



Training manual

TECHNOLOGY OF DAIRY PRODUCTS

T. Baibatyrov, A. Akhmetova

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Buffalo milk contains more than twice as much fat as cow milk on average (7.5 g/100 g vs 3.3 g/100 g) and is therefore more energy dense. The high fat content makes it particularly suitable for processing, with the pro-

They are sometimes referred to as different subspecies; river buffalo as *Bubalus bubalis bubalis* and swamp buffalo as *Bubalus bubalis carabensis*. Swamp buffalo are reported to be mainly used as draught animals and their

Water buffalo (*Bubalus bubalis*) milk is ranked second in the world in production, contributing 11.1 percent of the world milk production in 2006–09, with India (60 percent) and Pakistan (30 percent) being the main producers (FAOSTAT, 2012). Buffalo have historically been divided into swamp and river buffalo based on morphological, behavioural and geo-

Buffalo milk

ing cow breeds with a higher CLA content in their milk. Levels of water-soluble vitamins in human milk reflect maternal levels and depend on the mother's diet, but these vitamins are synthesized within the body of the cow and levels are not diet-dependent in cow milk.

The conjugated linoleic acid (CLA) content in cow milk is generally reported to vary from 0.1 to 2.2 g total FA depending on season, region, farming system and feeding, and animal and breed. For example, milk from the Maftrival cow breed was shown to contain a significantly higher ($P < 0.05$) percentage of CLA than Jersey cow milk (0.35 g total FA vs 0.23 g/100g total FA. This has possible implications with regard to promoting

Cow milk generally contains between 3 and 4 g of fat/100 g, although with a higher κ-casein content in their milk. values as high as 5.5 g/100 g have been reported in raw milk. Most milks

Casains comprise nearly 80 percent of the protein in cow milk but less than 40 percent in human milk. Casains can form leathery curds in the stomach and be difficult to digest. In addition, the type of caseins that predominate in the two milks also differs, human milk containing more β -casein, which is more susceptible to peptic hydrolysis than α S-casein, particularly α S1-casein, which predominates in cow milk. The casein content of cow milk varies between breeds and cheese makers often use milk from breeds

man milk does not contain β -lactoglobulin, one of the main proteins associ-

Goat milk has a smaller fat globule size than cow milk which may make it more easily digestible. Anecdotal evidence, stemming in part from cultural beliefs and in part from research studies, suggests that goat milk has low-

FAs and are a source of rapidly available energy, particularly relevant for people suffering from malnutrition or fat absorption syndrome and in the diets of preterm babies (feeding formulas for premature infants often contain medium-chain triacylglycerols) and elderly people. Goat milk also contains branched-chain FAs with fewer than 11 carbon atoms, of which there are almost none in cow milk; this is thought to give goat milk its characteristic "goaty and nuttony flavours". Although some reports suggest that goat milk contains less trans-18:1 FA than cow milk, other studies have shown that the trans-FA content is similar in the two milks. The actual con-

The proportion of SFA in goat milk (by supplementing the diet with plant oil) is comparable to that in cow milk. However, goat milk is rich in short- and medium-chain FAs with 6–10 carbon atoms, containing up to twice as much as cow milk. For this reason, caproic (C6:0), caprylic (C8:0) and capric acids (C10:0) are named after goats. These FAs have a different metabolism to

products such as cheeses and yoghurt. In contrast to cow milk, the lactose content of goat milk can be increased

Milk from goats (*Capra hircus*) accounted for 2.4 percent of global milk production in 2010 (FAOSTAT, 2012). India is the main producer of goat milk (30 percent), followed by Bangladesh (17 percent) and Sudan (11 percent). Home consumption of goat milk is reported to be very high: goats are the main suppliers of dairy and meat products for rural populations. Some goat breeds, such as the Bedouin goat, are able to survive under extreme environmental conditions on meagre fodder and water intake, which makes them particularly suited for surviving in regions with harsh climatic conditions. However, the goat is not just associated with underdevelopment and poverty – dairy goat farming is also significant to the economies of some Mediterranean countries owing to the connoisseur interest in goat milk

Goat milk

duction of 1 kg of butter requiring 14 kg of cow milk compared with only 10 kg of buffalo milk. The proportion of in buffalo milk, 65–75 g/100 g total FA, is comparable to that in cow milk.

The milk also contains trans-FA at 3 g/100 g total FA (mainly C18:1 trans-11), and a small amount of CLA (0.4 g/100 g total FA).

Reindeer and moose milks

Reindeer (*Rangifer tarandus*) herding is carried out from northern Scandinavia to eastern Siberia. Renewed interest in reindeer milk lies in the expanding market for gourmet products. Moose (*Alces alces*), also known as European elk, are found in the Baltic states, Canada, Finland, Norway, Russia, Sweden and United States (Alaska). Moose milking farms can be found in Russia and Sweden.

Both these species are noted for their concentrated milks, which have a cream-like consistency and very high fat and protein contents. The total fat in reindeer milk can be over six times as high as in cow milk (21.5 g/100 g compared with 3.3 g/100 g), and the protein content four times as high as in cow milk (13.0 g/100 g compared with 3.3 g/100 g).

The high protein and fat contents make these milks energy dense. The high energy and protein contents enable the calf to survive the harsh Arctic winter; the concentrated milk is particularly suited to the migratory lifestyle of the reindeer. The high protein content also means a higher content of amino acids, all amino acids being present in amounts that are 2–6 times those found in cow milk. Reindeer milk may be suitable as a protein supplement, especially for athletes, given the high absolute content of almost all amino acids in reindeer milk compared with milk from other dairy animals.

About 80 percent of the protein in reindeer milk is caseins, similar to cow milk. Although reindeer milk contains β -lactoglobulin, one study has reported that there is only partial cross-reactivity between cow and reindeer milks, suggesting that reindeer β -lactoglobulin lacks important bovine epitopes that bind IgE. No information was found on the protein profile of moose milk.

Both reindeer and moose milks are low in lactose, containing nearly half the value found in cow milk (average values of 2.9 and 2.6 g/100 g compared with 4.7 g/100 g), although the lactose content of moose milk can be as low as 0.6 g/100 g milk. The Saami people, who are reindeer herders, are reported to be rather intolerant of lactose; hence reindeer milk is particularly suitable as part of their diet. Moose milk could provide an alternative source of dairy for people displaying a reduced tolerance of lactose.

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This edition was published by Alimناه on January 15, 2019№1 was issued in accordance with the license agreement.			
The manual is developed in accordance with the standard curricula of bachelor's, master's, doctoral specialties of B068, M111 - "Food production" specialty, scientists and employees of agro-industrial complex The complex and analytical going is carried out near description of technology of poultry farming and horse breeding, production of wool and other industries. Basic principles of breeding and feeding of agricultural animals open up in train knowledge required. Other methods of milk processing, such as making dried milk powder, sterilised milk (Ultrahigh-Temperature or 'long-life' milk and bottled sterilised milk), canned (evaporated or condensed) milk, or milk by-products such as casein, are not possible at a small scale because of the very high costs of equipment and the specialist technical knowledge required. Details of the individual processing methods are given in textbook: Pasteurised milk; Butter and ghee; Sour milk and yoghurt; Cheese-making; Ice cream production and National Kazakh meals. Overview of the types of dairy processing that are possible at a small scale of operation. can increase the value of the milk when these products are sold. This textbook gives an processing methods also produce foods that have different flavours and textures, which scale to extend its shelf life by several days, weeks or even months. Some of these However, there are a number of preservation techniques that can be used at a small Milk is a valuable nutritious food that, if untreated, will spoil within a few days.			
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CHAPTER 1 - THE ROLE OF MILK AS A SOURCE OF MACRONUTRIENTS

Milk is a major source of dietary energy, protein and fat, contributing on average 134 kcal of energy/capita per day, 8 g of protein/capita per day and 7.3 g of fat/capita per day in 2009 (FAOSTAT, 2012). However, when different geographic regions are considered, the contribution from milk to the various nutritional components varies considerably: milk provides only 3 percent of dietary energy supply in Asia and Africa compared with 8–9 percent in Europe and Oceania; 6–7 percent of dietary protein supply in Asia and Africa compared with 19 percent in Europe; and 6–8 percent of dietary fat supply in Asia and Africa, compared with 11–14 percent in Europe, Oceania and Americas.

Water is the main component in all milks, ranging from an average of 68 percent in reindeer milk to 91 percent in donkey milk. The main carbohydrate is lactose, which is involved in the intestinal absorption of calcium, magnesium and phosphorus, and the utilization of vitamin D. Lactose also provides a ready source of energy for the neonate, providing 30 percent of the energy in bovine milk, nearly 40 percent in human milk and 53–66 per cent in equine milks.

Cow milk

Traditionally, two cattle species have been recognized, *Bos taurus* (hum-pless cattle) and *Bos indicus* (zebu cattle), although there is no reproductive barrier between them. Some listings identify as many as 1 000 cattle breeds, even though some of these are actually local varieties of a breed. Even so, nearly 35 percent of dairy cows (about 70 million head) belong to the Hol-stein-Friesian breed.

The popularity of this breed is largely because of its high average milk production and superior ability to convert feed into protein. This is not an ideal situation from a biodiversity point of view, and widespread use of this one breed may put some breeds in danger of extinction.

Cow milk accounted for 83 percent of global milk production in 2010 (FAOSTAT, 2012). Cow milk contains more protein and minerals, especially

Cow milk contains more protein than does human milk, but human milk contains more lactose, resulting in comparable energy contents. Cow milk and human milk differ in the amounts of various proteins they contain. Hu-

er allergenicity than cow milk. These studies report that although goat milk contains the same proteins (including β-lactoglobulin) as cow milk, some goat milk proteins differ in their genetic polymorphisms, resulting in lower allergenicity. The major fraction in goat casein is β-casein, which makes it similar to human milk. Milk from some goat breeds that lack αs1-casein altogether (which predominates in cow milk) has been shown to be less allergenic.

However, these reports must be approached with caution. Several studies have shown that goat milk is not appropriate for children with immunoglobulin E (IgE)-mediated cow milk allergy, leading in some cases to allergic reactions including life-threatening anaphylactic shock.

The recent guidelines issued by the World Allergy Organization states that goat milk should not be used as a substitute for children with cow milk allergy.

Goat milk has been reported to contain four times as much of the oligosaccharide sialic acid as cow milk (about 23 mg/100 g vs 6 mg/100 g). Oligosaccharides represent an important fraction of human milk (1.3 g/100 g), and are thought to promote bifidobacteria growth and play a role in brain development in the newborn child.

Goat milk has a higher content of retinol than cow milk. Vitamin B₁₂ content in goat milk is an order of magnitude lower than in cow milk. Like cow milk, goat milk is a poor source of folate.

Goat milk contains a relatively large amount of free amino acids, particularly of the non-protein amino acid taurine (obtained biosynthetically from cysteine) at 9 mg/100 g. This is 20-fold more than in cow milk and is similar to the level in human milk. A higher content of cysteine (53 percent more than in cow milk) is also reported in goat milk.

Sheep milk

Although China was the top producer of sheep (*Ovis aries*) milk in 2010 (17 percent), about 61 percent of the world’s sheep milk is produced in the Mediterranean region and Middle East, and mainly used as a raw material for producing cheese and other dairy products.

Much less information is available on sheep milk composition than on cow, buffalo and goat milks. Although some reviews cover both goat and sheep milks, most discuss goat milk in depth and sheep milk only superficially. Most studies are related to effects of animal feeding on FA composition.

The average contents of protein (5.6 g/100 g) and fat (6.4 g/100 g) in sheep milk is high; only buffalo milk contains more fat on average when

Musk ox milk

The musk ox (*Ovibos moschatus*) is an Arctic mammal that belongs to the subfamily Caprinae, as do goat and sheep. Data on only proximate composition were available for musk ox, obtained from one study. Musk ox milk contains more protein and fat but less lactose and water than cow milk. However, the fat content (5.4 milk g/100 g) is not high for an Arctic animal. The ash content in musk ox milk is more than double that of cow milk (1.6 g/100 g compared with 0.7 g/100 g).

Llama and alpaca milks

Llama (*Lama glama*) and alpaca (*Lama pacos*), both domesticated species of South American camelids, have historically not been bred for dairy purposes. Information on milk composition and consumption is scarce. These milks are an underutilized nutritional and economic resource for the people living in the mountainous areas of South America.

Alpaca milk is richer in protein and ash than milks from the other camelids and cow milk. Llama milk does not contain measurable amounts of β-lactoglobulin.

No studies are available on the FA composition of alpaca milk, but one study reported the FA composition of llama milk. The proportions of SFA, C4–C10, MUFA and PUFA in llama milk fat are comparable to the values in cow milk. The predominant FAs in llama milk are C16:0, C18:1, C14:0 and C18:0.

Mare (Equus caballus) and donkey (Equus asinus) milks are renowned for their therapeutic properties. Approximately 30 million people in Russia,

Mare and donkey milks

The predominant FAs in yak milk are the same as in cow and buffalo milks, and similarly, only a small amount of polyunsaturated FA (PUFA) is reported (2 g/100 g total FA). SFA accounts for about 65 g/100 g total FA in yak milk. The short chain C4:0–C10:0 content is low in yak milk. Small quantities (0.2 g/100 g total FA) of CLA have also been reported. Yak milk contains almost twice as much β -lactoglobulin (average 708 mg/100 g) as in cow milk (300–400 mg/100 g). Yak milk was also reported to contain 67 mg of lactoferrin/100 g, 2–6 times more than values reported in cow milk.

The proximate composition of yak milk is very similar to that of buffalo milk: the milks are significantly different ($P<0.05$) only in their total protein content. Like buffalo milk, the fat content of yak milk is much higher than of cow milk, while its water content is more than 5 g/100 g lower. An analysis of published studies on yak milk showed that the water content can vary by as much as 10 g/100 g among samples of yak milk.

The yak (Bos grunniens) is the only bovine reared in the mountainous regions of China, Mongolia, Russia, Nepal, India, Bhutan, Tajikistan and Uzbekistan, and hence the populations rely on the yak for milk, meat, fur and transportation. Several factories in China, Nepal and Mongolia produce dried yak milk for domestic consumption.

Yak milk

The FA profile of sheep milk is fairly similar to that of goat milk: five FAs make up more than 75 percent of the fat (C10:0, C14:0, C16:0, C18:0 and C18:1). SFA content (65–75 g/100 g total FA) is comparable to that in cow, buffalo and goat milks. The average fat globule size is reported to be even smaller in sheep milk than in goat milk.

Sheep milk contains more retinol than cow and goat milks. As in goat milk, the non-protein amino acid taurine is reported to be present in sheep milk. The FA profile of sheep milk is fairly similar to that of goat milk: five FAs make up more than 75 percent of the fat (C10:0, C14:0, C16:0, C18:0 and C18:1). SFA content (65–75 g/100 g total FA) is comparable to that in cow, buffalo and goat milks. The average fat globule size is reported to be even smaller in sheep milk than in goat milk.

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Milk Milk and dairy products in human nutrition from major dairy species is considered. Sheep milk also contains more lactose than human, cow, buffalo and goat milks. The higher lactose content is compensated for by lower sodium and potassium levels, although most of the other minerals are present in higher amounts in sheep milk, in line with the higher ash content.

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MF	microfiltration
mg	milligrams
MUFA	monounsaturated fatty acid
PEF	pulsed electric fields
PUFA	polyunsaturated fatty acid
SFA	Saturated fatty acid
TA	Titratable Acidity
UHT	Ultra-high temperature processing
UP	Ultrapasteurisation
UTP	uniform trans-membrane pressure
UV	ultraviolet
viz.	«that is to say», «to wit», or «as follows»
v/v	Volume concentration

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Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Mongolia and eastern and central Europe drink mare milk. These two monogastric species produce similar milk, with no significant differences between them (P < 0.05) in protein, fat, lactose, ash or water contents. Their milks contain substantially lesser amounts of fat and protein than cow milk, and are nearest in composition to human milk because of their high lactose and low protein contents (FAO, 1972). Their ash contents are also lower than that of cow milk (0.3–0.5 g/100 g vs 0.7 g/100 g) and thus more similar to human milk (0.2 g/100 g). According to some reports, mare milk can contain up to 15 mg of ascorbic acid/100 g, much more than cow milk.

Compared with cow milk, equine milk fat has a high content of PUFA (more than 20 g/100 g total FA in both mare and donkey milks compared with about 6 g/100 g total FA in cow milk) and a low content of SFA (average 40 g/100 g total FA in mare milk and 55 g/100 g total FA in donkey milk, compared with 65–75 g/100 g total FA in cow milk). The milks also contain the indispensable FAs alpha-linolenic acid (ALA) and linoleic acid (LA) (6 g ALA/100 g total FA in mare milk and 4 g ALA/100 g total FA in donkey milk; 10 g LA/100 g total FA in mare milk, 6 g LA/100 g total FA in donkey milk). Values for ALA in cow, goat and sheep milks range between 2 and 4 g/100 g total FA, and values for LA between 0.3 and 0.6 g/100 g total FA. In human milk ALA can range from 1 to 3 g/100 g. The high LA and ALA contents and low C18:0 content of equine milks are attributed to equines being monogastric animals: FAs are hydrogenated in the digestive tract of ruminants before absorption, but not in the digestive tract of equines. The unsaturated long chain FA content of equine milk is related to amounts consumed with forage. No trans-FA or CLA have been reported in donkey milk, while mare milk has been reported to contain negligible amounts of CLA and trans-C18:1 (vaccenic acid).

The equine milks resemble human milk in their relatively low content of caseins (40–45 percent of total protein content). A recent study showed that caseins in equine milks are rapidly digested by gastric juices, in contrast to the caseins from cow and goat milks which are digested slowly. As 40–50 percent of equine milk protein consists of whey protein, equine milk is not very suitable for cheese production. The whey proteins include lysozyme, which has been reported at 100–200 mg/100 g of donkey milk, compared with only 7–13 µg/100 g of cow milk. Although equine milk whey contains β-lactoglobulin, the sequence homology between proteins isolated from

equine milks and cow milk is only 60 percent. Owing to the similarity of milk proteins in equine and human milk, equine milks have been recommended for children with severe IgE-mediated cow milk protein allergy. To summarize, the similarity of equine milk to human milk in total protein and lactose contents and FA and protein profiles and the fairly low mineral content suggests that equine milk could be a better food for infants than is cow milk, although the lower total fat in equine milks make them less energy dense than human milk. Although one study documents the use of donkey milk to feed unweaned infants, further studies are needed, particularly because adverse effects on iron nutrition may be expected. The protein profile of equine milk makes it particularly suitable for consumption by people who are allergic to cow milk.

Dromedary camel and Bactrian camel milks

In arid and semi-arid areas camels play a major role in supplying the Arabian camel (Camelus dromedaries, single-humped) mainly found in desert areas Milk and dairy products in human nutrition in the Middle East, North and East Africa, Southwest Asia and Australia, and the Bactrian camel (Camelus bactrianus, two-humped), found in northwestern China and Mongolia, southern Russia, Tajikistan and Kazakhstan. Out of an estimated 18 million camels in the world only 2 million are Bactrian camels. Sub-Saharan Africa accounted for over 87 percent of camel milk production in 2006-9 (FAOSTAT, 2012). Somalia is the largest single producer of camel milk (53 percent of global camel milk production), followed by Ethiopia (12 percent) and Mali (8 percent) (FAOSTAT, 2008). Camels have a stomach with three compartments rather than four but with similar functional properties to ruminant stomachs; therefore they are sometimes called “pseudo-ruminants”. The lactose and protein contents in the milk from the two camel species are similar but their fat contents are different, with Bactrian camel milk containing more fat.

In overall proximate composition, dromedary camel milk is very similar to cow milk. The SFA content of Bactrian camel milk (average 50 g/100 g total FA) appears to be lower than that of cow milk, while that of dromedary camel milk (average 60 g/100 g total FA) may be slightly lower than that of cow milk. The main FAs reported in most studies of dromedary camel milk

The dairy industry is, in many countries, a major contributor to the manufacturing capacity of the food sector, and as more components of milk are utilised in processed foods, so this importance is likely to grow. Already dairy operations range from the straightforward handling of liquid milk through to the production of highly sophisticated consumer items, and it is of note that all this activity is based on a raw material that is readily perishable at ambient temperatures.

This competitive, commercial position, together with the fact that the general public has a high regard for dairy products, is an indication of the extent to which milk producers and processors have combined to ensure that retail products are both nutritious and hygienically acceptable.

In some instances, the increased capacity has arisen simply from an expansion of a traditional method, but in others a totally new approach has had to be adopted either for the manufacturing process per se, or for utilisation of the end products. Success has also depended on the derivation of accurate process controls, both through automation, and through improved procedures for quality control. Together, these diverse facets make up the modern dairy industry, and it is to be hoped that these book will do justice to the innovative genius of those who have been involved in its evolution.

PREFACE

ABBREVIATIONS AND ACRONYMS

ADI	acceptable daily intake
BMI	body mass index
bTB	bovine tuberculosis
CFR	Cost and Freight
CHD	coronary heart disease
CIP	Clean-in-place (CIP) is a method of cleaning the interior surfaces of pipes, vessels, process equipment, filters and associated fittings, without disassembly
CLA	the conjugated linoleic acid
CMA	cow-milk allergy
CVD	cardiovascular disease
e.g.	for example
ESL	Efficient and safe production
FA	fatty acid
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	The Food and Agriculture Organization Corporate Statistical Database
FDM	fat in dry matter
FPCM	fat and protein-corrected milk
GI	glycaemic index
GMP	good manufacturing practices
HP	high pressure
HTST	High Temperature/Short Time pasteurization
i.e.	that is
IgE	immunoglobulin E
LAB	lactic acid bacteria
LA	linoleic acid
LNP	lactase non-persistence
LTLT	low temperature long time pasteurization

In the evaluation of product quality, the lack of defects is very important. thickness attribute in chocolate-flavoured milk. amount of stabiliser(s) used (i.e. hydrocolloids) is also responsible for the also responsible for the typical bitter and cocoa flavour of these milks. The correlated with the perceived thickness of the product in the mouth, and is with the sensory property of smoothness. The amount of added cocoa is manufactured product, whilst the particle size of the powder is correlated component has a significant influence on the rheological properties of the and the particle characteristics are arguably the most important. The former fat-free milk powder available to mix with cocoa butter in the chocolate organoleptic properties of these flavoured milks. Of these properties, the associated with viscous, mouth coating, fatty/oily, cocoa and darker notes. mouth. Milk chocolate drinks with low levels of sugar and fat are usually caramel and sweeter. Samples with high-fat levels are faster melting in the chocolate milks with high sugar contents are more milky/dairy, vanilla/ significant differences in the sensory properties of chocolate notes, while character of the product. Different levels of sugar and fat produce very manufacture of chocolate milks lead to a wide variability in the sensory characteristics and different levels of these ingredients used during the total dry milk solids, 3.5 milk fat and 25 fat from cocoa or milk. The specific has to contain (g 100 g) at least 25 dry cocoa matter, 2.5 defatted cocoa, 14 According the European Union Directive 2000/36/EC, milk chocolate beverages. to partially replace skimmed milk (i.e. 10–20%) in chocolate-flavoured milk fat or cream. Demonstrated that acid whey could be used successfully powders, whey powders and skimmed milk powder sprayed with anhydrous dried and spray-dried whole milk powders, high-fat powders, butter-milk some instances, dairy solids are added to the base milk, for example roller-consistency and prevent sedimentation of cocoa particles in the product. In sucrose and cocoa powder, and some hydrocolloids are added to improve the milk ready to drink. Basically, these flavoured milks are made from milk, a cocoa powder formulation to milk, either hot or cold and (b) chocolate in many countries. There are two common modes of consumption: (a) adding **Chocolate-flavoured milk** is a popular and widely consumed dairy product

Other types of milks
Chocolate-flavoured milk

also been used to describe soy milk flavour. More recently, there have been such as green, raw soy, grassy, painty, rancid, astringent, and bitter have to describe the flavour properties of soybean products. More specific terms and taste. The term 'beany' has often been chosen by many researchers vocabularies or lexicons to describe its characteristics of flavour, aroma the acceptance of soy milk has led to the development of descriptive also contribute to off-flavour(s) in the milk. The necessity of enhancing alcohols produced by three lipoxigenase isozymes contained in soybean polyphenols and saponins. Hexanal and other aldehydes, ketones and astringency and bitterness. The astringent compounds are thought to include consumption of soy milk is limited in western countries due to soy aroma, with similar nutritional characteristics. Despite this marketing concept, the different nutritional properties, it is marketed as though it is a milk product of cancer, osteoporosis and coronary heart disease. Although soy milk has been attributed with several health benefits including the prevention an alternative to dairy milk, and as a good way to consume soybean, which Soy milk consumption is growing in popularity. It is being marketed as

Soy milk

market segments. egg and malt, and they positively influence acceptability within certain chocolate-flavoured milks. Other flavour attributes included are cooked, show that cocoa aroma is a major driver influencing the acceptability of product obtained from a representative sample of consumers. These studies descriptive analysis, which is then related to preference ratings for the an objective characterisation of product sensory attributes achieved by been determined by preference mapping tools. The procedure requires Consumer preferences of commercial chocolate-flavoured milks have and roasted.

have been developed and include using terms such as milky, vanilla, carob aroma, taste and flavour. Sensory languages to document these properties chocolate milk sensory quality is normally done on the appearance, texture, manufacturing to monitor the quality of these ingredients. The evaluation of melting temperature and hardness are usually carried out by most chocolate instrumental measurements of colour, viscosity, particle size, snap force, precipitate, white spots on the surface and mottled surface. chocolate on surface, chocolate particles in suspension, chocolate Current defects in the appearance of chocolate milks are undissolved

homogenized. Homogenized milk curd end will give a soft, more porous and permeable.

