**Some common cheese making steps:-**

* [**Treatment of Milk**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#treatment)
* [**Additives**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#additive)
* [**Inoculation and Milk Ripening**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#inoculation)
* [**Coagulation**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#coagulation)
	+ **enzyme**
	+ **acid**
	+ **heat-acid**
* [**Curd Treatment**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#curd)
* [**Cheese Ripening**](http://www.foodsci.uoguelph.ca/dairyedu/cheese.html#ripening)

 **TREATMENT OF MILK FOR CHEESE MAKING:-**

 The milk for most cheese varieties is subjected to one or more pretreatments shows below:-

**Standardization of fat: protein ratio**

Addition of skim milk

Removal of some fat

Addition of ultra filtration retentate

**Addition of CaCl2**

**Adjustment of pH (e.g. by gluconic acid-6-lactone)**

**Removal or killing of contaminating bacteria**

Thermization (e.g. 65°C x 15 s)

Pasteurization (e.g. 72°C x 15 s)

Bactofugation

Microfiltration

 **Standardization of fat: casein ratio:-**

 The objective of milk composition standardization is to:

1. obtain the maximum economic return from the milk components.

2-produced products with same properties throughout the year and to apply quality control and dairy legal’s.الاستماع

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 3- The concentrations of fat and casein and the ratio of these components are two very important parameters affecting cheese quality. while the concentrations of these components in cheese are determined and controlled by the manufacturing.

**Standardization by Adding skim milk**

**Standardization by cream removing**

**Clarification:-**

 Like most dairy products, cheese milk must first be **clarified .**The principal clarification procedures are as follows.

(1) **Cloth filters** are common to remove debris at the farm but should not be necessary at the processing plant.

(2) **Centrifugal clarifiers,** medium speed centrifuges, remove particles which run away filtration. The loss of milk solids by this process is minimal.

 (3) **Bactofugation** is a high speed centrifugal process which separates bacterial cells and spores. This process is particularly important to remove spore formers bacteria such as *Clostridium tyrobutyricum* Bactofugation removes 95% of the spores of milk which means the risk of late gas defect due to germination and growth of *Clostridium tyrobutyricum* is much reduced but not eliminated.

(4) **Microfiltration** is a membrane process which has been used in a few European cheese plants since 1985. Think of microfiltration as an ultrafine sieve. Microfiltration achieves about 99% reduction of spore forming bacteria relative to 95% by bactofugation. The disadvantage is that microfiltration can be applied only to skim milk because the milk fat globules are too large to pass through the microfiltration membrane.

**Thermization**: -

 The milk may then be subjected to a sub-pasteurization treatment of 63-65° C for 15 to 16 sec, this treatment results in a reduction of high initial bacteria counts before storage. It must be followed by proper pasteurization.

**Pasteurization: -**In order to make the milk safe for human consumption it is pasteurized. This process rapidly heats and cools the milk. Pasteurized milk has been heated to(72° C) for 15 seconds. Milk must be heat treated to reduce the bacterial load, eliminate pathogenic bacteria (kills the disease causing organism’s) and inactivate enzymes, without significantly affecting the physical and chemical properties of the milk.

The effects of Pasteurization are

* Longer flocculation (coagulation) times
* Weak or no curd formation
* Excessive loss of fines
* Poor syneresis (moisture release)
* Coarse textured curd with reduced ability to stretch and melt.

Milk treatment at very high time/temperatures can affect the taste and performance of milk Cooked or burnt flavor and changing the chemistry of proteins.

### Additives:-

The following may all be added to the cheese milk:

**Calcium chloride**: -

 Calcium chloride is added in a few amounts ranging between **0.01-0.02%** of milk weight which used in cheese manufacturing **to replace calcium redistributed during pasteurization** to achieve constant coagulation time and produce curd with suitable properties. Milk coagulation by rennet during cheese making requires an optimum balance among **ionic calcium** (soluble) and insoluble calcium phosphate salts. Because calcium has reverse solubility with respect to temperature, the heat treatment from pasteurization causes the equilibrium to shift towards insoluble forms. Near normal equilibrium is restored during 24 - 48 hours of cold storage, but cheese makers can't wait that long, so CaCl2 is added to restore ionic calcium and improve rennet ability. The calcium assists in coagulation (time and curd characteristics’), reduces the amount of rennet required and producing curd with high tension or strength, easy to cutting and whey drainages with little lost of fat and casein in whey which leads to obtained higher cheese yield

 **Oxidizing agents:-**

**Sodium or potassium nitrate** (NaNO3 or KNO3) added is at levels of about 8 to 10 grams of potassium nitrate to 100 liters of Edam, Gouda, and Swiss milk to inhibit growth of gas forming bacteria *Clostridium tyrobutyricum or E.coli* in the cheese during fermentation ( prevent gases formation and blowing occur by certain harmful fermentations through the production of H2, and CO2 and off-flavours (butanoic acid) in many ripened cheeses).

