Dairy Products and Processing

Slide 1 Dairy Products and Processing, Definitions and standards, Processing steps, Shelf-life, Fermented dairy products

Slide 2 Definitions

Raw milk: The lacteal secretion, practically free from colostrum,

Obtained by the complete milking of one or more healthy cows (PMO).

"Consumer Milk" products:

- Homogenized milk: ?3.25% fat
- Reduced fat milk: 2% fat
- Low fat milk: 1% fat
- Fat-free milk: skim milk, <0.5% fat

(All with 8.25% solids-non-fat)

Other "milk products": lactose reduced milks, heavy cream, cultured milks, yogurt, cottage cheese, ice cream, butter

Slide 3 Shelf-life:

Time for which a product can be stored without the quality falling below a certain acceptable minimum level

Consumer milk: 14 days, under refrigeration (Muir, 1996)

Slide 4 Pasteurized Milk Ordinances (PMO)

Produced by Public Health Service/Food and Drug Administration

Sanitary regulations for milk and milk products

Specifies sanitation measures throughout production, handling,

Pasteurization and distribution of milk

(http://vm.cfsan.fda.gov/~ear/p-nci.htm#pmo96)

Slide 5 Fluid Milk Processing

Raw milk storage-Cleaning and decreaming (Separator)-Homogenization-Fat standardization-Heat treatment-Chilling (Heat exchanger)-Intermediate storage-Filling / Packing

Slide 6 Raw Milk Quality and Storage

Chemical, bacteriological, and temperature standards for Grade A raw milk for pasteurization, ultra pasteurization or aseptic processing (PMO)

- Temperature: 45ºF or less within 2 hr. after milking

Bacterial counts: <100,000 cfu/ml for individual farm milk and <300,000/ml as commingled milk prior to pasteurization

- Somatic Cell Counts: <750,000/ml

- Antibiotic presence: negative

Storage time at plant max. 72hr

Longer holding times allow growth of psychrophilic bacteria which can secrete heat-resistant proteases and lipases

Slide 7 Bacteria that limit milk shelf-life

lipolytic and proteolytic psychrotrophs

- Heat resistant enzymes

- Ex. Pseudomonas fluorescens

Psychrotrophic spore formers (thermoducrics)

- Heat resistant spores

- Ex. Bacillus cereus

Slide 8 Thermization (Lewis and Heppell, 2000)

57-68°C for 15 seconds

Only effective if cooled to 4°C after treatment

Applied to raw milk that needs to be stored for several days prior to use

Purpose: reduce gram-negative psychotropic spoilage organisms (enzyme production)

Slide 9 Clarifications and Clearing

Clarification: removal of small particles

- Straw, hair etc. from milk; 2 lb. /2,642 gal

- based on density

“Bactofugation”: Centrifugal separation of microorganisms from milk:

- Bacteria and particularly spores have higher density than milk

- Two-stage centrifugation can reduce spore loads up to >99%

- Optimal temperature for clarification is 55-60ºC

Microfiltration

- Micro filter membranes of 1.4 □m or less can lead to reduction of bacteria

- And spores up to 99.5-99.99%.

Slide 10 Milk Fat Standardization/Decreaming

Separation of skim milk (about 0.05% fat) and cream (35-40% fat)

Based on the fact that cream has lower density than skim milk

Centrifugal separators are generally used today

Standardization of fat content: Adjustment of fat content of milk or a

Milk product by addition of cream or skim milk to obtain a given fat content

Slide 11 Homogenization

Definition: Treatment of milk or a milk product to insure breakup of fat globules such that no visible cream separation occurs after 48 h at 40ºF (4.4ºC)

Effects of homogenization:

No cream line formation due to smaller fat globules

Whiter color

More full-bodied flavor, better mouth feel

Process requirements:

Homogenization most efficient when fat phase is in a liquid state

Cream >12% fat cannot be homogenized at normal pressure, high pressure homogenization process is necessary

Homogenization is a mechanical process where milk is forced through a small passage at high velocity

Slide 13 Pasteurization

Purpose: Inactivation of bacterial pathogens (target organisms Coxiella burnettii)

- assurance of longer shelf life (inactivation of

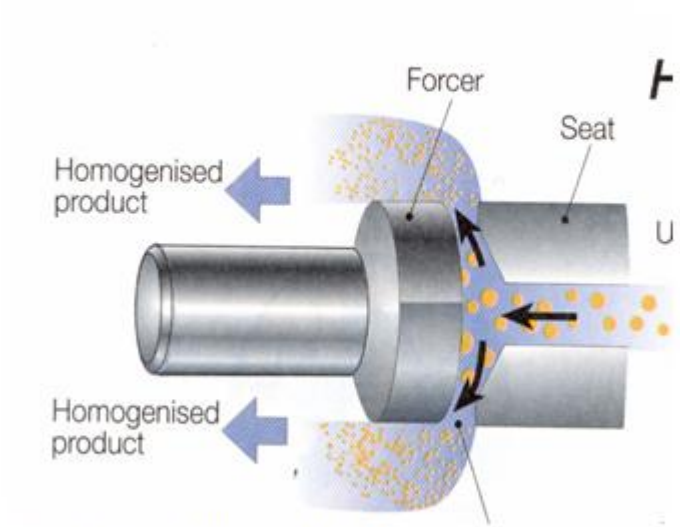
most spoilage organisms and of many enzymes)

Pasteurization

Heat treatment of 72ºC (161°F) for 15 sec (HTST) or 63ºC (145°F) for 30 min (or equivalent)

does not kill all vegetative bacterial cells or spores (Bacillus spp. and Clostridium spp.)

