UNIVERSIDAD POLITECNICA DE VALENCIA

ESCUELA POLITECNICA SUPERIOR DE GANDIA

Licenciado en Ciencias Ambientales

“Factors influencing raw milk quality and dairy products”

TRABAJO FINAL DE CARRERA

Autor/es:

Raúl Alcázar Chirlaque

Director/es:

Lenka Kouřimská.

José Fresquet Gozalvo.

GANDIA, 2011

INDEX

SUMMARY:

In the Western world today, cow's milk is produced on an industrial scale, and is by far the most commonly consumed form of milk. Commercial dairy farming using automated milking equipment produces the vast majority of milk in developed countries. The largest producers of dairy products and milk today are India followed by the United States, Germany, and Pakistan.

The dairy industry is a large and dynamic segment of the agricultural economy of many nations. The widespread consumption of dairy products and well-publicized recent epidemics of animal disease has increased consumer concern about the quality of foods of animal origin. Coincident to these trends, globalization has influenced the definition of "high-quality" milk and consumer expectations are increasingly affecting animal management practices. An understanding of concepts regarding milk secretion and milk quality is necessary to meet evolving consumer expectations.

KEYWORDS: milk, quality, analysis, factors, process, cow, fat, yoghurt.

1. INTRODUCTION:

The objective of this project is to monitoring and check the quality of some Czech dairy products from different brands. This will perform a series of analysis (like fat content, protein content, acidity.etc) and will be compare this, with the values of the bottles brands.

Milk is an opaque white liquid produced by the mammary glands of mammals. It provides the primary source of nutrition for young mammals before they are able to digest other types of food. The early lactation milk is known as colostrum, and carries the mother's antibodies to the baby. It can reduce the risk of many diseases in the baby. The exact component of raw milk varies by species, but it contains significant amounts of saturated fat, protein and calcium as well as vitamin C. The composition of milk varies among mammals, primarily to meet growth rates of the individual species. The proteins contained within the mother's milk are the major components contributing to the growth rate of the young animals. Human milk is relatively low in both proteins and minerals compared with that of cows and goats. Milk, an almost complete food, consists of proteins (mainly casein), fat, salts, and milk sugar, or lactose , as well as vitamins A, C, D, certain B vitamins, and lesser amounts of others. Milk is a major source of calcium and a good source of phosphorus. Low-fat and skim milk fortified with vitamins A and D have the same nutritional value as whole milk, but with fewer calories and less cholesterol.

Humans are an exception in the natural world for consuming milk past infancy, despite the fact that more than 75% of adult humans show some degree (some as little as 5%) of lactose intolerance, a characteristic that is more prevalent among individuals of African or Asian descent. The sugar lactose is found only in milk, forsythia flowers, and a few tropical shrubs. The enzyme needed to digest lactose, lactase, reaches its highest levels in the small intestines after birth and then begins a slow decline unless milk is consumed regularly.

In many cultures of the world, especially the Western world, humans continue to consume milk beyond infancy, using the milk of other animals (especially cattle, goats and sheep) as a food product. For millennia, cow's milk has been processed into dairy products such as cream, butter, yogurt, kefir, ice cream, and especially the more durable and easily transportable product, cheese. Modern industrial processes produce casein, whey protein, lactose, condensed milk, powdered milk, and many other food-additive and industrial products.

1.1. IMPORTANCE OF MILK FOR NUTRITION

Milk is a highly nutritious food, which is rich in several nutrients like calcium, potassium, vitamins and protein. People have been using cow's milk since 6,000-8,000 B.C. And since 14^{th} century, it has gained immense popularity as one of the healthiest foods. Milk meets the basic requirements of the body. It is highly beneficial in the growth and development of bones. It is also helpful in fighting against diseases like gout, kidney stones, breast cancer, rheumatoid arthritis, migraine headaches and others. Considering the innumerable health benefits of cow's milk, knowing about its nutritional value will be highly helpful.

1.1.1. NUTRIENTS IN MILK:

- ***Macronutrients*** (energy, protein, carbohydrate, fat, fibre).
- ***Water-soluble vitamins*** (thiamin, riboflavin, niacin, niacin from tryptophan, vitamin B6, vitamin B12, folate, pantothenate, biotin, vitamin C).
- ***Fat-soluble vitamins*** (retinol, carotene, vitamin D, vitamin E).
- ***Minerals*** (sodium, potassium, calcium, magnesium, phosphorus iron, copper, zinc, chloride, manganese, selenium, iodine).

1.1.2. MILK COMPOSITION:

Milk is composed of milk fat, lactose (milk sugar), protein, minerals, and water. Colostrums is the first milk from the mammal after bearing young, it has a much higher constituent (except lactose) than the succeeding milk. Colostrums also contain the immune globulin, the carriers of antibodies to protect the young from infectious diseases.

- **MILK FAT:**

Milk fat consists of triglycerides containing at least 52 kinds of fatty acids. The fat in milk contributes unique characteristics to the flavour, texture, appearance and satiability of dairy foods as well as providing a source of fat soluble vitamins, essential fatty acids and other health promoting compounds.

- Phospholipids and glycosphingolipids.
- Trans vaccenic acid (VA).
- Unsaturated fatty acids.
- Saturated fatty acids.

- **PROTEINS:**

Milk protein is complete in that it contains all eight essential amino acids in the correct amounts. Milks protein has two major components; casein which is the most abundant protein in milk. It forms a thin film on the enamel surface which prevents loss of calcium and phosphate from the enamel when the teeth are exposed to acids in the mouth. Whey proteins are lactalbumin and lactoglobulin, and are similar to the blood proteins, albumin and globin.

- **LACTOSE:**

Lactose is the main carbohydrate found in milk and dairy products and is digested by the enzyme lactase into its absorbable components -glucose and galactose which are then used as fuel by the body.

- **MINERALS:**

Milk contains significant quantities of all of the minerals essential for human nutrition except copper, iron, and manganese.

- ***Calcium (Ca)*** is a key mineral and is found in high quantities of milk. It is not only needed for skeletal growth and maintenance, but it also assists in:
  - The contraction of muscle fibres.
  - Blood coagulation for wound healing.
  - Nerve impulses.
  - Activation of enzymes (which help control the body’s metabolism).

✓ **What Is Calcium, and Where Do We Get It?**

Calcium is a mineral that the body needs for numerous functions, including building and maintaining bones and teeth, blood clotting, the transmission of nerve impulses, and the regulation of the heart's rhythm. Ninety-nine percent of the calcium in the human body is stored in the bones and teeth. The remaining 1 percent is found in the blood and other tissues. The body gets the calcium it needs in two ways. Good sources include milk and dairy products, which have the highest concentration per serving of highly absorbable calcium, and dark leafy greens or dried beans, which have varying amounts of absorbable calcium. The other way the body gets calcium is by pulling it from bones. This happens when blood levels of calcium drop too low, usually when it's been awhile since having eaten a meal containing calcium. Ideally, the calcium that is "borrowed" from the bones will be replaced at a later point. But, this doesn't always happen. Most important, this payback can't be accomplished simply by drinking more milk.

- ***Phosphorous***: Is another important mineral found in milk and is linked with calcium. The ratio of phosphorous to calcium is important in order to maximise the absorption of calcium. Phosphorous also plays a vital role in the body's biochemical reactions.

- ***Fe*** is low in milk of many species relative to the needs of the neonate. Fe is essential for the neonate as part of hemoglobin. In many species the neonate is born with some liver stores of Fe; however, the piglet does not and needs an Fe supplement (injection) soon after birth. Fe in milk is bound to lactoferrin, transferrin, xanthine oxidase, and some to caseins.

- ***Zn*** in cow's milk is mostly bound to casein, but some is bound to lactoferrin.

- ***Cu*** is bound to the caseins, to ß-lactoglobulin, to lactoferrin, and some to the milk fat membranes.

- ***Mo*** is bound to xanthine oxidase, an enzyme associated with the cell membrane and on the inner surface of the milk fat globule membranes.

- ***Mn*** is associated with the milk fat membranes.

- ***Co*** is an essential part of vitamin B12.

- **VITAMINS:**

  - ***Vitamin D*** plays an important role in the absorption of calcium and phosphorus and is essential for healthy bones and teeth.
    The body produces vitamin D when the skin is exposed to sunlight and therefore dietary sources are of less importance.

  - ***Vitamin B12*** is required for maintenance of healthy nerves and red blood cells, energy production and normal cell division.

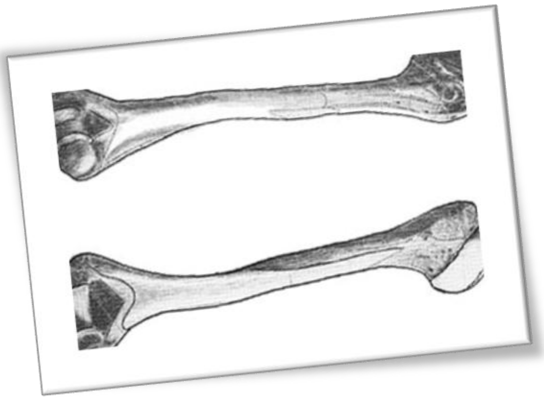
  - ***Riboflavin (vitamin B)*** is necessary for the release of energy from foods and healthy membranes and skin, again riboflavin is a water-soluble vitamin and does not store in the body, and any excess amounts are excreted unchanged in the urine.

1.1.3. HEALTH BENEFITS OF MILK:

- ***Teeth:*** The amounts of calcium and phosphorous in milk and dairy products are also beneficial for the development and maintenance of healthy teeth.

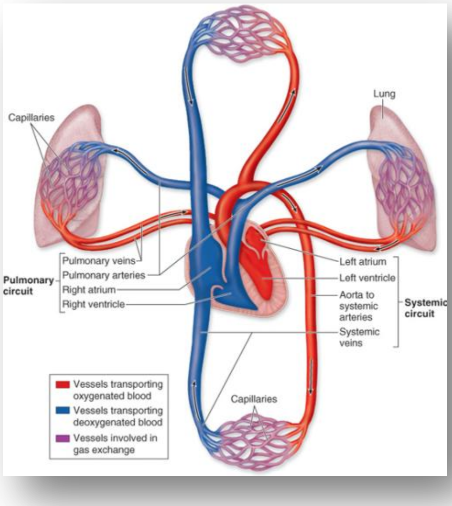
Healthy teeth

- ***Bones health***: Adequate consumption of milk and dairy from early childhood and throughout life can help to make the bones strong and protect them against diseases like osteoporosis (calcium, phosphorous, magnesium and protein).



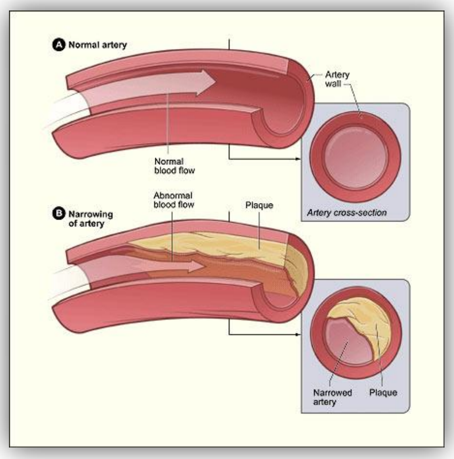
Bones

- **Milk and cardiovascular disease:** milk and dairy consumption with a reduced risk for cardiovascular disease. In addition, it is also thought that calcium may bind harmful fats together in the gut and prevent their absorption, which in turn prevents levels in the blood increasing.



Cardiovascular system.

- ***Milk and blood pressure:*** An increasing number of studies suggest that consuming 3portions of dairy each day, along with 5 portions of fruit and vegetables as part of a low salt diet can reduce high blood pressure in both adults and children.



Normal and blocked artery.

- ***Cholesterol in milk***: Saturated fatty acids are usually associated with increased risk of cardiovascular disease through their cholesterol raising effects (*Fig.4*); however studies have indicated that this does not apply to all saturated fatty acids in milk. In fact some of the saturated fatty acids in milk may reduce the cholesterol raising effects of other saturated fatty acids.

- **Obesity:** In addition to these some researches shown that consumption of milk and dairy products is related to weight loss.

- ***Type 2 diabetes:*** Studies suggest that regular consumption of low fat dairy products can help to reduce the risk of type 2 diabetes, which has been a longstanding problem in adults, and is becoming increasingly common in children and adolescents.

Normal and excessive glucose in blood.

1.1.4. ALLERGY AND INTOLERANCE TO MILK:

- ***Milk allergy*** is one of the most common food allergies in children. Although cow's milk is the usual cause of milk allergy, milk from sheep, goats and buffalo also can cause a reaction. And, some children who are allergic to cow's milk are allergic to soy milk too. A milk allergy usually occurs a few minutes to a few hours after you consume milk. Signs and symptoms of milk allergy range from mild to severe and can include wheezing, vomiting, hives and digestive problems.

Milk allergy

- ***Lactose intolerance:*** People often confuse a milk allergy with lactose intolerance, but they are not the same thing. Lactose intolerance is caused by deficiency of intestinal lactase (hypolactasia). To ingest milk with a meal may also improve tolerance. Instead of drinking regular milk, fermented milk may be an option.

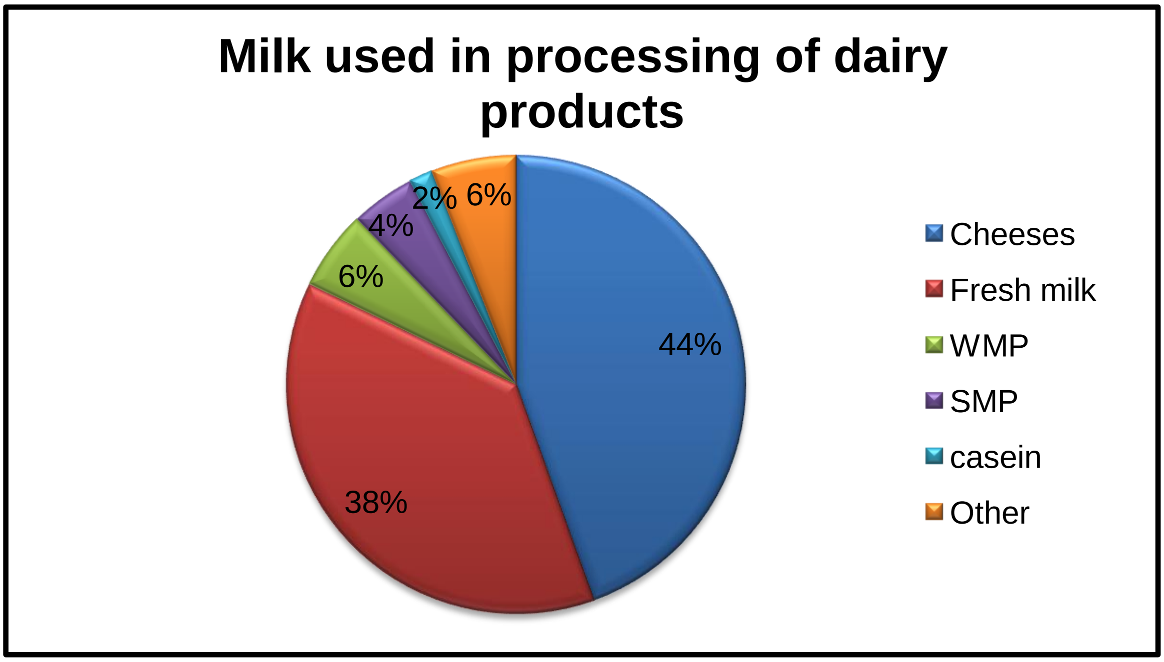
- ***Milk protein allergy*** can develop in both breastfed and formula-fed children. However, breastfed children are usually less likely to develop food allergies of any sort. Occasionally, though, breastfed children develop cow's milk allergy when they react to the slight amount of cow's milk protein that's passed along from their mother's diet into her breastmilk. In other cases, certain babies can become sensitized to the cow's milk protein in their mothers' breastmilk, but don't actually have an allergic reaction until they're later introduced to cow's milk themselves.

