

Decreto 616 de 2006

LECHE HIGIENIZADA: *Es el producto obtenido al someter la leche cruda o la leche* termizada a un proceso de pasteurización, ultra-alta-temperatura UAT (UHT), ultrapasteurización, esterilización para reducir la cantidad de microorganismos, u otros tratamientos que garanticen productos inocuos microbiológicamente.

LECHE PASTEURIZADA: Es el producto obtenido al someter la leche cruda, termizada o recombinada a una adecuada relación de temperatura y tiempo para destruir su flora patógena y la casi totalidad de flora banal, sin alterar de manera esencial ni su valor nutritivo ni sus características fisicoquímicas y organolépticas. Las condiciones mínimas de pasteurización son aquellas que tiene efectos bactericidas equivalentes al calentamiento de cada partícula a 72°C - 76°C por 15 segundos (pasteurización de flujo continuo) o 61 °C a 63° C por 30 minutos (pasteurización discontinua) seguido de enfriamiento inmediato hasta temperatura de refrigeración.

LECHE TERMIZADA: *Producto obtenido al someter la leche cruda a un tratamiento* térmico con el objeto de reducir el número de microorganismos presentes en la leche y permitir un almacenamiento mas prolongado antes de someterla a elaboración ulterior. Las condiciones del tratamiento térmico son de mínimo 62°C durante 15 a 20 segundos, seguido de enfriamiento inmediato hasta temperatura de refrigeración.

La leche termizada debe reaccionar positivamente a la prueba de fosfatasa alcalina, siendo prohibida su comercialización para consumo humano directo.

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LECHE ULTRAPASTEURIZADA: *Es el producto obtenido mediante proceso térmico en* flujo continuo, aplicado a la leche cruda o termizada en una combinación de temperatura entre 135 ° C a 150 ° C durante un tiempo de 2 a 4 segundos, seguido inmediatamente de enfriamiento hasta la temperatura de refrigeración y envasado en condiciones de alta higiene, en recipientes previamente higienizados y cerrados herméticamente, de tal manera que se asegure la inocuidad microbiológica del producto sin alterar de manera esencial ni su valor nutritivo, ni sus características fisicoquímicas y organolépticas, la cual deberá ser comercializada bajo condiciones de refrigeración.

LECHE ULTRA-ALTA-TEMPERATURA UAT (UHT) LECHE LARGA VIDA: *Es el* producto obtenido mediante proceso térmico en flujo continuo, aplicado a la leche cruda o termizada a una temperatura entre 135 °C a 150 °C y tiempos entre 2 y 4 segundos, de tal forma que se compruebe la destrucción eficaz de las esporas bacterianas resistentes al calor, seguido inmediatamente de enfriamiento a temperatura ambiente y envasado aséptico en recipientes estériles con barreras a la luz y al oxígeno, cerrados herméticamente, para su posterior almacenamiento, con el fin de que se asegure la esterilidad comercial sin alterar de manera esencial ni su valor nutritivo ni sus características fisicoquímicas y organolépticas, la cual puede ser comercializada a temperatura ambiente.

Clarification 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 55-60°C
 - Microfiltration
 - Microfilter membranes of 1.4 μm or less can lead to reduction of bacteria
 - and spores up to 99.5-99.99%.
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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 psychrotrophic spoilage organisms (enzyme production)
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Pasteurization of milk

- Heating milk at a definite temp for a definite time to destroy pathogens but not all bacteria
 - 62°C for 30 min
 - 70°C for 15 sec to 100°C for 0.01 sec (HTST)
 - 138°C for 2 sec (UHT)
 - to inactivate enzymes (lipase), control rancid & oxidized flavor, and increase shelf life
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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 72°C (161°F) for 15 sec (HTST) or 63°C (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
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Efficacy of Pasteurization

- prior to pasteurization (1938) :
milkborne outbreaks constituted **25%** all disease outbreaks