The efficiency of homogenization depends mainly on three factors: temperature, pressure and type of valve. The mechanical condition of the homogenizer, the incorporation of air into the circuit and the nature of the treated products can also modify the effects of treatment.

It goes without saying that the homogenization should take place at temperatures that keep all the fat in the liquid state, otherwise there would be of churning: to ensure effective treatment requires temperatures above 54 °C.

The choice of the pressure depends on the type and number of homogenising valves. Most often the homogenization is done in two stages by means of two valves that are broken in the second, aggregates of fat globules formed after the passage through the first. In this case, a pressure of 14,000 to 17,000 kPa first stage and 3000 (Kpa) in the second generally gives good results. However with certain types of valve, such as multiple stages, the homogenizer can give a good performance while operating at significantly lower pressures.

Homogenization must be sufficiently effective to prevent crème. The result can be verified immediately by determining the index of homogeneity. Another method can also be used to measure at the microscopic examination of a sample of milk, the size of fat globules and their distribution according to their diameter.

Cooling

All microorganisms were not eliminated by pasteurization, the heat treatment must be followed by an abrupt cooling. Thus, after pasteurization, milk is cooled to a temperature near freezing to slow the development of germs still present.

Stage post-pasteurization and during the packaging, it is also important to avoid contamination, especially by psychrotrophic bacteria, which are the main responsible for the subsequent deterioration of pasteurized products. Shown that pasteurized milk inoculated *Pseudomonas fluorescens* deteriorated after four days at 10 °C, 16 days at 5 °C and 36 days at 0 °C.

Packaging

Intended to convey the fluid milk products in networks of production and distribution, the container must have certain qualities:

the attributes of appearance, texture and mouth-feel.

differences between non-fat and other types of milk are mainly found in reduced fat its content ranges from <0.1, 1 to 2 g 100 g⁻¹ . Sensory the fat content of whole milk is 3.5 g 100 g⁻¹ while in products with in milk greatly affects the sensory properties of the product. On average, has longer distribution times. It is also of interest to note that the level of fat specific packaging that increases the refrigerated shelf life of milk to 6 or more weeks, i.e. ESL. This product is more convenient for marketing and properties of the milk, including some UHT processing combined with a available on the market worldwide, which are either raw or processed milks. The type of heat treatment is of major importance in the sensory There is a wide range of liquid milk products and milk beverages milk for manufacturing purposes [2].

(6) The word “milk” used herein includes only milk, goat’s milk, sheep’s milk for manufacturing purposes.

(5) Lactating animals are cows, goats, sheep, and water buffalo producing standards of this ordinance.

buffalo. Water buffalo milk shall be produced according to the sanitary colostrums, obtained by the complete milking of one or more healthy water (4) Water buffalo milk is the normal lacteal secretion practically free of shall be produced according to the sanitary standards of this ordinance.

obtained by the complete milking of one or more healthy ewes. Sheep milk (3) Sheep milk is the lacteal secretion practically free from colostrums normally manufactured from goat milk.

for in 21 CFR or recognized as non-standardized traditional products shall only be used to manufacture dairy products that are legally provided obtained by the complete milking of one or more healthy goats. Goat milk (2) Goat milk is the lacteal secretion practically free from colostrum by the complete milking of one or more healthy cows.

(1) Milk is the lacteal secretion practically free from colostrum obtained The term “milk” shall include the following

2.1 Different types of market milks

CHAPTER 2 - TECHNOLOGY OF DRINKING MILK: PASTEURIZED MILK, STERILIZED AND UHT

Iron is the most difficult mineral to add to foods and ensure adequate absorption, and because soluble iron has the highest ‘bio’-availability, it often causes changes in flavour and appearance. On the other hand, insoluble forms, such as elemental iron powders, do not produce changes in the sensory characteristics of products, but may be very poorly absorbed. A metallic aftertaste and flavour defects caused by the oxidation-mediated rancidity of fats and colour changes resulting from interactions with anthocyanins, flavonoids and tannins have been described as negative effects produced in food fortified with iron. An example of an iron source is ferrous sulphate (i.e. a water-soluble iron compound), which has been successfully used to fortify infant formulae, but can produce a metallic aftertaste in liquid products.

Milk enriched with fibre

Fibre intake in the diet is continuously increasing due to its beneficial effects on health (risk reduction of coronary heart disease, high blood cholesterol and cancer, attenuation of levels and fluctuations of blood glucose and insulin, and control of weight due to its satiety effect). When fibre is added to a food, the taste and textural properties can be modified.

A small quantity of soluble fibre has been successfully added to skimmed milk. It produces an improvement in the texture of the product, which becomes similar in taste to reduced-fat or whole milks. Fibre enriched milk improves in palatability and tolerance compared to other skimmed milk products, making it recommendable for people on a diet or who need a low-fat diet, but do not like the taste of skimmed milk.

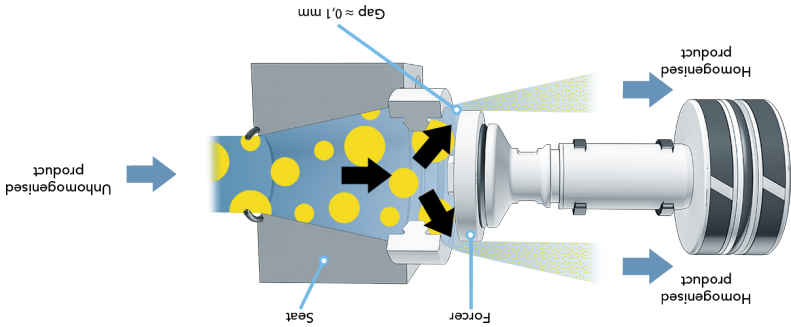
Lactose-reduced milk

Consumers, who are lactose intolerant, do not produce enough of the enzyme lactase, which breaks down lactose to glucose and galactose. This lead to poor digestion of the carbohydrate in the intestine and, as a consequence, bacterial activity in the colon produces gas, bloating, pain and sometimes diarrhoea. Most technological approaches to obtain lactose-free milk products consist of adding lactase to milk to hydrolyse the lactose to glucose and galactose. Since the main carbohydrate is glucose instead of lactose, the taste of this milk is sweeter than normal milk, and many consumers do not like it. To resolve this handicap, a technological alternative based on a chromatographic process to separate lactose from skimmed milk has been developed. This process permits lactose-free milk to be produced, which does not taste any different to ordinary milk so consumers with lactose tolerance can enjoy the good taste of milk.

easily, under the influence of heat, for example, that the same milk not affects the stability of proteins, in that the milk is homogenized clot more One consequence of physico-chemical homogenization is that it slightly texture softer, smoother for the same fat content.

was widespread. On the other hand, this treatment gives the milk flavor and dispersed throughout the liquid, the homogenization of milk consumption Because it has the advantage of stabilizing the emulsion of the fat evenly

Figure 4 – Milk homogenization process



Homogenisation

Homogenization is a process that serves to prevent the fat globules rising to the surface of milk by reducing their diameter. It is obtained by passing milk under high pressure through orifices or valves very close (Figure 4).

cooked.

The main faults to avoid are the color of milk and made the taste of aseptic packaging.

Another method is to sterilize milk at 115 °C for 20 seconds, then store and “hot” at 80 °C, and sterilized in its packaging at 115 °C for 15 to 20 minutes. The milk is pre-sterilized at 130 °C for 3 or 4 seconds, and then bottled milk. The milk then presents a full guarantee of hygiene and conservation.

Sterilization is to destroy, by a high heat, all of the microbial flora of milk. homogenized milk because raw milk lipases cause rancidity in homogenized milk. important to avoid mixing of raw milk, even small amounts, pasteurized or immediately after, which prevents the lipolysis. In the same vein, it is Pasteurization can also destroy the lipase, before homogenization,

some technological and formulation approaches to reduce the objectionable flavours of these products. For example, the perception of astringency decreases with the addition of sucrose or by increasing soymilk viscosity. Moreover, sugar addition produces a decrease in bitterness and reduces the attributes related to ‘beaniness’. The genetic removal of the lipoxigenase isozymes from soybeans led to the production of soymilk, which had less cooked beany aroma, cooked beany flavour and astringency than soymilk made with normal soybeans [3].

2.2 Technology of drinking milk: pasteurized milk, sterilized and UHT

To become fluid milk, raw milk must undergo the physical treatment, such as clarification, standardization, homogenization and heat treatment course. Only the latter which differentiate pasteurized milk, sterilized milk and UHT milk, and other treatments are almost identical for these products.

Before addressing the technical preparation of milk consumption, we will present first time, the steps are common to all these products. Then we will introduce the techniques specific to each product: Pasteurized milk, sterilized milk and UHT milk

Reception

The step of receiving the milk must be done without damage to fat globules or incorporation of air into the conduct of milk while maintaining the necessary quality controls, these are detailed in the chapter on quality control of milk and milk products.

Clarification

The clarification is the process by which milk is subjected to a centrifugal force in order to extract more dense particles, such as cellular debris, leucocytes and foreign material. Without this treatment, these particles sediment in homogenized milk, to become visible in transparent containers.

The principle of operation of a clarifier is identical to that of a centrifugal separator (Figure 1). The characteristic difference between a clarifier and a centrifugal separator is the design of the stack of discs: holes without distribution in the clarifier and the number of outlets (one on the clarifier, two on the splitter).

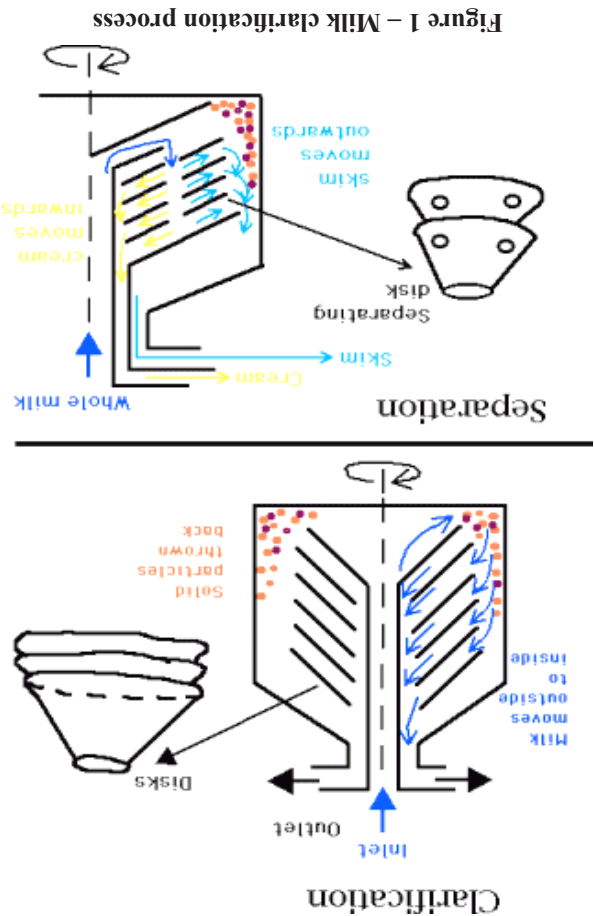
There are calcium-, magnesium- and iron-enriched milks available on the market. These types of milks are designed to supply the mineral necessities of mothers during breastfeeding and pregnancy or infants. Calcium and magnesium are involved in bone development and maintenance; its consumption decreases the risk of several diseases, such as osteoporosis, hypertension and colon cancer. The fortification of milk with iron can help to prevent and eradicate iron deficiency anaemia, which is one of the most widespread nutritional deficiencies in humans.

The sensory quality of mineral-enriched milks depends on the mineral source used for fortification. It is necessary to reach the optimal level of 'bio'-available mineral without affecting the taste and appearance of milk. In general, calcium is added to milk with other minerals (e.g. phosphorus, magnesium), vitamins (D, K), and more recently, phosphop- tides and probiotic microorganisms have been added in order to improve the absorption of minerals. There are several commercially available calcium salts used for enrichment of milk. These include inorganic salts (chlorides, carbonates, phosphates), milk minerals (calcium phosphate) and organic salts like tricalcium citrate, calcium lactate, calcium gluconate and calcium gluconate. Some of them have a good solubility in milk but contain only low amounts of calcium, for example calcium gluconate or calcium lactate, and others like inorganic salts have a high quantity of calcium, but are poorly solu- ble. Regarding their influence on sensory properties, generally carbonates and phosphates impart astringent, bitter and chalky tastes to milk. Calcium lactate and calcium chloride promote bitter notes at high concentrations, whilst calcium carbonate may come across as soapy or lemony and calcium phosphate has a bland flavour, but imparts a gritty mouth-feel. Tricalcium citrate is a neutral tasting salt with a high calcium level and medium solubility; moreover, it is the most economic salt for calcium fortification, and these advantages make it now the first choice for enrichment of milk with calcium.

flavour, and decreases milk fat flavour. However, although the addition of high amounts of CLA to milk would help to obtain maximum health benefits, this is impractical because of cost constraints.

In milk with naturally increased levels of CLA, the amount of these fatty acids are lower, and the results of several researchers suggest that consumer acceptability attributes of CLA-enriched milk are similar to products with low levels of CLA.

Mineral-enriched milk



The choice of location clarifier may depend on certain factors, including the ability of the device and the method of standardization. The clarification is accomplished by either of the following steps:

- At the reception, prior to storage of raw milk;
- Between storage and standardization;
- Between standardization and the entrance to the pasteurizer;
- Between the regeneration and the heating plate pasteurizer, in which case the device is a combination separator-clarifier.

The product undergoes scales of temperature and time (63 °C for 30 minutes or 73 °C for 16 seconds). However, in order to obtain prolonged storage of pasteurized milk, it generally applies a more severe temperature and / or holding time, while avoiding areas exceed limits beyond which the milk would taste of cooked or suffer a reduction of excessive nutritional value.

Pasteurization tank at low temperature is still used, in particular to prepare different types of products in small quantities. But it is the continuous process at high temperature, by systems in plaques (Figure 3), which is most in use. It is an economical method, accurate and reliable. The equipment can operate at great speeds and be fully automated.

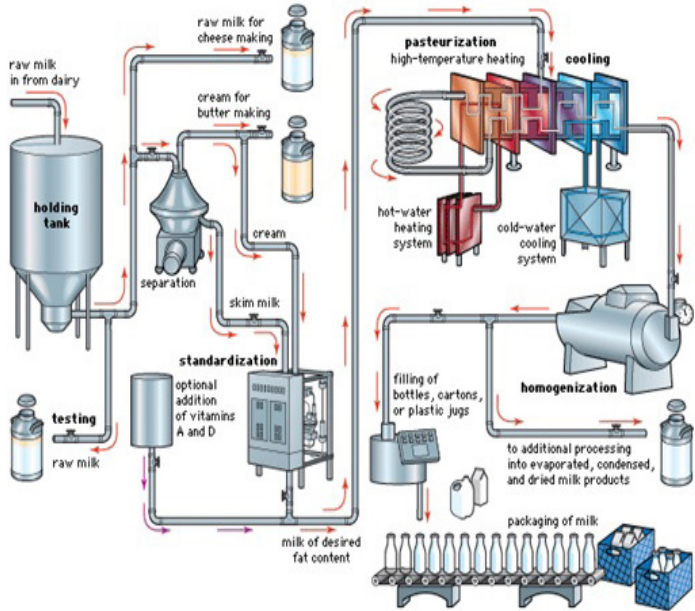


Figure 3 – Milk pasteurization process

To improve the flavor of milk, can be integrated in pasteuriser a vacuum chamber which would remove certain volatile compounds. However, equipment for this treatment requires more monitoring and increases the losses when changing products.

Moreover, there is also an increased interest in enriched milks and very often functional ingredients are added and constitute part of the composition of a milk beverage. Other modifications, which can be applied to milk, are lactose- reduced milk or the addition of cocoa powder for the production chocolate-flavoured milks; these processes increase the number of possibilities for increasing the consumption of milk as beverage products. On the other hand, soymilk, which is not a dairy beverage, is briefly reviewed in this chapter, as normally it is used by consumers as an alternative option to cow's milk (or milk from other species of mammals) in cases of allergy or lactose intolerance. Soymilk consumption is quickly increasing in western countries, and it has a particular and much defined flavour

Raw cow's drinking milk represents only a small fraction of total milk consumption. The governments of the different countries, e.g. European Union, have implemented strict regulation on dairy hygiene with rules prohibiting or restricting the placing on the market, within its territory, of raw milk for direct human consumption. Raw milk has been shown to have more 'taste and quality' than heated milk, maintaining especially the freshness. It is natural, creamy and has a high odour intensity. However, spoilage bacteria in milk produce foul smells and off-flavours.

Different heat treatments can be applied in the dairy industry (pasteurisation, uperisation, sterilisation, UHT), and these treatments provoke the development of heated off-flavours and a slight brown colour depending on the intensity of the heat and the duration of its application. Moreover, some other off-flavours related to the packaging and storage can be present in heated milk. Dairy industries have been developing different strategies to produce safe milk with a similar taste to fresh milk, and extension of the shelf life has been a prime objective. Ultrapasteurisation (UP) enables dairy processors to produce milk with an ESL similar to the UHT process, but with fewer flavour defects and resembling the fresh taste of pasteurised milk.

In addition, the higher the storage time, the higher the possibility for developing organoleptic defects. The flavour of UP milk has not been studied as extensively as UHT milks, reported that UP milk developed stronger painty and rancid flavours during storage than HTST milk. The extended storage time of ESL milk increases the opportunity for light-induced oxidation, for Maillard reaction or product/package interactions.

Raw milk is principally fresh with no aftertaste. Although there has been considerable improvement with respect to the care and cleaning of the dairy

is related to cholesterol and high-energy contents. However, from a taste negative perceptions for whole milk with a high amount of fat because this knowledge, are also implicated. Health awareness among consumers has but other factors, such as health, cost, convenience, habits and nutritional The consumption of a certain type of milk is not only influenced by taste, between skimmed milk (0.1 g 100 g⁻¹) and reduced-fat milk are greater. However, the sensory differences and mouth-feel perceptions, and there are relatively few sensory differences shown that whole milk has high score due to its taste, perceived as creamiest manner. The sensory evaluation of milks with different fat contents have g 100 g⁻¹) content do not affect the sensory properties of milk in a linear mouth-feel and total fatiness. However, the different levels of fat (<0.1–3.5 whiteness, glass coating, thickness (visual and oral), creaminess, residual a whiteness to low-fat milk produces an increase in the sensory perception of milk smell and flavour, transparency and blueness. The simple addition of and thickness. Low-fat milks are usually described with terms like boiled milk, which is related to the perception of other sensory attributes like aroma flavour compounds. The fat content in the product determines the colour of the flavour of whole milk is more intense due to the naturally occurring fat Whole milks are whiter and more viscous than skimmed milks. Also, milk are influenced by the fat content.

trigeminal nerve. Previous studies have also shown that taste perceptions of oil, creamy). This is because the tactile sensations are mediated by the large to stimulate taste or smell, but do produce tactile sensations (i.e. determined by the fat concentration in the product. Fat molecules are too Milk sensory properties of appearance, texture and flavour are largely *Whole and fat-reduced milk*

responsible for causing flavour defects. properties of the milk during storage, but sometimes can actually be directly of the heat. Packages are designed to preserve the freshness and sensorial appearance and intensity are usually related to the time and temperature heat treatment of the milk, other off-flavours may appear in milk. Their normally subjected to a heat treatment for hygienic reasons. During the undesirable changes in aroma and taste attributes of milk; hence, milk is metabolism shorten the shelf life of raw milk and, as a consequence, produce flavours are usually developed at the farm. Moreover, microbial growth and cows, farms and milk collection and delivering systems, numerous off-

perspective, whole milk is more valuable than a low-fat product. A positive relationship between creaminess and preference has been found with higher fat products being perceived as the creamiest.

Some studies have been carried out to develop fat substitutes that enhance the sensory characterisation of low-fat milk. As the colour is a key attribute in the sensory perception of whole milk, it is important that an effective fat substitute makes the colour of milk whiter, less green and less blue; non-fat dry milk is sometimes added to skimmed and low-fat milks as a fat substitute. Their use increases the relative viscosity of skimmed milk, although it does not provide the product with the desirable sensory attributes of flavour, appearance, colour and thickness. Commercially available protein-based fat substitutes have also been unsuccessfully evaluated as an alternative to milk fat.

Enriched and modified milks

Over the past few years, consumers’ growing interest in healthy eating has led to the promotion and appearance on the market of many different types of modified milks. Apart from milks with different levels of fat, which have been on the market for a long time, there are other milks enriched with specific components (or modified), which are considered to have some health benefits. Some examples are milks fortified with vitamins, fibre, calcium, conjugated linoleic acids (CLA) or health-promoting microorganisms. There are also other milk products, such as cholesterol-reducing and lactose-free milk, and soymilk is an alternative to dairy fluid milk. Sometimes the sensory profile of these developed milks is very different to that of traditional fluid milk. Attempts are being made to describe the sensory characteristics of these enriched milks in order to better satisfy consumer demands.