1.2. IMPORTANCE OF MILK IN WORLD ECONOMY

Consumption of milk is very heterogeneous in different countries and regions, due both to cultural patterns and income levels of the population. In general, the countries of Europe and North America (Canada and U.S.) are where there are higher levels Overall consumption between 200 and 300 liters of milk-equivalente1, although the relative importance of each type of product is different. For example, in northern Europe, North America and Oceania is very high relative consumption of liquid milk (pasteurized or UAT, in some countries), while the Mediterranean countries (France, Italy, Spain) are distinguished by the high participation of cheese in the milk diet.

The milk used in processing dairy products in the EU in 2006 according to data from the European Commission are; cheeses 37.3 %, fresh milk 31.6 %, butter 16.2 %, skimmed SMP 3,8 %, whole WMP 4.7 %, casein 1.4 % and other 5 %.

To calculate correctly the levels of milk production and processing, economists use a unit of calculation known as the milk equivalent: Number of kilograms of milk required to make a specific dairy product:



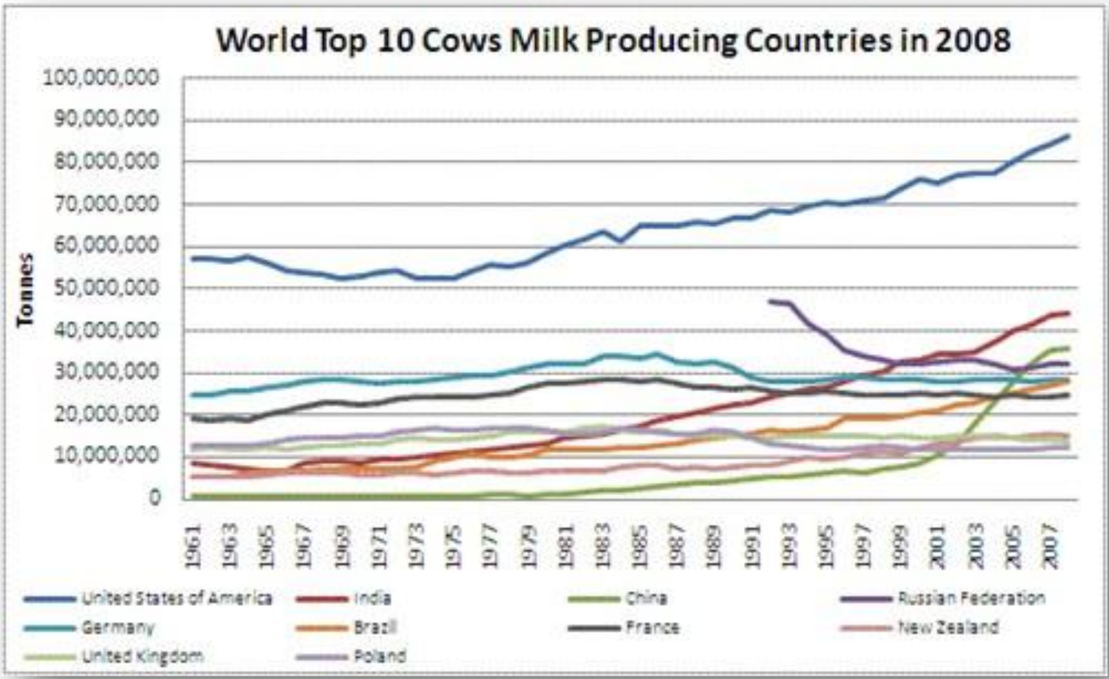
Milk for dairy products

World cow's milk production in 2008 stood at over 578 million tonnes, with the top ten producing countries accounting for 55.4% of production. The USA is the largest cow's milk producer in the world accounting for 14.9% of world production, producing over 86 million tonnes in 2008, an increase of 2.4% when compared to 2007.

India is the second largest cow's milk producer, accounting for 7.6% of world production and producing over 44 million tonnes in 2008. The UK is the 9th largest producer in the world producing over 13 million tonnes in 2008 and accounting for 2.4% of world cow's milk production.

World milk production (IDF)	
Year	**Milk production (mil t)**
2001	589
2004	620
2005	633
2006	645
2007	655
2008	684
2009	695

Total of milk production in the world



Milk producing countries

The European Union dairy farmer is allocated a maximum annual milk and milk fat production quota. If their production exceeds the maximum limit, they must pay a penalty to this institution.

In Europe, are the largest dairy companies in the world, being Nestlé (from Switzerland) the largest (16,861 million Euros in 2007). Number two is Danone from France (9,241 million Euros of dairy revenue in 2007).

Lactalis, another French company, was number 3 in 2007. From 2009 FrieslandCampina from the Netherlands will also rank among the top players on this list.

The biggest dairy companies (in 2008) (IDF)

	Company	Country
1	Nestlé	Switzerland
2	Danone	France
3	Lactalis (incl. Galbani)	France
4	FrieslandCampina	Holland
5	Fonterra	New Zealand

2. CZECH REPUBLIC AGRICULTURE

2.1. INTRODUCTION

The Czech Republic lies in the very heart of Europe at the watershed of three seas, which has predestined it to take the role of a bridge between East and West. It´s neighbors include not only the developed western countries, Germany to the west and Austria to the south, but also countries in process of transformation, i.e. Poland to the north and Slovakia to the east.

The area of the Czech Republic is 78 866 km^2 (21st place in Europe) and it has a population of more than 10 million (12th place in Europe). According to the World Fact book the population in July 2006 was 10,235,455.

A third of the Czech territory (33 % is occupied by forests and more than a half (54 %) is agricultural. Table gives an overview of changes in land use before and after the Velvet Revolution (November 1989). The year 1989 was the last year under socialistic conditions and the year 1993 saw the splitting of Czechoslovakia into the Czech Republic and Slovakia. The development has been characterized by a slight decline in arable land area and by a growing share of permanent grassland. It is a consequence of the state subsidy policy, which should influence the restructuring of Czech agriculture.

Agricultural land use				
	1989	**1993**	**1997**	**2000**
	in ,000s of hectares			
agricultural land	4,296	4,282	4,280	4,280
arable land	3,232	3,173	3,091	3,082
of which: cereals	1,670	1,607	1,696	1,647
oilseeds	110	270	294	409
potatoes	115	77	73	69
sugar beet	127	91	95	61
fodder	1,079	962	786	725
permanent grassland	828	873	953	961
of which: meadows	572	610	668	671
pastures	256	263	285	290
hop-gardens	11	11	11	11
vineyards	16	16	16	16
set aside arable land *	3	32	57	70

* set aside arable land means an area which is not cultivated for different reasons (economical or social) and gives no production. (Source: Statistical Yearbooks of the Czech Republic).

In the late 1980s Czechoslovak agriculture was characterized by maximum concentration on production, by the attempt to use all agricultural land for intensive production and by relatively large state subsidies. Large-scale agriculture produced significant surpluses in practically all basic commodities (which were exported mostly to COMECON countries).

After the Velvet Revolution (1989) and the introduction of democratic conditions, Czech agriculture, like the whole national economy, found itself at a cross-roads. It was absolutely clear that massive redistribution, central planning and ownership along the lines of "everyone owns everything and nobody owns anything" had to be abandoned. Social demand required the acceleration of economic reforms aiming at a market economy, and the architects of economic reform decided on shock therapy, consisting of:

- Radical liberalization of prices,
- The greatest possible liberalisation of foreign trade,
- Rapid privatization.
- Changes in the taxation system.

The transformational changes have had a major effect on both the farm structure and the structure and dimensions of agricultural production. A part of the reform process was the restoration of the right to own land and other agricultural property, carried out under the Land Act of 1991 (the so called Restitution Act). On the basis of the law on property relationships and property claims within cooperatives, passed in 1992 (the so called Transformation Act), agricultural cooperatives were transformed into private business. Other companies, and in part also agricultural cooperatives, were formed in the course of 1993 and 1994 within the privatization of state farms. Also the number of private farmers and their share of agricultural land increased during the whole period of transformation and privatization of Czech agriculture.

The transformation of Czech agriculture is still unfinished. The changeover from large-scale production oriented towards other economies, to an agriculture fulfilling mainly extra-production functions and securing the development of the countryside will continue for many years to come. There are unlikely to be further very major changes in the structure of production in arable areas, but in mountainous and foothill regions it is absolutely necessary to create conditions for the development of extensive forms of farming, ecological farms and the ever more popular agro-tourism.

Assistance is provided to agriculture in a number of different ways. First, there are Ministry of Agriculture direct support programmes. Second, government regulation ensures that farmers are given financial incentives to maintain the countryside to a cultured standard and to develop functions of agriculture outside production. This latter type of subsidy is taking up an ever larger share of aid to agriculture and fully corresponds to the world-wide trend of encouragement for multifunctional agriculture.

2.2. SOIL AND TOPOGRAPHY

Geographically, the Czech Republic is situated on the boundary of two different mountain systems. The state borders are formed by the Šumava, the Bohemian Forest (Ceský les), the Ore Mountains (Krušné hory), the Giant Mountains (Krkonoše), the Orlické hory, and the Jeseníky. In the centre are the Czech Highlands (Ceská vysocina) and the Bohemian and Moravian Uplands (Ceskomoravská vrchovina). In the eastern part of Czechia are the West Carpathians (Západní Karpaty, i. e. the Beskydy and the White Carpathians - Bílé Karpaty). The outlines of both mentioned mountain systems are filled by valleys, the most fertile of them being the valleys of the Morava river in Moravia and the valley around the middle course of the Labe river (Polabská nížina) in Bohemia. The highest place in the country is Snežka (located in Krkonoše (Giant Mountains) at 1,602 m above sea level), the lowest place (only 115 m above sea level) is the point where the river Labe leaves the Czech Republic. A third of the Czech territory is above 500 m.

The borders of Czechia are between the latitudes of 48°33' and 51°03' north and the longitudes of 12°05' and 18° 51' east. The distance from the western and the most eastern parts is 278 km, likewise the maximum north - south distance is 493 km.

The Czech Republic has very diverse soils. According to soil genetic and agronomical classification, they can be divided into five groups. Cambisols represent the prevailing type (40 percent of total agricultural land), followed by stagno-gleyic luvisols and cambisols (20 percent), luvisols (19 percent), chernozems (11 percent) and fluvisols (10 percent). According to soil maps there are in Czechia 60 percent of middle heavy soils, 20 percent light, 15 percent heavy and 5 percent of stony soils.

The most fertile soils can be found in lowlands along the big rivers (the lower part of the Labe river in Bohemia and the Morava iver in Moravia). On the other hand, the worst (shallow and stony) soils are in higher elevations.

2.3. CLIMATE AND CZECH AGRICULTURAL ZONES

The climate of the Czech Republic is formed by mutual penetration and blending of oceanic and continental effects. The westerly flow is characteristic of the described region as well as intensive cyclonic activity, which causes frequent exchange of air masses with a great deal of precipitation. The maritime influence is more obvious in Bohemia, while in Moravia the continental climate is more marked. The climate is strongly affected by the altitude and by relief. Some 52,817 km^2 , i.e. 67 percent, of the Czech Republic is below 500 m.

The average annual air temperature varies between 6 and 9°C and the average annual sum of precipitation between 400 and 700 mm, however with a big fluctuation in individual years.

The state territory is divided into 10 climatic regions, described by several criteria (sum of temperatures above 10°C, moisture security, average annual temperature and average annual precipitation - all these criteria are assigned on average for each of the last fifty years of meteorological observation).

Production conditions and exploitation of agricultural land from the viewpoint of soil and climatic conditions (irrespective of administrative borders) are characterized by the means of agricultural production areas. This categorization of the territory is useful for economics and statistics and also for measures of the state and regional agricultural policy. The new framework of the agricultural production areas was created in 1996 on the basis of evaluation of agricultural soils and consists of five agricultural production areas and 21 sub regions.

Definition of agricultural production areas		
Production area	**Characteristics**	**share (%)**
maize	production of maize, sugar beet and cereals; hot and dry climate with very fertile soils; elevation to 250 m above sea level, percentage of ploughed land 80 - 90 %,	7
beet	production of sugar beet and cereals; warm climate and fertile soils; elevation up to 350 m above sea level, percentage of ploughed land 80 - 90 %	24
cereals	production of cereals; slightly warm and slightly wet climate and medium fertile soils; elevation 300 - 600 m above sea level, percentage of ploughed land 60 - 80 %	41
potato	production of potatoes and cereals; slightly warm to slightly cold and wet climate; medium and less fertile soils; elevation 400 - 600 m above sea level, percentage of ploughed land 60 - 80 %	18
grass	fodder production with emphasis on cattle; cold and damp climate with less fertile soils; elevation over 600 m, percentage of ploughed land under 50 %	10

2.4. RUMINANT PRODUCTION SYSTEMS

- **Dairy and beef:**

Changes in both state subsidy policy and consumer demand have together led to a major fall in the production of milk and beef.

On the basis of the long-term program of development and support of cattle rearing, the restructuring of the herd continued. Dairy breeds prevailed (87 percent). The most widespread race remains the Czech Spotted Cattle (52 percent) which are kept for combined milk and meat. The second most important race is Holstein with its distinct dairy use (40 percent). Other breeds make up the remaining 8 percent.

Most of the cattle population in Czech Republic in 2000 was dairy breeds kept under large-scale conditions of the agricultural cooperatives and trading companies. The supply and accessibility of modern technologies improved the conditions for introducing free housing systems for dairy cows. According to the estimates of the Ministry of Agriculture the share of this housing reached about 60 percent in 2000.

In the last ten years, herds of dairy cows have been reduced by more than 50 percent. Despite direct subsidies and in spite of the moderate improvement of the producer's position in the market, the decline of dairy cow numbers continued in 2000 under the influence of the continuing unprofitability of milk production. On the other hand there is a basic improvement in yield, which today is around an average of more than 5,000 kg of milk per cow per year and is therefore already comparable with that of some EU states.

The increase in yield is the result of the effect of targeted subsidies for dairy farming and the continual improvement in the genetic work of breeders. Unfortunately it has not yet proved possible to increase the consumption of milk and dairy products significantly, so it is necessary to export some of the production. The share of exported milk products in 2000 was almost 24 percent.

Dairy										
		1989	1993	1997	2000	2001	2002	2003	2004	2005
dairy cows	in ,000 head	1,248	830	702	615	483	477	459	433	439
yield	Litres cow/year	3,982	3,824	4,366	5,255	5,762	5,720	5,764	5,983	6,062
milk	millions of litres	4,893	3,350	2,703	2,701	2782	2728	2645	2602	2661

Beef					
		1989	1993	1997	2000
cows without market production	***in ,000 head***			47	67
beef production		524.5	390.3	293.6	208.0
supply	***in ,000s of tons***	518.5	390.3	306.5	227.6

Home grown beef on the Czech market decreased gradually owing to falling cattle numbers during past years so that it was necessary to import. The reason also lies in changes in consumer demands: some consumers have replaced beef in their diets with the cheaper pork while others have moved from red to white meats. A similar declining trend in beef consumption can be observed abroad, too.

- **Sheep and goats:**

The sheep (and in much smaller numbers also goats) have their uses in Czech republic, namely for maintaining the amenity value of the countryside. The main product - lamb - which is one of a few commodities exported to the EU - countries, is also very important.