 - Today: milk products associated with **< 1%**
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Destruction of Built-In Safety Systems by Pasteurization

Component	Breast Milk	Raw Milk	Pasteurized Milk	Infant Formula
B-lymphocytes	X	X	inactivated	inactivated
Macrophages	X	X	inactivated	inactivated
Neutrophils	X	X	inactivated	inactivated
Lymphocytes	X	X	inactivated	inactivated
IgA/IgG Antibodies	X	X	inactivated	inactivated
B12 Binding Protein	X	X	inactivated	inactivated
Bifidus Factor	X	X	inactivated	inactivated
Medium-Chain Fatty Acids	X	X	reduced	reduced
Fibronectin	X	X	inactivated	inactivated
Gamma-Interferon	X	X	inactivated	inactivated
Lactoferrin	X	X	inactivated	inactivated
Lysozyme	X	X	inactivated	inactivated
Mucin A/Oligosaccharides	X	X	reduced	inactivated
Hormones & Growth Factors	X	X	reduced	inactivated

Scientific American, December 1995

The Lancet, Nov 17, 1984

Heat Treatment

- Standards for Grade A pasteurized milk and milk products (PMO)
 - Temperature: Cooled to 45°F or less
 - Bacterial counts: <20,000 cfu/ml
 - Coliform Counts: <10/ml
 - Phosphatase: < 1μg/ml
 - Antibiotic presence: negative
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Heat Resistant Pathogens in Pasteurized Milk

Johne's bacteria (paratuberculosis bacteria)—
Suspected of causing Crohn's disease, now
routinely found in pasteurized milk

B. Cereus spores survive pasteurization

Botulism spores survive pasteurization

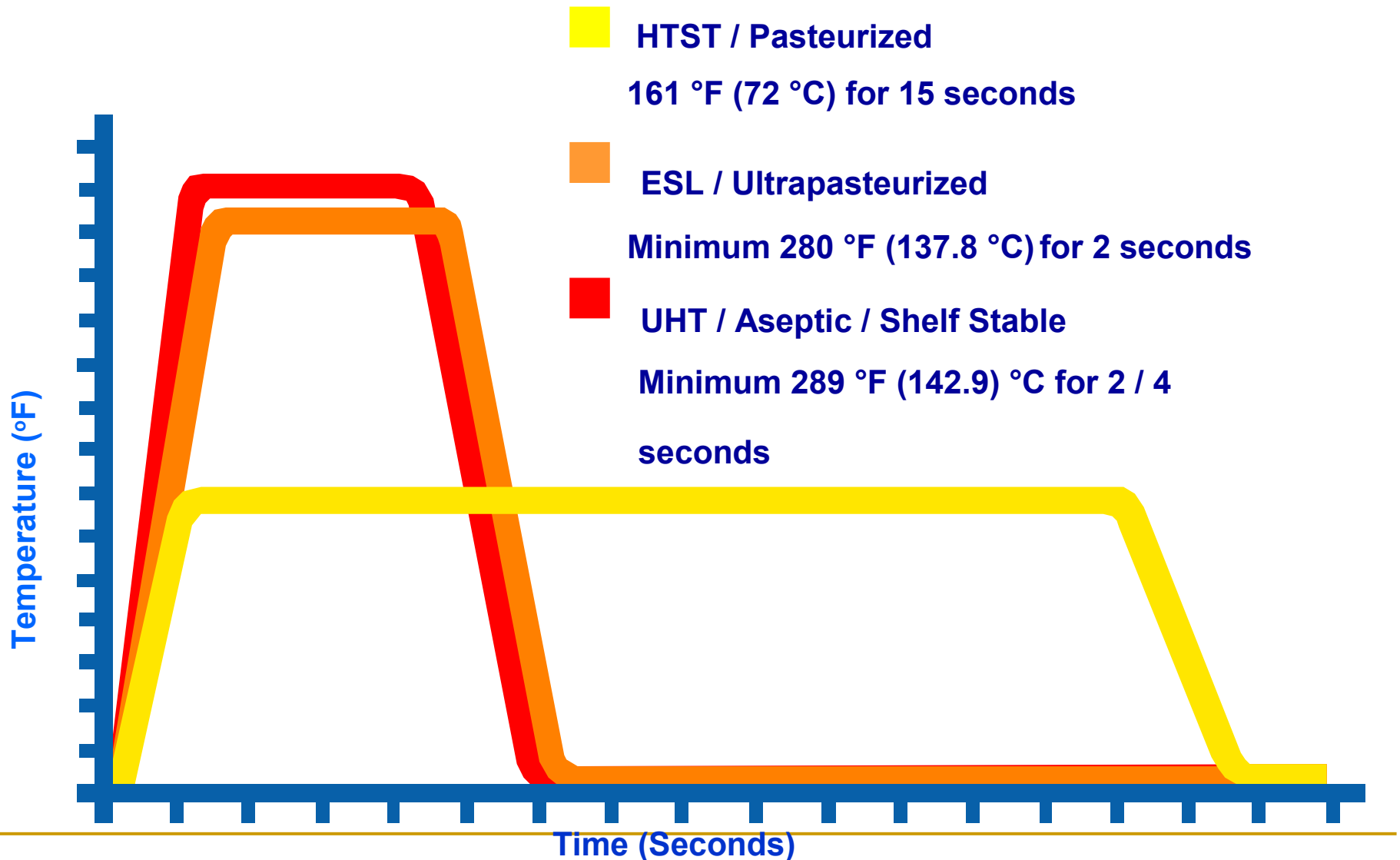
Protozoan parasites survive pasteurization

