

Table 2: *Comparison of three types of milk: composition in 100 ml.*

Proteins.

Regarding the protein content, it was found that it is (3.41 ± 0.17%) lower than that reported in previously mentioned works; while the recorded total solids (ST) value is (13.65 ± 0.79%), higher than that reported by Misiunas et al (1999): (13.06 ± 0.44) and Soryal et al (2005): (13.45 ± 0.94%) and lower than that reported by Páez et al (1996), for Criollas and Anglo Nubian crosses (15.97 ± 0.83%). Non-fatty solids (SNG) accounted for 61.8% of ST, a percentage lower than that reported by Soryal et al (2005). The chemical composition of the Creole milk showed high values of total solids (proteins 5.13%; fat 4.91%) (Olieszewski et al, 2002).

Goat milk protein usually has a ratio between essential and total amino acids of 0.46 and an essential vs. non-essential ratio of 0.87 (Singh and Singh, 1985). The size of casein micelles is smaller in goat's milk (50 nm) compared to cow's milk (75 nm) (Alais, 1988). These goat's milk caseins are characterized by containing more glycine, as well as less arginine and sulfurized amino acids, especially methionine (Capra, 2004).

The protein profile of goat's milk resembles the human more than cow's milk does; Similarly, goat β-lactoglobulin has been shown to be easier to digest than the vaccine. Approximately 40% of all patients sensitive to cow's milk proteins tolerate goat's milk proteins, possibly because lactoalbumin is immunospecific between both species (Chacón, 2005).

Fats.

Another component of milk is fat, which constitutes from 3 to 6%. The quality of goat milk fat is an important factor because it defines the ability of milk to be processed and has a relevant role in the

nutritional and sensory qualities of the products obtained from it (Chávez et al, 2007). Like other ruminant species, the fat composition in goat's milk is affected by various factors such as: race, individual characteristics, lactation status, management, climate and food composition.

The lipid component is recognized as the most important of milk in terms of cost, nutrition and physical and sensory characteristics of the product. Within the lipid component, triglycerides represent about 98%, but some simple lipids such as diacylglycerols and cholesterol esters are also found in goat's milk, as well as phospholipids and fat-soluble compounds such as sterols and cholesterol (Park, 2007).

Goat milk fat is a concentrated source of energy, which is evidenced by observing that one unit of this fat has 2.5 times more energy than common carbohydrates (Richardson, 2004). Triglycerides represent almost 95% of total lipids, while phospholipids are around 30-40mg/100ml and cholesterol 10mg/100ml.

The fatty composition of goat's milk is primarily responsible for its properties against high cholesterol, since it prevents excess saturated fatty acids from being absorbed from the body, thus reducing the concentration of LDL cholesterol and triglycerides and increasing HDL cholesterol concentration or good (CAPRAISPANA, 2011). It usually has more fat than cow (4.1 vs. 3.5%) sometimes reaching 5.5%. A characteristic of goat's milk is the small size of the fat globules compared to that of the globules in cow's milk (2 µm in goat's milk versus an average of 3-5 µm in cow's milk), which It has been associated with better digestibility (Alais, 1988; University of Maryland, 1992).

In addition, it contains more essential fatty acids such as caproic that makes its derivative products more popular in the market and with a greater number of short and medium chains (Capra, 2004). These contents vary according to different factors including the time of lactation of the animals and can reach 6% in the first days of it (Ludeña et al, 2006). In the first week of lactation, the fat is 4.63%, which decreases to 3.56% in the third week, and then does not vary until the seventh week and then registers a growth until the end of lactation. Milk fat is high at the beginning of lactation, since the goat consumes its reserves, but then decreases rapidly by losing these resources. At the end of the period, fat increases due to lower milk production. The average fatty percentage was 4.89%, this being significantly higher than those obtained by other authors (Zeng et al, 1997; Chornobai et al, 1999; Kuchtík and Sedlácková, 2003).