Sheep and goats									
	1989	1993	1997	2000	2001	2002	2003	2004	2005
	in ,000 head								
sheep	399	254	121	84	90	96	103	116	140
goats	41	45	38	32	28.5	13.6	12.8	11.9	12.6

Sheep rearing is going through big changes both in structure and economics. All these changes have negatively influenced results. The sharp fall of wool prices in 1991 caused a big decrease in sheep numbers (the share of sheep for wool production was almost 63 percent). Since 1995 the main product is lamb. Dual purpose breeds are preferred now: in 2000, 67 percent dual purpose was kept and 30 percent for lamb. Sheep are kept first of all for quality lamb and for grazing grassland mainly in fodder production areas. Almost 80 percent of sheep rearers have small herds up to 10 head, mostly for domestic use and only about 30 percent goes through slaughter to the market.

Sheep numbers are still decreasing, so the goal of subsidiary programs is to boost the number of sheep, firstly by merging and extending flocks with a bigger number of sheep, secondly by lamb production for the local and foreign demand. A part of the systematic approach is the optimizing of pastures and the management of grazing areas to increase herbage production and to maintain the amenity value of the countryside. In 1998, the government program (focused on sheep breeding in uplands) began, but its effects are not yet evident. The end of reduction of flocks can be expected in the coming years and since 2000 numbers have slowly begun to increase again. Goat numbers fell in the five years from 1995 to 2000 by about 30 percent and then halved again from 2000 to 2004.

No increase is expected and the only change will consist of preferences for large flocks instead of individual stock raising and in the expansion of the meat breed, especially the one appropriate for joint grazing with cattle and sheep.

2.5. THE PASTURE RESOURCES

It is difficult to give an overview on grassland in the Czech Republic because of the lack of information and the dearth of statistics.

Rychnovská et al. (1985) define meadows and pastures phytocenologically as plant associations and divide them according to moisture conditions into five grassland types. However, they differ very much in their productivity and fodder quality. Three of these types can be characterized by extreme conditions (stands on very wet or swampy or inundated localities with predominance of *Carex spp*., then dry places belonging to *Nardus stricta* communities, and xerophytic stands of *Bromus* type). These are without any economical importance and can be evaluated only from the point of view of their ecological - non-productive - functions. It is estimated they make up approximately 30 % of all grassland.

Grassland belonging to the phytocenological order of *Molinio-Arrhenatheretea* is most often used. It can be divided into two parts: *Molinietalia* and *Arrhenatheretea*. The productivity of *Molinietalia* depends on the local moisture conditions and management (both influencing the botanical composition). On light soils the stands are created mainly by *Alopecurus pratensis, Festuca pratensis* and *Holcus lanatus* and on heavier soils *Deschampsia caespitosa* prevails. The meadows and pastures of *Arrhenatheretea* could be divided into regularly double-cut meadows with a big share of cultural grass and clover species like *Arrhenatherum elatius, Festuca pratensis, Festuca rubra, Dactylis glomerata* and *Alopecurus pratensis* or productive pastures with *Lolium perenne, Cynosurus cristatus, Poa pratensis, Phleum pratense, Trifolium repens* and on less fertile soils with *Agrostis tenuis, Festuca rubra, Anthoxanthun odoratum* or *Briza media*.

Animal production in lowlands - where most cattle are kept in stables under large scale conditions - is based on fodder from arable land. Grassland offers only a small amount of hay in these areas because of their small acreage. They are situated mostly around rivers and brooks and are not suitable for mechanized harvesting. That is why almost a quarter of arable land is under fodder crops (in 1989 it was a third). In the growing period feeding consists of fresh fodder, while in winter it is based on silage or haylage (mainly) from maize.

There is more grassland at higher altitudes. The meadows there serve for hay but the production is very often not exploited at all because there is no need of fodder. Very important is however maintaining of the countryside and that is why grazing beef cattle (and sheep) in these areas is supported by state subsidies. Under local conditions continuous grazing prevails, which is a cheap way of grassland management.

Development of hay production				
	1989	1993	1997	2000
	t ha^{-1}			
meadows	5.35	3.34	3.67	2.95
pastures	3.48	2.18	2.54	2.15
fodder on arable land	7.56	6.72	6.26	5.66

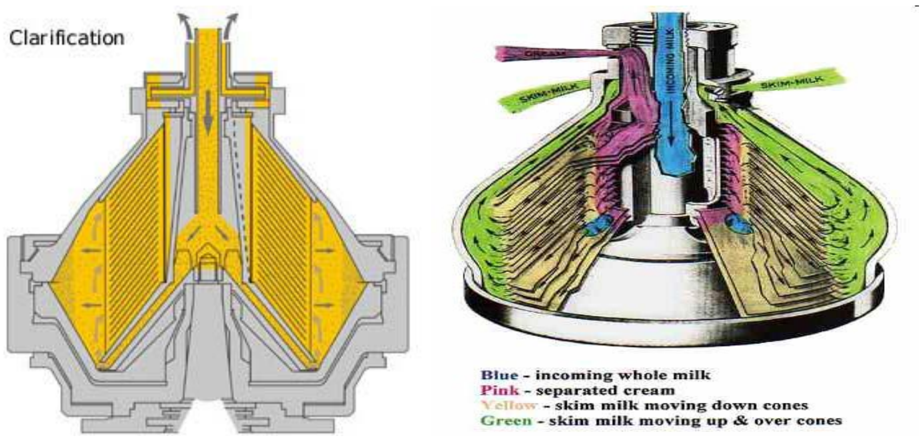
3. MILK PRODUCTION AND KINDS

3.1. MILK PROCESSING:

The milk goes through several processes in its production, which are:

- Centrifugal separation.
- Standardisation of fat content.
- Pasteurisation.
- Homogenisation.
- Deaeration.
- Bactofugation.

- **CENTRIFUGAL SEPARATION:** Centrifugation is a separation operation used in the food industry for the treatment of milk, principally for standardization of milk and milk products, and the production of cream and/or skim milk. This operation use a centrifugal force to separate the two mixed of liquid or insoluble solids form liquids (suspension). In this case, the fat globules separate of the rest of the milk suspension. The original milk feed (3,7 % fat) is separated into a cream portion (higher than 30 % fat) and a skim milk portion (around 0,05 % fat). The milk should be at a temperature around of 40ºC before entering the centrifuge.



Clarificator and centrifugator

- **STANDARDISATION OF FAT CONTENT:** Standardization is defined as the industrial adjustment of milk or cream fat content to a precisely specified or desired value. It is of key importance for dairies, which face the challenge of transforming milk into standardized serial products for daily consumption – a broad product range with a variety of fat contents, satisfying all requirements. In general, the fat content of raw milk is higher than the fat content of the various dairy products to be manufactured. The standardized fat content of these products usually ranges between a minimum of 0.5 and a maximum of 3.5 percent.

Standarisation of milk machine

- **Two methods of standardisation:**

  - **Batch-wise in tanks** (This step according to both these methods is to separate whole milk in to cream and skim milk.)
  - **Direct in line standardization** (The term "whole" milk or raw milk is used for milk as it is delivered to the dairies with a fat content around 4%.)

When carrying through the standardization in batches two methods are used, namely:

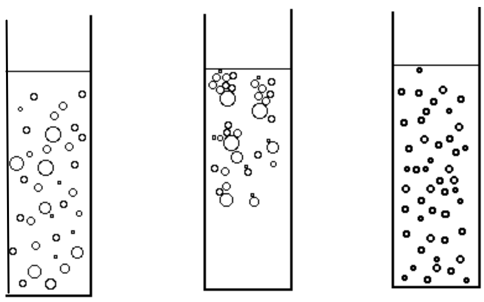
- ***Pre-standardization:*** means that the milk is standardized prior to the pasteurization.
- ***Post-standardization:*** means that pasteurized milk is mixed with cream or skim milk depending on if the fat.

- **PASTEURIZATION:** Pasteurization destroys most disease producing organisms and limits fermentation in milk by partial or complete sterilization. It does not destroy organisms that grow slowly or produce spores. While pasteurization destroys many microorganisms in milk, improper handling after pasteurization can recontaminate milk. Many dairy farms use a home-pasteurizing machine to pasteurize small amounts of milk for personal use. Raw milk can also be pasteurized on the stovetop. Microwaving raw milk is not an effective means of pasteurization because of uneven heat distribution.

  There are three types of pasteurization:

PROCESS	TEMPERATURE	TIME
LTLT pasteurization of milk	63°C	30 min
HTST pasteurization of milk	72-75°C	15-20 s
Ultra-pasteurization of milk	125-138°C	2-4 s

- **HOMOGENISATION:** Standard industrial process of stabilizing the fat emulsion against gravity separation. Causes disruption of fat globules into much smaller ones. Consequently it diminishes creaming and may also diminish the tendency of globules to clump or coalesce.



Raw milk, cold raw milk (after 1 hour) and Homogenized milk during storage.

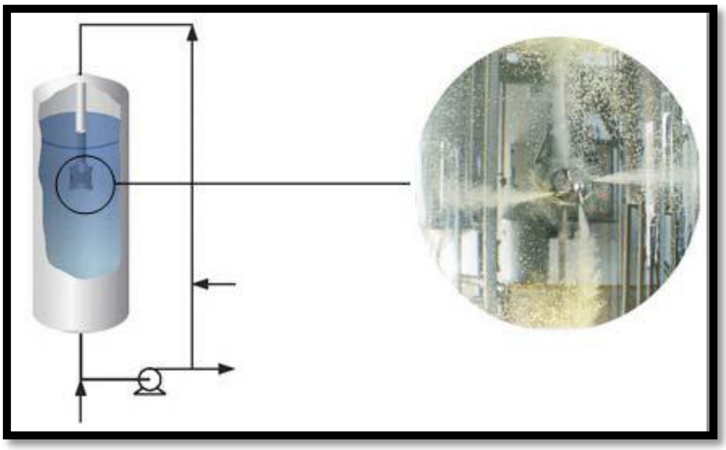
Advantages of homogenisation:

- Smaller fat globules leading to no cream-line formation.
- Whiter and more appetizing colour.
- Reduced sensitivity to fat oxidation.
- More full-bodied flavor, better mouthfeel.
- Better stability of culture milk products

Disadvantages of homogenisation:

- Homogenized milk cannot be efficiently separated.
- Increased sensitivity to light.
- Reduce heat stability
- The milk will not be suitable for production of semi-hard or hard cheeses because the coagulum will be too soft and difficult to dewater.

- **DEAERATION:** Milk always contains greater or lesser amounts of air and gases. The volume of air in milk in the udder is determined by the air content of the cow's blood stream. More air is introduced into milk during handling at the farm and transportation to the dairy, the milk contain 10% air by volume.



Milk deaeration

- **BACTOFUGATION:** Bactofugation is a process in which a specially designed centrifuge called a Bactofuge is used to separate microorganisms from milk. Bacteria, especially heat resistant spores, have a significant higher density than the milk. The optimal bactofugation temperature is 55-60˚C.

- There are ***two types*** of modern Bactofuge:

  - The two-phase Bactofuge has two outlets at the top: one for continuous discharge of bacteria concentrate via a special top disc, and one for the bacteria-reduced phase.

  - The one-phase Bactofuge has only one outlet at the top of the bowl for the bacteria-reduced milk. The bactofugate is collected in the sludge space of the bowl and discharged at preset intervals.

3.2. <u>IMPORTANTS KINDS OF MILK:</u>

- **COLOSTRUM:** Chemically, colostrum is milk of the mammary glands very rich in proteins, vitamin A, and sodium chloride, but contains lower amounts of carbohydrates, lipids, and potassium than normal milk. The most pertinent bioactive components in colostrum are growth factors and antimicrobial factors. The antibodies in colostrum provide passive immunity while growth factors stimulate the development of the gut. They are passed to the neonate and provide the first protection against pathogens. The passive immunity from the mother gets transferred to the newborn.

  - ***Chemical composition of colostrum:***

Time after calving	Water [%]	Prot. [%]	Casein [%]	Albumin glob.[%]	Lactose [%]	Fat [%]	Ash [%]	Chlores [%]	Acidity [SH]
0 h	73.01	17.57	5.08	11.34	2.19	5.10	1.01	0.153	18.40
12 h	85.47	6.05	3.00	2.95	3.71	3.80	0.89	0.156	11.20
48 h	88.56	3.74	2.63	0.99	3.97	2.80	0.83	0.149	9.60
120 h	87.33	3.86	2.68	0.87	4.76	3.75	0.85	0.131	8.50

- Coagulation when heated

- Large proportion of whey protein is immunoglobulin’s:
  - Brownish-yellow colour.
  - Peculiar smell.
  - Rather salty taste.
  - High content of catalase and peroxidise.

- **CASEIN MILK:** Casein is the main protein found in milk and contains 21 amino acids. Acid Casein is produced by controlled acid precipitation from skim milk. It is insoluble in water, completely soluble in alkali and heat stable.

  - There are two varieties of Casein.

    Edible Acid Casein is a low fat milk protein, free of the carbohydrate, has a good flavour profile and excellent nutritional properties making it ideal for medical and nutritional applications. It is used in coffee whiteners, infant formulas, and processed cheese for use in pharmaceutical industries.

    - ***Technical Acid Casein*** have good binding properties and are used for the manufacture of paper coatings, adhesives, paints, cocrete, textile fabrics and cosmetics.

    - ***Casein composition:***

Origin	Water [%]	Total Solids [%]	Lactose [%]	Fat [%]	Proteins [%]	Ash [%]
Cow	85.50-89.50	10.50-14.50	3.60-5.50	2.50-6.00	2.90-5.00	0.60-0.90
Goat	**84.80-88.80**	11.20-15.20	4.20-4.60	3.80-4.20	3.60-3.80	0.75-0.95
Sheep	77.80-81.80	18.20-22.20	3.50-4.50	7.20-10.60	5.40-7.10	0.75-0.95
Buffalo	70.10-77.10	**22.90-29.90**	4.50-4.90	7.70-8.10	**14.60-16.30**	0.75-0.95
Camel	**85.40-88.40**	11.60-14.60	**4.90-5.10**	4.30-4.50	3.30-3.60	0.70-0.90
Zebu	84.80-86.60	13.40-15.20	4.70-4.90	4.60-5.60	3.40-3.80	0.70-0.90
Reindeer	62.90-66.90	34.10-36.10	3.50-3.70	**17.80-18.80**	10.80-13.80	**1.60-1.80**

- **GOAT MILK:** Goat milk differs from cow or human milk by having higher digestibility, distinct alkalinity, higher buffering capacity, and certain therapeutic values in human medicine and nutrition.
  Some goats are bred for milk, which can be drunk raw, although some people recommend pasteurization to reduce bacteria such as Staphylococcus aureus and Escherichia coli. If the strong-smelling buck is not separated from the does, his scent will affect the milk. Is commonly processed into cheese, goat butter, ice cream and other products.

  This milk can replace sheep's milk or cow's milk in diets of those who are allergic. However, has lactose (sugar), and may cause gastrointestinal problems for individuals with lactose intolerance. It has small fat globules, which means the cream remains suspended in the milk, instead of rising to the top, as in raw cow's milk; therefore, it does not need to be homogenized.

- **SHEEP MILK**: Fat globules of the sheep milk ranges in size from 0.5 to 25 microns, but the largest fraction is between 3 and 8 microns (nearly twice as big as the fat globules in cow milk. More capric fatty acids (special flavour). Sheep milk is typical “casein milk” as it contains an average 4.5 per cent of casein and only around one per cent of whey proteins.

