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RESEARCH REGARDING THE ROLE AND IMPORTANCE OF MILK IN ALIMENTATION

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Abstract: *In this article are presented notions regarding one of the main foods in human alimentation, namely, raw milk. This is a pale liquid with complex composition and pleasant taste and smell. The milk is more easily assimilated by the organism than any other aliment because of the nutrients that can be found in optimal proportion; it can also be consumed as fresh milk or under the form of dairy products.*
The present paper also deals with a comparative study regarding the chemical composition specific to the milk coming from different providing species.
Keywords: *milk, raw milk, chemical composition, differences between species*

1. INTRODUCTION

Milk is the liquid produced by the mammary glands of the mammals after the birth process, being obtained in optimal hygienic conditions and from healthy animals. It is a pale liquid with a very complex composition, sweetish taste and pleasant smell. Thanks to the fact that it contains all the essential nutrients that the organism needs and it is also easily digestible, the milk occupies a very important place in human nutrition. In terms of physical and chemical properties, the milk represents an emulsion in which the lactose and the minerals are soluble, the lipids are in suspension and the proteins are colloidal. [3]

Figure 1: Raw milk

In alimentation, the edible milk comes in procent of almost 90% from cows. The milk coming from sheeps, goats and water buffalo is less used, this one being industrialized in dairy products and cheese.

There are several types of edible milk, as it follows:

- Normalized milk, which is obtained by mixing two batches of milk from the same species, but with different fat content. For example, milk with 2,8% fat content, obtained by mixing a batch of milk with 1,5% fat content with another one that has 4,2% fat content.
- Skimmed milk or skim milk, which is the milk obtained after milkfat is removed.

The high-protein milk is the milk that is condensed with a percentage of dry matter bigger than 12,5%.

2. MATERIAL AND METHOD

2.1. Chemical composition of milk

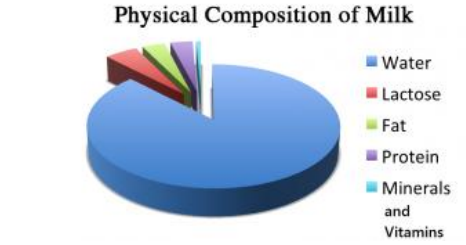

Figure 2: Chemical composition of milk

From a physical and chemical point of view, milk represents a very complex system. It can be considered an emulsion of fat globules within a water-based liquid, that also contains several other substances; some are colloidal (proteins), and others are fluid (lactose, salts and vitamins). The chemical composition of milk is determined by animal, breed, alimentation, age, ways of fattening, etc [5]

The main components of milk:

- water 87,5%;
- total milk solids12,5%;
- non-fat milk solids 9%;
- the fat content 3,5%.

Non-fat milk solids:

- proteins 3,4%;
- casein 2,8%;
- lactalbumin 0,1%;
- lactose 4,5%;
- minerals 0,7%.

Milk proteins. Among different components of milk, proteins have a special biological value thanks to their optimal supply of amino-acids. It is considered that, at the time, the milk provides almost 30% of the animal protein essential to the human nutrition.
Casein is the basic protein component and it represents almost 80% of the entire protein content. Apart of amino-acids, its molecule also contains phosphorus and sulfur. The casein can be obtained from milk by precipitation by acids with pH=4,6. In its native form, casein is like a white powder, hygroscopic, without taste or smell. The coagulation of casein, under the intervention of coagulating enzymes, is the base of cheese production.
Lactalbumin is an easily assimilable protein. It contains a big number of essential amino-acids which gives the lactalbumin a high biological value.
Minerals. The milk contains 0,7-0,9% minerals: chlorides, phosphates and calcium citrates, sodium, potassium, magnesium. In very low quantities there can also be found zinc, iron, aluminum, copper, etc. Among the main nutritive elements there are calcium and phosphorus, which can be found in optimal quantities and in an easily assimilating form for a developing body. From a technologically point of view, a very important role is the one of the calcium salts which are directly involved in the process of milk-clotting.
Lactose, also called milk sugar, can be found in fresh milk in proportion of 4,3-5,7% (on the average 4,8%). Under the influence of microorganism, the lactose can suffer different fermentations, with important applications in the technology of dairy products. Therefore, under the influence of lactic acid bacteria, the lactose is converted into lactic acid, process which is called lactic acid fermentation. The resulted lactic acid determines the coagulation of the casein and gives to the respective product acid flavor (acid dairy products, fresh cheese).
The fat content is the most variable component of milk; its content being determined by several factors. The normal range of variation regarding the fat content of cow milk is 3-5,4% with an average value of 3,7%.
Vitamins. Milk represents an important source of vitamins, in different quantities: A, D, E, K, B1, B2, B6, PP, B12 etc. The vitamin content within the milk varies in terms of species, breed, lactation period, alimentation.
Enzymes are chemical compounds, with catalytic role in biochemical processes. Among the milk enzymes, the most important from a practical point of view are: **lipase, phosphatase** and **peroxidase**. [2]
The lipase hydrolyses the fats, freeing the lipids; the protease disintegrates the proteins until they reach that stadium of peptone and amino-acids; also, the presence of phosphatase is a control test of pasteurization.
The peroxidase is an enzyme of indirect oxidation, decomposed at a temperature of 80°C, and being used at assessing the effectiveness of pasteurization.
Other components. Milk also contains small **gases** (azote, carbon dioxide, xanthophyll), various organic acids (citric acid, pyruvic acid) and immunoglobulin.