Other reports report that the average percentage fat content was (5.21 ± 0.54%), higher than those reported by other authors for herds of the same breed: Misiunas et al (1999): 4.81 ± 0, 28%; Soryal et al (2005): 4.37 ± 0.57% and Álvarez and Paz (1998): 4.91%; while Páez et al (1996) determined higher fat levels in Criollas x Anglo Nubian crossed goat milk (6.30 ± 0.90%).

Minerals.

The mineral content in goat's milk is higher than in human milk; goat's milk contains about 134 mg of Ca and 121 mg of P per 100 grams of milk and can have up to 13% more calcium than bovine milk but is not a good source of other minerals such as iron, cobalt and magnesium Table 3 shows the values reported for the amounts of minerals present in goat and cow's milk (Park, 2006).

They are a small part of the milk constituents, ranging from 3 to 8 g/l. However, in some cases they are fundamental, both from a technological and nutritional point of view. Mineral materials are found as soluble salts or as insoluble colloidal phase and their determination is important for the screening of frauds or alterations of milk.

Component	Goat	Cow
Ca (mg)	134	122
P (mg)	121	119
Mg (mg)	16	12
K (mg)	181	152
Na (mg)	41	58
Cl (mg)	150	100
S (mg)	28	32
Fe (mg)	0.07	0.08
Cu (mg)	0.05	0.06
Mn (mg)	0.032	0.02
Zn (mg)	0.56	0.53
I (mg)	0.022	0-021

Source: Park (2006)

Table 3: *Mineral content in goat and cow's milk (amount in 100 gr).*

Water.

On the other hand, the water content in goat's milk is 87%. Being a liquid food, logically the highest content is aqueous. Therefore, we cannot consider milk as an overly energetic food and even less if its fat is eliminated. Precisely because of this, the fact that, despite being traditionally considered a food low in sugars and rich in lipids and proteins, the percentage of carbohydrates is higher than that of the other components (Park, 2006).

Vitamins.

In milk we find all fat-soluble vitamins represented: A, D, E and K and a large majority of water-soluble vitamins: thiamine, niacin, pantothenic acid, biotin, pyridoxine, folic acid and cobalamin. Its quantity varies considerably depending on the time of the year and the animal's diet. The amount of riboflavin is very high and, to a lesser extent, that of vitamins A, B1 and B12. However, the figures for vitamins C and D are relatively low (Pece et al, 2005) Table 4.

Vitamin A (UI)	158	191
Vitamin D (UI)	2.0	2.3
Thiamine (mg)	0.04	0.05
Riboflavin (mg)	0.18	0.12
Vitamin B6 (mg)	0.035	0.001
Folic acid (mcg)	2.0	0.2
Vitamin B12 (mcg)	0.50	0.02
Vitamin C (mg)	2.0	2.0

Table 4: *Vitamin content in goat milk.*

Enzymes.

Milk contains various enzymes, including alkaline phosphatase, lysozyme, lactoperoxidase, catalase, lipase. The last three play a bacterial growth inhibitory function. In general, it can be said that these enzymes are scarce, but the reactions and transformations they produce are of such importance that they can condition the composition and properties of milk. They are very sensitive to variations in pH and temperature, so that an elevation of the temperature causes them to be quickly inactivated and thus allow the quality and handling of the product to be assessed (Frau et al, 2007).

The chemical qualities of goat's milk can be summarized as follows:

- Contains sugar and oligosaccharide fractions similar to human milk.
- Milk contains 13% less lactose than cow's milk and 41% less than human milk.
- Its globules or drops of fat are smaller and more easily attacked by digestive juices.
- The fatty acids contained in goat's milk have a metabolic quality with a unique ability to limit cholesterol deposits in body tissues.
- Goat's milk, compared to cow's milk, has the same amount of protein, fat, iron, vitamin C and D. Goat's milk contains more vitamins A and B and less lactose content.

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