- **BUFFALO MILK:** Buffalo milk is very white and smooth. It is significantly lower in cholesterol and higher in calcium than cows, sheep’s or goats milks. And unlike the array of industrially produced soya and other cereal milks it is totally free of additives and chemical formulations. In addition to the significant cholesterol and calcium benefits Buffalo Milk is also a rich source of iron, phosphorus, vitamin A and of course protein. Buffalo Milk also contains high levels of the natural antioxidant tocopherol. Peroxidate activity is normally 2-4 times that of cow’s milk. The high milk solids of Buffalo Milk not only make it ideal for processing into superb dairy products but also contribute to significant energy savings in conducting that process. Yogurts are natural thick set without recourse to adding addition milk proteins or gelling agents as with lesser milks.

- **CAMEL MILK:** Camel milk is a staple food of desert nomad tribes and is richer in fat and protein than cow milk. It is said to have many healthful properties. It can readily be made yogurt, but can only be made into butter or cheese with difficulty. Butter or yogurt made from camel milk is said to have a very faint greenish tinge.

  Camel milk cannot be made into butter by the traditional churning method. The cheese produced from this process has low levels of cholesterol and lactose. The sale of camel cheese is limited owing to the low yield of cheese from milk and the uncertainty of pasteurization levels for camel milk which makes adherence to dairy import regulations difficult.

- **ANOTHER KINDS OF MILK:**

  - ***Zebu milk:*** similar to cow milk. It´s typical for direct consumption or for fermented drinks preparation. Source of animal proteins for people in S and SE Africa, Indians and Pakistanis.
  - ***Reindeer milk:*** pleasant and spicy taste and aroma. Not for processing and drink for natives.
  - ***Evaporated milk:*** Unsweetened condensed milk. Available in reduced fat or regular. High source of calcium.
  - ***Acidophilus milk*:** Adding a live bacterial culture to the milk after pasteurization. Easier to digest for some people.

4. COW MILK COMPOSITION AND KINDS

4.1. COMPOSITION OF COW MILK:

- Milk is a very complex product consist about 87% water and 13% dry matter (dissolved in the water).It is called emulsion (of fat in water), or colloidal solution (sugar in water).

  - ✓ 87.3% water (range of 85.5% - 88.7%)
  - ✓ 3.9 % milkfat (range of 2.4% - 5.5%)
  - ✓ 8.8% solids-not-fat (range of 7.9 - 10.0%):
    - protein 3.25% (3/4 casein)
    - lactose 4.6%
    - minerals 0.65% - Ca, P, citrate, Mg, K, Na, Zn, Cl, Fe, Cu, sulphate, bicarbonate, many others
    - acids 0.18% - citrate, formate, acetate, lactate, oxalate
    - enzymes - peroxidase, catalase, phosphatase, lipase
    - gases - oxygen, nitrogen
    - vitamins - A, C, D, thiamine, riboflavin, others

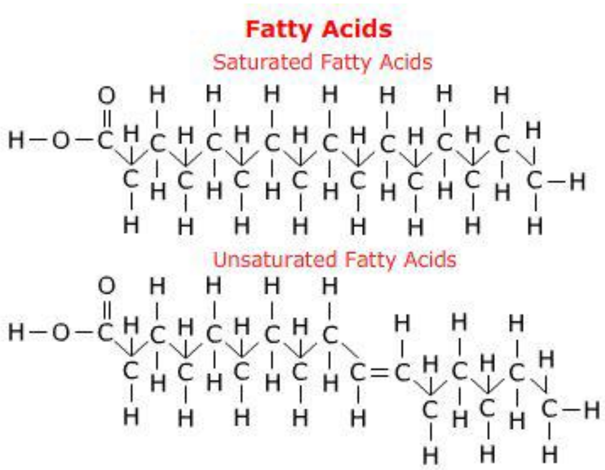
- Constituents of milk can vary for several factors:
  - Cows of different breeds.
  - Animal (individual cow, diseases, feeding).
  - Point in the lactation period.

▪ **MILKFAT COMPOSITION IN COW MILK:** The milk fat exists as small globules or droplets dispersed in the milk serum. Milk fat consists of triglycerides, and monoglycerides, fatty acids, sterols, carotenoids, vitamins (A, D, E, and K). As the fat globules are not only the largest particles in the milk but also the lightest (density at 15.5C 0.93g/cm^3), they tend to rise to the surface when milk is left to stand in a vessel for a while.

- The milk fat is divided in two parts:

  - ***Saturated fat*** is fat that consists of triglycerides containing only saturated fatty acid radicals. There are several kinds of naturally occurring saturated fatty acids, which differ by the number of carbon atoms -from 1 to 24. Saturated fatty acids have no double bonds between the carbon atoms of the fatty acid chain and are thus fully saturated with hydrogen atoms. (Fig.9)

  - ***An unsaturated fat*** is a fat or fatty acid in which there are one or more double bonds in the fatty acid chain.(Fig.9)



Satured and unsaturated fatty acids.

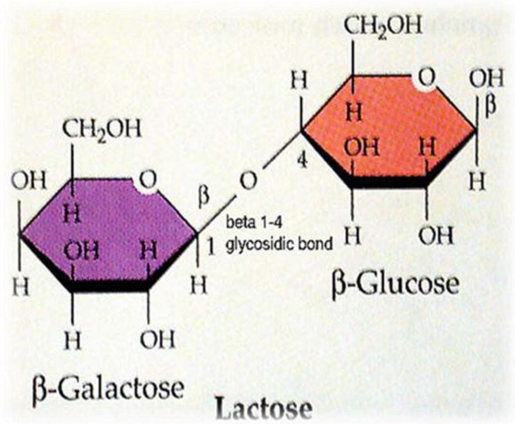
- **PROTEIN COMPOSITION IN COW MILK:** the most important nutrient in milk and essential in our diet. Giant molecules built up of smaller units, called amino acids.

  - Casein consist 80%. It form complex particles (with calcium and magnesium), micelles.
  - Whey proteins; high nutritional values, useful in food industry, lactalbumin and lactoglobulin.
  - Membrane protein

  - ***Concentration of proteins in milk:***

Proteins	Proportions (%)	g/l (average)
Caseins:	100%	26,50 g/l
Caseins αS1	36	9,55
Caseins αS2	10	2,65
Caseinsβ	34	9,00
Caseinsκ	13	3,45
Caseins γ	7	1,85
Whey proteins:		5,8 g/l
β-lactoglobulin	100%	2,9
α-lactalbumin	50	1,3
Sérumalbumin	22	0,3
Immunoglobulin	5	0,7
Proteose peptone	12	0,6
	10	

- **LACTOSE COMPOSITION:** Is a sugar found only in milk of carbohydrates group, that is the most important energy source in our diet. It's a disaccharide molecule which contains glucose and galactose monosaccharide. Other bacterial enzymes convert this mono-saccharide in lactic acid. This is what happens when milk goes sour or spoils.



Lactose molecule

- **MINERALS IN COW MILK:** Total concentration of mineral in milk is < 1%. Calcium and phosphorous are the major minerals found in cow milk. These minerals are required in large quantities by the rapidly growing neonate for bone growth and development of soft tissues. Calcium and phosphorous mostly are associated with the casein micelle structure.

    - ***Concentration of minerals in milk:***

Minerals	*Total (g/L_{milk})*
Ca^+	*30,00*
Mg^+	*5,00*
Na^+	*22,00*
K^+	*38,00*
Pi	*21,0*
Cl^-	*29,00*
Citrate	*9,00*

- **ENZYMES IN COW MILK:** Produced by living organism, has to ability to work in chemical reactions and affect the course and speed of such reactions. They do this without being consumed, sometimes called biocatalysts. Temperature is the most important rule for enzymes, because they are most active in an optimum temperature in the range between 25-50°C. The pH also has an optimum range, but there are some functions that work better in acid solution, and other´s in alkaline solutions.

  - The most important enzyme´s in milk are:
    - ***Peroxidase*** *(transfers O2 from H2O2 to other oxidisable substances)*
    - ***Catalase*** *(splits hydrogen peroxyde into H20 & free O2)*
    - ***Phosphatas***e *(splits phosphoric acid esters ino phosphoric acid & corresponding alcohol)*
    - ***Lipase*** *(splits fat into glycerol & fee fatty acids)*
    - ***Lactose***

- **VITAMINS COMPOSITION IN MILK:** Cow Milk contains all the vitamins required. The fat soluble vitamins, A, D, E, and K, associated with the milk fat globule, are found primarily in the milk fat; milk has limited amounts of vitamin K. The B vitamins are found in the aqueous phase of milk.

  Vitamins are essential organic compounds required in the diet. Most are not synthesized in the animal (there is some synthesis by the microflora in the intestine). Therefore, milk levels can be influenced by dietary levels.

  - ***Vitamins concentration of milk:***

Vitamines	Amount mg/L_{milk}	Adult daily requirement (mg)	In case of deficiency
A	0,2 –2	1 -2	Blindness
B1	0,4	1 -2	Stunted growth
B2	1,7	2 –4	Loss of appetite, indigestion
C	5 –20	30 –100	Fatigue
D	0,002	0,01	Skeletal deformation

4.2. DIFFERENT KIND´S OF COW´S:

- **The most importants kind´s of cow in milk production, are:**

- ***Ayrshire:*** The first cows of this breed were thought to have arrived in New England from Scotland's County Ayr in the early 1820's. Well adapted to rocky farms and harsh winters, the Ayrshires thrived, eventually spreading to dairy farms all across the country. Average output is 17,000lbs. /7,711kg (~2000 gallons) of milk per 305 day-cycle/year, with 3.9% butterfat, 3.3% total protein.

- ***Brown Swiss:*** Believed to have originated in the Alps of Switzerland, these hardy animals are tolerant of harsh climate and produce large quantities of milk, close behind the Holsteins. Officially recognized as a breed in the U.S. in 1906, the first small group of cows arrived here in 1869. Though few animals were actually imported, this hasn't stopped their steady growth in number, and today, the Brown Swiss are very important members of the dairy industry. Average output is 21,000lbs./9525kg (~2450 gallons) of milk per cycle with 4.0% butterfat, 3.5% total protein.

- ***Guernsey:*** As their name suggests, these cows hail from the British Isle of Guernsey in the English Channel. Well-bred by monks from select French Norman/Breton cattle lines (Alderneys from Normandy, Froment du Leons from Brittany), the first to arrive in the U.S. were brought by ship in 1840. Guernseys are small, about three-fifths the size of a Holstein, but produce up to 14,700lbs./6,350kg (~1700 gallons) milk with 4.5% butterfat, 3.5% total protein each cycle.

- ***Holstein-Friesian:*** Originally bred in Northern Germany, and the North Holland/Friesland regions of the Netherlands. These familiar black and white cows were selectively bred to make large quantities of milk from the area's most abundant natural food source- grass.
  First brought to the U.S. in the late 1850's, their ready adaptibility, and economic production of large volumes of milk relative to other cows has made them common on dairies worldwide. Figures for average milk output range up to 28,000lbs./12,700kg (~3260 gallons) per cycle, with 2.5-3.6% butterfat, 3.2% total protein.

- ***Jersey:*** Developed on Britain's Isle of Jersey, close to the Isle of Guernsey just off the coast of France. With a history as a pure breed that dates back several hundred years, they are descendants of stock from the French region of Normandy.
  The 1850's saw the arrival of the first Jersey's in the U.S. Like the Guernsey, they, too, are small, but produce relatively large amounts of milk- on average, 16,000lbs./7,260kg (~1860 gallons) per cycle, with a high butterfat content of 4.9%, total protein 3.7%.

- ***Milking Shorthorn:*** Part of the Shorthorn cattle breed originally developed for beef in Britain, descendants of these moderate producers were bred and selected for milk rather than meat. Arriving in the U.S. in 1783, the first mulit-purpose Milking Shorthorns provided the early settlers with not only milk, but meat and pulling power as well. A typical cow produces 15,400lbs./6,990kg (~1880 gallons) of milk per cycle with a butterfat content of 3.8%, total protein 3.3%.

  - **<u>Another kind of milk cow´s:</u>** (Canadienne, Dutch Belted, Kerry, Milking Devon, Norwegian Red, Zebuetc.)

5. MILK COLLECTION, COOLING AND STORAGE

5.1. MILK COLLECTION PROCESSING:

After milking, milk should be cooled and stored in the milk room of the farm or dairy plant. Milk for industrial processing can be transported to the dairy plant by the farmers themselves, or it can be picked up at the dairy plant. In both cases, it is possible to contract out these collection activities to third parties, for example, professional transporters.

Due to organizational or economic difficulties, it may not be possible to cool the milk on the farm. In areas far away from the dairy plant it may be troublesome to collect milk and take it directly to the plant. In such cases, especially if there are many small suppliers, it is be preferable to take milk first to a collection point, and then transport it from there to the dairy plant or milk collection centre.

Process of manual milking

- ***Small collection:*** Milk that is available in cans, whether on the farm or at the collection point, can be picked up and transported by many convenient means of transportation (bicycles, small barrows or trucks). The cans should be protected against the sun, both while they are at the roadside awaiting collection and during transportation.
  It is advisable to use insulated or even refrigerated trucks to transport cooled milk in cans over long distances and under high ambient temperatures. When there are many individual suppliers, there are many different types of milk cans, providing logistic and cleaning problems. It is therefore advisable to use standard shape milk cans with a smooth surface.

Transport for small collection

- ***For bulk collection:*** Milk available from the farm in bulk, for instance from farm cooling tanks, should also be picked up in bulk. It is not a good practice to use cans to transport milk that is already available in bulk (storage) tanks, because there is an extra risk of contamination. Furthermore, the temperature of milk in cans is more difficult to control than milk in bulk, and filling, emptying and cleaning of milk cans demands much labour and is costly.

  Truck-mounted tanks or road tankers can be used for the transport of milk in bulk. The tanks should be insulated and may be covered by a shield to protect against strong sunshine. On the farm, or at the collection centre, the loading hose from a milk transport truck is connected to the outlet valve on the storage tank, and the milk is pumped over.

Transport for a bulk collection

  Pumping is stopped as soon as the cooling tank has been emptied, thereby preventing air from being mixed into the milk. The tanker is fitted with a flow meter and pump so that the volume is automatically recorded. In other cases, the storage tank has to be calibrated to make dip-stick measurements reliable.

  The tank of the bulk collection vehicle is divided into a number of compartments in order to prevent the milk from slushing around during transportation.

- ***Logistic advantages:*** Transporting cooled milk from a storage tank at a farm or collection centre has many advantages. It enables the plant to organise an efficient system of collection and transportation.

  Since the milk has been cooled, it can be picked up at the farm or the collection centre at any hour of the day, without the risk of spoilage. In contrast, uncooled milk must be picked up as quickly as possible after milking, which leads to peak hours in the operation.

Each type of collection has its own advantages. Can collection is for small farms; bulk collection is for larger suppliers; and there are combinations with transport tanks for farms in between.

The most important issue is that milk must be cooled as quickly as possible. Once this has been accomplished, all parties (farmer, dairy and consumer) will benefit.

5.2. PROCESS OF MILK COOLING:

5.2.1. Cooling with basic facilities:

If the milk must be stored on the farm for long periods of time, any cooling method is better than no cooling. However, if cooling facilities are basic and the time required to transport milk to the collection centre or dairy plant is comparatively short, it is advisable to deliver milk as soon as possible to the nearest milk collection centre.

Several systems are available for cooling milk. The simplest systems use water from a main or well. If abundant quantities of well water are available, the milk can be immersed in the well. This method, however, is not advisable if the well water is also used for drinking, because the immersion of cans easily leads to contamination of the well. Simple systems of cooling that use water will bring the milk to a temperature only 3 – 5 °C above that of the water. This means that water at a temperature of 11 – 12 °C is able to cool milk to about 15 °C (at the lowest). Apart from the fact that this temperature is still high, water of 11 – 12 °C will generally not be available in warm tropical conditions. Such conditions require artificial cooling with special equipment.