CLA-enriched milks

Milk and dairy products are major sources of CLA in human diet. Growing medical evidence suggests that CLA helps to prevent cancer, and coincides with the recent advances in enhancing CLA levels in milk. The CLA content of milk can be increased in two ways: first, with direct fortification of milk with CLA oil (i.e. known as synthetic enrichment of CLA), and second, the content of CLA in milk can be enhanced naturally by modifying the cow’s diet. The use of very high levels of synthetic CLA-enriched milks seems to reduce the overall acceptability, flavour and freshness perception of the product. Fortification of the milk with CLA produces a grassy/vegetable oil

produce multiple products such as pasteurized milk and pasteurized butter. product and secondly, to improve its keeping quality. This step is used to microorganisms of alteration. This treatment first, to ensure the safety of the destruction of pathogenic microorganisms and a large number of Pasteurization is a heat treatment sufficient to moderate and the *Pasteurisation, Sterilization*

the separator. injecting the cream at the entrance to the homogenizer, part skim milk from to 10-12% in order to obtain satisfactory homogenization. This is done by only the cream passing through the homogenizer, the fat must be reduced, In facilities where, for reasons of efficiency and energy conservation, of the regeneration of raw milk pasteurizer. surplus cream. In the manufacturing, this method of standardization is out system for continuous analysis. A special release is to evacuate the aircraft mixture is carried out in controlled proportions according to the results of a in partially skimmed or total milk. To obtain the desired fat content, the programmed remixes for skimmed milk and cream, separated in a first step type of fully automated device: The separator-clarifier-normalizer is indeed with two products whose fat content is known. But increasingly rely on one direction. This system can be easily controlled, since the mixing is done can to a controlled injection of skimmed milk in whole milk pasteurization As for the continuous process, it may be more or less automatic. This calculated to arrive at the percentage of fat in the desired mixture. to mix in a container of whole milk, skim milk or the cream in proportions Standardization can be done in batch or continuous. In the first case it is and economy.

standardization, both compliance with regulations for reasons of efficiency of these levels. In practice, this means accurate measurements during company should adhere precisely to the standards established for each By offering its customers a choice of milk at different fat content, the *Standardization*

fat. Skim milk contains no more than about 0.1% fat. globules. In general, removing 100 liters of milk, 10 liters of cream 35-40% of the separator, the flow of milk through it and the size distribution of fat The amount of fat that we can separate the milk depends on the design

Thermisation

In many large dairies, it is not possible to pasteurize and process the milk immediately after receipt. Part of the milk must be stored in tanks for several hours or several days. In these conditions, even refrigeration is not enough thrust to avoid serious deterioration of quality.

Many dairies thus preheat the milk to a temperature below the temperature of pasteurization, to temporarily inhibit the growth of bacteria, including pathogens. This process is called thermisation. The milk is heated to 63-65 °C for about 15 seconds, a combination of temperature and time n’inactive not that the enzyme phosphatase.

To avoid the proliferation of aerobic spore forming bacteria after thermisation, milk must be cooled rapidly to 4 °C or less and must not be mixed with untreated milk. Many experts believe that thermisation has a positive effect on some spore forming bacteria. Heat treatment returns many spores in a vegetative state, and they are destroyed during pasteurization of milk later.

Thermisation is only used when the dairy is unable to process all deliveries. Otherwise, this step is ignored.

Separation of fat (Skimming)

Although the lipid and aqueous phases of milk do not mix, decanting and spontaneous coalescence of fat globules on the surface of milk is slow, so they are accelerated by means of centrifugal separators which discharge continuously cream one hand, and skim milk on the other. Figure 2 illustrates schematically the operation of these devices.

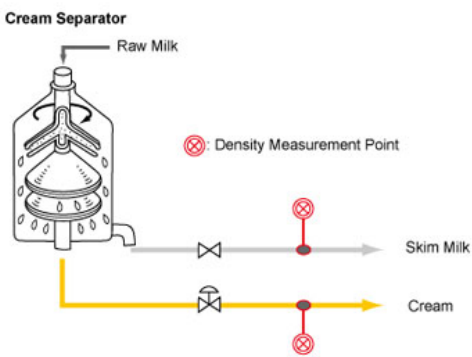


Figure 2 – Milk skimming process

Butter is essentially the fat of the milk. It is usually made from sweet cream and is salted. However, it can also be made from acidulated or bacteriologically soured cream and saltless (sweet) butters are also available. Well into the 19th century butter was still made from cream that had been allowed to stand and sour naturally. The cream was then skimmed from the top of the milk and poured into a wooden tub. Buttermaking was done by hand in butter churns. The natural souring process is, however, a very sensitive one and infection by foreign micro-organisms often spoiled the result. Today's commercial buttermaking is a product of the knowledge and experience gained over the years in such matters as hygiene, bacterial acidifying and heat treatment, as well as the rapid technical development that has led to the advanced machinery now used. The commercial cream separator was introduced at the end of the 19th century, the continuous churn had been commercialized by the middle of the 20th century.

3.3 Butter manufacturing

Sour cream is prepared from fresh and sweet cream standardized to contain 18-20 % fat. The standardized cream is pasteurized by LTLT or HTST Method and cooled to 60-65 °C. At this temperature it is homogenized employing two-stage homogenization process. Low temperature homogenization is preferred to promote formation of fat clusters, which during ripening flocculate and also increase the viscosity of the product and improve the texture. Homogenized cream is then inoculated with 2-4% fresh and active starter culture containing lactic acid and flavour producing microorganisms, namely, Streptococcus lactis, Streptococcus cremoris and diacetyl lactis. The inoculated cream is then incubated at a temperature of 22°C and allowed to develop titratable acidity and desired body and texture. Usually, it takes 10-12 hrs to attain the desired acidity. Sometimes some thickening agent or rennet is also added to sweet cream to increase the firmness of the sour cream. When the cream has attained the desired acidity (0.60% LA or pH 4.5) it is cooled with gentle stirring and chilled to 2-4 °C followed by packaging. Alternatively, the cream after homogenization and inoculation is filled in the containers and the packages are incubated at 22-25°C. The acidity develops. Then the packages are transferred to cold rooms where cooling of the product is achieved [5].

Classification of Butter

Butter may be classified based on treatment given to cream, salt content, method of manufacturing and end use.

I. Classification based on acidity of cream used for butter making

Sweet cream butter: sweet cream butter (made from non-acidified cream; this includes butter in which no bacterial culture have been added to enhance diacetyl content) having pH of 6.4 (acidity of the churned cream does not exceed 0.2%).

Mildly acidified butter (made from partially acidified sweet cream) having pH in the range of 5.2 to 6.3

Sour cream butter (made from ripened cream which has more than 0.2% acidity) having pH 5.1.

II. Classification based on salt content

Salted butter: Butter to which salt has been added. It is added to improve flavor and keeping quality of butter.

Unsalted butter: this type of butter contains no salt.

III. Classification based on end use

Table Butter: the product made from pasteurized cream obtained from cow or buffalo milk or a combination thereof with or without ripening with the use of standard lactic culture, addition of common salt, annatto or carotene as colouring matter and diacetyl as flavouring agent.

White Butter: the product made from pasteurized cream obtained from cow or buffalo milk or a combination thereof without ripening and without addition of any preservative including common salt, any added colouring matter or any added flavouring agent.

IV. Classification based on the manufacturing practice

Pasteurized cream butter/ Pasteurized Table butter: this is made usually from pasteurized sweet cream. Such butter usually has a milder flavor than that made from similar cream not pasteurized.

The butter obtained by traditional process of churning as practiced at domestic levels.

The buttermaking process involves quite a number of stages. The continuous buttermaker has become the most common type of equipment used (Fig. 7).

- b) ripened by bacteria, with eyes: swiss
- 3) semi-hard – Moisture 40-47%
 - a) ripened principally by bacteria: Brick
 - b) ripened by bacteria and surface microorganisms: Limburger
 - c) ripened principally by blue mould:
- 4) external– camembert
- 5) internal– gorgonzola, Blue, roquefort.
- 6) soft -Moisture>47%
 - a) Unripened– cottage
 - b) ripened– neufchatel

Cheese production process

Cheese production process had shawed on a Figure 8.

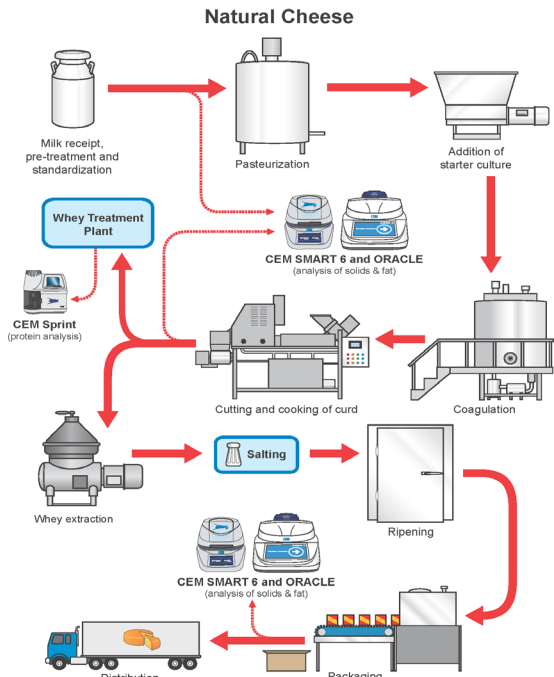


Figure 8 - Cheese production process

- a) be attractive in its form and presentation;
- b) provide effective protection to the product against physical shock, light and heat;
- c) preserve the contents of odors or flavors;
- d) Facilitate handling of the product;
- e) being adapted to modern requirements of production.

Types of containers

Cardboard container, despite its low resistance, is appreciated by consumers for its appearance, its form and convenience. It also affords good protection of the product. Made of cardboard coated with polyethylene, it is generally pre-assembled at the factory. Sometimes more sophisticated manufacturing to respond to particular uses; it can be covered with a thin layer of aluminum on its inner surface, forming an effective barrier against the ingress of oxygen and better preserve the product.

The equipment used for this type of packaging are numerous and offer great flexibility and speed. The entire operation, including the mounting of the container, filling, sealing and crating, is increasingly integrated to meet the new requirements of plants.

The plastic container, as rigid or flexible, is widely used in the dairy industry. The advantages of the flexible form are: lower cost, the ability to manufacture or assemble the containers directly on the dosing, reducing the need for storage space, the lower price of metering required. Among the disadvantages of flexible packaging, handling difficult point for the consumer and a product of inadequate protection against the rays of light.

The glass container, although virtually disappeared from many markets, still exists in some areas of Canada and especially the United States. Its rigidity provides some protection against physical shocks and makes the product more attractive.

Conditioning devices

Facilities vary depending on the type of packaging used and the desired pace, they are 2 types: those which operate by gravity and those so-called volumetric generally manufactured in stainless steel for parts that come into contact with the food and provided a cleaning system.

It is advantageous to have an elevated tank to supply the filling by gravity. Operating without pumping, this arrangement avoids the incorporation of air into the product, facilitates the precision of filling, draining and cleaning by circulation.

(c) Flavor neutral to slightly oxidized
(d) acceptable to neutral flavor
Secondary phase:
(c) acceptable flavor with slight flavor of cooked
(b) taste of cooked
(a) taste of cooked very pronounced
Primary phase:
The different phases of the evolution of taste are:
Minimum heat treatment to destroy microorganisms is sufficient to de-nature the β -lactoglobulin, which causes a release of sulfhydryl groups, which have a decisive effect on the taste of the product. They are indeed responsible for the taste of cooked fresh milk treated, their property of reducing groups will then be used to retard the oxidation of milk during storage. The heat treatments used to eradicate the seeds of milk trigger chemical reactions or physico-chemical reactions generally. By raising the temperature, these reactions are accelerated, but the rate of destruction of microorganisms is considerably higher than the speed of chemical reactions. In other words, the rate of destruction of microorganisms is proportional to the temperature, while the speed of chemical reactions is mainly linked to the duration of treatment.

Physico-chemical aspects of UHT

The UHT milk is heated in continuous flow at a temperature of at least 132 °C for a few seconds to cool to room temperature and aseptically packed in the order:
(a) to ensure its stability and nutritional value long enough to meet the requirements;
(b) to release of all pathogenic microorganisms and toxins that may affect the health of the consumer;
(c) to destroy any microorganism that can grow during storage.
The principle of milk treated at ultra high temperature (UHT) is known for nearly a century: already in 1893, it was built devices that can process the milk to 125 °C for 6 minutes. In 1909, there was a continuous flow tubular able to heat the milk to 130 °C -140 °C, but it was not until 1951 that it was possible to aseptically packaged by the process "Martin Canning". Ten years later (1961), the Company Tetra Pak, Sweden provided the first satisfactory commercial aseptic packing.

Packaging and Storage

Table cream is packaged in retail packs in glass bottle, laminated pouches, plastic containers etc. and stored at 4-7 °C and distributed as early as possible.

3.2 Sour cream manufacturing

It is a cream product, which is prepared by ripening or souring of sweet cream to a titratable acidity of 0.60%, L.A with desirable lactic acid bacteria. It has slightly acidic flavour and smooth texture. Sour cream is usually used in the preparation of different foods and sometimes in drinks and beverages. The following steps are involved in the preparation of sour cream Fig 6.

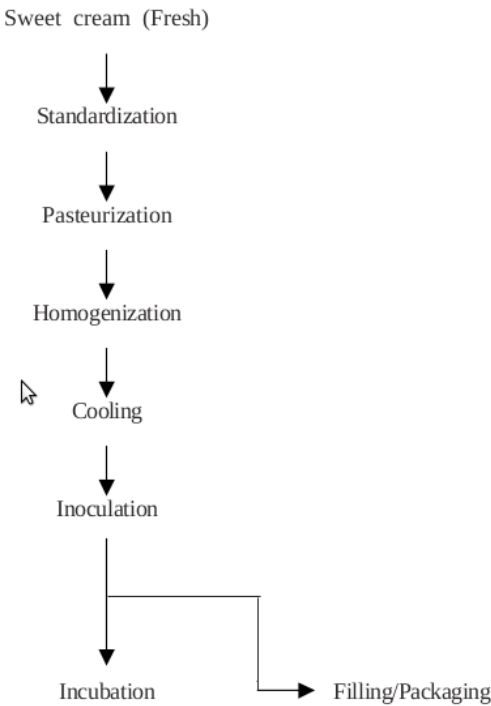


Figure 6 - Flow diagram for preparation of sour cream

Several schemes to classify cheese have been proposed to assist international trade and to provide compositional and nutritional information. The basis for such classification include age, type of milk, country of origin, ripening process/agents, important compositional varieties, like moisture and fat, general appearance, texture and rheological qualities.
However, none of the above schemes is complete in itself. There are about 2000 names of cheeses. It is very difficult to classify the different cheeses satisfactorily, in groups. There are probably only about 18 types of natural cheeses. These are: cheddar, gouda, edam, swiss, Brick, Herve, camembert, Limburger, Parmesan, Provolone, romano, roquefort, sapsago, cottage, neuchatel, trappist, cream and Whey cheeses. However, given certain standards for cheese.
Such a grouping, though informative, is imperfect and incomplete. These can also be classified on the basis of their rheology, and according to the manner of ripening as shown below:
(1) Very hard (grating) – Moisture < 35% on matured cheese and ripened by bacteria, e.g. Parmesan, romano.
(2) Hard -Moisture < 40%
(a) ripened by bacteria, without eyes: cheddar

Classification of Cheese

Has also defined cheese on the basis of ripening as follows:
Ripened cheese is cheese which is not ready for consumption shortly after manufacture but which must be held for some time at such temperature and under such other conditions as will result in necessary biochemical and physical changes characterizing the cheese in question.
Mould ripened cheese is a ripened cheese in which the ripening has been accomplished primarily by the development of characteristic mould growth through the interior and/or on the surface of the cheese.
Unripened cheese including fresh cheese is cheese which is ready for consumption shortly after manufacture.
Cheese or varieties of cheeses shall have pleasant taste and flavor free from off flavor and rancidity. It may contain permitted food additives and shall conform to the microbiological requirements prescribed in the regulation.

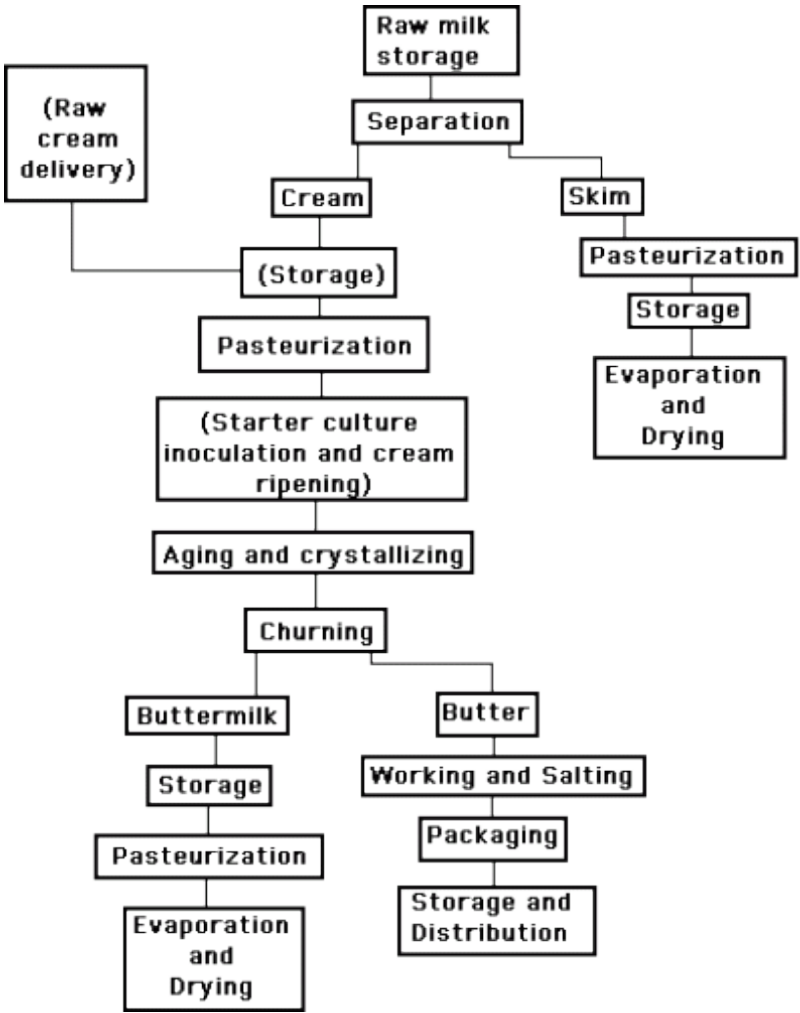


Figure 7 - Flow diagram for preparation of butter

The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer. The cream should be sweet (pH >6.6, TA = 0.10 - 0.12%), not rancid and not oxidized.

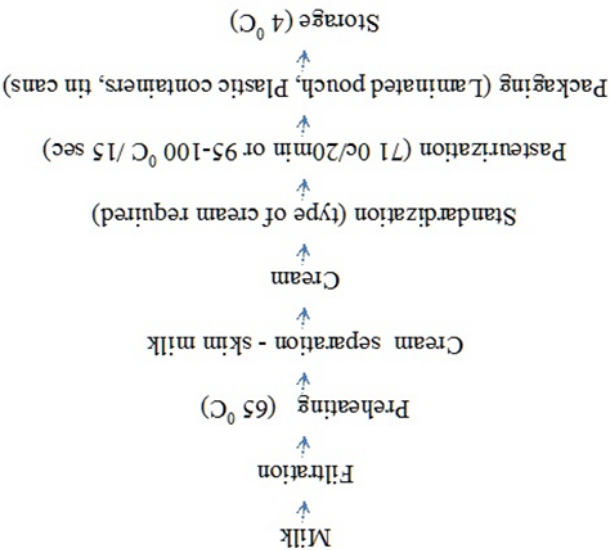
and remove volatile off flavors. the pathoges, inactivate enzymes, eliminate gaseous tainting substances, Cream is pasteurized at 71 0c for 20 min in a batch process and 95 to 100°C for 15 sec in a pasteurizer. Pasteurization is done mainly to destroy

Pasteurization of Cream

This refers to the adjustment of the fat level in cream to the desired percentage, confirming to standard requirements. The fat percentage in cream is adjusted to the prescribed level by the addition of skim milk or cream. Desired level of fat in cream for butter making is 33 to 40 per cent. Standardization to both higher and lower level leads to higher fat loss in butter milk. Reduction fat by adding water should be avoided as it interferes with ripening of cream and also results in butter with 'flat' or 'washed off' flavour.

Standardization of Cream

Figure 5 – Flow Diagram for the production of cream



The skim milk and cream both form vertical walls within the and are separated by led through separate outlets

this is rarely done today. After draining, the butter is worked to a continuous fat phase containing a finely dispersed water phase. It used to be common practice to wash the butter after churning to remove any residual buttermilk and milk solids but

After draining, the butter is worked to a continuous fat phase containing buttermilk is also continuous.

Thus the cream is split into two fractions: butter grains and buttermilk. In traditional churning, the machine stops when the grains have reached a certain size, whereupon the buttermilk is drained off. With the continuous pumped to the churn or continuous buttermaker via a plate heat exchanger which brings it to the requisite temperature. In the churning process the cream is violently agitated to break down the fat globules, causing the fat to coagulate into butter grains, while the fat content of the remaining liquid, the buttermilk, decreases.

As a rule, aging takes 12 - 15 hours. From the aging tank, the cream is pumped to the churn or continuous buttermaker via a plate heat exchanger which brings it to the requisite temperature. In the churning process the cream is violently agitated to break down the fat globules, causing the fat to coagulate into butter grains, while the fat content of the remaining liquid, the buttermilk, decreases.

In the aging tank, the cream is subjected to a program of controlled cooling designed to give the fat the required crystalline structure. The program is chosen to accord with factors such as the composition of the butterfat, expressed, in terms of the iodine value which is a measure of the unsaturated fat content. The treatment can even be modified to obtain butter with good consistency despite a low iodine value, i.e. when the unsaturated proportion of the fat is low.

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If ripening is desired for the production of cultured butter, mixed cultures of *S. cremoris*, *S. lactis diaceyl lactis*, *Leuconostocs*, are used and the cream is ripened to pH 5.5 at 21°C and then pH 4.6 at 13°C. Most flavour development occurs between pH 5.5 - 4.6. The colder the temperature during ripening the more the flavour development relative to acid production. Ripened butter is usually not washed or salted.

From the intermediate storage tanks, the cream goes to pasteurization at a temperature of 95°C or more. The high temperature is needed to destroy enzymes and micro-organisms that would impair the keeping quality of the butter.

cheese products, such as, lactose-free goat cheese products, and half-fat and reduced fat cheeses.

Definition

The word ‘cheese’ is derived from the old English ‘cese’ which in turn was derived from the Latin ‘caseus’ which means correct or perfect thing. Cheese may be defined ‘as the curd of milk separated from the whey and pressed into a solid mass’. This definition of cheese is satisfactory but too limited and vague from a technical standpoint. Therefore, a relatively complete definition is as follows: cheese is the curd or substance formed by the coagulation of milk of certain mammals by rennet or similar enzymes in the presence of lactic acid produced by added or adventitious microorganisms, from which part of the moisture has been removed by cutting, warming and pressing, which has been shaped in mould and then ripened (also unripened) by holding for sometime at suitable temperatures and humidity. The expansion of the numbers of types of cheese makes a simple definition of cheese difficult. Thus the definition, the curd produced from milk by enzyme activity and subsequent separation of whey from the coagulum does not cover whey cheese, lactic cheese, cream cheese and some of the cheeses produced by newer techniques, viz. ultrafiltration and reverse osmosis. The definition is, therefore, not universally acceptable.

Cheese is the fresh or matured solid or semi-solid product obtained:

By coagulating milk, skim milk or partly skimmed milk, whey, cream or butter milk or any combination of these materials, through the action of rennet or other suitable coagulating agents and by partially draining the whey resulting from such coagulation, or by processing techniques involving coagulation of milk and/or materials obtained from milk (provided that the whey protein casein ratio does not exceed that of milk) and which give an end product which has similar physical, chemical or organoleptic characteristics as the product defined under.

Cheese means the ripened or unripened soft or semihard, hard and extra hard product, which may be coated with food grade waxes or polyfilm, and in which the whey protein/casein ratio does not exceed that of milk.

Cheese is obtained by coagulating wholly or partly milk and/or products obtained from milk through the action of non-animal rennet or other suitable coagulating agents and by partially draining the whey resulting from such coagulation and/or processing techniques involving coagulation of milk and/or products obtained from milk which give a final product with similar physical, chemical and organoleptic characteristics. The product

f) oxidized flavor

Manufacturing processes UHT milk

Preparation of UHT milk is done in two steps: the sterilization of milk and aseptic packaging.

Aseptic Packaging

Once sterilized, the milk must remain in a state of total asepsis: the packaging device can be connected directly to one or more packaged, or it can be coupled to an aseptic tank, depending on the choice of the process.