2.2 Physical properties of milk

Opacity shows the milk's lack of transparency. This property is dependent of the content of particles in the suspension of fat, proteins and some minerals. It is linked to the entirety of light radiations with different frequencies reflected by the milk. Therefore, the milk with a higher fat content has a white-yellowish color, being more opaque.

Density of milk represents its mass divided by its volume and it is measured in g/cm³. The milk's density is influenced by:

- ✓ temperature of the milk (at 20°C it is compared with the standard value); at temperatures between 15 - 25°C, it is added 0,0002°C for every degree higher than 20°C and the same value is subtracted when the temperature at the time of measurement is bigger than 20°C.
- ✓ providing species: the milk's density is of 1,029 -1,033 for cow and goat milk; the density is of 1,029 for the water buffalo milk; for the sheep milk the density is of de 1,033.
- ✓ alimentation – the feeding with forages which contain a lot of water decreases the density, by decreasing the dry matter within milk
- ✓ the chemical composition of the milk (the content in the milk solids and the ratio between the fat and the non-fat substance). The density increases with the growth of non-fat substance's quantity because the main components of milk have above par densities: the proteins 1,346 and lactose 1,666. The density decreases with the growth of the fat quantity because the density of the fat is below par (0,935 – 0,947). The milk's density varies in inverted ratio with the proportion of gases and with the physical state of the milk's fat. By the degreasing, more or less advanced, the density increases over the value of the whole milk's density.
- ✓ Milk falsification
- ✓ mammitis – the udder's infection decrease the milk's density under 1,029 [4]

Viscosity. The milked milk is more viscous than water (e.g.: at a temperature of 20°C the normal value of the viscosity is 2 Centipoise, when that of the water is 1 Centipoise). The viscosity is influenced by the milk's composition, the stage of sectioning of fat globule, the hydration status of proteins and temperature variations. Therefore, this property is determined by the status in which the fat and the casein are found. [2]

The refractive index is established by using a refractometer, in the buttermilk, after the removal of fat and proteins, or in the milk, as it is. When it comes to ordinary milk the refractive index is 1,35; smaller values might hint at the falsification of milk by adding water.

The boiling point of milk at atmospheric pressure is higher (105,55°C) than that of water, because of the substances dissolved within the milk (lactose, minerals). In this process, under the action of heat towards the entire mass, the transition of milk into vapors can be observed. This property has an important role in tracking the dilution with water.

The freezing point (cryoscopy) represents the temperature at which the milk freezes (-0,52º. -0,59ºC). The milk can change its freezing point depending on the thermal treatment and the osmotic pressure. As a result, when the milk is sterilized, phosphates precipitation happens and the freezing is accelerated. If the milk is diluted with water, the freezing point inclines to 0ºC.

Acidity of milk. In our country, the milk acidity is determined using the Thorner method. For a fresh and normal milk, the titratable acidity is between 15°T and 19°T. An exceeded acidity indicates a high acidity and the possibility for the respective milk to not resist to the transportation and to the thermal treatment. The acidity under 15°T indicates the fact that the milk was produced by unhealthy animals.

The milk that shows any issue regarding the flavor, smell, color, irrespective of the provenience will be eliminated from the processing and alimentary consume, being normalized, thing which means that it will be brought to a percentage from 2% to 3% in terms of fat. [2]

2.3 Organoleptic assessment of milk

Table 2.1: [4]

Characteristics	**Type of milk**		
	Normalized	**Skimmed**	**High Protein**
Aspect	Homogeneous liquid, without visibly foreign matter and sediments		
Consistency	Fluid		
Color	white, with slightly yellow hue, uniform	white, with slightly blue hue, uniform	White-yellowish
Flavor and smell	pleasant, slightly sweet, characteristic taste of slightly boiled milk, without foreign taste or smell		

The organoleptic characteristics represent the properties of milk as they are sensory perceived. These properties act in terms of triggering the stimuli, more or less intensive under the effects of color, smell, taste, texture etc.