- **Cooling rings:**

Whenever running water is available, milk can be cooled by putting a perforated tubular ring around the neck of the can of warm milk. After the ring has been connected to the mains, water will spray onto the can and flow over its surface. If ice water from a cold water tank is used, the water should be collected under the can and recirculated, for example, by standing they can on a rack over the cold water tank.

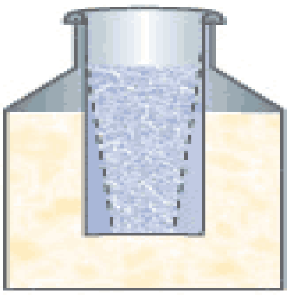
- **Surface coolers:**

Surface coolers consist of a series of small-diameter horizontally arranged tubes. Mounted on top of each other, these tubes terminate at each end in a header. The headers connect the tubes, thus allowing the cooling agent to circulate through them.

The warm milk is distributed over the surface of the cooler, i.e. over the set of horizontal tubes, by means of a spreader-pipe or a tray with small openings fitted on the top of the upper tube. Surface coolers may consist of two independent sections on top of each other. The upper section is cooled with water from the mains or from a well, whilst iced water or direct cooling is applied in the lower section. The surface cooling system, also called ‘open cooling system’, is simple, but requires a proper sanitisation programme. Special care must be taken to prevent airborne contamination.

- **Ice-cones:**

If small amounts of milk have to be collected and transported over long distances, and it is not technically or economically feasible to cool the milk in advance, metal ice-cones may be used. These cones are inserted in the milk cans, so that the rim of the cone rests on the collar of the can and fits sufficiently tightly to prevent milk splashing out during handling and transport. The cone takes up about one-third of the volume of the can. If the cones are filled with crushed ice, the milk can be cooled from 30 °C to 5 – 10 °C during transport. The cones and the ice can be taken to the farms or collection centres by the milk transport truck. The ice should be transported in an insulated box, and the cones must be properly sanitised after they have been used; preferably at the chilling centre or dairy plant.



- ***Water tanks:***

The simplest cooling system involves an open tank with cold water. Milk cans have been inserted into the tank, where they are immersed in the water up to their ‘neck’. The water must be refreshed continuously or at regular intervals.

To allow de-aeration of the milk during cooling, the lids of the cans should be loosened. The tank may be covered with a lid to protect the milk from flies and dust. If well water or water from a main supply is used, this system only enables slow cooling to comparatively high temperatures. Better results are obtained by using iced water, and the cooling rate can be improved further by forced circulation of the iced water in the tank. To limit losses of cold by radiation, the tank and its cover must be insulated.

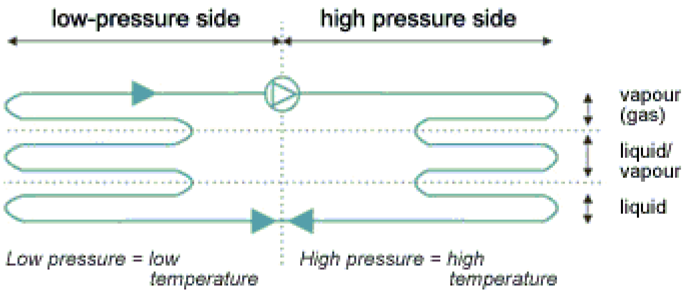
5.2.2. Modern cooling systems:

Cooling systems transfer the heat of the milk via a cooling agent to either air or water. This transfer goes via a separated wall, so there is never direct contact with the milk. The refrigerant or cooling agent absorbs the heat of the milk inside the evaporator. Each refrigerant has, by a certain pressure, its own boiling point. The cooling rate depends on the design of the equipment. The final temperature depends on the thermostat setting or milk flow through the plate coolers. Large differences in temperature increase the rate of cooling. High speed and turbulent motion of liquids along the wall will improve the heat transfer rate.

If milk is cooled in a modern way, electricity is needed to generate the temperature required. The electricity runs the condensing unit, which condenses the evaporated liquid and makes the process a continuous cycle.

- **Cooling cycle*:***

The cooling cycle can be divided into a low- and high-pressure side.



- ***Low-pressure side*:** The evaporator is partially filled with refrigerant. When the compressor starts, the gas above the liquid will be sucked away. Due to this, the pressure will decrease. The liquid starts to boil as soon as the pressure sinks below the pressure of the present temperature.

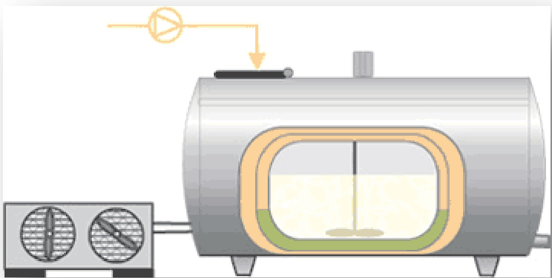
- Parts belonging to the refrigerant will evaporate and take the heat out of the remaining cooling medium. This makes the remaining part colder. If the temperature reduces below the milk temperature, the heat will flow from the milk to the boiling refrigerant. This heat causes an amount of refrigerant to evaporate. The temperature will remain constant once the quantity of heat, which is transported by the compressor, is in balance with the amount of heat from the milk.

- ***High-pressure side*:** The high-pressure side of the compressor is connected to the condenser. The purpose of the condenser is to remove the condensation heat to the surrounding area. The compressor pumps gas into the condenser. As long as the pressure remains below the pressure belonging to the condensing temperature, only the pressure will rise. As soon as the pressure rises above the pressure belonging to the condensing temperature, a heat transfer will start from the gas to the surrounding area. First the 'super heat' is taken away. The super heat is the temperature difference between the heated gas above boiling point and the boiling point. Condensation will start after this. To condensate with a certain capacity, a particular temperature difference is needed. The pressure will be constant as soon as the temperature difference is large enough to condensate all of the gas pumped in by the compressor.

5.2.3. DIFFERENTS SYSTEMS OF COOLING OF MILK:

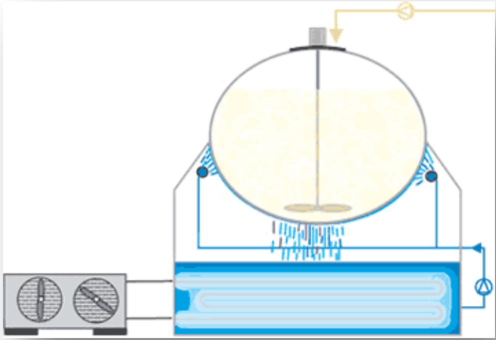
- **Direct expansion cooling**

This is the most common milk cooling system. The bottom of the tank has been designed as an evaporator, while the heat of the milk goes through the stainless steel wall to the refrigerant. The refrigerant evaporates, which takes the heat away from the milk. Since direct expansion tanks do not have a cold buffer, energy must always be available. In this type of system, the milk is cooled directly and agitated after arrival in the tank.



- **Icebank cooling**

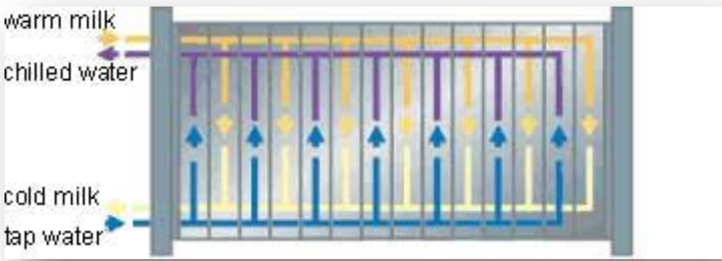
In indirect cooling systems, the evaporator is situated in a reservoir filled with the heat carrier, which is mostly water. The evaporator consists of a system of coils or pipes in which the cooling medium evaporates and cools the heat carrier.



The biggest advantage of an icebank system is that it allows the cooling capacity to be stored in an isolated reservoir with a heat carrier and 'cold buffer' or 'ice buffer'. In areas where there is not sufficient energy, an icebank system provides an efficient cooling solution.
The formation of ice around the pipes in the reservoir forms the cold buffer that can be used for cooling the milk.

- **Pre-coolers .**

Milk comes from the cows to an end unit, from where it is pumped at a constant rate through a filter to the plate cooler. The plate cooler consists of corrugated stainless steel plates. The milk flows over one side of these plates, whilst on the other side tap or well water flows in the opposite direction. When the milk leaves the plate cooler its temperature has been reduced to 2 – 4 °C above the water temperature, prior to final cooling and storage in the cooling tank.



Pre-cooling with cold tap water lowers the total and running costs for the plant by reducing the demand for chilled water. A prerequisite for this is, of course, a supply of inexpensive natural cold water. It is always possible to combine pre-cooling with other cooling systems to reduce the energy costs even more.

- **Instant cooling**

Today, farms are becoming larger and larger, meaning more work, more cows and more milk – and less time between milkings. This process provides farmers with potential cooling problems, because all the milk has to be cooled and stored. The sheer quantity of milk, combined with high milk flows and longer milking periods, makes it more difficult for conventional bulk tanks to cope.

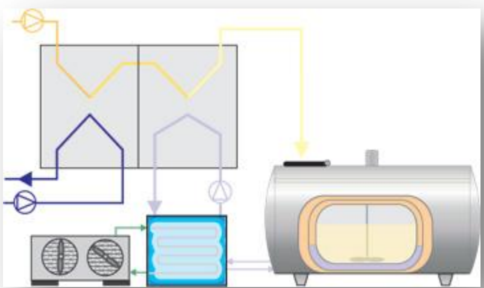
Quicker milking means greater milk amount per time. Overloaded cooling systems mean slower cooling and higher bacteria counts, and long cooling times involve prolonged agitation with the risk of buttering. Maintaining taste and quality is made more difficult, which puts the entire milk production at risk. Instant cooling is an in-line system, which cools the milk in a matter of seconds before it reaches the storage tank.

The milk goes from the cows to the end unit and balance tank, from where it is pumped at a constant rate through a filter to the plate cooler. The plate cooler is the heart of the cooling system and consists of corrugated stainless steel plates on one side of which the milk flows in one direction, while on the other side, chilled water flows in the opposite direction.

- **Ecombies.**

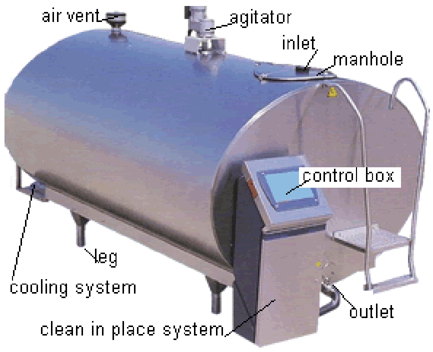
Ecombies involve a two-step cooling process. It is very advantageous to combine instant cooling with pre-cooling using chilled water. Pre-cooling with cold tap or well water lowers the total costs, including running costs for the plant by reducing the demand for chilled water.

In pre-cooling, the plate heat exchanger is divided into two sections. In the first section, the milk is cooled with cold tap or well water. In the second section, the milk is cooled down to the final storage temperature using chilled water.



5.3. STORAGE OF MILK

In dairy farming a bulk milk cooling tank is a large storage tank for cooling and holding milk at a cold temperature until it can be picked up by a milk hauler. The bulk milk cooling tank is important milk farm equipment. It is usually made of stainless steel and used every day to store the raw milk on the farm in good condition. It must be cleaned after each milk collection. The milk cooling tank can be the property of the farmer or being rented to the farmer by the dairy plant.



Metallic storage tank

6. MILK QUALITY CRITERIA

6.1. Commission regulation (EC) No.1662/2006:

Annex III to Regulation (EC) No 853/2004 is amended as follows:

3. Section IX is replaced by the following:
'SECTION IX: RAW MILK, COLOSTRUM, DAIRY PRODUCTS AND COLOSTRUM-BASED PRODUCTS

For the purpose of this Section,

1. "Colostrum" means the fluid secreted by the mammary glands of milk-producing animals up to three to five days post parturition that is rich in antibodies and minerals, and precedes the production of raw milk.

2. "Colostrum-based products" means processed products resulting from the processing of colostrum or from the further processing of such processed products.

6.1.1. CHAPTER I: RAW MILK AND COLOSTRUM — PRIMARY PRODUCTION

Food business operators producing or, as appropriate, collecting raw milk and colostrum must ensure compliance with the requirements laid down in this Chapter.

6.1.1.1. I. HEALTH REQUIREMENTS FOR RAW MILK AND COLOSTRUM

1. Raw milk and colostrum must come from animals:

(a) That does not show any symptoms of infectious diseases communicable to humans through milk and colostrum;

(b) that are in a good general state of health, present no sign of disease that might result in the contamination of milk and colostrum and, in particular, are not suffering from any infection of the genital tract with discharge, enteritis with diarrhoea and fever, or a recognisable inflammation of the udder;

(c) that do not have any udder wound likely to affect the milk and colostrum;

(d) to which no unauthorised substances or products have been administered and that have not undergone illegal treatment within the meaning of Directive 96/23/EC.

(e) in respect of which, where authorised products or substances have been administered, the withdrawal periods prescribed for these products or substances have been observed.

2. (a) In particular, as regards brucellosis, raw milk and colostrum must come from:

(i) cows or buffaloes belonging to a herd which, within the meaning of Directive 64/432/EEC (1), is free or officially free of brucellosis;
(ii) sheep or goats belonging to a holding officially free or free of brucellosis within the meaning of Directive 91/68/EEC (2); or
(iii) females of other species belonging, for species susceptible to brucellosis, to herds regularly checked for that disease under a control plan that the competent authority has approved.

(b) As regards tuberculosis, raw milk and colostrum must come from:

(i) cows or buffaloes belonging to a herd which, within the meaning of Directive 64/432/EEC, is officially free of tuberculosis; or
(ii) females of other species belonging, for species susceptible to tuberculosis, to herds regularly checked for this disease under a control plan that the competent authority has approved.

(c) If goats are kept together with cows, such goats must be inspected and tested for tuberculosis.

3. However, raw milk from animals that does not meet the requirements of point 2 may be used with the authorisation of the competent authority:

(a) in the case of cows or buffaloes that do not show a positive reaction to tests for tuberculosis or brucellosis, nor any symptoms of these diseases, after having undergone a heat treatment such as to show a negative reaction to the alkaline phosphatase test;

(b) in the case of sheep or goats that do not show a positive reaction to tests for brucellosis, or which have been vaccinated against brucellosis as part of an approved eradication programme, and which do not show any symptom of that disease, either:
(i) for the manufacture of cheese with a maturation period of at least two months; or
(ii) after having undergone heat treatment such as to show a negative reaction to the alkaline phosphatase test; and

(c) in the case of females of other species that do not show a positive reaction to tests for tuberculosis or brucellosis, nor any symptoms of these diseases, but belong to a herd where brucellosis or tuberculosis has been detected after the checks referred to in point 2(a)(iii) or 2(b)(ii), if treated to ensure its safety.

4. Raw milk and colostrum from any animal not complying with the appropriate requirements of points 1 to 3, and in particular, any animal showing individually a positive reaction to the prophylactic tests visà-vis tuberculosis or brucellosis as laid down in Directive 64/432/EEC and Directive 91/68/EEC, must not be used for human consumption.

5. The isolation of animals that are infected, or suspected of being infected, with any of the diseases referred to in point 1 or 2 must be effective to avoid any adverse effect on other animals' milk and colostrum.