Pasteurization temperature is continuously recorded The temperature has to be recorded so that there is a record that the process is achieving the lethality that it was designed to achieve.



From the "Dairy Processing Handbook" 1995. Tetra Pak

Slide 14 Efficacy of Pasteurization prior to pasteurization (1938):

Milk borne outbreaks constituted 25% all disease outbreaks

Today: milk products associated with < 1%

Slide 15 Heat Treatment (Con't)

Standards for Grade A pasteurized milk and milk products (PMO)

Temperature: Cooled to 45ºF or less

Bacterial counts: <20,000 cfu/ml

Coliform Counts: <10/ml

Phosphatase: < 1 g/ml

Antibiotic presence: negative

Slide 16 Heat Treatment (Cont.) Ultra pasteurization: Thermal processing at 138ºC (280ºF) for at least 2 seconds

- UP milk: ultra-pasteurized and "non-aseptically" packaged, refrigerated storage
- UHT milk: ultra-pasteurized and aseptically packaged, storage at room temperature; avoid Recontamination

Standards for Grade A aseptically processed milk (UHT)

- Temperature: none
- Bacterial counts: no growth
- Antibiotic presence: negative

Slide 17 Vitamin Fortification

Preferably after separation

Has to occur before pasteurization

Can be continuous (using a metering pump) or batch addition

Slide 18 Filling / Packaging

Functions of packaging:

- Enable efficient food distribution
- Maintain product hygiene
- Protect nutrients and flavor
- Reduce food spoilage

- Convey product information

Different containers:

- Glass bottles (translucent vs. dark): can be reusable or recyclable

- Plastic containers

- Cartons

- Plastic bags

Slide 19 Shelf Life of Heat Treated Fluid Milk

Shelf life depends on:

- Raw milk quality (bacterial and chemical quality)

- Processing conditions

- Post-processing storage

Loss of taste and vitamins by light exposure:

- Light-impermeable containers

Extended Shelf life (ESL) milk

- No single, specific definition of ESL

Pasteurized milk with a shelf life beyond the current typical shelf life of these products (10 - 14 days)

- Generally involves measures to eliminate or minimize “post-pasteurization” contamination

Slide 20 Fermented Dairy Products

Fermented foods:

- Food products produced by biological transformation (by bacteria or fungi)

- Carbohydrate breakdown as major characteristics (lactose lactate)

Preservation: production of acids and alcohol (by “beneficial” bacteria) to inhibit spoilage bacteria and pathogens

Slide 21 Cheeses:

- Product made from the curd of the milk of cows

(Or other animals)

- Casein coagulated by rennin and acid

- Subsequent heating, salting, pressing, aging

Slide 22 Classification of Cheeses (Potter, 1995)

Soft

- unripened: cottage cheese, cream cheese

- ripened: Brie, Camembert

Semisoft

- Munster, Limburger, Blue

Hard

- Cheddar, swiss

Very hard (grating)

- Parmesan, Asiago

Whey cheeses (ricotta)

Processed cheese

Slide 23 Cheddar Cheese Making Process

Pasteurized milk-Setting the milk-Cutting the curd-Cooking the curd-Cooking the curd-Draining the whey-Milling and salting, Pressing-Pressing-Ripening

Slide 24 Cheddar cheese making process

Starting ingredient: pasteurized whole milk

Setting the milk

- While stirring heat to 31°C

- add lactic-acid producing starter cultures

- (add natural color)

- add rennin to coagulate caseins and form curds

- stop stirring and let set

Cut the curd

- increase surface area
- release the whey

Cooking (38°C for 30 minutes)

- removes more whey
- increases growth and acid production of cultures

Slide 25 Cheddar cheese making (cont.)

Draining whey and matting the curd

- remove excess whey
- form curds into a slab
- Cheddaring: cutting curd slab into blocks to allow excess Whey to drain, and allow acidity to increase

Milling and salting

- cut curds into small pieces
- 2.5% salt is added: drains whey, inhibits spoilage organisms And adds flavor

Pressing to remove more whey

- Moisture content will affect bacterial growth and texture

Ripening: bacteria develop flavor and texture over time

Slide 26 Ripening: flavor and texture development

Primary proteolysis

- 60 days; residual chymosin
- Caseins broken down into medium molecular wt. peptides

Secondary proteolysis

- Starter cultures break down peptides to lower molecular

Weights.

Temperature: 5-7°C

PH: 5.0 - 4.7

- inhibits growth of spoilage organisms

- inhibits enzyme activity

Slide 27 Cheese flavor development

A complex, dynamic process

Nature of the flavor evolves

Proteolysis essential for full flavor development

- Proteolytic enzymes

Allow LAB to utilize proteins present in milk to obtain essential amino acids necessary for growth

- Generates peptides and amino acids

Impart flavor directly or serve as flavor precursors

Slide 28 Whey

100 lb. of milk => 10 lb. cheese + 90 lb. whey

(NYS produces 3.6 billion lb. /year)

Low solids, high lactose

Highly perishable (contains starter organisms)

Acid whey: drained from cheese curd acidified to 4.6 by

Cultures (or acid); ex. Cottage cheese

Sweet whey: drained from curd formed by rennet coagulation ex. Cheddar

Slide 29 Whey Products

Concentrated and spray dried

Whey powder

Whey protein concentrates

- Different % purity

- Food ingredient

Lactose

- Food ingredient

- fermented into alcohol

Whey cheeses

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