**Hydrogen peroxide:-**

 hydrogen peroxide is sometimes used (0.05-0.08 %)as an alternative treatment for pasteurization(antimicrobial agent)after milking , it is inexpensive substance and easily decomposed by the catalase enzyme, using of hydrogen peroxide in cheese making leads to the negative aspects such as longer flocculation times ,Weak curd formation loss of fines , Poor syneresis (moisture release) and decreasing of nutritional value by oxidation of some essential amino acids like Thr (sunlight flavor).

**Bleaching agent:-**

 some types of cheeses such as mold-ripened cheeses ( Blue and Roquefort cheeses) need to have white curd to make the mold growth and color more marked, Benzoyl peroxide (BP) has been used for over 50 years as a bleaching agent in whey processing and milk for cheese making at levels of about 10- 20 mg/kg.

Goats' and sheeps' milk are flat white in color because they lack -carotene. Cows' milk may be whitened (contains more carotene) to mimic goats' or sheeps' milk especially in spring.

**Carbon dioxide:-**

is addedtopasteurized milk to produce carbonic acid which lowers the pH to calf rennet optimal pH and in turn assists coagulation, Increased rate of gel firming and higher curd firmness at cutting .

**Starter stimulating substances** are added to stimulating starter microorganisms growth such as yeast extract, hydrolyzed proteins, free amino acids vitamins…..

**Emulsifying agents** Sodium citrate or phosphate andGlyceryl- monostearate (GMS) usually added to emulsifying fat in some types of chesses such as procced and ricotta which results in texture improving.

**Ripening Agents**

A wide range of products are available to accelerate cheese ripening or to develop a broader flavour profile.

 **1- Lipase:** Lipases, normally present in raw milk (endogenous) are inactivated during pasteurization. The addition of (kid goat lipases and Lipases from Mucor . miehei and Aspergilli strains are commercially available )are common to induced Lipolysis and useful for the manufacture of mold-ripened cheeses, blue cheeses, and some Italian types( Romano).

 Lipases triacylglycerol acylhydrolase, E.C. 3.1.1.2 hydrolyze triacylglycerols to di- and mono-acylglycerols and short-chain free fatty acids which plays a significant role in the flavorful and volatile flavor formation.

**2-Enzyme Cocktails**

 Mixtures of enzymes from various sources added to the milk to accelerate ripening of aged cheeses. These cocktails include both lipases and proteases, with a predominance of proteases for Cheddar. Bacterial enzyme extracts from lactic acid bacteria have also been used.

**Colorants:-**

 The most important dyes for coloring chesses are derived from plants and vegetables and include yellow-orange annatto, carotene and paprika. Annatto is the most widely used color material for natural and process cheese.The fruit of the annatto tree (*Bixa orellana*), found in the tropics, is the source of annatto color for cheese and butter.Its active coloring agent is bixin which becomes norbixin when extracted with an alkli.

 Amount of in norbixin annatto rang from 0.5-1.5 %.For use in cheese; annatto is extracted by an alkaline solution such as 0.1M NaOH. Commercial annatto solution is added in range 10-20ml \100kg milk depending on cheese type and should be diluted with water about five times before adding to cheese milk then stirred in well. The alkaline extracted form is water soluble and attaches to casein in cheese.

 Annatto is also used for coloring butter, It is prepared by extraction with vegetable oil such as rape- seed. This product, unlike the annatto for cheese ,is fat soluble.

Annatto intended for use in butter is not recommended in cheese as is it may not disperse well and the cheese surface may appear spotty.

 The following are some facts about annatto.

* Annatto cheese color is added to some cheese to standardize seasonal changes in color or to create orange cheese such as Cheddar and Cheshire.
* Annatto is a carotenoid similar to -carotene and Vitamin A in structure, but it has no Vitamin A activity.
* About 10% of annatto goes into the whey.
* Annatto color is red to yellow pigment but it usually appears as orange. The red constituent is more apparent with decreasing pH (6-4.8) changing the orange to pink while at pH < 4.8 the pink becomes nearly white.
* Bleaching of annatto is also caused by oxidizing agents(annatto is oxidized easy) such as copper, iron, chlorine and light.
* Oxidation of annatto is also confident by heat.
* Alternatives to annatto are:
	+ Beta-carotene which is too yellow and makes the cheese taste like carrots.
	+ Apo-8-carotenal which has the advantage that it is not lost in the whey.

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**Antibiotics are** added to inhibit growth of gas forming bacteria *Clostridium tyrobutyricum or E.coli* in the cheese during fermentation ,usually **Nisin** (antimicrobial agent)is used for this purpose.

 **Spices and Herbs:-**Some spices and herbs is Added to give the desired flavor in cheese such as mint (Sage cheese), onions, garlic ( Besa or owshary cheese) and cinnamon and cumin(Kuminost cheese).