6.1.1.2. II. HYGIENE ON MILK AND COLOSTRUM PRODUCTION HOLDINGS

A. Requirements for premises and equipment

1. Milking equipment and premises where milk and colostrum are stored, handled or cooled must be located and constructed so as to limit the risk of contamination of milk and colostrum.

2. Premises for the storage of milk and colostrum must be protected against vermin, have adequate separation from premises where animals are housed and, where necessary to meet the requirements laid down in Part B, have suitable refrigeration equipment.

3. Surfaces of equipment that are intended to come into contact with milk and colostrum (utensils, containers, tanks, etc. intended for milking, collection or transport) must be easy to clean and, where necessary, disinfect and must be maintained in a sound condition. This requires the use of smooth, washable and non-toxic materials.

4. After use, such surfaces must be cleaned and, where necessary, disinfected. After each journey, or after each series of journeys when the period of time between unloading and the following loading is very short, but in all cases at least once a day, containers and tanks used for the transport of milk and colostrum must be cleaned and disinfected in an appropriate manner before re-use.

B. Hygiene during milking, collection and transport

1. Milking must be carried out hygienically, ensuring in particular:

(a) that, before milking starts, the teats, udder and adjacent parts are clean;

(b) that milk and colostrum from each animal is checked for organoleptic or physico-chemical abnormalities by the milker or a method achieving similar results and that milk and olostrum presenting such abnormalities is not used for human consumption;

(c) that milk and colostrum from animals showing clinical signs of udder disease are not used for human consumption otherwise than in accordance with the instructions of a veterinarian;

(d) the identification of animals undergoing medical treatment likely to transfer residues to the milk and colostrum, and that milk and colostrum obtained from such animals before the end of the prescribed withdrawal period are not used for human consumption; and

(e) that teat dips or sprays are used only after authorisation or registration in accordance with the procedures laid down in Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market (1):

(f) that colostrum is milked separately and not mixed together with raw milk.

2. Immediately after milking, milk and colostrum must be held in a clean place designed and equipped to avoid contamination.

(a) Milk must be cooled immediately to not more than 8 oC in the case of daily collection, or not more than 6 oC if collection is not daily;

(b) Colostrum must be stored separately and immediately cooled to not more than 8 oC in the case of daily collection, or not more than 6 oC if collection is not daily, or frozen.

3. During transport the cold chain must be maintained and, on arrival at the establishment of destination, the temperature of the milk and the colostrum must not be more than 10 oC.

4. Food business operators need not comply with the temperature requirements laid down in points 2 and 3 if the milk meets the criteria provided for in Part III and either:

(a) the milk is processed within two hours of milking; or

(b) a higher temperature is necessary for technological reasons related to the manufacture of certain dairy products and the competent authority so authorises.

C. Staff hygiene

1. Persons performing milking and/or handling raw milk and colostrum must wear suitable clean clothes.
2. Persons performing milking must maintain a high degree of personal cleanliness. Suitable facilities must be available near the place of milking to enable persons performing milking and handling raw milk and colostrum to wash their hands and arms.

6.1.1.3. III. CRITERIA FOR RAW MILK AND COLOSTRUM

1. (a) The following criteria for raw milk apply pending the establishment of standards in the context of more specific legislation on the quality of milk and dairy products.

   (b) National criteria for colostrum, as regards plate count, somatic cell count or antibiotic residues, apply pending the establishment of specific Community legislation.

2. A representative number of samples of raw milk and colostrum collected from milk production holdings taken by random sampling must be checked for compliance with points 3 and 4 in case of raw milk and with the existing national criteria referred to in point 1(b) in case of colostrum. The checks may be carried out by, or on behalf of:

   (a) the food business operator producing the milk;

   (b) the food business operator collecting or processing the milk;

   (c) a group of food business operators; or

   (d) in the context of a national or regional control scheme.

2. (a) Food business operators must initiate procedures to ensure that raw milk meets the following criteria:

   (i) for raw cows' milk:
   Plate count at 30 oC (per ml) ≤ 100 000 (*)
   Somatic cell count (per ml) ≤ 400 000 (**)

(*) Rolling geometric average over a two-month period, with at least two samples per month.
(**) Rolling geometric average over a three-month period, with at least one sample per month, unless the competent authority specifies another methodology to take account of seasonal variations in production levels.

(ii) for raw milk from other species:
Plate count at 30 oC (per ml) ≤ 1 500 000 (*)

(*) Rolling geometric average over a two-month period, with at least two samples per month.

(b) However, if raw milk from species other than cows is intended for the manufacture of products made with raw milk by a process that does not involve any heat treatment, food business operators must take steps to ensure that the raw milk used meets the following criterion:
Plate count at 30 oC (per ml) ≤ 500 000 (*)
(*) Rolling geometric average over a two-month period, with at least two samples per month.

4. Without prejudice to Directive 96/23/EC, food business operators must initiate procedures to ensure that raw milk is not placed on the market if either:

(a) it contains antibiotic residues in a quantity that, in respect of any one of the substances referred to in Annexes I and III to Regulation (EEC) No 2377/90 (1), exceeds the levels authorised under that Regulation; or

(b) the combined total of residues of antibiotic substances exceeds any maximum permitted value.

5. When raw milk fails to comply with point 3 or 4, the food business operator must inform the competent authority and take measures to correct the situation.

6.1.2. CHAPTER II: REQUIREMENTS CONCERNING DAIRY AND COLOSTRUM-BASED PRODUCTS

6.1.2.1. I TEMPERATURE REQUIREMENTS

1. Food business operators must ensure that, upon acceptance at a processing establishment,

(a) milk is quickly cooled to not more than 6 ºC;
(b) colostrum is quickly cooled to not more than 6 ºC or maintained frozen,
and kept at that temperature until processed.

2. However, food business operators may keep milk and colostrum at a higher temperature if:

(a) processing begins immediately after milking, or within four hours of acceptance at the processing establishment; or

(b) the competent authority authorises a higher temperature for technological reasons
concerning the manufacture of certain dairy or colostrum-based products.

6.1.2.2. II. REQUIREMENTS FOR HEAT TREATMENT

1. When raw milk, colostrum, dairy or colostrum-based products undergo heat treatment, food business operators must ensure that this satisfies the requirements laid down in Chapter XI of Annex II to Regulation (EC) 852/2004. In particular, they shall ensure, when using the following processes that they comply with the specifications mentioned:

(a) Pasteurisation is achieved by a treatment involving:

(i) a high temperature for a short time (at least 72 ºC for 15 seconds);

(ii) a low temperature for a long time (at least 63 ºC for 30 minutes); or

(iii) any other combination of time-temperature conditions to obtain an equivalent effect, such that the products show, where applicable, a negative reaction to an alkaline phosphatase test immediately after such treatment.

(b) Ultra high temperature (UHT) treatment is achieved by a treatment:

(i) involving a continuous flow of heat at a high temperature for a short time (not less than 135 ºC in combination with a suitable holding time) such that there are no viable
microorganisms or spores capable of growing in the treated product when kept in an
aseptic closed container at ambient temperature, and

(ii) sufficient to ensure that the products remain microbiologically stable after incubating for 15 days at 30 ºC in closed containers or for seven days at 55 ºC in closed containers or after any other method demonstrating that the appropriate heat treatment has been applied.

2. When considering whether to subject raw milk and colostrum to heat treatment, food business operators must:

(a) have regard to the procedures developed in accordance with the HACCP principles pursuant to Regulation (EC) No 852/2004; and

(b) comply with any requirements that the competent authority may impose in this regard when approving establishments or carrying out checks in accordance with Regulation (EC) No 854/2004.

6.1.2.3. III. CRITERIA FOR RAW COWS' MILK

1. Food business operators manufacturing dairy products must initiate procedures to ensure that, immediately before processing:

(a) raw cows' milk used to prepare dairy products has a plate count at 30 ºC of less than 300 000 per ml; and

(b) processed cows' milk used to prepare dairy products has a plate count at 30 ºC of less than 100 000 per ml.

2. When milk fails to meet the criteria laid down in paragraph 1, the food business operator must inform the competent authority and take measures to correct the situation.

6.1.3. CHAPTER III: WRAPPING AND PACKAGING

Sealing of consumer packages must be carried out immediately after filling in the establishment where the last heat treatment of liquid dairy products and colostrum-based products, takes place by means of sealing devices that prevent contamination. The sealing system must be designed in such a way that, after opening, the evidence of its opening remains clear and easy to check.

6.1.4. CHAPTER IV: LABELLING

1. In addition to the requirements of Directive 2000/13/EC, except in the cases envisaged in Article 13(4) and (5) of that Directive, labelling must clearly show:

(a) in the case of raw milk intended for direct human consumption, the words "raw milk";

(b) in the case of products made with raw milk, the manufacturing process for which does not include any heat treatment or any physical or chemical treatment, the words "made with raw milk";

(c) in case of colostrum, the word “colostrum”;

(d) in case of products made with colostrum, the words “made with colostrum”.

2. The requirements of paragraph 1 apply to products destined for retail trade. The term “labelling” includes any packaging, document, notice, label, ring or collar accompanying or referring to such products.

6.1.5. CHAPTER V: IDENTIFICATION MARKING

By way of derogation from the requirements of Annex II, Section I:

1. Rather than indicating the approval number of the establishment, the identification mark may include a reference to where on the wrapping or packaging the approval number of the establishment is indicated;

2. in the case of the reusable bottles, the identification mark may indicate only the initials of the consigning country and the approval number of the establishment.

7. FACTORS INFLUENCING THE QUALITY OF MILK

To produce milk of good quality, means that so much at level of composition like microbiologically the milk that comes to the consuming public it must be in conditions suitable for his consumption. To carry out this one task we have to develop a work of campaign to raise public awareness, which it includes from the stockbreeders, milking and the authorities related to the way, which have not realized that the milk chain does not end in producing milk in much quantity, but milk of the quality comes to the consumer.

Milk unfit for consumption is that that has a suppressed high place of bacteria and of somatic cells, presence of strange substance that submitted to a process of pasteurization, does not improve his quality.

Because this milk milked without no conditions of hygiene or in some cases with few hygiene, is contaminated. On having taken place in the alveoli, the milk takes place sterile, but as it is going down for the galactos channels and then they end in the cisterns they are contaminated with different microorganisms that determine his potential handling.

In the ambience there exist microorganisms that grow to different temperatures. There are those who grow to high temperatures that are the thermopiles and those that grow to temperature ambience, that there are the mesophiles. These bacteria are those who cause more problems to the milk industries.

Group there belong to this one the pathogenic bacteria and those that hurt to the dairy product that is prepared.

The milk is an excellent cultivation way for certain microorganisms especially the bacteria mesophiles, whose multiplication goes it is to depend on the temperature.

Also the microorganisms are in the exterior, psicrophile and termophiles, which are forming of spores so much aerobic as anaerobic, provoking many problems in the industries.

Due to the content of protein of the greasy milk, mineral lactose and vitamins, thousands of types of bacteria can multiply so rapid as because of that they duplicate his quantity every 15 minutes, when the temperature is between 30-37 °C. There are great the changes that the milk is suffering up to coming to the acidification and in this moment there are several million microorganisms for ml.

To diminish the contamination in the milk we have to bear in mind which factors they affect the quality.

7.1. SANITARY FACTORS:

The absence of pathogenic germs in the milk must be the essential target on any market. The cows must be free of tuberculosis, brucellosis and mastitis.

The contaminated raw milk or products prepared with raw milk (especially white cheese and yellow type cheddar) can transmit illnesses, such as: brucellosis, tuberculosis leptópirosis, etc.)

These bacteria that produce these illnesses are destroyed by the pasteurization, nevertheless there exist vines of staphylococcuses that produce enteretoxines resistant thermos flask and are diarrheal causers.

7.2. FACTORS OF COMPOSITION:

The most important components of the milk must be essential targets on any market of dairy products (protein, fat, lactose, mineral salt and vitamins).

The milk is a nourishing product, it possesses more than 100 substances that are already be in suspension, solution or emulsion in water.

The composition of the milk depends on several factors: The race, epoch of lactation, production level. The mastitis and the adulteration modify the components of him milk.

7.3. HYGIENIC FACTORS:

To obtain milk and not to have to clean it in his process, it is necessary to anticipate his contamination applying the norms of hygiene and disinfection of the way where the animals manage.

Once the milk leaves the cow, it is small what it is possible to do to increase his value, but if it is possible to do very much to prevent from losing it before coming to the consumer. The laboratory control panel does not grant clean milk, only there indicate us the flaws at level of farm, center of gathering, truck recollector and plant. Also they do not indicate all that is necessary to clean this milk in plant, so that it lasts.

The factors that affect in the hygienic quality of the milk are:

- Hygiene of the animal.
- Hygiene of the Milker.
- Hygiene of the Milking.
- Hygiene of the tools.
- Environmental health.

7.3.1. Hygiene of the Animal

Clean milk cannot be obtained of dirty cows. During the milking they are clear of the udder, nipples, of the flanks of the animal and of the belly, particles of dry guano, ground, free hair, etc, that they fall down inside the milk bucket, which transport a considerable number of bacteria. The microorganisms associated with these impurities are to small of the type forming of gas, Escherichis-aerobacter.

The external cleanliness of the udder and nipples will have to be done washing with water. If the udder and nipples are not dry, the dirty water (particles of dissolved ground can fall down inside the bucket with milk. A bad custom is to milk with the wet hands.

7.3.2. Hygiene of the Milker

Both the health and the hygiene of the personnel that it milks, influences the hygienic quality of the milk. If the milking one is sick, there exist illnesses that can be transmitted through the milk (fever typhoid, infections of gullet, tuberculosis, hepatitis, etc.)

The health of the personnel must be controlled periodically. The milkman's producer must select healthy personnel; the milking one must have hygiene with his body, since a hygienic small person can contaminate the milk with harmful microbes. The clothes must be clean, if it is possible to use it for this purpose, otherwise to use aprons of plastic that can wash himself at once finishes the milking.

7.3.3. Hygiene of the tools

Not only has the hygiene of the personnel helped to improve the quality of the milk, also the hygiene of the tools.

The milking bucket must have the following characteristics:

- It must have the minor possible gap
- Smooth and solid surface
- Easy to clean and to disinfect
- Tinned copper must be of stainless steel, aluminium ó.
- Plastic material must not be use.

- **Cleanliness of the tools**

The procedure of cleanliness of the tools is the following one:

1. To rinse with abundant cold water immediately after using it.
2. To wash it with detergent and to rinse with abundant water.
3. To disinfect it with warm water or solution disinfectant of iodine or chlorine.
4. To allow to dry.

The appropriately clean dairy tools are essential to produce quality milk. This cleanliness process is simpler using procedures and facility adapted. An effective work can be achieved by a minimal effort.

7.3.4. Environmental health

The milking stables must remain clean. The clay and ordure are pollutant foci that damage the hygienic quality of the milk. After every milking it is necessary to clean the apartment of the stable with abundant water, this way garbage does not accumulate. The apartment must have a slope of 1 ½ cm. for every meter of length, so that it slips with facility.

The milking area must be free of insects and rodents, therefore it is recommended to fumigate periodically.

7.4. <u>FACTORS OF HANDLING:</u>

These factors are those of major importance for the influence that they have in the quality of the milk.

1. ***Nutritional handling:*** when they exist desbalance in the feeding or sudden changes of the diet it produces rumial acidosis, provoking acidity (hyperacidic milk).

2. ***Handling of the routine of milking:*** The milking routine including in this one to the machine of milking, his state and functioning, it is the most important factor for the contagion of the mastitis in the farm.

7.5. GENETIC FACTORS:

7.5.1. Breed and individual cow

Milk composition varies considerably among breeds of dairy cattle: Jersey and Guernsey breeds give milk of higher fat and protein content than Shorthorns and Friesians. Zebu cows can give milk containing up to 7% fat.