The as eptic tank is used to store milk ready to be placed in containers. It is first sterilized and valves for milk are surrounded by vapor barriers that keep sterile. When the milk is directed to the aseptic packing, its volume is replaced with sterile filtered air.

The packer must ensure aseptic sterilization of the container and maintaining a sterile environment for its filling. The container is usually sterilized using hydrogen peroxide at a concentration of 30-35%, which is then evaporated at a temperature above 100 °C, which is essential for the sterilization of paper.

In most systems, the packaging material is composed of polyethylene, aluminum and laminated paper. Such material adequately protects the product from light and gases. Aseptic packaging is the most delicate operation of UHT, and in terms of control and preventive measures: It requires a vigilant staff and well trained both in terms of operations and at the interview.

Advantages of UHT milk

UHT treatment is considered a major revolution in dairy technology, this process offers, in particular, the double advantage of a long-life milk consumption without the need for refrigeration. The distribution becomes more economical because it can be extended on a weekly time limit for example, and is not subject to the limits of course. Thanks to its long shelf life, the rate of returns is very low.

Preparation of UHT milk lends itself well to automation. In this respect, it is important that equipment used in this process is equipped with an automated system of cleaning and sanitation CIP [4].

Cream is not a definite specific substance. It contains all the milk constituents but in varying proportions. Cream for sale to consumers is produced with different fat contents. Cream of lower fat content, 10 – 18%, is often referred to as half cream or coffee cream, it is increasingly used for desserts and in cooking. Cream with a higher fat content, typically 35 – 40 %, is usually considerably thicker. It can be whipped into a thick froth and is therefore referred to as “whipping cream”. The milk fat in cream may vary from 10 to 75 per cent.

Cream excluding sterilized cream is the product of cow or buffalo milk or a combination there of which conations not less than 25 per cent milk fat (table 1). Cream is rich in energy giving fat and fat-soluble vitamins A, d, e, and K, the contents of which depends on the fat level in cream.

Classification

Cream may be defined as that portion of milk which is rich in milk fat or that portion of milk into which fat has been gathered and which contains a large portion of milk fat, or when milk fat is concentrated into a fraction of the original milk.

3.1 Cream manufacturing

In the Kazakhstan dietary regimen, milk fat in the form of cream, butter and ghee contributes significantly towards nourishment of people of almost all age groups. These products are good sources of fat soluble vitamins A, d, e and K. in the ancient vedic literature it is mentioned that ghee derived from cow milk has got excellent nutritional and tonic qualities specially beneficial to persons convalescing after chronic illness and bone fracture. Cream is a fat rich component and has been known from time immemorial as the fatty layer that rises to the top portion of the milk when left undisturbed. Cream is sold in many varieties.

Although used for several purposes, it is primarily something of a luxury because of its excellent flavor, body and texture.

CHAPTER 3 - TECHNOLOGY OF CREAM, SOUR CREAM AND BUTTER

Cram may be classified broadly as: (a) market cream, which is used for direct consumptions, and (b) manufacturing cream, which is used for the manufacturing of dairy products.

The various types of cream are:

- Table cream
- Light cream
- Coffee cream
- Whipping cream
- Heavy cream
- Plastic cream

Table 1 - Chemical composition of cream

Constituents	Percentage
Water	45.45 - 68.2%
Fat	25- 60%
Protein	1.69 -2.54%
Lactose	2.47-3.71%
Ash	0.37-0.56%
Total solids	31.8-54.55%
Solids not fat	4.55-6.80%

Production of Cream: the basic principle of cream separation, whether by gravity or centrifugal method, is based on the fact that milk fat is lighter than the skim milk portion.

At 16 °C the average density of milk fat is 0.93 and skin milk 1.036. Hence when milk, which may be considered to be a mixture of fat (as cream) and skin milk, is subjected to either gravity or a centrifugal force (Fig. 5), the two components, viz. cream and skin milk, by virtue of their differing densities stratify from one another.

Centrifugal method is used commercially to separate cream from milk. When milk enters the rapidly revolving bowl of the cream separator, it is immediately subjected to a centrifugal force, which is 3000 to1600 times greater than gravitational force. While both the fat and skim milk are subjected to the centrifugal force, the differences in density affects the heavier i.e. portion skim milk more intently and forced to the periphery while the fat portion moves towards the centre.

According to a report, though the economic recession has put a check on the cheese consumption pattern across the world, more importantly in the developing nations, the future outlook for global cheese market still remains bright with consumption of cheese projected to grow by more than 20% during 2008-2015. Purchasing decisions, being increasingly guided by price, cheaper yet healthy and wholesome foods are surfacing back into the spotlight. Consumers are additionally exhibiting shifting preferences from imported cheese brands to locally produced cheese. Post recession, the demand for organic cheese is slated to make a comeback, with manufacturers expected to expand their product offerings. Innovation and product diversification will be the most prominent market strategies for manufacturers and suppliers in the post recession period. The product mix is poised to change from traditional types of cheeses to new cheeses that suit the demand in developing dairy markets like china and India. The growing demand for dairy products that meet consumers changing diet and nutritional needs will result into strong growth for innovative and healthier

According to a report, though the economic recession has put a check on the cheese consumption pattern across the world, more importantly in the world and subsequently the art of cheese making has now evolved into a lucrative business.

World Market for Cheese

Cheese continues to be a popular addition to every day diet, thanks to the high amount of protein, calcium, minerals and vitamins it contains. The consumption of cheese, over the years, has improved significantly across the world and subsequently the art of cheese making has now evolved into a lucrative business.

Introduction

Cheese is one of the oldest foods of mankind. It is commonly believed that cheese evolved in the Fertile Crescent between the rivers Tigris and Euphrates in Iraq some 8000 years ago. It originated accidentally as a result of the activities of nomadic tribes. Since animal skin bags were a convenient way of storing liquids for nomadic people, these were used for storing surplus milk. Fermentation of the milk sugars in the warm climate prevailing would cause the milk to curdle in the bags. The swaying animals would have broken up the acid curd during journeys to produce curds and whey. The whey provided a refreshing drink on hot journeys, while the curds, preserved by the acid of fermentation and a handful of salt, became a source of high protein food supplementing the meager meat supply.

CHAPTER 3 - TECHNOLOGY OF CHEESE

Salt is used to improve the flavour and the shelf-life, as it acts as a preservative. If the butter is to be salted, salt (1-3%) is spread over its surface, in the case of batch production. In the continuous buttermaker, a salt slurry is added to the butter. The salt is all dissolved in the aqueous phase, so the effective salt concentration is approximately 10% in the water.

After salting, the butter must be worked vigorously to ensure even distribution of the salt. The working of the butter also influences the characteristics by which the product is judged - aroma, taste, keeping quality, appearance and colour. Working is required to obtain a homogenous blend of butter granules, water and salt. During working, fat moves from globular to free fat. Water droplets decrease in size during working and should not be visible in properly worked butter. Overworked butter will be too brittle or greasy depending on whether the fat is hard or soft. Some water may be added to standardize the moisture content. Precise control of composition is essential for maximum yield.

The finished butter is discharged into the packaging unit, and from there to cold storage [6].

For the domestic yogurt, all manufacturers of yoghurt and lactic yogurt cultures offer recipes that, with minor variations, can be summed up as follows:

Use at the start of fresh whole milk or partially skimmed milk, enriched after 3 to 5% of skimmed milk powder, UHT milk can also be used.

Heat the mixture to 85 °C for 30 minutes or alternatively until boiling.

Add gelatin or pectin if you wish.

Cool to 44-46 °C.

Inoculated directly with a leaven powder (bags), according to the manufacturer or from a commercial yogurt production recently at a rate of 2 to 3% (v/v).

Incubate without stirring for 4 to 6 hours in a container that will maintain the temperature above 42 °C.

The texture and taste is achieved desired, cool to 4 °C in the refrigerator.

Fruit and other ingredients may be added at the time of consuming the product [10].

Filling the vat and adding the ferments

Once the milk is ready, having been thermally treated or not, it is poured into a vat, in order to heat it up again to 25-30 °C. Lactic bacteria, ferments and molds (which grow and give the cheese its flavor and aroma in the curing process) are all added.

Advantages	
Pasteurized milk	The pathogenic organisms have been removed to minimize the risk of being harmful for human consumption in cheeses cured for less than 60 days.
Fresh milk	Having not undergone a thermal process, the “good” microorganisms have not been eliminated so that we obtain a more intense and flavorful cheese.

Afterwards if the milk is not immediately employed in the production process it is cooled to some 3°C or 4°C, which is the optimum temperature for preserving the milk.

Reception and pre-treatment

When the milk is received it is sanitized in order to eliminates the solid impurities that come from the dairy. Once sanitized the milk is homogenized to obtain certain level of fat content. For this machines are used to skim the milk by separating the lactic fat with centrifugal methods. If not we just have whole milk.

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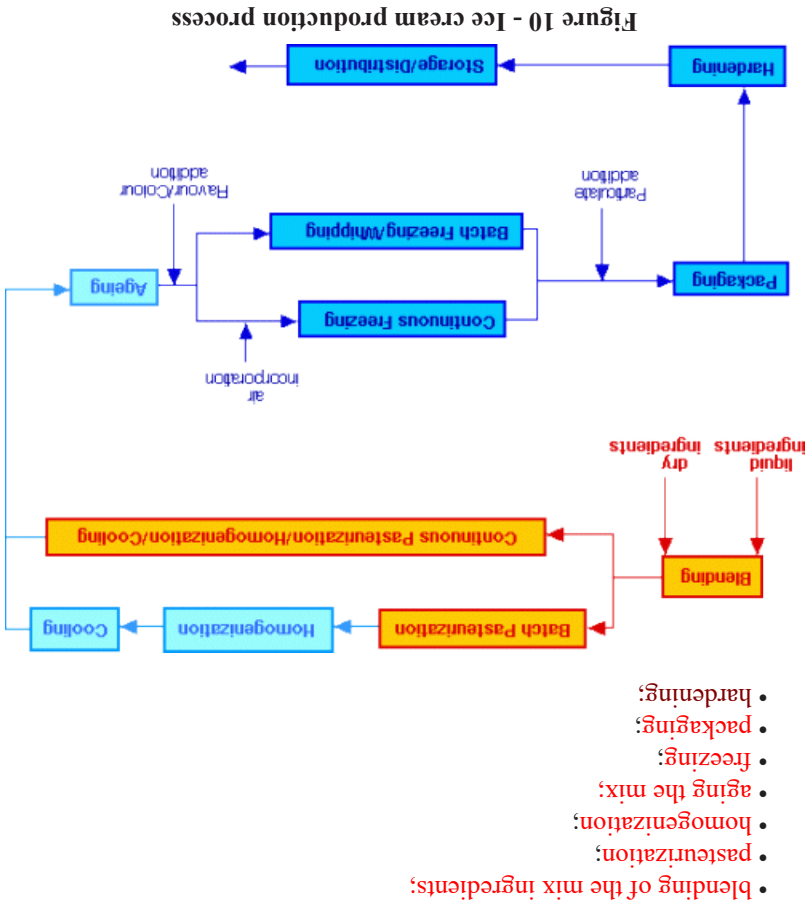
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Process flow diagram for ice cream manufacture: the red section represents the operations involving raw, unpasteurized mix, the pale blue section represents the operations involving pasteurized mix, and the dark blue section represents the operations involving frozen ice cream.



CHAPTER 6 - ICE CREAM MANUFACTURE

The basic steps in the manufacturing of ice cream are generally as follows:

- blending of the mix ingredients;
- pasteurization;
- homogenization;
- aging the mix;
- freezing;
- packaging;
- hardening;

(SNF)/F=SNF:F ratio desired in condensed milk
Q = Quantity of milk in Kg available for standardization
C = Amount of cream in Kg required
F1 = Percent fat in milk
S1 = Percent SNF in milk
F2 = Percent fat in cream
S2 = Percent SNF in cream
To calculate the amount of skim milk to be added to milk.
$$(SNF)/F ((Q*(S1)+(S*S3)))/(((Q*(F1)+(S*(F3))$$

Where
(SNF)/F = F ratio desired in condensed milk.
Q = Quantity of milk in Kg required
S = Amount of skim milk in Kg required
F1 = Percent fat in milk
S1 = Percent SNF in milk
F3 = Percent fat in skim milk
S3 = Percent SNF in skim milk
Standardized milk is now ready for further treatment.

IV) Fore warming/Preheating: Fore warming or preheating refers to heating of milk before it is condensed. The object of this process is to reduce or eliminate bacterial and mould contamination and to destroy undesired enzymes present in milk which encourage slow chemical deterioration in the final product during storage. This treatment exerts an important influence in controlling the viscosity to avoid age-thickening or age-thinning in the finished product. Fore-warming also helps in dissolving the sugar which is added during the next stage of operation. Sugar dissolves much more readily in hot milk than in cold milk. Further, evaporation takes place more rapidly if heated milk is fed into vacuum pan or evaporator during concentration. In brief fore-warming helps in the following:

- Destruction of microbial contaminants and enzymes
- Control of storage defects e.g. Age-thickening and Age-thinning.
- Dissolving sugar
- Un-interrupted boiling during evaporation process.
- Improve the heat stability of condensed milk.

Fore-warming temperature is determined as to provide optimum viscosity in the condensed milk without inducing thickening or thinning during storage. The temperature-time of fore-warming extends over a wide range, such as 82-93°C for 5-15 minutes; or 116-149°C for 0.5 to 5 minutes.

After heating the paste, the molds (recipients which give the cheese its shape and size) are filled. The molds can be pressed or not. This pressing causes more whey to seep out and allows the cheeses to acquire more accentuated shapes. We refer as cheeses in this sense as pressed paste cheeses or non-pressed paste cheeses. Many times the holes we see in the cheeses are produced in this phase of the process. If the paste is pressed with high whey content, we manage to press the pieces tightly together, thus obtaining a cheese with no holes. On the other hand if the pieces of paste are

Pressing

Once paste has been cut and the whey has been removed it is heated between to 30°C and 48°C, while it is shaken so the pieces remain separate and do not stick together. The more the pieces are heated, the drier the cheese is since the increase in the temperature causes more whey to be removed. Depending on the temperature to which the paste has been heated, we have soft paste, semi-cooked paste or cooked paste.

Heating

Why is the liquid part of the milk that is has not been used for the cheese production.

Milk = Cheese + WHEY

When the coagulation has finished, the curdled paste is then cut with knives. The paste is cut in order to obtain smaller or larger pieces, depending on the way we wish to keep in the paste. Normally a humid cheese uses larger pieces which act like a sponge. In this phase of production the whey excess is removed.

Cutting of the paste

Next rennet is added (extract obtained from ruminants' stomach or from some plants). This is the moment when milk becomes cheese because the pulling together the greatest part of the fat and other components. Another method of coagulation is that which is obtained from the acidification of the milk. If we leave milk at room temperature, its acidity progressively increases until it takes on the aspect of the aspect of sour milk.

Coagulation

- Although there are several types of yogurt manufacturing (farm, stirred, mixed fruit, fruit unmixed), the basic mixture of these products is essentially the same. It consists of a fixed volume of fresh milk, whole or partially skimmed milk, bacteriological quality, free of antibiotics and other antimicrobial agents, which expands slightly dry by either of the following:
- Addition of whole milk powder or skimmed;
- Addition of milk concentrated by evaporation or osmosis;
- Rétenat addition of milk or whey;
- Concentration by direct evaporation, reverse osmosis.

The content of total solids is adjusted between 12 and 15% depending on the texture in question. During the preheating of the product, usually adding a stabilizer such as gelatin and/or pectin. The product then undergoes successively a homogenization and hyperpasteurisation: in this last operation, the heating conditions are extreme: 85 °C / min. Their primary function is to prepare the product in order to obtain a thicker and creamy texture.

After cooling the mixture to 44-46 °C, the inoculum cultures of Lactobacillus bulgaricus and Streptococcus thermophilus in proportions similar to 1:1 is added to an inoculation rate of 1.5 to 2.5% (v/v). Other strains may also be added in varying proportions, usually less than the previous two, to give the yogurt certain textural and taste characteristics specific. It is preferable in the laboratory to grow and retain the strains used separately, for a better balance in the product.

After an incubation period of more or less advanced, or from 2 to 6 hours depending on the degree of acidification and referred the importance of the inoculum used, the product, if not already in the container is homogenized using a lisseuse before mixing it with different ingredients (fruits, cereals, stabilizer) and to the packaging. It is then placed in a refrigerator at 4 °C to slow bacterial action and to ensure a shelf life of possibly around 30 days.

Several variants can also be introduced to give rise to various types of products. In addition to its conventional preparation and presentation, as farm or brewed, plain or with fruit, yogurt can be found frozen in liquid drinks, pasteurized, sterilized and low calorie. Although the formulation of such products been modified by the addition of dry whey, or by skimming, these types of yogurt are still fermented milk products mainly by two thermophilic bacteria: *L. bulgaricus* and *S. thermophilus*.

I) Receiving Milk : Raw milk received for the manufacture of condensed milk should be of good quality. This is important because the quality and marketability of final product depends upon the initial quality of raw milk. Great care, therefore, must be taken to ensure that only good quality milk is received for processing into sweetened condensed milk. After the milk has been accepted on the basis of standard platform tests, it is weighed, sampled and further processed.

II) Filtration/Clarification: The objective is to remove visible foreign matter.Simple filtration may remove suspended particles by straining process while clarification removes the same by centrifugal sedimentation. Filters generally,contain cloth or pad of described pore size, which retain smaller particles,while clarification removes sediments/slime much more efficiently than filtration.Clarifiers remove even finer particles that escape filters. The clarified milk is then chilled and stored in large storage tanks until further processing.

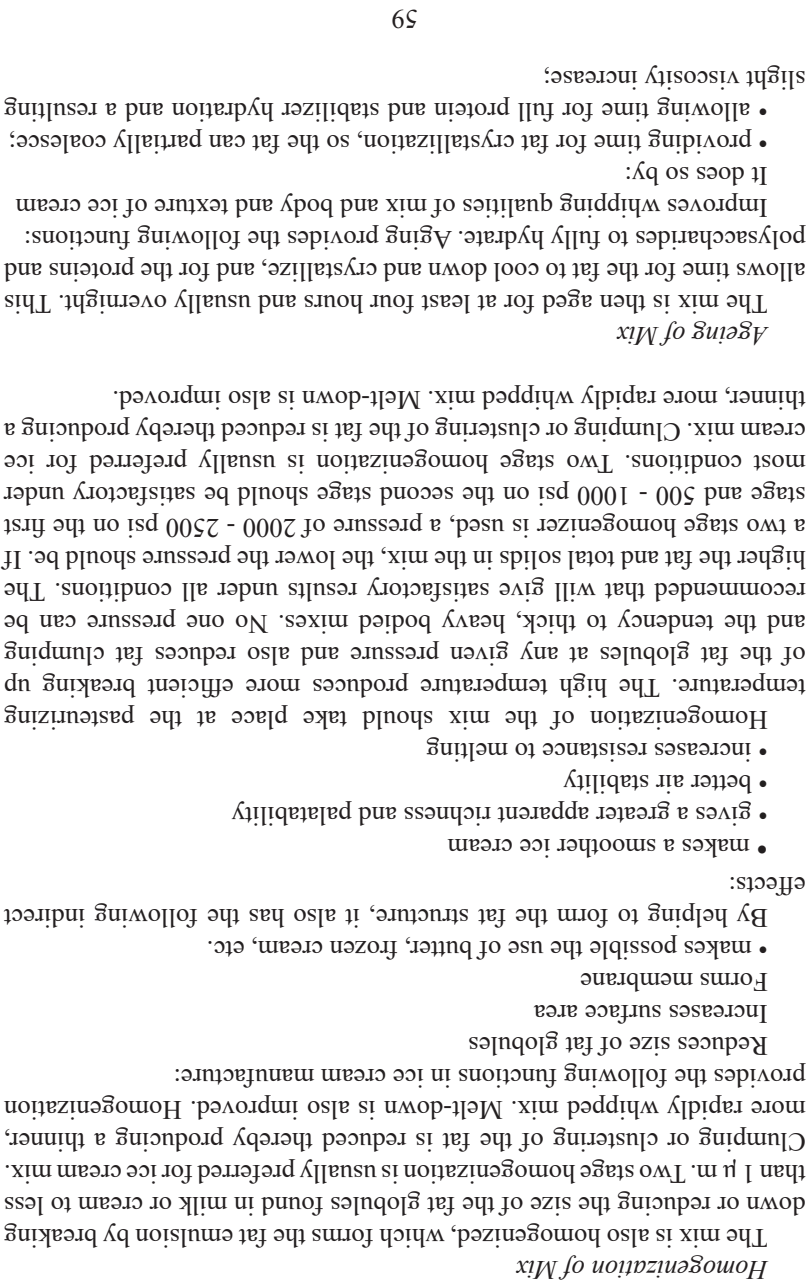
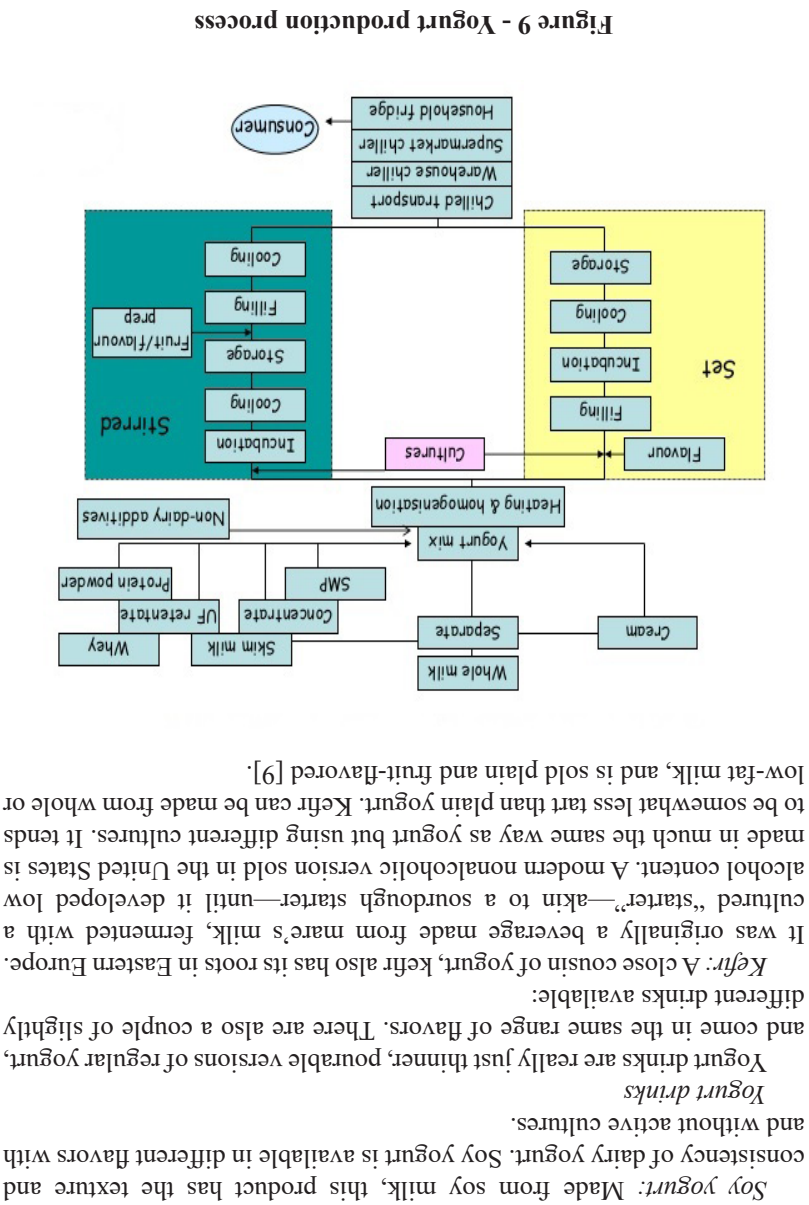
III) Standardization: The object is to standardize fat and solids-not-fat in milk to obtain a final product, which meets the legal standards. This operation is of considerable importance as the yield and keeping qualities of the final product are very much dependent on it. Further it also helps in maintaining the requirements of legal standards in the final product. Standardization establishes the desired ratio of fat: SNF in milk . Standardization of milk involves addition of sufficient quantity of cream or skim milk to ensure the resultant product has the correct fat: SNF ratio to yield the final product of desired composition. The following steps are followed to know whether cream or skim milk is to be added to milk for standardization purpose.