Aspect: it represents the manner of presentation. The raw whole milk is displayed as a homogeneous liquid, opalescent, without visibly foreign matter and without sediments. This property is given, on the one hand, by the component substance of the milk and, on the other hand, by their dispersed state in the mass of milk. The aspect of the milk can be modified only when the hygienic conditions of the milking are not met and when in the milk mass can appear impurities such as hairs, straws from the straw-bedded yards, food wastes (e.g. bran), dust, etc.

Color represents the entirety of light radiations of different frequencies, which are reflected by the milk and which create the specific impression on the retina of the human eye. The color of the milk is white, but with different overtones influenced by the next factors:

- breed – cow milk has white color, with a slightly yellow hue; sheep and water buffalo milk are white – mat; goat milk has white color with a weak yellowish hue;
- season – the milk milked in the summer is whiter than the one milked in the winter, because of the dried forages, that means a higher percentage of dry matter, has a yellower color.

The white color is given, firstly, by casein and albumin which are found in colloidal form and, secondly, by the globules of fat which are in a state of emulsion. After the process of skimming, the milk has a whiter color with blue reflections given by the riboflavin and other different pigments from the flavanols group.

Consistency stands for the degree of density, of solidity and viscosity of milk. The raw whole milk is characterized by fluid consistency, without being viscous, philanthe and mucilaginous. This property indicates the healthiness of the udder and the hygienic conditions.

Taste. The raw whole milk has a specific taste, slightly sweet and also a flavor specific to the species that provides it. The taste is given by lactose and the flavor is given by the proportion of different milk components, especially by milk fat and proteins. Milk taste is influenced by the next factors:

- breed – cow milk has a sweet taste, meanwhile the sheep, water buffalo and goat milk have a more intense taste, determined by a higher concentration of volatile fatty acids;
- type of forage.

Smell is represented by the sensation that the chemical volatile substances induce to the sense of smell. The raw whole milk has a characteristic smell, specific to the species from which it comes from. It has to be slightly butyric and ketonic. The foam and the fat globules from milk have the property of contacting very easily the unpleasant smells from the preserving environment.

Texture stands for the dispersion of milk components, representing the liquid, with its specific properties. This notion is especially linked to the consistency. It is mostly used when it comes to the evaluation of fermented dairy products, cheese products and fat dairy products.

Degree of contamination stands for what is pure and impure. It can be verified by using the lactofiltrum test. The presence of impurities in milk indicates poor hygiene, determined by causes which act both before and after milking.[5]

3. RESULTS AND DISCUSSION

3.1. Limits of acceptability

Table 3.1: The chemical composition of the milk according to the species

Criteria	Cow	Sheep	Goat	According to
Fat	3,60	4,20	5,60	ANNEX FROM SERVICE PROVIDERS CONTRACT NO.2/15.07.2012
Protein	4,20	4,70	5,50	
Lactose	3,40	4,40	4,40	
Total of solids	12,20	13,40	14,20	