Elliott Ryser. Public Health Concerns. In: Marth E, Stelle J, eds.
Applied Dairy Microbiology, New York, Marcel Dekker, 2001.

Heat Treatment

- Ultra pasteurization: Thermal processing at 138°C (280°F) for at least 2 seconds
 - UP milk: ultrapasteurized and “non-aseptically” packaged, refrigerated storage
 - UHT milk: ultrapasteurized 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
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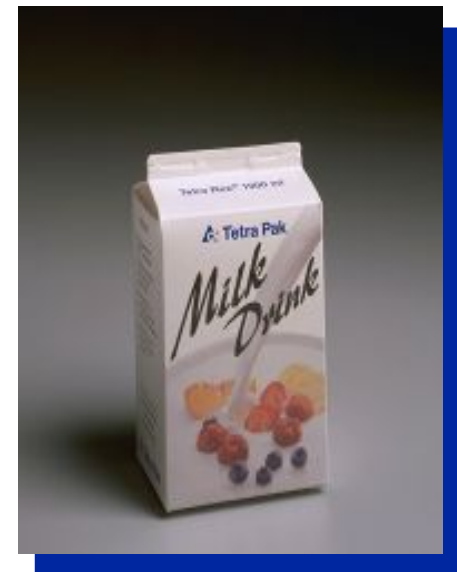
HTST / Pasteurized, ESL / Ultrapasteurized And UHT Processing For Low Acid Products



N.B. Graph not drawn to scale

HTST / Pasteurized Processing For Low Acid Products

- Normal HTST processing at minimum 161 °F (72 °C) / for 15 seconds or comparable
- Shelf life of milk varies depending on many factors such as raw milk, manufacturing practices and cleaning routines - up to 28 days at 39 °F (4 °C) storage



ESL / UHT Processing For Low Acid Products

- Process at minimum 280 °F (137.5 °C) for 2 sec.
- Shelf life of products: 39 °F (4 °C) storage
 - 45 - 80 days on milk
 - 60 - 90 days on non-dairy cream, soy