Find the ratio of SNF/Fat desired in the final product. (e.g., 22/9 = 2.44).
Accurately calculate the Fat and SNF percent of milk in the storage tank.
Find the ratio of SNF/Fat in milk, i.e., 8.9/3.6 = 2.47 or 9.58/6.5 = 1.47
If the ratio in milk is higher than the ratio desired in the final product, SNF is in excess in milk and hence more source of fat (i.e. cream) should be added to milk.
If the ratio is less, fat is more in milk and hence SNF source (i.e. skim milk)should be added to get the final desired ratio.The quantity of cream or skim milk to be added to milk for standardizing purpose may be determined by the following general formula:

To calculate the amount of cream to be added to milk:

$$(SNF)/F (Qxs1 + Cxs2)/(Qxs1 + Cxs2)$$

Where



CHAPTER 7 - SWEETENED CONDENSED MILK MANUFACTURE

Different steps involved in the manufacture of Sweetened Condensed Milk are given in the Figure 11.

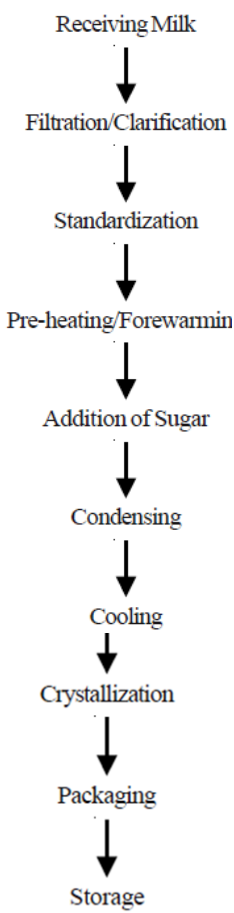


Figure 11 - Flow diagram for preparation of sweetened condensed milk

dry when poured on the mold, we end up with a cheese with holes. Except in very few occasions the absence of hole does not necessarily indicate a cheese of higher quality.

Salting

Now the cheese has been pressed and we move on the salting phase. This can be done by applying dry salt directly to the paste, or by immersion in salt water or brine.

Curing

Curing is the last phase of the production and can last anywhere from a few hours to a various months.

In the curing process numerous flavors and aromas develop. It takes place in special areas prepared for this process, where the temperature and humidity are proper for each kind of cheese. These curing cellars can be natural, such as the caves where the Cabrales cheese is cured, or in special rooms prepared just for this process.

Throughout the curing process the cheeses slowly loses its humidity through evaporation. This causes a decrease in weight, and a percentual increase in dry extract compared to the whole weight of the cheese. This means that, if for example, 1 kilogram of cheese is made up the first day of 450 grams of dry material and 550 grams of water, after some time in the curing process, will no longer weigh 1 kilogram, but rather 900 grams and the composition will be the same 450 grams of dry material an d 450 grams of water. Depending on the time the cheese is left to cure in the cellars, we refer to cheese as fresh, soft, aired, cured, aged or mature [7].

Cottage cheese is a fresh cheese curd product with a mild flavor. The first known use of the term “cottage cheese” dates back to 1831 and is believed to have originated because the simple cheese was usually made in cottages from any milk left over after making butter.

Cottage cheese is drained, but not pressed, so some whey remains and the individual curds remain loose. The curd is usually washed to remove acidity, giving sweet curd cheese. It is not aged or colored. Different styles of cottage cheese are made from milks with different fat levels and in small-curd or large-curd preparations. Cottage cheese which is pressed becomes hoop cheese, farmer cheese, pot cheese, or queso blanco.

Curd size is the size of the chunks in the cottage cheese. The two major types of cottage cheese are small-curd, high-acid cheese made without

temperature, ice crystal growth is possible and the rate of crystal growth is dependant upon the temperature of storage. This limits the shelf life of ice cream.

A primer on the theoretical aspects of freezing will help you to fully understand the freezing and recrystallization process.

Hardening involves static (still, quiescent) freezing of the packaged products in blast freezers. Freezing rate must still be rapid, so freezing techniques involve low temperature (-40°C) with either enhanced convection (freezing tunnels with forced air fans) or enhanced conduction (plate freezers).

The rate of heat transfer in a freezing process is affected by the temperature difference, the surface area exposed and the heat transfer coefficient ($Q=U A \Delta T$). Thus, the factors affecting hardening are those affecting this rate of heat transfer:

Temperature of blast freezer - the colder the temperature, the faster the hardening, the smoother the product.

Rapid circulation of air - increases convective heat transfer.

Temperature of ice cream when placed in the hardening freezer - the colder the ice cream at draw, the faster the hardening; - must get through packaging operations fast.

Size of container - exposure of maximum surface area to cold air; especially important to consider shrink wrapped bundles - they become a much larger mass to freeze. Bundling should be done after hardening.

Composition of ice cream - related to freezing point depression and the temperature required to ensure a significantly high ice phase volume.

Method of stacking containers or bundles to allow air circulation. Circulation should not be impeded - there should be no 'dead air' spaces (e.g., round vs. square packages).

Care of evaporator - freedom from frost - acts as insulator.

Package type, should not impede heat transfer - e.g., styrofoam liner or corrugated cardboard may protect against heat shock after hardening, but reduces heat transfer during freezing so not feasible [11].

rennet, and large-curd, low-acid cheese made with rennet. Rennet is a natural complex of enzymes that speeds curdling and keeps the curd that forms from breaking up. Adding rennet shortens the cheese-making process, resulting in a lower acid and larger curd cheese, and reduces the amount of curd poured off with leftover liquid (whey). Sometimes large-curd cottage cheese is called "chunk style."

Cottage cheese can be eaten in a variety of different ways: by itself, with fruit and sugar, with salt and pepper, with fruit puree, on toast, with tomatoes, with granola and cinnamon, in salads, as a chip dip, as a replacement for mayonnaise in tuna salad or used as an ingredient in recipes such as jello salad and various desserts. Cottage cheese with fruit such as pears, peaches, or mandarin oranges is a standard side dish in many "home cooking" or meat-and-three restaurants' menus.

A 13-g (4-oz) serving of 4% fat product has about 120 calories, 5 g fat (3 g saturated), 3 g carbohydrates, and 12 g protein. It also contains about 500 mg sodium, 70 mg calcium, and 20 mg cholesterol.

Some manufacturers also produce low-fat and nonfat varieties. A fat-free kind of a similar serving size has 80 calories, 0 g fat (0 g saturated), 6 g carbohydrates, and 14 g protein.

Cottage cheese is popular among dieters and some health food devotees. It is a favorite food among bodybuilders, runners, swimmers and weightlifters for its high content of casein protein (a longer-lasting protein) while being relatively low in fat. Pregnant women are advised that cottage cheese is safe to eat, whereas some cheese products are not recommended during pregnancy [8].

CHAPTER 5 - MANUFACTURING TECHNOLOGY OF YOGURT

Manufacturing technology of yogurt

The name “Yogurt” is reserved for the fermented milk obtained according to the fair and traditional practices, the development of only specific thermophilic lactic acid bacteria *Lactobacillus bulgaricus* and say *Streptococcus Thermophilus* to be planted simultaneously and be living in the finished product because of at least 10 million bacteria per gram relative to the galaxy.

Types of Yogurt

Regular (dairy) yogurt

Whole milk yogurt: The richest of the plain yogurts, whole-milk yogurt has from 6 to 8 grams of fat per cup. Some brands of whole-milk yogurt, called farm-style, come with a layer of yogurt cream on top.

Low-fat yogurt: Low-fat yogurt may contain anywhere from 2 to 5 grams of fat per cup.

Nonfat yogurt: Nonfat yogurt contains less than 0.5 percent milk fat by weight. It is less tangy than either low-fat or whole-milk yogurt and makes a good stand-in for sour cream.

Greek yogurt: Over the past decade or so, Greek yogurt has become increasingly popular. Greek yogurt is traditionally yogurt that has been strained and had the whey removed, resulting in a thicker yogurt. If sugar or fruit preserves are added, it may be just as sugary as conventional yogurts.

Whipped yogurt: Whipped yogurts have more air, which gives them a lighter consistency. They have fewer calories, because there’s less actual yogurt in the container. But you also get less calcium, protein, and other beneficial nutrients.

Other yogurts

Goat’s milk yogurt: This is a full-flavored yogurt with a slightly more pronounced gamy flavor. If you’re a fan of goat cheese, you’ll enjoy goat’s milk yogurt.

Labneh (labne): This thick Middle Eastern yogurt “cheese” is smooth and creamy like sour cream. It is often eaten with a drizzle of olive oil and chopped mint, and served with pita bread.

Sheep’s milk yogurt: This is a rich and creamy full-flavored yogurt. Like goat’s milk yogurt, it has a lightly gamy flavor.

between 6- 12 revolutions per minute. Steam is admitted in to the sterilizer until the temperature reaches 118 °C and the sterilizer is maintained at this temperature for not less than 15 min. After sterilization is completed, the steam is shut off and cans are cooled to 25- 30 °C either by means of the spray or by immersing in cold water. After cooling the cans are passed through an oscillating machine, which breaks up any curd formed during the process of sterilization and retains the smooth homogeneous texture of evaporated milk.

Continuous Sterilization: This is used for large scale continuous operation. This system consists of many compartments, which are maintained at different temperatures/ pressures. The filled cans entering the apparatus roll through the chambers by means of spiral track, which ensures that the heat distribution to each can is uniform. This rolling motion of cans takes the place of the methods of agitation provided in the batch method. The filled cans are preheated before they pass to the main sterilizing section. The movement of cans is controlled so that they remain in the sterilizing chamber for 15 min. After sterilization process is complete the cans pass to the cooling section, which under similar pressure conditions to those of the sterilizer. Both systems have their merits and demerits. During sterilization the temperature of evaporated milk is raised rapidly to 116-118°C and held at this temperature for 15 minutes and their cooled.

Storage: After sterilization cans of evaporated milk are unloaded from the sterilizer, and cooled by water spray. The cans are then shaken mechanically to break any curd or lump which might have formed during sterilization to have homogeneous consistency. Excessive shaking is avoided as it may decrease viscosity. As evaporated milk is a sterilized product it may be stored at or below room temperature. The present trend is to store at below room temperature to check deterioration in quality and thereby prolong keeping quality [12].

The modern trend is towards high temperature short time heating such as 115-118 °C without holding. Tubular heat exchangers are commonly used for fore warming or preheating; either a double-tube or shelf-and-tube heat exchangers are preferred. Plate heat exchangers may also be used.

V) Addition of Sugar: Sugar is added for the purpose of preserving condensed milk without resorting to sterilization by heat. Sucrose is generally referred as sweetening agent. Refined cane sugar or beet sugar is used in the manufacture of sweetened condensed milk. Other sweetening agents such as glucose,dextrose and corn syrup have been tried to partially replace sucrose. The disadvantages of these sweetening agents are their reduced sweetening capacity compared to sucrose and their adverse effects on colour and the rate of thickening during storage. Hence they are not suitable.

Amount of Sugar/Sugar ratio: The quantity of sugar added to milk should be enough to preserve the milk. It has been recommended that a sugar ratio of 62.5 would protect the condensed milk from bacterial defects. Generally sugar ratio of 62.5 to 64.5 % is considered adequate to protect condensed milk against bacterial spoilage and to protect against causing sugar crystallization. Sugar ratio is the sugarin-water concentration of condensed milk.

The following formula is used for thin purpose.

% Sugar ratio =(% Sugar in condensed milk)/(100 –%Total milk solids in condenses milk)*100

Example:

Condensed milk contains 31.0% total milk solids and 43.1% added sugar. What is the sugar ratio?

Solution: % Sugar ratio =(43.1)/(100 – 31)* 62.5%

The following formula is used to determine percentage of sugar required in condensed milk for desired sugar ratio.

Percent Sugar in condensed milk =((100 –%TMS)* SR)/100

Where, TMS = Total milk solids in condensed milk

SR = Sugar ratio

Example:

If, TMS in condensed milk = 31.0%

SR = 62.5

% Sugar in condensed milk =((100 – 31) 62.5)*100 = 43.1

Amount of sugar to be added to milk to get the desired % Sugar in condensed milk.

Kurt is wholesome food with more than one thousand years of history. Usually the technology of kurt production as follows: to the milk with temperature of 32-34 °C is poured 3-5% of ferment, prepared from the pure culture lactobacillus. Milk ripening goes on for 6-8 h. Then, the curd is heated to 60 °C and hold for 30-40 min. In this case, the albumen and globulin are deposited and bonding with casein enriches the product. Also kurt contain the lactose. Precipitated whey is removed and the curd is filled to the cotton sheeting bags. After 2-3 h of self-pressing the curd is salted and formed in the shape of ball or cake weighing 40-60 g. Formed briquets are sun dried. Chemical composition of ready product as follows: fat – 12%, salt – 2%, moisture – 15%, acidity – 300-350 °T.

Kurt is hard pressed and dried long storage cheese, given from the salted caseated milk. It is made from cow, goat, sheep, horse and camel milk.

Kurt has a unique composition: milk protein, bioactive substances, carbohydrates, enzymes, microelements, vitamins. Kurt from goat milk contains large amount of protein, fat, calcium, vitamin A, thiamine, iron, magnesium and potassium.

Kurt has the property of restoring the beneficial microflora of intestine and easy and quickly digested in human body. Vitamin A as a component of kurt is necessary for improvement of vision, cell growth and renewal and increase the immunity. Kurt also contains vitamin E, vitamin D, ascorbic acid. On mineral composition kurt is a rich source of calcium, which strengthens bones, involving in collagen formation and improves metabolism.

The technology of kurt is implemented by the next way. The cottage cheese is produced by the method described in the standard of Kazakhstan. Low-fat cottage cheese is pounded on a cutter during 12-15 min for receiving the homogeneous consistence product without lumps and grains. The vegetable dried paprika and spicy dried mint are grinded on the grinder and sifted.

The sodium chloride, grinded paprika and mint are added to scrubbed low-fat cottage cheese, after that the dry whey is added. The mixture is

8.1 Kurt producing technology

PRODUCTS

CHAPTER 9 - TECHNOLOGY OF KAZAKH NATIONAL MILK

Pasteurization

2 Pasteurization is a process that protects against spoilage by eliminating bacteria, yeasts, and molds. Pasteurization involves quickly heating and cooling the product under controlled conditions which microorganisms cannot survive. A temperature of 185-201.2° F (85-94° C), held for about 30 seconds, is necessary to adequately reduce microorganisms and prepare the formula for filling. Several pasteurization methods are commercially available—one common method warms the formula by sending it through a tube adjacent to heat plate heat exchanger. Thus the formula is heated indirectly. Another method heats formula directly and then uses the heated liquid to preheat the rest of the incoming formula. The preheated formula is further heated with steam or hot water to the pasteurization temperature. After pasteurization is complete, the batch may be processed further by homogenization.

Homogenization

3 Homogenization is a process which increases emulsion uniformity and stability by reducing the size of the fat and oil particles in the formula. This process can be done with a variety of mixing equipment, which applies high shear to the product. This type of mixing breaks the fat and oil particles into very small droplets.

Standardization

4 The resulting composition is standardized to ensure key parameters, such as pH, fat concentration, and vitamin and mineral are correct. If any of these materials are at insufficient levels the batch can be reworked to achieve the appropriate levels. The batch is then ready to be packaged.

Packaging

5 Packaging process depends on the manufacturer and type of equipment employed, but in general, the liquid formula is filled into metal cans which have lids crimped into place. These can be filled on conventional liquid filling equipment commonly used in the food and beverage industry.

Sterilization

6 The filled packages can be subsequently heated and cooled to destroy any additional microorganisms. The finished cans are then packed in cartons and stored for shipping [16].

a) Quantity of milk in the pan
b) Area of the heating surface
c) Capacity of the vacuum pump
d) Temperature of condenser

condensed to the desired consistency depends upon the following factors:
a working vacuum 63-65 cm is attained. The speed with which the milk is operation heat is so applied as to ensure that the milk boils vigorously and inlet is partially closed in order to maintain constant level of milk. During When the milk level is sufficiently high to cover the heating surfaces the milk the heating coil is covered with milk then the steam is gradually admitted. and milk is drawn by the action of reduced pressure. When each section of cm vacuum is obtained. The milk inlet valve of the pan is opened slightly before the operations commence and vacuum pump is operated until 50-55 Operation of Vacuum pan: The vacuum pan is sterilized with steam being usually employed in most condenseries for condensing milk.
degree than is the case with the unsweetened variety. Vacuum pan method (VI) Condensing: Sweetened condensed milk is concentrated to a greater filtered to remove any extraneous matters.
microorganisms, which the sugar may contain and sugar solution can be from added sugar solution. But boiling of solution destroys practically all disadvantage of this method is additional water has to be evaporated milk in the vacuum pan towards the end of the evaporation process. The water in a separate tank called sugar well. This mixture is then added to quality of the product. Another method is to dissolve sugar by boiling in and survival capacity of microorganisms thereby adversely affecting keeping sugar in the fresh milk during fore warming increases the heat resistance in the evaporation of water is experienced. Further the presence of added agitation. The sweetened milk is then drawn into the vacuum pan. If sugar is run into a sugar mixing pan where sugar is mixed in a fine stream with proper stability of the finished product. In one method part of fore warmed milk is to the milk in the batch has definite effect on keeping quality and physical Method of adding sugar: The temperature and time of addition of sugar Sugar in milk = (%Sugar in condensed milk)/(%Ratio to concentration)
Ratio of concentration = (%TMS in condensed milk)/(%TMS in fresh milk the percentage of sugar in condensed milk by ratio of concentration.
First determine ratio of concentration by dividing Percent total milk solids in condensed milk by % total milk solids in fresh milk. Then divide

and sterilization. In raw milk it has been suggested that salt balance of milk i.e. ratio of calcium +Magnesium to citrate + Phosphate is important for the stability of milk towards heat. If the ratio of Ca + Mg/Citrate + Phosphate is disturbed the heat stability may be affected. The more common cause of heat coagulation is the disturbed salt balance. Depending on the location of pH of maximum stability with respect to natural pH of concentrated milk either sodium salt of orthophosphate (disodium phosphate) or calcium chloride/ monosodium phosphate are used as stabilizers. This is the basis of a process of pilot-sterilization in which various quantities of selected stabilizers are added to the concentrated milk in 170 ml (60 oz) tins which are then sterilized and the condition of the product carefully examined in order to determine whether any stabilizer is necessary and if so in what amount it should be used. Depending upon the type of milk and the processing condition used 100 to 300 gm of stabilizing salts per 100 kg of evaporated milk may be needed to improve the heat stability. Calculated amount of salt is added to the evaporated milk in the form of a solution using just enough water to dissolve it.

VII) Packaging: The evaporated milk is filled in suitable cans or containers either manually or mechanically. It is essential that the packaging is done as quickly as possible. After cans have been filled they should be sealed immediately. The sealing process requires care, as the seal has to withstand the heat and pressure of sterilization.

VIII) Sterilization: The object is to destroy all bacteria their spores and enzymes thereby preserve the product for a longer time. In addition sterilization process is also used to increase the viscosity and improve body and texture to give a creamy consistency to the product.

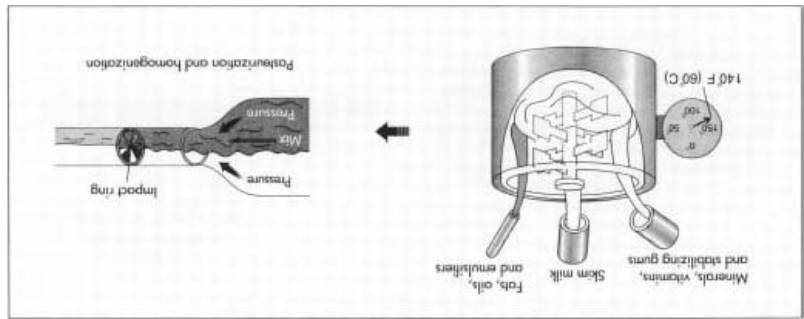
Two important factors in sterilization process are:
The temperature attained
The period during which this temperature is maintained.
The temperature time of heating during sterilization should be such as to ensure sterility consistent with sufficient body and texture without causing objectionable discolouration or excessive cooked flavour.

Two systems are in common use for sterilization:
Batch Sterilization: This method is suitable for small scale operation and is also useful for cans of various sizes. In this system the cans leaving the filling machine are placed in racks. The racks are then loaded into a steam-tight boiler. The racks are moved by a revolving mechanism, which keeps them in motion throughout the process,the speed of rotation varies

I The primary ingredients are blended in large stainless steel tanks. The skim milk is added and adjusted to 140° F (60° C). Fats, oils and emulsifiers are added next. Additional heating and mixing may be required to yield the proper consistency. Minerals, and stabilizing gums may be added at various points in the process depending on their sensitivity to heat. Once mixing is complete, the batch can be temporarily stored or transported via pipeline to pasteurization equipment.

Mixing ingredients

Figure 13 -Once mixing is complete, the batch can be temporarily stored or transported via pipeline to pasteurization equipment. After pasteurization is complete, the batch may be processed further by homogenization.



The method of manufacture depends on the type of formula being made. The following steps describe a general procedure for a ready-to-feed, milk-based formula.

The Manufacturing Process

A variety of materials are added to ensure the formula stays homogeneous and that the oil and water soluble components do not
Once mixing is complete, the batch can be temporarily stored or transported via pipeline to pasteurization equipment. After pasteurization is complete, the batch may be processed further by homogenization.
Once mixing is complete, the batch can be temporarily stored or transported via pipeline to pasteurization equipment. After pasteurization is complete, the batch may be processed further by homogenization.

Emulsifiers/stabilizers

carefully mixed within 5-10 minutes. After that kurt is formed as flat round cakes. The formed kurt is dried up at the temperature of 45-50 °C within 5-6 hours.
Another method of production of kurt which is produced from cow, sheep or goat milk by souring with pure growths of lactic streptococci with the subsequent separation of whey from a clot and drying is developed by Tverdokleb et.al. The normalized milk with a mass fraction of fat 0,6% is pasteurized at 80-85 °C with endurance of 10-20 min and cooled up to 32-34 °C, bring ferment in quantity of 5% and fermented to receiving the dense clot with acidity 75-76 °T. Then the clot is warmed up to 38-42 °C and maintained within 20-30 min for acceleration of whey selection. Then the whey is removed and the clot is pressed within 3-5 hours in the sacks with mass of 7-9 kg and the moisture content of 76-80%. The clot is formed in whetstones, flat cakes, etc. For salty kurt production , before the formation the protein mas is salted. Then kurt is dried in express drying chambers at 35-40 °C, and formed 20-60 g [13].

8.2 Kumis producing technology

Kumis, a mildly alcoholic drink made from fermented mare’s milk, is the popular national beverage of Kazakhstan. Now experts are working to make it an export success in Europe as well.

Kumis has been widely known since ancient times. Avicenna (Ibn Sina), the 11th century great philosopher and physician praised its therapeutic effects a thousand years ago. Today, the beverage is enjoying a new wave of interest across Europe and it is being brewed in Germany, Austria, Italy, Belgium, the Netherlands, Ukraine, Mongolia and Yakutia in Siberia.

Kumis has significant nutritional value and a pronounced antimicrobial effect thanks to the presence of antibiotic substances produced by microorganisms during fermentation. Its combination of alcohol, carbon dioxide and lactic acid excites the activity of gastric glands and improves digestion. Its antibiotic substances boost resistance to infection and its lactic acid bacteria create favourable intestinal micro-flora.