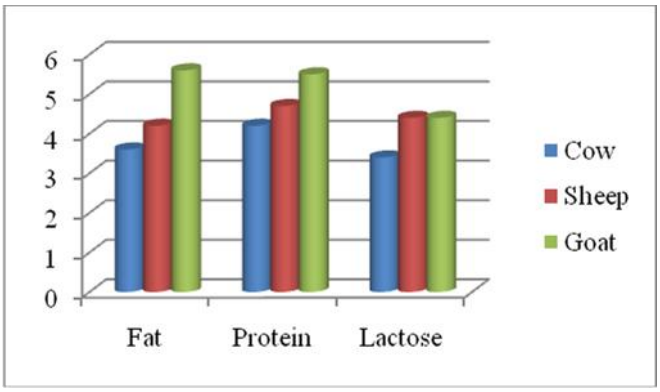

Figure. 3: Chemical composition of the milk according to the species

3.2. Results

Table 3.2: Results

Unit source	Assortment	No. sample	Fat	Protein	Lactose	TS
Mixed breeding and exploitation farm	Cow milk	1	3,59	3,66	4,50	12,20
		2	3,58	3,37	4,52	12,22
		3	3,64	3,47	4,46	12,34
		4	3,81	3,44	4,56	12,62
		5	4,12	3,37	4,41	12,68
	Sheep milk	1	6,83	5,74	4,29	17,85
		2	6,85	5,58	4,29	17,86
		3	6,59	5,51	4,32	17,42
		4	6,83	5,56	4,29	17,72
		5	6,60	5,51	4,31	17,40
	Goat milk	1	9,63	7,69	4,01	22,19
		2	9,53	7,77	3,99	22,16
		3	9,68	7,78	4,13	22,49
		4	9,54	7,78	3,99	22,18
		5	9,68	7,79	4,15	22,50

3.3. Graphic interpretation

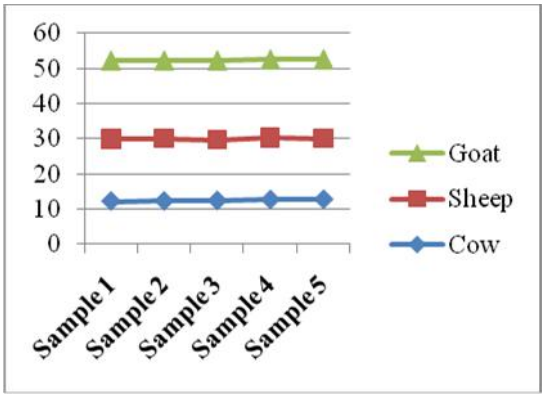

Figure 4: Milk fat variation according to species species

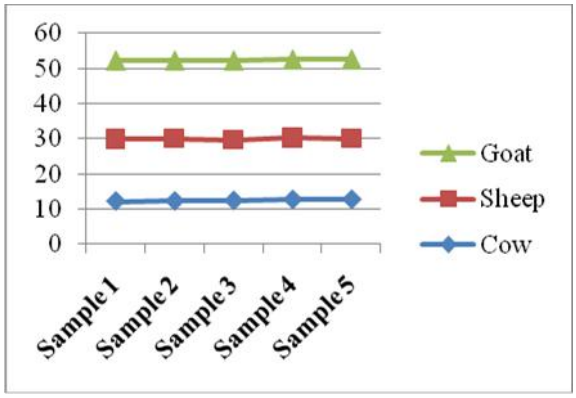

Figure 5: Milk protein variation according to species

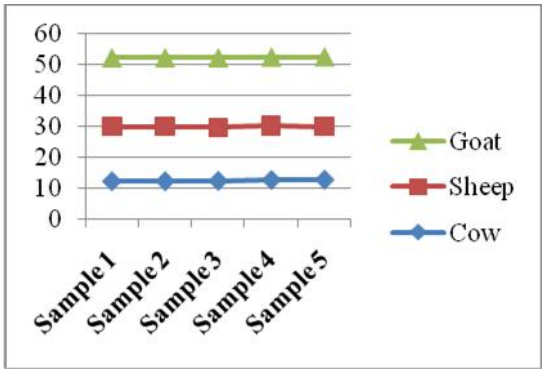

Figure 6: Lactose variation according to species species

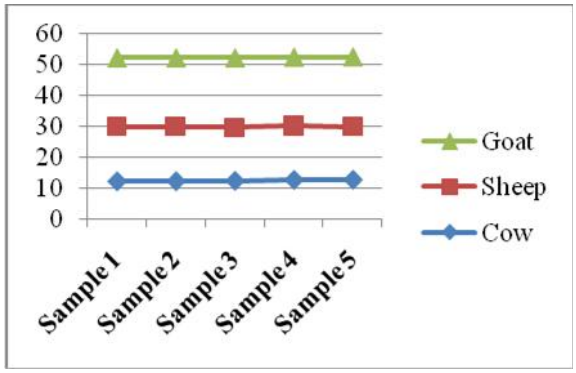

Figure 7: TS variation according to species

4. CONCLUSION

1. Milk is one of the most important foods in human alimentation and by processing it a wide range of products are obtained.
2. Thanks to the nutrients, found in optimal proportions, the milk is better absorbed by the organism in comparison with any other aliment and being consumed as fresh milk, but also under to form of various dairy products.
3. The knowledge of the organoleptic characteristics of milk is of high importance because it helps at the identification of milk's qualities or flaws.
4. The specialists from dairy products farms and from the food industry, but also merchants and consumers, are especially interested in the following organoleptic characteristics: color, aspect, smell, taste, texture and the degree of contamination.

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