7.5.2. Variability among cows within a breed

The potential fat content of milk from an individual cow is determined genetically, as are protein and lactose levels. Thus, selective breeding can be used to upgrade milk quality. Heredity also determines the potential milk production of the animal. However, environment and various physiological factors greatly influence the amount and composition of milk that is actually produced. Herd recording of total milk yields and fat and SNF percentages will indicate the most productive cows, and replacement stock should be bred from these.

7.6. ENVIRONMENTAL FACTORS:

7.6.1. Interval between milkings

The fat content of milk varies considerably between the morning and evening milking because there is usually a much shorter interval between the morning and evening milking than between the evening and morning milking. If cows were milked at 12-hour intervals the variation in fat content between milkings would be negligible, but this is not practicable on most farms. Normally, SNF content varies little even if the intervals between milkings vary.

7.6.2. Stage of lactation

The fat, lactose and protein contents of milk vary according to stage of lactation. Solids-not-fat content is usually highest during the first 2 to 3 weeks, after which it decreases slightly. Fat content is high immediately after calving but soon begins to fall, and continues to do so for 10 to 12 weeks, after which it tends to rise again until the end of the lactation.

7.6.3. Age of cow

As cows grow older the fat content of their milk decreases by about 0.02 percentage units per lactation. The fall in SNF content is much greater.

7.6.4. Feeding regime

Underfeeding reduces both the fat and the SNF content of milk produced, although SNF content is more sensitive to feeding level than fat content. Fat content and fat composition are influenced more by roughage (fibre) intake. The SNF content can fall if the cow is fed a low-energy diet, but is not greatly influenced by protein deficiency, unless the deficiency is acute.

7.6.5. Disease

Both fat and SNF contents can be reduced by disease, particularly mastitis.

7.6.6. Completeness of milking

The first milk drawn from the udder is low in fat while the last milk (or strippings) is always quite high in fat. Thus it is essential to mix thoroughly all the milk removed, before taking a sample for analysis. The fat left in the udder at the end of a milking is usually picked up during subsequent milkings, so there is no net loss of fat.

7.7. MICROBIAL PATHOGENS IN MILK:

Micro-organism is the term applied to all microscopically small living organisms. We tend to associate micro-organisms with disease. Micro-organisms which cause disease are called pathogens. However, few micro-organisms are pathogens and micro-organisms play a crucial part in the life of our planet. For example, they provide food for fish, they occur in soil where they provide nutrients for plants and they play an important role in ruminant digestion.

In dairying some micro-organisms are harmful—e.g. spoilage organisms, pathogens—while others are beneficial—cheese and yoghurt starters, yeasts and moulds used in controlled fermentations in milk processing.

The micro-organisms principally encountered in the dairy industry are bacteria, yeasts, moulds, and viruses.

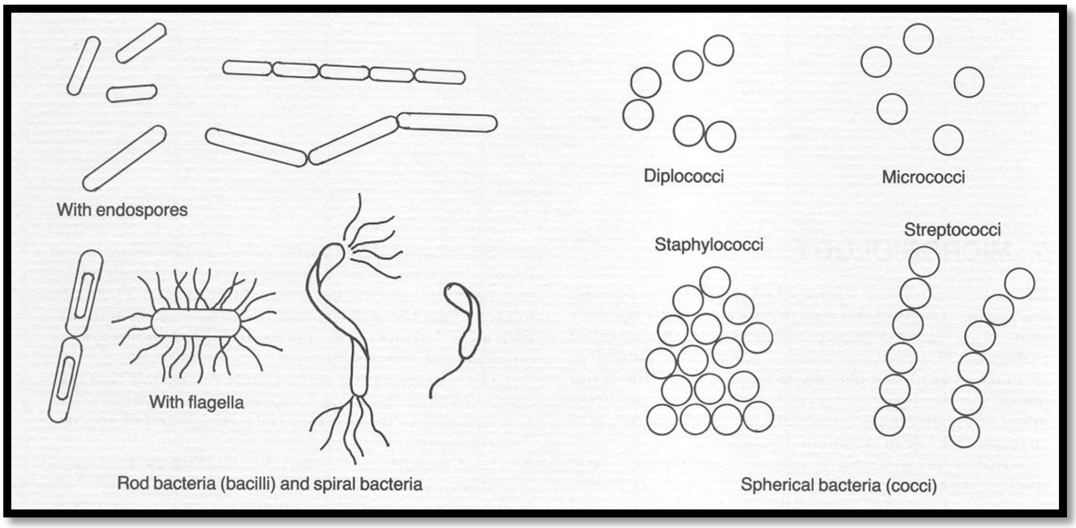
7.7.1. BACTERIA

Bacteria are single-celled organisms. They are present in air, water and on most solid materials. Bacterial cells are very small and can only be seen with the aid of a microscope.

When observed under a microscope the cells can be seen to differ in shape and in conformation of groups of cells. Cells are either spherical or rod-shaped (Figure 7). Spherical bacteria are called cocci; those that are rod shaped are called bacilli. This is the first basis for differentiating between bacterial cells.

Bacteria are also classified according to cell cluster formation:

Diplococci – two cocci cells paired.
Staphylococci – a number of cells clustered together.
Streptococci – a number of cells arranged in a chain.



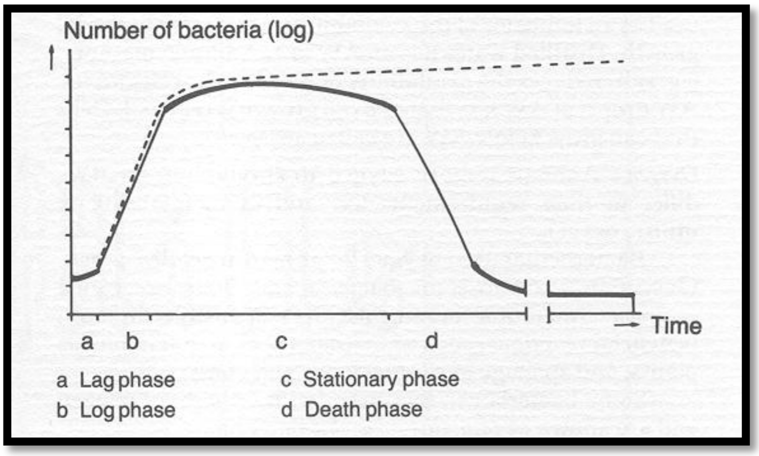
Different kinds of coccis

Some bacteria are capable of locomotion by means of flagellae—long, hair-like appendages growing out of the cell. Some rod-shaped bacteria contain spores. These are formed when the cells are faced with adverse conditions, such as high temperature: once suitable conditions are re-established the spores germinate to form new cells.

7.7.1.1. Bacterial growth

Bacterial growth refers to an increase in cell numbers rather than an increase in cell size. The process by which bacterial cells divide to reproduce themselves is known as binary transverse fission. The time taken from cell formation to cell division is called the generation time. The generation time can therefore be defined as the time taken for the cell count to double.

The curve shown in Figure shows the phases of bacterial growth following inoculation of bacteria into a new growth medium. The following phases can be identified:



- ***Lag phase:*** There is usually some delay in growth following inoculation of bacteria into a new medium, during which time the bacteria adapt to the medium and synthesise the enzymes needed to break down the substances in the growth medium.

- ***Log phase:*** Once the bacteria have adapted to the new medium they start to reproduce quickly and their numbers multiply evenly for each increment of time. A plot of the log number of cells against time gives a linear relationship: this is therefore called the log phase. The cells are at their greatest activity in this phase. Transferring cultures to a fresh medium at regular intervals can maintain the cells in an active state. An active culture can rapidly dominate any new environment.

- ***Stationary phase:*** As the bacteria dominate the growth medium, they deplete the available nutrients or toxic waste products accumulate, slowing the rate of reproduction. At the same time, cells are dying off: A state of equilibrium is reached between the death of old cells and formation of new cells, resulting in no net change in cell numbers. This phase is called the stationary phase.

- ***Death phase:*** In the next phase the formation of new cells ceases and the existing cells gradually die off: This is called the death phase.

  The log phase can be prolonged by removing toxic waste, by adding more nutrients or both.

7.7.1.1.1. Factors affecting bacterial growth

- ***Temperature:*** Theoretically, bacteria can grow at all temperatures between the freezing point of water and the temperature at which protein or protoplasm coagulates. Somewhere between these maximum and minimum points lies the optimum temperature at which the bacteria grow best.

- ***Nutrients:*** Bacteria need nutrients for their growth and some need more nutrients than others. Lactobacilli live in milk and have lost their ability to synthesise many compounds, while Pseudomonas can synthesise nutrients from very basic ingredients.

- ***Water:*** Bacteria cannot grow without water. Many bacteria are quickly killed by dry conditions whereas others can tolerate dry conditions for months; bacterial spores can survive dry conditions for years. Water activity (AW) is used as an indicator of the availability of water for bacterial growth. Distilled water has an AW of 1. Addition of solute, e.g. salt, reduces the availability of water to the cell and the AW drops; at AW less than 0.8 cell growth is reduced. Cells that can grow at low AW are called osmophiles.

- ***Oxygen:*** Animals require oxygen to survive but bacteria differ in their requirements for, and in their ability to utilise, oxygen. Bacteria that need oxygen for growth are called aerobic. Oxygen is toxic to some bacteria and these are called anaerobic. Anaerobic organisms are responsible for both beneficial reactions, such as methane production in biogas plants, and spoilage in canned foods and cheeses. Some bacteria can live either with or without oxygen and are known as faculative anaerobic bacteria.

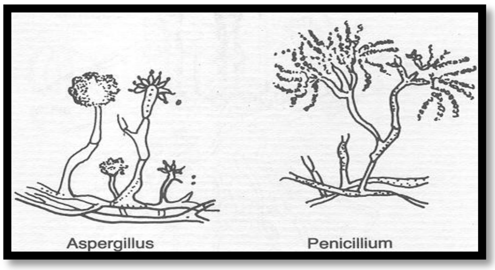
- ***Acidity:*** The acidity of a nutrient substrate is most simply expressed as its pH value. Sensitivity to pH varies from one species of bacteria to another. The terms pH optimum and pH maximum are used. Most bacteria prefer a growth environment with a pH of about 7, i.e. neutrality. Bacteria that can tolerate low pH are called aciduric. Lactic acid bacteria in milk produce acid and continue to do so until the pH of the milk falls to below 4.6, at which point they gradually die off.

- **Bacterial types commonly associated with milk:**

  •*Aeromonas hydrophilae*
  •*Bacillus spp. (anthracis & cereus)*
  •*Brucella spp.*
  •*Campylobacter (coli & jejuni)*
  •*Clostridium (botulinum & perfringens)*
  •*Coxiella burnettii*
  •*E. coli (EPEC, ETEC, VTEC)*
  •*Enterobacter sakazakii*
  •*Enterococcus (faecalis & faecium)*
  •*Legionella spp.*
  •*Listeria monocytogenes*
  •*Mycobacterium (bovis, tuberculosis & paratub)*
  •*Salmonella spp. (dublin, enteriditis, typhoide & zooepidermicus)*
  •*Shigella spp.*
  •*Staph. aureus*
  •*Streptococcus spp. (pyogenes, agalactiae, etc)*
  •*Vibrio spp. (cholera, parahaem. & vulnificus)*
  •*Yersinia spp. (enterocolitica & pseudotuber.)*

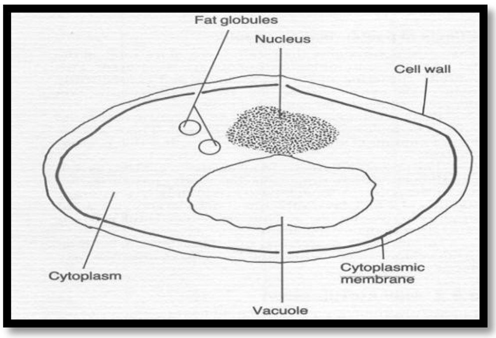
7.7.2. MOULDS

Moulds are a heterogeneous group of multicelled organisms which reproduce asexually either by spore formation or by fragmentation. They can grow on a wide variety of substrates and are generally regarded as spoilage organisms. However, moulds are used in the production of antibiotics and in certain cheese varieties. Moulds are aerobic organisms and their growth on foods can be retarded by excluding air through careful packaging. They can be killed by relatively mild heat treatments, but mould spores are more resistant to heat.



7.7.3. YEASTS

Yeasts are unicellular organisms which reproduce asexually by budding. They are used industrially to ferment carbohydrates to such products as alcohol and citric acid. Yeasts are not usually used in milk processing and are normally regarded as spoilage organisms in dairy products.



7.7.4. VIRUSES

Viruses are extremely small organisms comprising a spherical head containing the genetic material and a cylindrical tail. They cannot reproduce themselves, and must invade other cells in order to reproduce. Viruses that attack bacterial cells are known as bacteriophages, that attack acid-producing bacteria inhibit acid production in milk.

Virus types commonly associated with milk:

- Bird Flu virus.
- Hepatitis A & E.
- F & M virus.
- Rabies virus.
- VS virus (vesicular stomatis).

7.7.5. MILK MICROBIOLOGY

In addition to being a nutritious food for humans, milk provides a favourable environment for the growth of microorganisms. Yeasts, moulds and a broad spectrum of bacteria can grow in milk, particularly at temperatures above 16°C.

Microbes can enter milk via the cow, air, feedstuffs, milk handling equipment and the milker. Once microorganisms get into the milk their numbers increase rapidly. It is more effective to exclude micro-organisms than to try to control microbial growth once they have entered the milk. Milking equipment should be washed thoroughly before and after use—rinsing is not enough.

Microbial growth can be controlled by cooling the milk. Most micro-organisms reproduce slowly in colder environments. Cooling milk also slows chemical deterioration.

The temperature of freshly drawn milk is about 38°C. Bacteria multiply very rapidly in warm milk and milk sours rapidly if held at these temperatures. If the milk is not cooled and is stored in the shade at an average air temperature of 16°C, the temperature of the milk will only have fallen to 28°C after 3 hours. Cooling the milk with running water will reduce the temperature to 16°C after 1 hour. At this temperature bacterial growth will be reduced and enzyme activity retarded. Thus, milk will keep longer if cooled.

Natural souring of milk may be advantageous: for example, in smallholder butter-making, the acid developed assists in the extraction of fat during churning. The low pH retards growth of lipolytic and proteolytic bacteria and therefore protects the fat and protein in the milk. The acidity of the milk also inhibits the growth of pathogens. It does not, however, retard the growth of moulds.

Naturally soured milk is used to make many products, e.g. irgo, yoghurt, sour cream, ripened buttermilk and cheese. These products provide ways of preserving milk and are also pleasant to consume. They are produced by the action of fermentative bacteria on lactose and are more readily digested than fresh milk.The initial microflora of raw milk reflects directly microbial contamination during production. The microflora in milk when it leaves the farm is determined by the temperature to which it has been cooled and the temperature at which it has been stored. Rapid tests are available for estimating the bacterial quality of milk.

7.7.6. PROCESSES OF ELIMINATION OF MICROBIAL PATHOGENS IN MILK

- ***Pasteurisation of milk***

Pasteurisation reduces the cream layer, since some of the fat globule membrane constituents are denatured. This inhibits clustering of the fat globules and consequently reduces the extent of creaming. However, pasteurisation does not reduce the fat content of milk.

Pasteurisation has little effect on the nutritive value of milk. The major nutrients are not altered. There is some loss of vitamin C and B group vitamins, but this is insignificant.