The dry mare’s milk is first mentioned in the accounts of the conquests of Genghis Khan. The Mongolian conqueror ordered each of his warriors to always carry dried meat and dried kumis in his traveling bag [14].

many factors such as initial quality of raw milk, fore warming, concentration of chemical stabilizers to be added to any given batch of condensed milk for most satisfactory heat stability. Heat coagulation of milk is influenced by (VI) Pilot Sterilization: The purpose is to determine the amount and type milk in tank as indicated by pilot sterilization test. and held in storage tank. Stabilizing salts may be added to concentrated (V) Cooling: After homogenization concentrated milk is cooled to 5°C stage and 35 kg/sq cm at second stage. stage homogenizer at about 50°C with a pressure of 175 kg/sq. cm at first to split. Condensed milk removed from evaporator is passed through two set up as the fat particles pass quickly through the orifice, cause the particles means of a positive displacement pump. The mechanical forces, which are In this process milk is forced through a small orifice at a high pressure by of about 2 micron or less is required to keep the fat distributed uniformly. of the fat particles (globules) vary from 1 to 20 micron while a diameter the top to form the creamy layer during storage. In raw milk, the diameters in the milk so that they are uniformly distributed in milk and do not rise to evaporated milk. The homogenizer reduces the mean size of the fat globules equipment called homogenizer. This is an essential part of production of Homogenization refers to a process of forcing milk under pressure through defect can be reduced or eliminated by homogenization of condensed milk. Fat separation in evaporated milk during storage is a major defect. This (IV) Homogenization: After concentration the milk is homogenized. have continuous operation. Multiple effect evaporators are used for handling large amount of milk to (III) Concentration: Preheated milk is concentrated in an evaporator. not holding time. preheated either at 95-1000 C for few minutes (5-10) or at 140-1450 C with product the fluid milk is preheated before it is condensed. Milk may be concentrated product and for imparting optimum viscosity to the finished (II) Preheating/Forewarming of milk: To improve the heat stability of will clot or curdle during sterilization and will thus be rendered un-saleable. milk can be used since, if the acidity of evaporated milk is above normal it ensure that it is free from any heat resisting microorganisms. Only fresh It is important that the raw milk should be of very good quality in order to that which applies in case of sweetened condensed milk as discussed earlier. used in the preparation of evaporated milk is treated in a similar manner to (I) Receiving milk/filtration/clarification/standardization: The raw milk

lactose than the milk from which it is made [15]. thermophilus and species of torula has markedly less not-fat solids and flavour. Chal made from pure cultures of lactobacillus casei, streptococcus at higher temperatures (85 °C/185 °F) for 5 minutes negatively impacts pasteurization does not affect the quality of the milk, but pasteurization 25 °C (77 °F), and then subsequently for 16 hours at 20 °C (68 °F). Holder and lactose-fermenting yeasts incubating in inoculated milk for 8 hours at Chal may be cultured with lactobacillus casei, streptococcus thermophilus contained Lactobacilli lactic; streptococci and yeast. l Dornic degree (1°D) is equal to 0.1g of lactic acid per liter. The chal to cow's milk, which sours within 3 hours). Dornic acidic degrees are used to describe acidity in milk products, with (50 °F). At 30 °C (86 °F) the milk sours in approximately 8 hours (compared Camel milk will not sour for up to 72 hours at temperatures below 10 °C soured milk. mixed in; the matured chal will consist of one third to one fifth previously ceramic jar by adding previously soured milk. For 3–4 days, fresh milk is Chal is typically prepared by first souring camel milk in a skin bag or unaffected by shelf life. in its liquid and lyophilized form — a characteristic which is (reputedly) properties[citation needed] not found in fresh camel or cow milk, both Fermented chal is reputed to possess virucidal and virus inhibiting the surface of chal. has proved difficult to export. Agarar (fermented cream) is collected from summer food. Due to preparation requirements and perishable nature, chal Turkmenistan. In Kazakhstan the drink is known as shubat, and is a staple Chalk, or shubat - beverage of fermented camel milk, sparkling white

8.3 Chal, or shubat producing technology

protein isolates. The latter helps eliminate or reduce carbohydrates that can cause flatulence and abnormal stools. Other useful proteins can be derived from nuts, fish, and cottonseed oil but these have limited application in infant formulas.

Fats and carbohydrates

Fats and oils are an important dietary requirement for infants. Therefore formulations attempt to match the serum fatty acid profile of real breast milk. These fatty acids include eicosapentaenoic acid (EPA) which may be derived from fish oil and other sources. In actual breast milk there is a significant amount of fatty compounds known as triglycerides. For example, docosahexaenoic acid (DHA) is believed to be an important triglycerides. Triglycerides which are similar to (but not biochemically identical to) those found in breast milk can be derived from egg yolk phospholipids. Alternatively, fatty acid precursors (molecules which react to form dietary fatty acids) may be added to infant formula. These precursors (e.g., alpha and gamma linolenic acid) allow the infants’ bodies to synthesize the necessary fatty acids. However, this method is not as efficient for delivering fatty acids as breast milk is.

Diluents

The diluent is the carrier or bulk of the liquid of the formula. For milk based formulations, skim milk may be used as the primary diluent. In milk free formulations, purified water is used.

Minerals

A number of essential minerals are added to infant formula. These include calcium, phosphate, sodium, potassium, chloride, magnesium, sulfur, copper, zinc, iodine, and iron. Iron is one of the most important components since all babies need a source of iron in their diet. Some parents are concerned that iron-fortified formulas cause intestinal problems in infants but this is a myth. In general parents can expect formula fed babies to experience more gastrointestinal problems than breastfed babies.

Vitamins

Vitamins are added to increase the nutritional value of formula. These include vitamins A, B12, C, D, and E as well as thiamine, riboflavin, niacin, pyridoxine, pantothenate, and folacin.

an optimum temperature for mass crystallization with properly prepared lactose and with vigorous agitation yields large number of small crystals of uniform size. The recommended amount of finally pulverized lactose for seeding purpose is 375-500 gm per 1000 kg of initial milk taken or 0.1 to 0.3 percent of condensed milk. For best result of forced crystallization the hot condensed milk should be cooled from pan temperature as rapidly as possible to the seeding temperature.

Method of Adding Seed lactose: The required amount of seed lactose is blended with small quantity of condensed milk and added to the batch with vigorous agitation. After seeding and forced crystallization, further cooling of the product is continued slowly to 24-25°C for about an hour or longer when the product is ready for packaging. The packed condensed milk is then stored until further use.

Cleaning and Sterilization of Plant: As with all other plants used in the preparation of food products the equipments used in the production of condensed milk should be cleaned and sterilized immediately after use. All internal surfaces of the plant should be washed first with cold water, then with detergent solution, hot water and finally sterilized by means of live steam. If cleaning-in-place (CIP) system is available, recommended procedures should be followed for cleaning and sterilization of the plant.

Sweetened Condensed Skim milk: The manufacture of sweetened condensed skim milk is similar in all respect to that of sweetened condensed whole milk.

CHAPTER 8 - MANUFACTURE OF EVAPORATED MILK

Unsweetened concentrated milk is known as evaporated milk and manufactured practically in the same manner as the sweetened condensed milk. In this product no sugar is added as preservative. To achieve preservation the product is sterilized by heat after concentration and sold in the hermetically sealed container in which it has been sterilize.

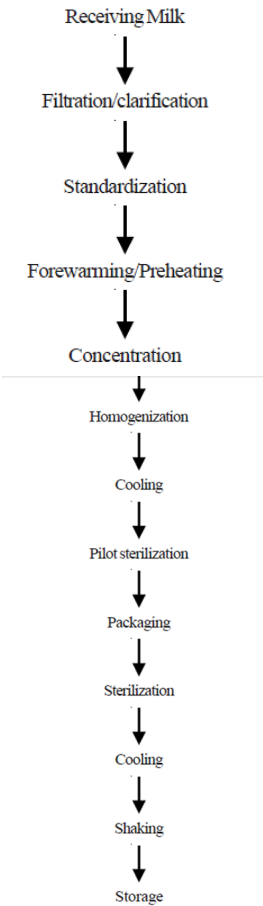


Figure 12 - Flow Diagram of Manufacture of Evaporated Milk

As described above, protein used in formulas can come from a variety of sources such animal milk or soybeans. Soy milk is made by taking soybeans, soaking them in baking soda, draining them, grinding the beans, then diluting the mixture with water and homogenizing it. The proteins, which come from soybeans, may be in the form of protein concentrates or

Proteins
Raw Materials

Formulas are available in three forms: powder, liquid concentrate, and ready-to-fed. Powder and liquid concentrate are less expensive but they require mixing/dilution prior to use. This may be a problem because they may be improperly mixed or mixed with water contaminated with bacteria. Ready-to-fed is the most expensive type but requires no mixing before use. This is an advantage because the mother can be sure the baby is getting the appropriate dose of nutrients and doesn't have to worry about contamination problems.

There are expensive, specially formulas for infants who have a strong sensitivity to both cow's and soy milk, or other medical or digestive conditions that are formula related.

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Non-milk based (containing no milk components at all)

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Some infants have a sensitivity, allergy, or potential allergy to formula based entirely on cow's milk. Formula made with vegetable derived milk or a limited amount of cow's milk derived components may be more suitable for these children. Most vegetable derived formulas are soybean based. However, allergies to soybean milk also exist, so this approach does not guarantee the product will be trouble free. In general, using hydrolyzed proteins can minimize allergy concerns. They are less likely to cause allergic reactions.

Animal or vegetable fat based formulas (containing vegetable and/or milk components)

These formulas typically start with cow milk as a base since most infants have no problem ingesting cow's milk. This type of formula is fortified with extra nutritional elements.

Milk based formulas (containing milk components such as casein or whey protein)

These formulas typically start with cow milk as a base since most infants have no problem ingesting cow's milk. This type of formula is fortified with extra nutritional elements.

Formula is made by blending similar materials in an attempt to match the characteristics of true milk. Formula design typically falls into one of three categories:

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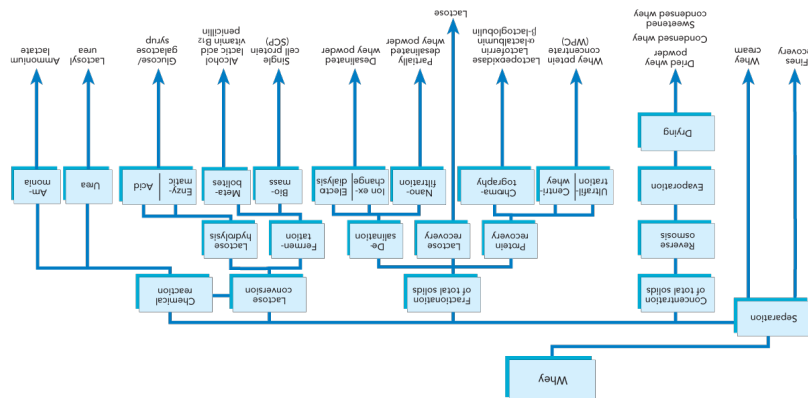
CHAPTER 10 - PROCESSING TECHNOLOGY
FOR INFANT FORMULA

Baby formula is a synthetic version of mothers' milk and belongs to a class of materials known as dairy substitutes. Dairy substitutes have been used since the early nineteenth century for products like oleomargarine and filled cheese. They are made by blending fats, proteins, and carbohydrates using the same technology and equipment used to manufacture real dairy products. Since the 1940s, advances in processing techniques such as homogenization, fluid blending, and continuous batching and filling have greatly improved the ways imitation dairy products, like formula, are made. The sales of infant formulas have also improved over the last several decades. Until the early 1990s, infant formula was sold only as a pharmaceutical product. Salespeople presented their brands to pediatricians who would then recommend the products to new mothers. In 1992 federal antitrust actions resulted in manufacturers shifting their marketing strategies toward more direct marketing techniques. Now, in addition to pharmaceutical sales, manufacturers rely heavily on direct mail campaigns and TV and print advertising to recruit new customers. In the United States alone, the infant formula industry is a \$3 billion-a-year business with approximately another \$1 billion in sales outside of the United States. There is some degree of controversy associated with marketing infant formula, however. There are concerns that formula is not as healthy for babies as breast milk and babies may actually become ill if the formula is improperly mixed or administered. Furthermore, once mothers have begun formula feeding on a regular basis it is difficult to return to breastfeeding. Leading authorities, including the World Health Organization (WHO), recommend that babies be completely breastfed for the first six months and that breast milk continue to be used as part of their diet until at least the beginning of the child's second year.

It should be noted that the design of infant formulas is highly complex due to the nature of the biological requirements of the developing child. What follows is a generalized description of some of the key areas of infant formulations and is not meant to be an exhaustive review of the relevant nutritional chemistry. The key to successful formula design is to match as closely as possible the physical and nutritional properties of breast milk. Milk is a natural emulsion, which means it is a fine dispersion of tiny droplets of fats and oils suspended in water. Milk also contains important components including proteins, sugars, minerals, salts, and trace elements.

Why must be processed as soon as possible after it is drawn from the cheese curd as its temperature and composition promote the growth of bacteria that lead to protein degradation and lactic acid formation. It is recommended that whey is drawn directly from the cheese process into short duration buffer storage then clarified, separated, pasteurized and cooled into storage to await further processing. If transporting the whey it can be concentrated by membrane filtration to reduce transport costs.

Figure 14 - Why processing alternatives



The block diagram in Figure 14 summarizes various processes used in the treatment of whey and its end products. The first stage is filtering the curd particles left in the whey, followed by separation of casein fines and fat and, partly to increase the economic yield and partly because these constituents interfere with subsequent treatment.

As Figure 17 shows, the pre-treated whey is pumped to a UF plant (2) where it is concentrated to about 35 % protein in DM. The retentate is pumped to the MF plant (3), while the permeate goes to a collecting tank after RO concentration and cooling.

The retentate from MF treatment, which contains most of the fat and bacteria, is collected separately, and the defatted permeate is forwarded to further ultrafiltration with diafiltration (4). The resulting WPI retentate is then further concentrated using high concentration NF (35-38 % DM) and spray-dried to reduce the moisture content to a maximum of 4 % before bagging.

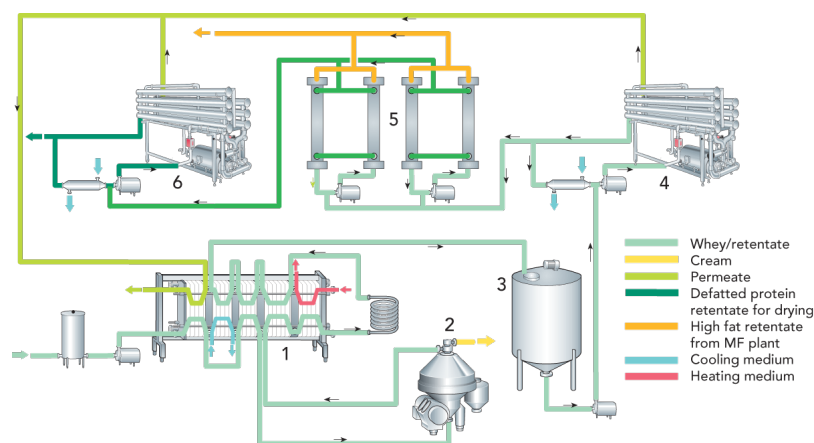


Figure 17 - Process for defatting of whey protein retentate

1. Pasteurizer
2. Separator
3. Holding tank
4. UF plant
5. MF for fat removal
6. UF and diafiltration

UF permeate

UF permeate from the production of WPC and WPI can be spray-dried or used for lactose production. These are explained in more detail below.

1	2	3	4	5	6	7	8	9	10
Bakery	X	X							X
Salad dressings		X							
Ice cream									
Whey spread/cheese		X							
Cheeses		X							
Beverages	X						X		
Confectionery		X	X	X					X
Pharmaceutical								X	
Yeast Products	X								
Industrial Products									

CHAPTER 11 – WHEY AND WHEY PRODUCTS PROCESSING

Whey is the liquid remaining after milk has been curdled and strained. It is a byproduct of the manufacture of cheese or casein and has several commercial uses. Sweet whey is a byproduct produced during the manufacture of rennet types of hard cheese, like Cheddar or Swiss cheese. Acid whey (also known as sour whey) is a byproduct produced during the making of acid types of dairy products, such as cottage cheese or strained yogurt.

Whey proteins consist of α -lactalbumin, β -lactoglobulin, serum albumin, immunoglobulins, and proteose-peptones.

Composition

Whey protein is the collection of globular proteins isolated from whey. The protein in cow's milk is 20% whey protein and 80% casein protein, whereas the protein in human milk is 60% whey and 40% casein. The protein fraction in whey constitutes approximately 10% of the total dry solids in whey. This protein is typically a mixture of beta-lactoglobulin (~65%), alpha-lactalbumin (~25%), bovine serum albumin (~8%) (see also serum albumin), and immunoglobulins. These are soluble in their native forms, independent of pH.

The amino acid cysteine in whey protein is a substrate for the synthesis of glutathione in the body which is a ubiquitous cellular antioxidant; laboratory experiments have suggested that whey protein and its components might reduce the risk of cancer in animals, suggesting an avenue for future medical research.

Production

To produce cheese, rennet or an edible acid is added to heated milk. This makes the milk coagulate or curdle, separating the milk solids (curds) from the liquid whey. Sweet whey is the byproduct of rennet-coagulated cheese, and acid whey (also called sour whey) is the byproduct of acid-coagulated cheese. Sweet whey has a pH greater than or equal to 5.6, acid whey has a pH less than or equal to 5.1.

Why is left over when milk is coagulated during the process of cheese production, and contains everything that is soluble from milk after the pH is dropped to 4.6 during the coagulation process. It is a 5% solution of lactose in water, with some minerals and lactalbumin. The fat is removed and then

Another use of whey is to make “cream of tartar whey”: “Put a pint of blue milk [blue milk is characterized by the appearance on its surface, eighteen or twenty-four hours after it is drawn, of small, indigo-blue fungal spots that rapidly enlarge until the whole surface is covered with a blue film] over the fire, when it begins to boil, put in two tea spoonfuls of cream of tartar, then take it off the fire, and let it stand till the curd settles to the bottom of the pan, then put it into a basin to cool, and drink it milk warm.” In areas where cheese is made, excess whey byproduct is sometimes sprayed over hay fields as a fertilizer.

Historically whey, being a byproduct of cheese making, was considered a waste product and was pumped into rivers and streams in the U.S.

Uses

Whey is used to produce whey cheeses such as ricotta, brunoise, and whey butter and many other products for human consumption. The fat content of whey is low; for example 1,000 kg of whey are required to make typically 1 kg of whey butter. It is also an additive in many processed foods, including breads, crackers, and commercial pastry, and in animal feed. Whey proteins consist primarily of α-lactalbumin and β-lactoglobulin. Depending on the method of manufacture, whey may also contain glycomacropetides (GMP). Dairy whey remaining from home-made cheesemaking has many uses. It is a flour conditioner and can be substituted for skim milk in most baked good recipes that require milk (bread, pancakes, muffins, etc.).

Throughout history, whey was a popular drink in inns and coffee houses. When Joseph Priestley was at college at Davenport Academy, 1752–1755, he records that, on the morning of Wednesday, 22 May 1754, he “went with a large company to drink whey.”This was probably “sack whey” or “wine whey”.

processed for human foods. Processing can be done by simple drying, or the relative protein content can be increased by removing lipids and other non-protein materials. For example, spray drying after membrane filtration separates the proteins from whey.

Whey can be denatured by heat. High heat (such as the sustained high temperatures above 72 °C associated with the pasteurization process) denatures whey proteins. While native whey protein does not aggregate upon renneting or acidification of milk, denaturing the whey protein triggers hydrophobic interactions with other proteins, and the formation of a protein gel. Heat-denatured whey can still cause allergies in some people.

Whey product	Whey						Whey concentrate or powder					
	Liquid whey	Natu- ral	Sweet- ened	Demine- ralized 40-50	Demine- ralized 70-90	Delac- tosed	Whey Protein Isolate	Pharma	Permeate powder			
1	2	3	4	5	6	7	8	9	10	X		
Animal Feed	X	X		X		X			X			
Human Con- sump-tion												
Baby food					X							
Diet food												
Sports nutrition							X					
Clinical nutrition							X					
Sausages												
Soups		X	X	X								

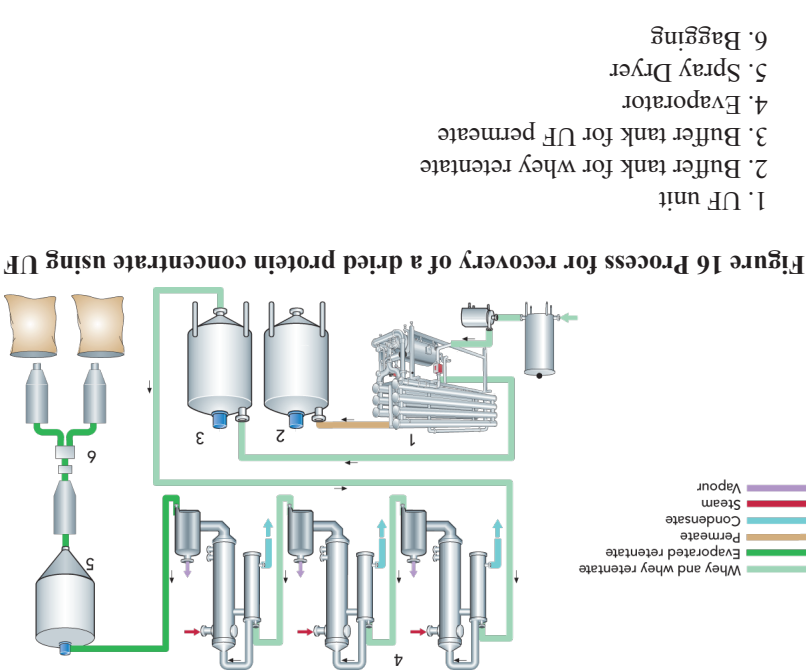
Table 3 - Examples of utilization of whey and whey products

Advances in microfiltration have drastically improved the quality and economics of product available, moving from a traditionally hot ceramic filter process to a cold organic spiral wound process in recent years.

Treatment of the whey retentate from a UF plant at around 35 % protein in DM can reduce the fat content of a whey protein powder from over 7% to less than 0.4 %. Microfiltration also concentrates fat globule membranes and most of the bacteria in the MF retentate, which is collected and pro-cessed separately; in some cases, this retentate is dried on the same dryer as the WPI, resulting in a high fat WPC powder. The defatted MF permeate is routed to a second UF plant for concentration; this stage also includes dialfiltration.

Whey protein isolate

Whey protein isolate (WPI) containing > 92 % protein in dry matter is growing rapidly in applications such as body-building supplements – where the fat and other non-protein constituents are undesirable as well as in egg white replacements for whipped products such as meringues or as a valu-able ingredient in foods and acidic fruit beverages.



Casein fines recovery and fat separation

Casein fines are always present in whey. They have an adverse effect on fat separation and should therefore be removed first. Various types of separation devices can be utilized, such as cyclones, centrifugal separators or vibrating/rotating screens, Figure 15.

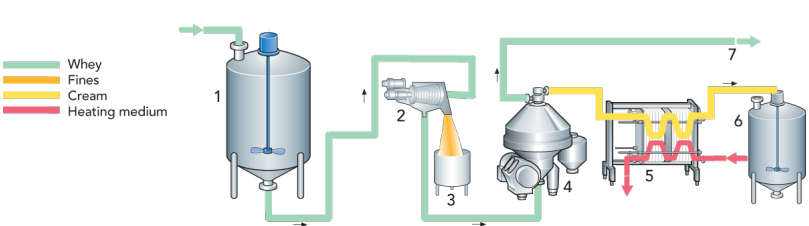


Figure 15 - Fines and fat separation from whey.

1. Whey collecting tank
2. Clarifier
3. Fines collecting tank
4. Whey cream separator
5. Whey pasteurizer
6. Whey cream tank
7. Whey for further treatment

Fat is recovered in centrifugal separators

The collected fines are often pressed in the same way as cheese, after which they can be used in processed cheese manufacture and, after a period of ripening, also in cooking.

The whey cream, often with a fat content of 25 – 30 %, can partly be reused in cheese-making to standardize the cheese milk; this enables the corresponding quantity of fresh cream to be utilized for special cream products. Normally, this works well for short maturation cheeses such as mozzarella, but note that the risk of rancid off flavours is heightened as the maturation time is increased. It is important to break the recycle loop to avoid the build-up of free fatty acids and other undesirables that are not trapped in the curd matrix. For cheddar production, whey cream is generally not reused due to the sensitivity of the starter to bacteriophages. In some of these cases, whey cream is converted to whey butter.

Whey is very often diluted with water. The figures above relate to undiluted whey. As to the composition of the NPN fraction, about 30 % consists of urea. The rest is amino acids and peptides (glycomacropeptide from renneting action on casein). Table 3 lists some fields of application for whey and whey products.

Advances in membrane filtration and chromatography have underpinned economically viable commercial processes for the fractionation of whey into highly purified protein and lactose products that allow end users to take advantage of the various functional properties of individual whey components. This is a trend that is expected to continue as research uncovers new bioactive properties and consumers become more educated about the nutritional value of whey.

	Cheese whey	HCl Acid Casein whey
True protein	0.60	0.60
NPN (non-protein nitrogen)	0.20	0.20
Lactose	4.5	4.6
Ash (minerals)	0.5	0.8
Calcium	0.035	0.12
Phosphorus	0.040	0.065
Sodium	0.045	0.050
Potassium	0.14	0.16
Chloride	0.09	0.11
Lactic acid	0.05	0.05

Drying

The use of drum dryers involves a problem: it is difficult to scrape the layer of dried whey from the drum surface. A filler, such as wheat or rye bran, is therefore mixed into the whey before drying, to make the dried product easier to scrape off.

Spray drying of whey, is at present, the most widely used method of drying. Before being dried, the whey concentrate is usually treated as

Concentration of total solids concentration

The first step in whey concentration typically involves increasing the dry matter from around 6 % to 18 – 25 % using RO (reverse osmosis) or a combination of RO-NF (nanofiltration). Then whey can either be transported to another site for further processing (e.g. evaporation and drying) or dried directly on site.

With dry matter above 25-30 %, it is more economical to use mechanical vapour recompression (MVR) evaporation to concentrate whey. Utilizing MVR in this second step to whey concentration can increase dry matter from as low as 20 % to 45 – 65 %.

After evaporation, the concentrate is flash cooled rapidly to 30 – 40 °C thus initiating nucleation of lactose crystals before being further cooled and stirred in specially-designed crystallization tanks. The product is held in the crystallizers for 4 – 8 hours to obtain a uniform distribution of small lactose crystals, which will give a non-hygroscopic product when spray-dried.

Concentrated whey is a supersaturated lactose solution and, under certain temperature and concentration conditions, the lactose can sometimes crystallize spontaneously before the whey leaves the evaporator. At concentrations above a dry matter content of 65 %, the product can become so viscous that it no longer flows.

Pasteurization and chilling

Whey that is to be stored before processing must be either chilled or pasteurized and chilled as soon as the fat and fines have been removed. For short-time storage (< 8 hours), chilling to > 5 °C is usually sufficient to reduce bacterial activity. Longer periods of storage and utilization of the whey in high-quality infant formula and sports nutrition applications require pasteurization of the whey directly after the removal of fat and fines; generally, this approach is recommended in order to cater to the increasingly strict demands on product quality.

of approximatively 25 %; this is regarded as the maximum for economic operation. It is then necessary to diafilter the concentrate to remove more of the lactose and ash and raise the concentration of protein relative to the total dry matter. Diafiltration is a procedure in which water is added to the feed as filtration proceeds, in order to wash out low molecular components which will pass through the membranes, basically lactose and minerals.

Table 17 - Composition in % of some whey protein concentrate powders

Product	1	2	3	4
Protein in dry matter	35	50	65	80
Moisture	3.8	3.8	3.8	3.8
Crude protein (Nx6.38)	36.2	52.1	63.0	81.0
True protein	29.7	40.9	59.4	75.0
Lactose	46.5	30.9	21.1	3.5
Fat	2.1	3.7	5.6	7.2
Ash	7.8	6.4	3.9	3.1
Lactic acid	2.8	2.6	2.2	1.2

Table 17 shows the compositions of some typical whey protein concentrate (WPC) powders.

A process line for the production of drier whey protein concentrate using UF is shown in Figure 16. Up to 95 % of the whey is collected as permeate and protein concentrations as high as 80-85 % (calculated on the dry matter content) can be obtained in the dried product. Typically, the evaporator is not used for protein concentrations above 60 % dry matter so as to minimize heat damage to the proteins. Advances in high-concentration nanofiltration allows these products to be concentrated to > 35 % dry matter prior to drying.

and so is loaded into a massive web of ceramic filters and stainless steel turbines. These machines work to separate out the lactose as well as the fats, leaving a liquid of 90% whey protein.

The next step is solidifying the protein. The liquid is put into a massive dryer that uses hot air followed by cold air to separate all the water from the whey, leaving a dry solid. Lastly, a “high-speed blender” mixes the newly formed powder with flavors like cocoa or vanilla to mask the chalky and sometimes bitter taste. This is the final product that is often mixed with milk or water and consumed for a quick serving of 10-40 grams of protein.

Whey protein typically comes in four major forms: concentrate (WPC), isolate (WPI), hydrolysate (WPH) and Native Whey.

Concentrates have typically a low (but still significant) level of fat and cholesterol but, in general, compared to the other forms of whey protein, they are higher in carbohydrates in the form of lactose — they are 29%–89% protein by weight.

Isolates are processed to remove the fat and lactose — they are 90%+ protein by weight. Like whey protein concentrates, whey protein isolates are mild to slightly milky in taste.

Hydrolysates are whey proteins that are predigested and partially hydrolyzed for the purpose of easier metabolizing, but their cost is generally higher. Highly hydrolysed whey may be less allergenic than other forms of whey.

Native whey protein is extracted from skim milk, not a byproduct of cheese production, and produced as a concentrate and isolate.

Because whey contains lactose, it should be avoided by those who are lactose intolerant. Dried whey, a very common food additive, contains 65-75 percent lactose and 11-12 percent protein. When used as a food additive, whey can contribute to quantities of lactose far above the level of tolerance of most lactose-intolerant individuals.

Liquid whey contains lactose, vitamins, protein, and minerals, along with traces of fat.

In 2005 researchers at Lund University in Sweden found that whey can help regulate and reduce sugar levels in blood sugar levels in people with type 2 diabetes by increasing insulin secretion.

People can be allergic to whey or other milk proteins (this is an allergy, not lactose intolerance). As whey proteins are altered by high temperatures, whey-sensitive people may be able to tolerate evaporated, boiled, or sterilized milk. Hard cheeses are high in casein, but low in whey proteins,

and are the least allergenic for those allergic to whey proteins. However, casein proteins (which are heat-stable) are the most important allergens in cheese, and an individual may be allergic to either or both types of protein.

In 2010 a panel of the European Food Safety Authority examined health claims made for whey protein. For the following claims either no references were provided on the claimed effect, or the provided studies did not test the claims or reported conflicting results:

- Increase in satiety leading to a reduction in energy intake
- Contribution to the maintenance or achievement of a normal body weight
- Growth or maintenance of muscle mass
- Increase in lean body mass during energy restriction and resistance training
- Reduction of body fat mass during energy restriction and resistance training
- Increase in muscle strength
- Increase in endurance capacity during the subsequent exercise bout after strenuous exercise
- Skeletal muscle tissue repair
- Faster recovery from muscle fatigue after exercise.

On the basis of the data presented, the 2010 panel concluded that a cause and effect relationship between the consumption of whey protein and these claims had not been established [17].

Table 2 shows approximate composition figures for whey from cheese and casein manufacture.

Table 2 - Approximate composition of separated whey, %

	Cheese whey	HCl Acid Casein whey
Constituent	%	%
Total solids	6.0	6.4
Water	94	93.6
Fat	0.05	0.05

The overall retention figures, however, depend very much on:

- The type of membrane
- The flux
- The character of the feed (pre-diluted with water, pre-concentrated after demineralization, etc.)

To obtain a more than 80 % protein concentrate, the liquid whey is first concentrated 20- to 30-fold by direct ultrafiltration to a solids content

Component	Weight in 100 kg Ordinary whey %	Retentate %	Weight in 16.7 kg Permeate %
True protein	0.55	3.25	0.01
Lactose	4.80	5.34	4.69
Ash	0.55	0.76	0.51
NPN*	0.18	0.24	0.17
Fat	0.03	0.18	Traces
Total DM	6.11	9.77	5.38
TPK**			35.72
* NPN = Non-protein nitrogen			
** TPK = Total Protein Kjeldahl			

Table 16 - Composition of whey and resulting retentate and permeate

Example: 100 kg of whey yields approximately 17 kg of retentate and 83 kg of permeate at close to six-fold (5.88) concentration. Table 16 shows the compositions of the feed (whey) and the resulting retentate and permeate.

mentioned above to form small lactose crystals, as this results in a non-hygroscopic product which does not go lumpy when it absorbs moisture.

Acid whey from cottage cheese and casein production is difficult to dry due to its high lactic acid content. It agglomerates and forms lumps in the spray dryer. Drying can be facilitated by neutralization and additives, such as skim milk and cereal products. Increasingly it is preferred that lactic acid is removed by a combination of nanofiltration and electrodialysis improving flavour, nutritional profile, drying and handling. Salt is also removed and typically a demineralisation level of > 60% corresponds to a level of acid reduction that is acceptable.

Fractionation of total solids protein recovery

Whey proteins were originally isolated through the use of various precipitation techniques, but nowadays membrane separation (fractionation) and chromatographic processes are used in addition to both precipitation and complexing techniques.

Fink and Kessler (1988) state that a maximum whey protein denaturation rate of 90 % is possible for all denaturable fractions. Proteose peptone, comprising some 10 % of the fraction, is considered undenaturable.

Whey proteins, as constituents of whey powders, can easily be produced by careful drying of whey. Isolation of whey proteins has therefore been developed. The whey proteins obtained by membrane separation or ion exchange possess good functional properties, i.e. solubility, foaming, emulsion formation and gelling, can be highly nutritional and in the case of WPI produce a very clear beverage enhancing it’s healthy image.

Protein recovery by UF

Protein concentrates have a very good amino acid profile, with high proportions of available lysine and cysteine.

Whey protein concentrates (WPC) are powders made by drying the retentates from ultrafiltration of whey. They are described in terms of their protein content, (percentage protein in dry matter), ranging from 35 % to 80 %. To make a 35 % protein product, the liquid whey is concentrated about six-fold to an approximate total dry solids content of 9 %.

Example: 100 kg of whey yields approximately 17 kg of retentate and 83 kg of permeate at close to six-fold (5.88) concentration. Table 16 shows the compositions of the feed (whey) and the resulting retentate and permeate.

Heat treatment is the most conventional processing method to guarantee microbial safety of dairy products. Throughout the twentieth century, various heat treatment methods were developed. Each heat treatment is designed with a specific temperature–time trajectory to achieve a certain

Innovative steam injection – a novel heating method

application. issue in the cost-effectiveness of this technology and, therefore, limits its module designs and improved processing concepts, fouling remains a major permeation fluxes and improved selectivity. However, despite the improved of the membrane. The UTP process concept resulted in an increase of module is maintained by applying high cross-flow velocities at both sides a constant trans-membrane pressure over the length of the membrane membrane pressure (UTP) concept industrially feasible. In the UTP concept module design. The ceramic membrane modules made the uniform trans- with the development of ceramic MF membranes and improved membrane effect on the cost-effectiveness of this technology.

During membrane filtration particles suspended in a liquid are retained by a semi-permeable membrane. Typical microfiltration (MF) membranes contain pores with a diameter between 0.1 and 10 μ m. The major industrial applications for MF in the dairy industry are removal of bacteria, whey defatting and micellar casein enrichment. Besides being a non-thermal treatment method, MF has the specific advantage that it is very effective in the removal of bacterial spores in comparison with conventional pasteurisation. A major drawback of MF is fouling at the membrane surface, which adversely affects selectivity and throughput. Fouling also requires frequent rinsing and cleaning procedures, which can have a detrimental

Microfiltration

for conventional methods. are not fully known. Additionally, some authors have stated that the energy consumption of ultrasound necessary to kill microorganisms is higher than part because the benefits of this technique in terms of nutritional safety food have been mainly carried out on laboratory scale. This could be in of enzymes and lactose hydrolysis. The studies related to preservation of inactivation of bacteria and enzymes, homogenisation of milk, extraction improvements exist. The main applications in milk and dairy products are ultrasound-assisted technologies for product modifications or process technology, no commercial food products are currently available; however,

WPI and permeate from skim milk

The production of ‘ideal’ or ‘native’ whey products from skim milk is of growing interest due to the resulting products’ unique properties which arise from the milk having not been subjected to the action of rennet, starter cultures or acid. Consequently, there is an absence of GMP (glycomacro-peptide), lactic acid levels above those that are naturally occurring, degradation of proteins by starter culture enzymes and risks from bacteriophages.

As figure 18 shows, skim milk is first microfiltered (1) to separate casein (MF retentate) from the MF permeate containing whey proteins, lactose, NPN and ash. The retentate, in liquid or powder form, can be used in a variety of products where casein fortification is beneficial; this includes cheese, dairy desserts and beverages.

Ultrafiltration-diafiltration (2) is then utilized to separate the whey proteins (UF retentate) from lactose, ash and NPN (UF permeate) giving a protein rich stream with > 90 % protein in dry matter. After storage (3), the UF retentate can be further concentrated to 36 – 37 % dry matter, preheated (5) to attain specific functional properties and the dried (6) to no greater than 4 % moisture.

The resulting permeate from UF (2) is concentrated directly and then stored ready for further processing. The type of membrane used to concentrate permeate depends on whether it is being used to standardize protein in milk powders, spray-dried as permeate or used for lactose production. This is explained in more detail below. UF milk permeate is also produced when making MPC (milk protein concentrate) and in this case, skim milk is sent directly to UF-DF (2) in figure 18.

Most non-thermal preservation techniques appear to be highly effective in inactivation of bacterial spores and enzymes remains difficult and therefore application of these novel technologies remains primarily limited to foods where enzymatic reactions do not affect product properties or where spore germination is unlikely. Combinations of non-thermal preservation processes with conventional or other emerging processes could extend their application. In some cases, combination of different technologies could allow a milder use of single treatments. The total preservation effect can be merely the sum of the effects of the individual treatments, but in terms of food quality and safety, a synergistic effect is preferable. For design of combined processes, it is of primary importance to distinguish factors that sensitize microorganisms or enzymes and factors that provoke complete inactivation of sensitised microorganisms or enzymes. An overview is given of different combinations of non-thermal technologies with heat, pressure, pH, use of antimicrobials and storage at low temperature. Mathematical models could be used as a tool to design highly efficient combined treatments and determine processing condition [20].

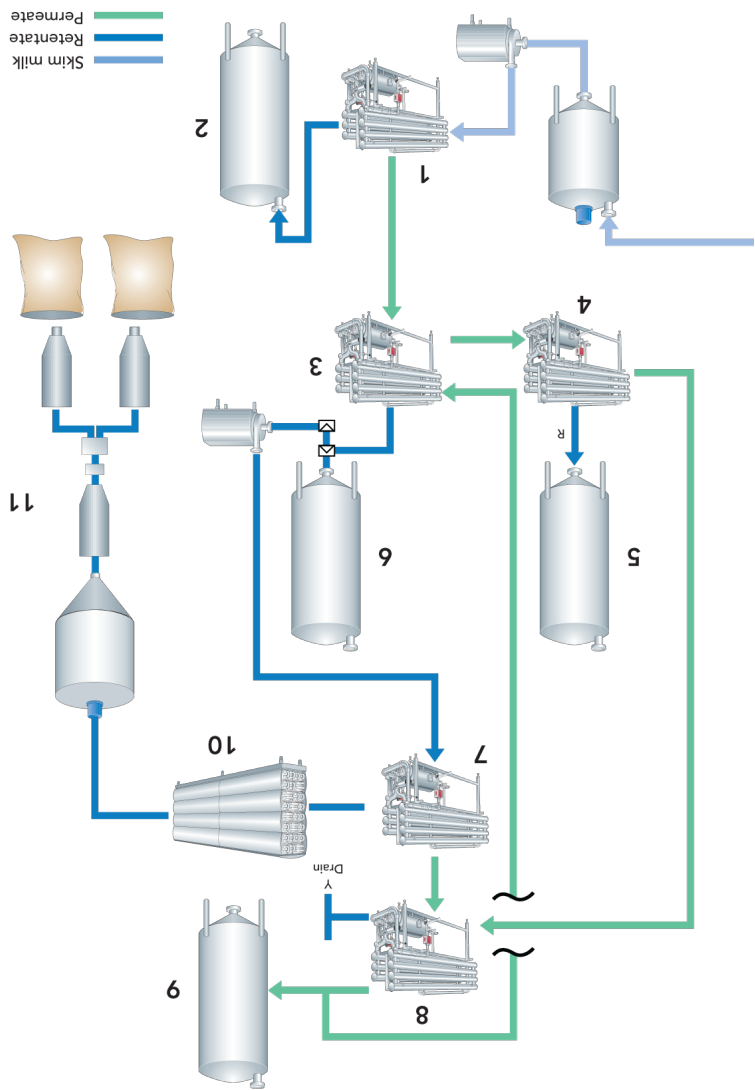
Combined technologies

time, while proteins and vitamins remain largely intact. that sufficient microbial inactivation is achieved within very short processing improved shelf life similar to UHT-treated products. The advantage of ISI is an alternative for conventional pasteurisation, while achieving a drastically heating technology to be applied for liquid foods. ISI is intended to serve as the innovative steam injection (ISI) approach is being developed as a novel while still guaranteeing a certain microbial inactivation. In this respect, therefore, of major importance to minimise heat load during processing, foods as fresh as possible. For conventional heat treatment processes, it is, Consumers demand long shelf life and safe products, but they also want responsible for the brown colour of heated milk.

Complex Maillard reactions lead, for example, to the formation of pigments value is, for example, affected due to inactivation of thiamin (vitamin B₁). proteins, loss of nutrients and formation of new components. The nutritional as destruction of microorganisms, inactivation of enzymes, denaturation of that take place during heating. Different reactions can be distinguished, such because of a large number of chemical, physical and biochemical reactions and nutritional characteristics of heat-treated dairy products are affected sensorial and nutritional characteristics as much as possible. The preserving inactivation of microorganisms, spores and enzymes, while preserving

- D
- Onion and garlic are responsible for the garlic/onion flavor in milk, and are more prevalent in pasture during ____.
- A. Fall
- B. Spring
- C. Early and late summer
- D. Early spring and late fall
- C
- Chemical sanitizers containing ____ are most widely used for sanitizing milking equipment.
- A. Bromine
- B. Saline
- C. Chlorine
- D. Iodine
- C
- Milk found in cows with a high somatic cell count would result in a decrease in ____.
- A. Butterfat
- B. Whey protein
- C. Casein
- D. Trace minerals
- A
- Milk is a good supplier of minerals except for ____.
- A. Magnesium-Iron-Manganese-Copper
- B. Riboflavin-Magnesium-Lactose-Manganese
- C. Phosphorus-Copper-Zinc-Calcium
- D. Potassium-Boron-Iron-Calcium
- B
- Adulterants of milk that are detrimental to man’s health are ____.
- A. Proteins
- B. Pesticides
- C. Water
- D. Minerals
- D
- Water added to milk is detected by checking the ____.
- A. Acid degree value
- B. Sediment content
- C. Titratable acidity

Figure 18 - Process for manufacturing WPI and milk permeate from skim milk



- What marketing tool would be used in the futures market by someone who owns a commodity such as milk and intends to sell it sometime in the future?
- A. Basis contract
B. Pooling
C. Short hedge
D. Speculating Buying
- Specific gravity of milk at 60 F is ____.
- A. 1.022
B. 1.032
C. 1.033
D. 1.042
- The Dairy Herd Improvement Association is a cooperative which provides ____.
- A. Data on breeding quota levels
B. Milk testing and record keeping program for dairy cows
C. Minimum prices paid by processors to producers for milk
D. Assistance to groups of dairy farmers who collectively market their milk.
- Farm water supplies must be protected from surface contamination. Water is usually tested for ____ as an indicator of possible sewage contamination.
- A. Proteolytic bacteria
B. Lipolytic bacteria
C. Coliform Bacteria
D. Psychrophilic bacteria
- What is the most popular type container used for fluid milk?
- A. Glass
B. Paper
C. Plastic
D. Pouch

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having great potential not only for food preservation, but also for production of innovative foods with modified functional properties or structures. Some pressurised foods, such as fruit jams, jellies, sauces, juices and yoghurts, avocado pulp, guacamole and cooked ham, are already commercially available. Most of the treatments are carried out in batch or in semi-continuous equipment. The retention of the food's original freshness, colour, flavour, taste and nutritional quality during microorganism inactivation is, perhaps, the main advantage of HP processing.

Pulsed electric fields

The use of high-intensity pulsed electric fields (PEF) is seen as an interesting alternative to conventional thermal processing methods for liquid or semi-liquid foods. Application of PEF technology has been successfully demonstrated for the pasteurisation of foods such as juices, milk, yoghurt, soups and liquid eggs. The high inactivation levels of various spoilage and pathogenic microorganisms with minimal temperature increase, and thus minimal im- pact on quality and nutritional factors make PEF a promising technology. An additional advantage of PEF is the reduced fouling compared to conventional pasteurisation. The disadvantage of PEF is the limited bacterial spore and enzyme in- activation. To increase the efficacy of PEF for inactivation of bacterial spores and enzymes, recent investigations have focused on the use of combined technologies, e.g. PEF and heat or PEF and the use of bacteriocins or acids. Application of PEF to milk and other liquid dairy products has been extensively reviewed in various recent publications.