The process kills many fermentative organisms as well as pathogens. Micro-organisms that survive pasteurisation are putrefactive. Although pasteurised milk has a storage stability of 2 to 3 days, subsequent deterioration is cause by putrefactive organisms. Thus, pasteurised milk will putrefy rather than develop acidity.

In rural milk processing, many processes depend on the development of acidity, and hence pasteurisation may not be appropriate.

- ***Milk sterilisation***

In pasteurisation, milk receives mild heat treatment to reduce the number of bacteria present. In sterilisation, milk is subjected to severe heat treatment that ensures almost complete destruction of the microbial population. The product is then said to be commercially sterile. Time/temperature treatments of above 100°C for 15 to 40 minutes are used. The product has a longer shelf life than pasteurised milk.

Another method of sterilisation is ultra-heat treatment, or UHT. In this system, milk is heated under pressure to about 140°C for 4 seconds. The product is virtually sterile. However, it retains more of the properties of fresh milk than conventionally sterilised milk.

8. MILK QUALITY ANALYSIS

Milk analysis is carried out to determine:

- Freshness
- Adulteration
- Bacterial content, and
- Milk constituents for payment calculation.

8.1. SAMPLING

A representative sample is essential for accurate testing. Milk processors usually pay for milk or cream on the basis of butterfat analysis, and a single butterfat test may be used to determine the butterfat content of thousands of litres of milk or cream. Therefore, an accurate and representative sample must be obtained.

Milk must be mixed thoroughly prior to sampling and analysis to ensure a representative sample. If the volume of milk is small, e.g. from an individual cow, the milk may be poured from one bucket to another and a small sample of milk taken immediately. But if large volumes of milk are handled, the milk or cream must be mixed by stirring. However, it is very difficult to obtain a representative sample of milk or cream when a large volume is dumped into a large container. In such a case the milk must be stirred thoroughly and small samples taken from three or more places in the container. For best results, milk or cream must be sampled when it is at a temperature between 15 and 32°C. If the cream is too cool it will be thick and viscous and will be difficult to sample.

Sour milk or cream, in which casein has coagulated, must be sampled frequently. Sampling sour milk follows the same procedure as for fresh milk. If the milk or cream has been standing for a long time and a deposit has formed on the surface and sides of the container, it should be warmed while agitating before a sample is removed.

For certain analyses, milk samples can be preserved and stored to await analysis. Samples of milk or cream for butterfat analysis can be preserved using formalin, corrosive sublimate or potassium dichromate. For general analyses, formalin is preferred, because the other two increase the solids content of the milk, influencing total solids determination.

8.2. NECESSARY TOOLS FOR STANDARIZATION

- The ability to standardise and thereby optimise dairy production strongly depends on the analytical tools available:
  - The faster results, the sooner the process can be adjusted.
  - The more accurate results, the closer adjustments to target values can be made.
  - The more frequent results, the better adjustments for sudden variations in composition may be done.
- Traditional wet chemistry methods are generally speaking either.:
  - Very precise, but slow, labour intensive and costly (e.g. the Röse-Gottlieb method) or
  - Rapid, but imprecise and operator dependent (e.g. Gerber method)

Furthermore, such methods often involve hazardous chemicals and require skilled personnel to be carried out correctly.

The main drawback, however, is that if these methods are used, there are only very limited opportunities to optimise the process.

The traditional precise methods are so slow that they can only be used for collection of historical data, not for instant corrections.

The faster, but less precise traditional methods require a considerable safety margin added to the limit in order to assure that no batches fall outside specifications. This extra margin represents a loss in the production.

With a rapid, accurate and operator independent analyser placed at-line - or even better: on-line - production personnel may not only obtain much faster and more reliable results; due to the speed, ease and low cost of analysis. They may also increase the frequency by which they check and adjust the process.

Such a tool will serve to reduce the variation between production batches considerably – and once the variation is narrowed, the target value may be brought closer to the limit, thereby improving profitability.

8.3. TYPES OF QUALITY ANALYZERS OF MILK

- **MilkoScan™ FT120 (Composition analysis of milk)**

MilkoScan™ FT 120 employs the FTIR measuring principle, in compliance with IDF and AOAC standards. A complete analysis of product composition with up to 24 parameters can be presented in just 30 seconds. MilkoScan FT 120 is suitable for both process control and sophisticated analysis in the lab.

The basic configuration offers determination of fat, protein, lactose, total solids and solids-non-fat in milk, cream and simple dairy products.

FOSS provides transferable ready-to-use calibrations for a wide range of dairy products e.g. concentrated milk and whey, infant formula, ice cream, juice, quark, cheese and yoghurt. Furthermore special modules allow development of user defined calibrations.

MilkoScan FT 120 is very user-friendly. All routine operation takes place from one single screen picture, samples can be analysed without pre-heating and data are stored automatically. When you implement the Automatic Clean and Zero Module, the instrument takes care of all necessary cleaning after analysis and zero setting prior to analysis.

Compositional analysis of up to 120 milk samples per hour

- Low cost per sample analysed

Ready to use calibrations

- FOSS calibrations are available for a wide range of parameters and products .
- Ready to use calibrations will dramatically reduce the calibration work for starting up a new parameter .

Robust flow system with in-line filter and 50 µm cuvette .

Built in sample pre-heater

- Efficient operation without need for heating of homogenous samples

Flexible upgrading possibility

- Powerful and easy to use Windows software with local language support
- Easy integration of data into networked environment
- Reduced need for special operator skills

Automatic clean and zero setting module

- Safe and efficient operation – also for process operators

High accuracy analysis

- Little dispute over results

Built-in quality assurance software with log of pilot samples

- Documentation of analytical results.

▪ **<u>BactoScan™ FC (Microbiology analysis of milk)</u>**

BactoScan™ FC is designed for fully automated determination of the hygienic quality of raw milk by counting the total number of individual bacteria cells (IBC) in raw milk samples.

It is used for payment analysis at central laboratories and is a valuable tool for monitoring on-farm hygienic status. By using the rapid and reliable BactoScan method, the dairies can also monitor incoming raw milk. Serious contamination can thereby be detected instantly, poor quality milk can be rejected and only the best-suited milk used for dairy production. The longer durability of high-quality raw milk, which can be sustained by the fast BactoScan response to farmers, gives dairies a direct economic benefit.

Six different models are available, with differences in capacity and sensitivity. According to the needs you can choose 50, 100 or 150 samples/hour.

- **<u>Fossomatic™ FC (Somatic cells analysis of milk)</u>**

Fossomatic FC includes the best of proven features such as:

- Performance options from 200 to 600 samples
- Closed reagent handling
- Effective waste handling
- Accurate measurements based on FOSS Flow Cytometry
- High-precision at grading limits using precision set-up
- Best of the new

To match the increasing demands of the modern laboratory Fossomatic FC includes a number of new features such as the:

- Robust pressurised pump system for sheath liquid
- Heating of rinse liquid
- Improved reliability and accessibility of valves, tubes, flow cell and sensors
- Temperature-controlled liquids to optimise staining and cleaning
- New software platform (FOSS Integrator IMT)
- Improved data handling
- On-line help

9. EXPERIMENTAL PART

9.1. GERBER TEST FOR DETERMINATION OF FAT CONTENT IN YOGHURT

Materials:

- Analytical balances
- Butyrometer (In the laboratory there are two types of butyrometres; one is used for youghurt, calibrated till 20% of fatness and second for cream is till 40%).
- Stoppers
- Pipettes of 11 ml for milk, 5 ml for cream and 3 ml for yoghurt.
- Automatic pipette for H_2SO_4 (5 and 10 ml)
- Automatic pipette for amyl alcohol (1 ml)
- Centrifuge for butyrometers
- Heated water baths

Chemicals:

- Gerber sulphuric acid, concentration 91%
- Amyl alcohol

Procedure:

- Put 10 ml of sulphuric acid into (91%) into butyrometer (40% scale for cream, 20% for yoghurt)
- Add 11 ml of milk, 5 ml of cream and 3g of yoghurt respectively for each analyse
- Add warm water in case of cream and yoghurt up to 11 ml
- Add 1 ml of amyl alcohol
- Close butyrometer by stopper, (doing a big press on him)
- Shake butyrometer very freshly and mix content by turning it up and down
- Introduce butyrometres into centrifuge equally (one opposite the other) and let it works for 6 minutes
- After put the butyrometres into the water bath heated at 65 to 68 ºC for 3 or 5 minutes
- Then read the fat content from the scale in grams per 100 ml of product (milk, cream or yoghurt)

- To express the fat content in grams per 100 g use de formula:

$$Y=a\cdot 11/m$$

Where; ***m*** is the weight of the sample in grams
a is the fat content taken from butyrometer scale

- Repeat three times for every sample

9.1.1. RESULTS AND DISCUSSION OF FATNESS IN YOGHURT

FAT CONTENT IN YOGHURT						
SAMPLES		**pH**	**Y AVERAGE ($g/100g_{yoghurt}$)**	**SD**	**Y AVERAGE ± SD ($g/100g_{yoghurt}$)**	**Fat content in the bottles ($g/100g_{yoghurt}$)**
1		4,24	7,92	0,71	**7,92±0,71**	8,3
2		4,48	2,33	0,37	**2,33±0,37**	2,5
3		4,38	2,39	0,12	**2,39±0,12**	3
4		4,25	8,19	0,24	**8,19±0,24**	8,8
5		4,26	7,42	0,17	**7,42±0,17**	8,5
6		4,34	8,20	0,49	**8,20±0,49**	8,5
7		4,30	7,25	0,05	**7,25±0,05**	8
8		4,19	2,27	0,20	**2,27±0,20**	2,5
9		4,19	2,27	0,15	**2,27±0,15**	2,3
10		4,44	1,91	0,07	**1,91±0,07**	2,6
11		4,28	2,62	0,16	**2,62±0,16**	2,8
12		4,25	2,62	0,17	**2,62±0,17**	2,8

Samples 1, 3, 5 and 7 don´t match the value obtained with the value of the product label, but the error is very small and therefore tolerable. This may be due to the introduction of any solid (small portions of strawberry) in the analysis when the desired sample to within butyrometer.

The remaining yoghurt samples analyzed, obtained values very close to the tolerable value stated in each of the bottles, if we look at the value but their standard deviation.

9.2. IMPROVED MILK CALIBRATION

9.2.1. RESULTS AND DISCUSSION OF IMPROVED MILK CALIBRATION

The machine used to analyze all parameters of milk is the Milkoscan FT120 (previously explained). It measures the different ranges of the parameters we need to know, to evaluate according to the criteria and the established laws in the EU.

Samples of milk	Casein (%)	Density (g/cm^3)	Protein (%)	Fat (%)	TS (%)	SNF (%)	Lactose (%)	FPD (°C)	Acidity (SH)	Citr.Acid (%)	Urea (%)	FFA ($mmol/10L_{milk}$)
Shop milk 1	2,43	1033,3	3,35	1,66	10,38	8,74	4,85	0,519	6,50	0,143	0,0407	3,30
Shop milk 2	2,45	1033,5	3,36	1,65	10,39	8,76	4,86	0,524	6,70	0,143	0,0411	2,74
Jersey 1	3,52	1029,7	4,59	6,54	16,44	9,70	4,44	0,633	10,16	0,116	0,0111	1,13
Jersey 2	3,52	1029,8	4,58	6,52	16,42	9,71	4,44	0,634	10,17	0,117	0,0067	1,65
Směs 1	2,91	1030,2	3,79	4,80	13,99	9,04	4,74	0,585	7,97	0,099	0,0132	1,42
Směs 2	2,91	1030,0	3,79	4,79	13,97	9,04	4,74	0,585	8,03	0,100	0,0118	1,10
H 1	2,53	1030,5	3,30	3,66	12,43	8,64	4,94	0,555	6,83	0,088	0,0136	1,47
H 2	2,53	1030,6	3,31	3,67	12,42	8,63	4,94	0,556	6,64	0,089	0,0165	1,43
Colostrum 1	3,03	1030,7	4,22	4,23	13,17	9,08	4,03	0,523	7,42	0,110	0,0071	<0,55
Colostrum 2	3,03	1030,8	4,22	4,22	13,14	9,08	4,04	0,520	7,32	0,110	0,0097	<0,55

All milk samples are within the range of casein, which corresponds to between 2.2 to 3.9%.

Except for the milk shop, all the other types of milk are below the density 1.0335, and may be that these come straight from the cow and have not been treated as above.

Jersey milk has much higher value than the rest in protein content. This is may be the type of breed of cow, above. Also, the colostrum has a lot of protein because it is the first milk of the mammary glands. (Theoretical details of this milk, previous amount). The rest have values similar to each other between 3-4% of proteins.

The fat content in milk is the value where there is greatest difference between the shop milk and direct milk from the cow. The rest of milk´s are not treated and therefore the values of fat are so high. It's the same that total solids content and solid non fat content, which is lower in the shop milk in the rest of milk.

The lactose content is significantly higher in all types than colostrum milk because, as already explained previously, comes directly from the mammary glands and the content is not so high.

The freezing point depression it´s similar in all the milks, because this propertie is not so alterable. The jersey kind is a little bit different possibly by the type of breed of cow.

We can see how the acidity in different types of milk is different according to origin or type of cow from which they come, In Citr. Acid values occur the same.

The values of Urea in milk are all within acceptable levels according to the criteria established. These values are between 0.014 to 0.079%.

Finally, the values of Free fatty acids content are markedly higher in the shop milk than the rest because it has been treated and the other comes directly from the cow. In the colostrum, the values are negative. This is because the fatty acid content is much higher than the rest of milk´s, because this untreated milk is coming directly from the mammary glands. The values shown are less than 0.55 mmol / L of milk, according to the criteria set limit.

9.3. CONCLUSIONS

After analyzing the fat content of twelve types of yoghurt, we see that are classified by the law of fermented products, according to their fat content analysis has been appropriate and that the results that although they are slightly below the values shown in the labels of yoghurt pots, comply with the current laws in the Czech Republic and Europe.

Regarding the values of milk samples, they are lower than those recommended, but we believe that the bug is the volumetric analysis because the values are homogeneous. The many health parameters studied and analyzed, give us the knowledge that according to the type of milk, the properties often vary significantly. Possibly, the type of breed of cow, the environmental situation in the area, the hygiene of equipment and the animals themselves, and all other factors studied in the preceding paragraphs, characterized each type of milk.

Although each kind of the milk has a different characteristics like taste, smell, fat, etc. all must meet the established laws, so that its consumption is healthy and rewarding at the same time.

10. REFERENCES

Scientific articles and books consulting:

- COMMISSION REGULATION (EC) No 1662/2006 of 6 November 2006 amending Regulation (EC) No 853/2004 of the European Parliament and of the Council laying down specific hygiene rules for food of animal origin. 18.11.2006. EN. Official Journal of the European Union L 320/1.
- S. K. Kon, (1972) Milk and Milk Products in Human Nutrition.
- El mercado internacional de leche y productos lácteos: situación actual y factores que explican su comportamiento. Ing. Alejandro Galetto**.** Sancor cul.
- Hemme, T., A. Weers y K. Christoffers. A Global Review. The Supply of Milk and Dairy Products. IFCN. Paper prepared for the UK Department of the Environment, Food and Rural Affairs.
- Dairy Processing HandbooK
- Chemical composition and coagulating properties of renneted milks from different breeds and species of ruminant. Journal of Dairy Research (1983), 50 : 215-229 Cambridge University Press doi:10.1017/S0022029900023025. Available on CJO 01 June 2009 .
- Bylund. G 1995. Diary processing handsbook, Tetra Pak, Lund. (Suisse) pág.436.

Web sites consulting:

- www.eur-lex.europa.eu
- www.milkfact.com
- www.rawmilk.org
- www.milkchemistry.com
- www.raw-milk-facts.com