Ultrasound

Ultrasound can be defined as waves with a frequency higher than 20 kHz that are able to travel through gas, liquid and solid materials. A distinction has to be made between low- and high-intensity ultrasound. Typical values for low-intensity ultrasound are low power levels ($\leq 1 \text{ W cm}^{-2}$) and high frequencies (0.1–20 MHz), which leave the system unchanged. This makes low-intensity ultrasound an excellent tool for measuring food properties. High-intensity ultrasound is characterised by high power levels ($10\text{--}1000 \text{ W cm}^{-2}$) and relatively low frequencies ($\leq 0.1 \text{ MHz}$) that can give rise to physical and chemical alterations within the material to which it is applied, the applications being mainly focused on the processing of products. High-energy ultrasound has been used for degassing of liquid foods, induction of oxidation/reduction reactions, extraction of enzymes and proteins, enzyme inactivation and induction of nucleation for crystallization. As preservation

High pressure (HP) is a non-thermal treatment of foods that consitutes a clear alternative to traditional heat treatments. In fact, HP is regarded as

High Pressure

designed precisely.

that microwave processing involves substantial capital costs and needs to be

difficulty of predicting the heating uniformity. This, together with the fact

food industry has been reluctant to adopt this technology, probably due to the

temperature. In spite of the known advantages of microwave heating, the

surfaces, and therefore, less time is needed to reach the desired process

microwaves penetrate the food directly and rapidly without contact with hot

compared to conventional heat treatment, during microwave heating, As

processing operations such as cooking, baking, drying and thawing. As

Microwave energy is used for domestic applications and for several

Microwaves

traditional treatments.

of these technologies and, therefore, to identify serious alternatives for the

developed studies, more research is needed to validate the effective- ness

and sensorial modifications are covered. In spite of the great number of

topics, effects on microorganisms and enzymes, as well as chemical

technologies alternative to the conventional thermal treatments. General

In this chapter, the authors have attempted to collect the most investigated

renaissance.

with consumer demands for minimally processed foods has led to their

without success. More recently, the technical-scientific progress together

new and they were tried out several decades ago in the food industry, but

and stable properties. Most of these novel technologies are not completely

technologies to improve its products and develop new ones with high-quality

These limitations are the drive for the dairy industry to search for new

sensorial characteristics, but more likely in the nutritional value of the food.

chemical changes take place giving rise to modifications not only in the

and enzymes. However, during some of these thermal treatments important

in the dairy industry because of their efficacy in inactivating microorganisms

be considered novel or emergent. Traditionally, thermal treatments are applied

This chapter evaluates a number of milk-processing technologies that can

CHAPTER 12 - NOVEL METHODS OF MILK PROCESSING

1. Microfiltration plant
2. Microfiltration retentate collection tank
3. Ultrafiltration-Diafiltration plant
4. Permeate reverse osmosis - nanofiltration plant
5. Concentrated permeate collection tank
6. Whey protein isolate collection tank
7. WPI high concentration membrane plant
8. Reverse osmosis/ polishing plant
9. Water storage tank
10. WPI preheater
11. Spray dryer
12. Bagging

Recovery of denatured whey protein

In general, serum protein or whey proteins cannot be precipitated by rennet or acid. It is, however, possible to precipitate whey proteins with acid, if they are first denatured by heat. The process is divided into two stages:

Precipitation (denaturing) of the protein by a combination of heat treatment and pH adjustment

Concentration of proteins by centrifugal separation

Denatured whey proteins can be mixed with cheese milk prior to renneting; they are then retained in the lattice structure formed by the casein molecules during coagulation. This discovery led to intensive efforts to find a method of precipitating and separating whey proteins, as well as a technique for optimizing the yield. Adding denatured whey proteins to the cheese is not permitted by law in several countries, and also for certain types of cheese. Denatured proteins, either by adding or by pasteurization at high temperatures, affect both yield and ripening of the cheese. Figure 19 shows the Centri-Whey process line for manufacture of denatured whey proteins. After pH adjustment, the whey is pumped via an intermediate tank (1) to a plate heat exchanger (2) for regenerative heating. The temperature of the whey is raised to 90 – 95 °C by direct steam injection (3), before it passes through a tubular holding section (4) with a holding time of 3 – 4 minutes. Acid is introduced during this stage, to lower the pH. The acid is

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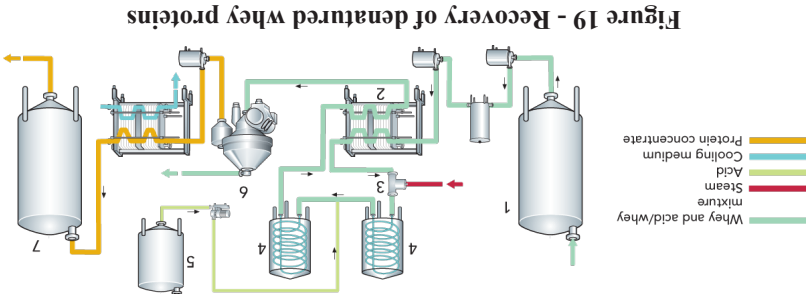
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- D. 96%
- A
- Which of the following directly influence(s) the total supply of milk?
- A. Prices paid milk producers
- B. Manufacturing plants
- C. Costs of fat production
- D. Foreign exports
- B
- The first compulsory pasteurization law (Chicago) applying to all milk except that from tuberculin tested cows was adopted in ____.
- A. 1898
- B. 1908
- C. 1918
- D. 1928
- A
- For the over 40 years the National Cheese Exchange had established the national cheeses cash prices. ON May 1, 1998 Cheese was traded at the _____ forthe first time.
- A. Chicago Mercantile Exchange
- B. New York Stock Exchange
- C. National Dairy Exchange
- D. Coffe, Sugar, Coca Exchange
- A
- The pasturized Milk Ordinance regulates what?
- A. Grade A Milk
- B. Manufacturing grade milk
- C. Grade B Milk
- D. Grade C Milk
- D
- Dairy Farmers can buy and sell dairy futures on what exchange?
- A. New York Stock Exchange
- B. National Dairy Exchange
- C. Coffee, Sugar, Coca Exchange
- D. Chicago Mercantile Exchange
- B
- According to the Food & Nutrition Board of the National Academy of Sciences, all people need at least _____ Milligrams of calcium per day.
- A. 100

of UF permeate from whey or skim milk as shown below. Only milk UF
There are currently a few options available for the further processing

UF permeate from whey and skim milk

- 1. Whey collecting tank
- 2. Plate heat exchanger
- 3. Steam injector
- 4. Holding tube
- 5. Acid tank
- 6. Clarifier
- 7. Collecting tank for denatured whey protein



either organic or inorganic (e.g. lactic acid or edible hydrochloric acid) as stipulated. Those proteins that can be, and have been, modified by heat are precipitated within 60 seconds in a tubular holding section (4). After regenerative cooling to about 40 °C, the precipitated proteins are separated from the liquid phase in a solids-ejecting clarifier (6). The clarifier discharges, at intervals of about 3 minutes, the accumulated protein in the form of a 12 – 15 % concentrate, of which about 8 – 10 % is protein. This method results in 90 – 95 % recovery of the coagulable proteins. The addition of concentrated whey protein to cheese milk – principally in the manufacture of soft and semi-hard cheeses – causes only minor changes in the coagulating properties. The structure of the curd becomes finer and more uniform than with conventional methods. The processed whey proteins are more hydrophilic than casein. In the making of Camembert cheese, for example, an increase in yield of 12 % has been reported.

permeate and lactose can be used for the standardization of protein in milk powders.

The processes for the manufacture of lactose and permeate powder are explained below in Fig. 20 [19].

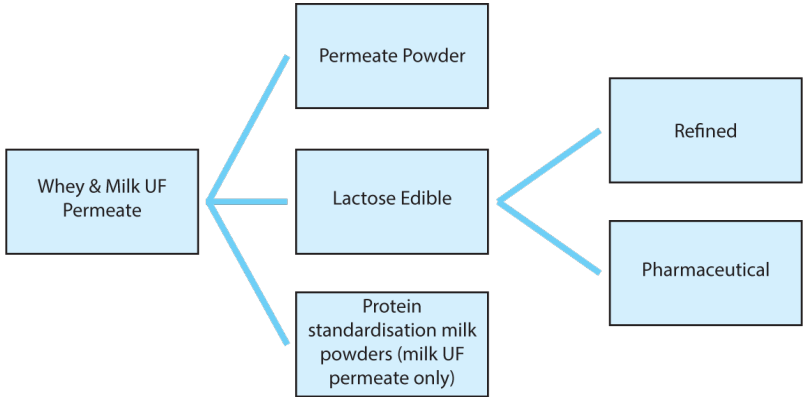


Figure 20 - Some typical options for the utilisation of milk and whey UF permeate

provided by milk and milk products.
A. 66%
B. 76%
C. 86%

About _____ percent of the calcium available in the food supply is
B
D. Slightly damp, warm bleeding
C. Excess water used in washing udders
B. Milking too soon after calving
A. Cracked or split inflations
Which of the following is not a cause of coliform mastitis?

- B
- D. Streptococcus Agalactiae
- C. Streptococcus Ubertis
- B. Staphylococcus Aureus
- A. Staphylococcus Dysgalactiae
- Which one of the following is not a cause of mastitis?
A
D. Phosphorus and Magnesium
C. Calcium and Iron
B. Calcium and Phosphorus
A. Calcium and Magnesium

in bone.
Milk provides _____ and _____ in approximately the same ratio as found

- B
- D. Acidity
- C. Freezing Point
- B. Sediment
- A. Phosphatase

production and handling of milk on the farm.
The _____ test may be of value in detecting gross carelessness in the

- B
- D. Phosphatase
- C. Standard Plate Count
- B. Coliform
- A. Lipase

The _____ test is used to detect if milk has been pasteurized properly.
D

TEST EXAMPLES

A
High-temperature short-time pasteurization (HTST) requires that every particle of milk is heated to a minimum temperature of _____ for _____ seconds or its equivalent.

- A. 161 F for 15 Seconds
- B. 101 F for 25 Seconds
- C. 121 F for 20 Seconds
- D. 131 F for 10 Seconds

C
Corn that is drought stressed is much more likely to be contaminated with molds, especially Aspergillus Flavus and the aflatoxin it produces. The best way to prevent the growth of Aflatoxins is to _____.

- A. Harvest the corn with a higher moisture, 32-34%
- B. Store corn wet, do not dry down
- C. Dry the corn down as soon as possible
- D. Process as silage

D
Which of the following will best control contagious mastitis?

- A. Pre-Milking teat dip
- B. Barrier type teat dip
- C. Antibiotic teat dip
- D. Germicidal teat dip

C
The Standard Plate Count (SPC) has a prescribed incubation time of _____ hours at _____ °C .

- A. 24 hours at 32 °C
- B. 48 hours at 43 °C
- C. 48 hours at 32 °C
- D. 12 hours at 45 °C

D
One type of test for antibiotics, common adulterants of milk, is based upon the principle that the growth of bacteria is _____ by them.

- A. Stimulated
- B. Enhanced
- C. Magnified
- D. Inhibited

D. Freezing point
A
Milk with low total solids will produce what off-flavor?
A. Flat
B. Malty
C. Salty
D. Acid
D
A cryoscopy is an important tool that test for _____ in milk.
A. Butterfat
B. Antibiotica
C. Pesticides
D. Added Water
C
Milk is the only source of _____ in nature.
A. Calcium
B. Phosphorous
C. Lactose
D. Fatty Acid
C
Which of the following is not an important reason for a five day-seven degree shelf life test?
A. Psychrotrophic bacteria reproduce at this temperature
B. Meaningful data can be available for control application in a reasonable time
C. It lowers variability among the cartons of milk
D. The temperature is at or near the maximum at which milk will be stored
A
The ideal cleaning material for removing milk stone from milking equipment surfaces is _____.
A. Acidic detergent
B. Phosphate
C. Surfactant
D. Chelate
B
The microbiological standard for Grade A raw milk at the producer farm is _____ bacteria or less milliliter of milk.

C
The Babcock test is a rapid, simple and accurate test for:
A. Water in milk
B. Titratable acidity
C. Fat content
D. Nonfat milk solids content
A
To remove fat from milkkinig equipment use:
A. Alkaline cleaner in hot water
B. Alkaline cleaner in cold water
C. Acid cleaner in cold water
D. Acid cleaner in hot water
B
Milk marketing cooperatives:
A. Are not permitted by Federal Orders
B. Provide marketing power for dairy farmers
C. Control Federal Orders
D. Operate only outside Federal Orders
A
A system of fairly distributing payment among producers in a Federal Milk Maret is called:
A. Pooling
B. Fluid milk procuts and cheese
C. Butter and non fat dry milk
D. Cheese and ice cream products
A
Quality of grade A milk is:
A. Are not permitted by Fedderal Orders
B. Provide marketing power for dairy farmers
C. A part of the testing by Market Administrators
D. Only checked if there is excess milk
A
The milk fat differential used in paying for raw milk is:
A. The price to be added or subtraaced per 1/10% of milk fat above or below a set percentage
B. A value established to penalize milk producers who have to much fat in their milk
C. A value set to penalize milk producers who have too little fat in their milk

D. The price to be added or subtracted per 50 percent of milk fat above or below a set percentage
D
Over the past 20 years the difference between the prices farmers receive for milk and the prices consumers pay for dairy products has:
a. Decreased slightly
b. Remained practically constant
c. Increased slightly
d. More than doubled
B
It takes approximately _____ lbs. of whole milk to make one pound of whole milk cheddar cheese.
a. 5
b. 10
c. 13
d. 22
D
Which of the following is considered a controversial pricing arrangement?
a. Component prices
b. Milk futures
c. Seasonal incentives
d. Dairy Compacts
A
The current supply & demand situation has which of the products from milk in short supply?
a. Cream and milk fat
b. Pasteurized milk
c. Cheese
d. Nonfat dry milk
D
Federal Milk Marketing Orders are a mechanism for:
a. The most economical utilization of milk
b. Finding a market for every producer's milk
c. Economical transportation of milk
d. Market stabilization
C
Cow's milk contains _____ percent lactose.
a. three

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Associate Professor
Assel Akhmetova, PhD

Technology of dairy products

TRAINING MANUAL

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b. four
 c. five
 d. six
 D
 For the maximum intake of calcium, one should consume _____.
 A. Whole Milk
 B. 2% Milk
 C. 1% Milk
 D. Skim Milk
 A
 While some extra-label drugs can be used by food-producing animals, other cannot. Which of the following is/are illegal drugs(s)?
 A. Clenbuterol
 B. Penicillin
 C. Tetracycline
 D. Iyomec
 B
 The process of concentrating milk currently being used on the farm is called _____.
 A. Condensing
 B. Ultra-filtration
 C. Reconstitution
 D. Pasteurizing
 B
 _____ milk is gaining in popularity because of the historically unfavorable price ratio of milk fat to vegetable fat.
 A. 1%
 B. Filled
 C. Skim
 D. Whole
 C
 It requires approximately _____ pounds of skim milk to make one pound of nonfat dry milk.
 A. 22
 B. 13
 C. 11
 D. 6
 D

A. Minerals and Lactose
 B. Milk-Fat and Milk-Sugar
 C. Casein and Lactalbumin
 D. Non-fat Solids and Lactic Acid
 B
 Which of the following is a name used for bacteria that grow in milk at 40-50 degrees F?
 A. Coliforms
 B. Psychrotrophs
 C. Thermophiles
 D. Mesophiles
 C
 The California mastitis test is done to?
 A. See if a cow has an infection
 B. Check for bacteria in milk
 C. Determine whether mammary glands are inflamed
 D. Check for mastitis-producing bacteria in the bulk milk
 D
 _____ is the time after processing during which a dairy product normally remains suitable for human consumption.
 A. Code date
 B. Product life
 C. Package date
 D. Shelf date
 A
 The off flavor most-likely to be found in milk that has not been cooled properly is?
 A. Sour
 B. Rancid
 C. Oxidized
 D. Bitter
 C
 The only mastitis pathogen using the mammary gland as its primary habitat is _____.
 A. Lactis
 B. Cremoris
 C. Agalactiae
 D. Themophilus

a. Mixture thickens with slight gelation
 b. Viscous gel forms, mass adheres to paddle
 c. Distinct precipitate forms, but no gel
 d. Slight precipitate forms and tends to disappear
 C
 In order to gain bargaining power, milk producers have formed _____ to manufacture milk products and market them directly.
 a. Manufacturing coops
 b. Supply coops
 c. Marketing coops
 d. Consumer coops

The somatic cell count standard for Grade A raw milk is _____ or less per milliliter of milk.
 A. 500,000
 B. 750,000
 C. 1,000,000
 D. 1,500,000
 A
 The ability of lipase in milk to attack milk fat and produce a rancid off flavor is enhanced by?
 A. excessive agitation of warm raw milk
 B. poorly cleaned milking equipment
 C. exposing milk to sunlight
 D. feed cows moldy hay
 C
 Fluid milk contains an average of _____ percent solids.
 A. 9
 B. 11
 C. 13
 D. 15
 A
 The two most important etiologic agents of mastitis are _____.
 A. Streptococcus agalactiae and Staphylococcus aureus
 B. Streptococcus uberis and Streptococcus dysgalactiae
 C. Pseudomonas aeruginosa and coliform bacteria
 D. Klebsiella and actinomycetes
 B
 _____ cause(s) flavors in milk such as acid, high acid, or sour milk.
 A. Chemical adulterants
 B. . Microorganisms
 C. Sediment
 D. Weeds
 C
 Aflatoxins sometimes found in dairy food are produced by?

a. Vaporization
b. Infusion heater
c. Vacuumization
d. Vac pac process
A
A high acid flavor (sour) in milk is caused by _____
a. Growth of bacteria in the milk
b. Exposure of cows to acid rain
c. Drinking hard water
d. Absorption of acid from corn silage
C
145. The enzyme _____ is almost completely inactivated at the proper times and temperatures approved for pasteurization.
a. Lactose
b. Acid glycerol
c. Alkaline phosphatase
d. Free fatty acids
D
A pooling method where by handlers with higher than average utilization pay into and handlers with lower than average utilization receive payment from is called _____.
a. Base excess pricing
b. Louisville take out and pay back
c. Individual handler pools
d. Producer settlement fund (equalization fund)
C
The absence of _____ and _____ is not an accident, because they would catalyze oxidation, there producing metallic or oxidized flavors.
a. Lead-casein
b. Boron-tin
c. Iron-copper
d. Zinc-brass
D
Milk protein contains _____ of the essential amino acids and in appreciable amounts.
a. 25%
b. 50%
c. 75%

The quantity of milk used to produce 1 pound of buttermilk depends chiefly upon the _____.
A. Protein content
B. Solids-non-fat Content
C. Bacteriology Content
D. Milk Fat content
A
Net profit after taxes divided by annual net sales is called _____.
a. Profit margin
b. Return on equity
c. Return in assets
d. Carry over profits
B
The fat in one serving of whole milk is (8 ounces) provides _____ calories.
a. 85
b. 90
c. 95
d. 100
D
The most prevalent off flavor of fluid milk is _____.
a. Malty
b. Oxidized
c. Flat
d. Feed
C
The microbiological standard for Grade A raw from single procedure is _____ bacteria per milliliter of milk prior to co-mingling with milk from other producers.
a. 200,000
b. 150,000
c. 100,000
d. 50,000
B
The application of heat to milk for the purpose of preservation, with the extra benefit of the protection of public health, continues to develop. Innovative methods are now available for processing milk at _____ with only fractions of a second holding times.

A. Protozoa
B. Bacteria
C. Mold
D. Yeasts
C
The Mid-American International Agri-Trade Council assists _____.
A. Midwest dairy producers
B. Midcentral dairy producers
C. Midwest food manufactures
D. Midcentral food manufactures
C
About _____ of the calcium available in the food supply is provided by milk.
A. 65%
B. 50%
C. 75%
D. 95%
B
Lactobacillus Bulgaricus and STreptococcus Themophilus are examples of _____.
A. Spoilage bacteria
B. Lactic acid producing bacteria
C. Odor producing bacteria
D. Yeasts and molds
D
With the exception of _____, all the following off flavors of milk are caused by bacteria.
A. Bitter
B. Malty
C. Yeasty
D. Salty
C
By definition, a product labeled «milk» must contain not less than _____ percent milk fat.
A. 0.5%
B. 2.0%
C. 3.25%
D. correct choice not listed

D
The most effective and economical means of reducing the exposure of cows to mastitis causing microorganisms is to _____.
A. Isolate animals with clinical mastitis
B. Disinfect or sterilized milking machine's between cows
C. Wear rubber or plastic gloves during milking and disinfect the gloves between cows
D. Use a bactericide for disinfecting the teats after milking
B
Most farm bulk milk tanks are designed for every-other-day (EOD) pickup and must cool 25 percent of the volume of the tank to _____ degrees F within two hours after milking.
A. 25
B. 45
C. 60
D. 70
A
The two most important diseases of cattle transmissible to man through milk are _____.
A. Tuberculosis and Brucellosis
B. Brucellosis and Scarlet Fever
C. Scarlet Fever and Q Fever
D. Tuberculosis and Anthrax
C
A consumer found an off-flavor in milk packaged in transparent plastic and exposed to high intensity fluorescent light. The off-flavor probably was?
A. High Acid
B. Bitter
C. Oxidized
D. Rancid (lipoxyzed)
A
Which group of flavors cannot be detected by odor?
A. Bitter, Salty
B. High Acid, Rancid
C. Feed, Garlic/Onion
D. Metallic/Oxidized, Malty
B
The components of milk responsible for richness and sweetness, in this order are?

_____ is exposure of hot milk or milk product to reduce pressure to affect the removal of volatile substances, especially those that enter milk from feed.

a. Psychrotrophic
b. Coliform
c. Psychrophilic
d. Thermoduric

C

Bacteria that survive specific heat treatment are said to be _____

A. Flooding
b. Milk lock
c. Patent
d. Oxidized

B

The insufficient removal of milk from the milk collection system is called _____.

a. Phosphorous
b. Iron
c. Chlorine
d. Zinc

B

Besides calcium, milk contains _____, a mineral that is found in brain tissue, muscles, teeth and bones.

a. Lysine
b. Casein
c. Tryptophan
d. Whey

A

When cows have mastitis, the protein content of milk may be higher, but the cheese yield is lower because of a decrease in _____ protein.

a. 80%
b. 70%
c. 60%
d. 50%

B

Marketing Orders. _____% of the milk eligible for fluid use is covered by Federal Milk

a. Aseptic processing
b. Ultra high temperatures
c. Sterilization
d. High temperature short time

C

Pasteurization is the process of heating every particle of milk and milk products to the minimum required _____ and holding it continuously for the minimum required _____ in equipment that is properly designed and operated.

a. Temperature and length
b. Time and temperature
c. Temperature and time
d. Time and length

B

A major Salmonellas outbreak in Chicago spawned increased emphasis on milk processing sanitation, FDA inspections and downtime equipment inspections to evaluate and eliminate possible _____ cross connections.

a. Raw to homogenized
b. Raw to sanitized
c. Sanitized to homogenized
d. Raw to pasteurized

D

Bulk milk cooling and storage and the increased use of milking systems on farms has resulted in _____ bacteria being the primary organisms in raw milk.

a. Thermophilic
b. Mesophilic
c. Coliform
d. Psychrotropic

A

The major reason milk from cows treated with antibiotics must be withheld from the milk supply is because _____.

a. A large proportion of the human population is sensitive to antibiotics
b. Antibiotics increase the somatic cell count of milk
c. Antibiotics cause an off-flavor in milk
d. Antibiotics kill some of the good bacteria found in milk

A

A _____ is a test for rancidity.

A. Acid degree value
B. Cyroscope
C. Disc assay
D. Titratable acidity

A

Mastitis in milk _____.

A. Has a direct effect on cheese yield
B. May cause increased rancidity
C. Decrease calcium content
D. Increases protein content

B

Which of the following is not one of the duties of the bulk milk hauler, who plays a critical role in milk handling?

A. Checking milk temperature
B. Making sure equipment has been cleaned correctly
C. Examining milk to determine appearance
D. Collecting a representative sample to be used for tests

A

Milk with an Acid Degree Value (ADV) of 1.0 or above will have a detectable _____ flavor.

A. Rancid
B. Malty
C. Acidic
D. Fruity

B

The four primary taste sensations are _____.

A. Bitter, metallic, sour, sweet
B. Bitter, salt, sour, sweet
C. Metallic, salt, sour, sweet
D. Burnt, bitter, salt, sour

C

Lactose is the principal _____ in milk.

A. Fat
B. Protein
C. Carbohydrate
D. Mineral

A. 3.00 percent milk-fat and 8.25 percent solids-non-fat
B. 3.50 percent milk-fat and 8.50 percent solids-non-fat
C. 3.50 percent milk-fat and 8.00 percent solids-non-fat
D. 3.25 percent milk-fat and 8.25 percent solids-non-fat

B

Cheddar cheeses sold in the United States, which are not made from pasteurized milk, must be ripened at least _____ days.

A. 30
B. 60
C. 120
D. 150

A

The milk in what class receives the highest price in market?

A. Class I
B. Class II
C. Class III
D. Class IV

C

Flavors of milk may be caused in general by _____.

A. Water content of the milk
B. Temperature that milk is stored
C. Feeds consumed by the cow
D. Amount of sunlight the cow receives

C

The major cause of the salty flavor in milk is _____.

A. The large intake of salt by the cow
B. Associated with sunlight exposure
C. Mastitis
D. Bacteria