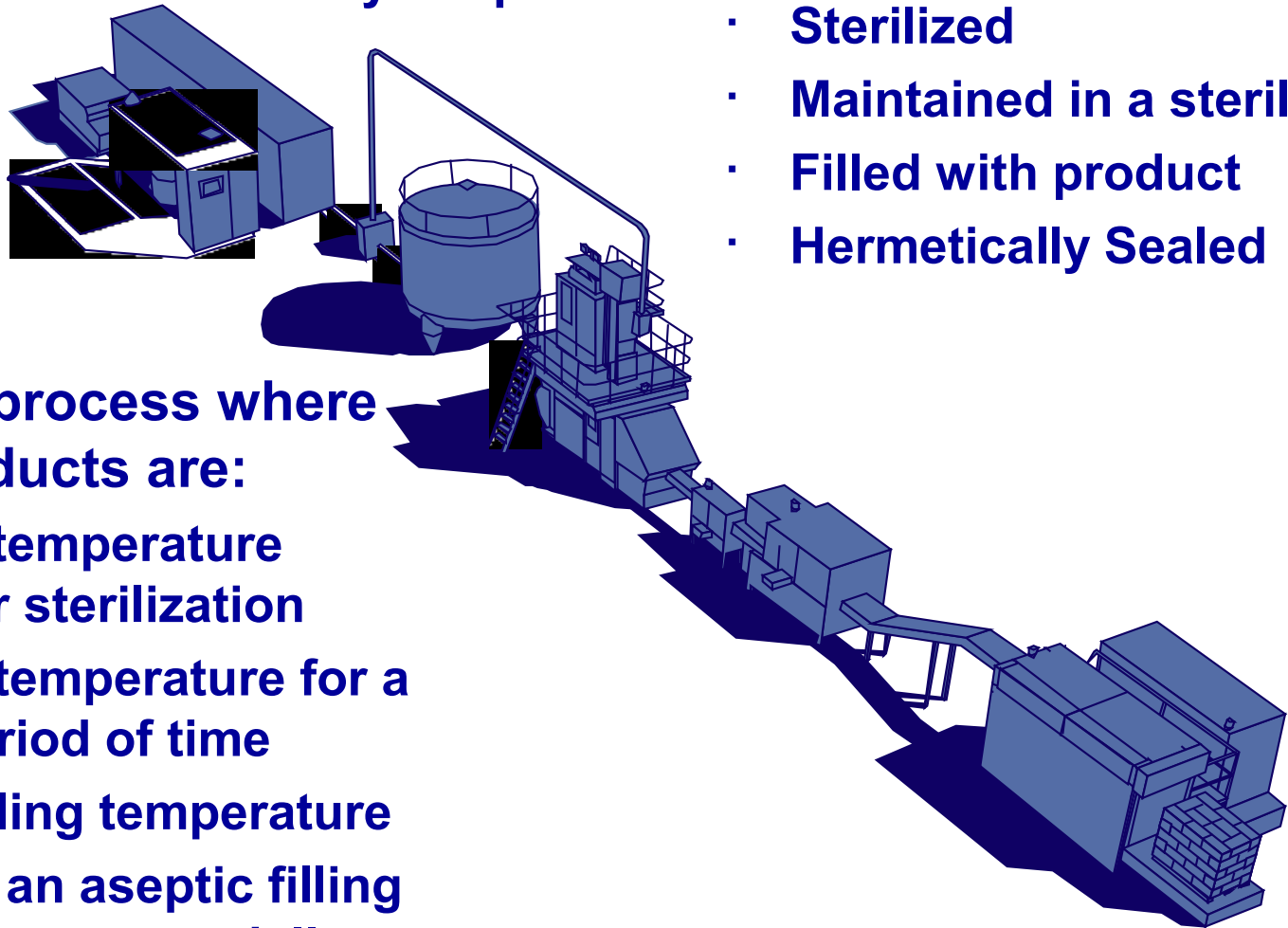
UHT Processing For Low Acid Products

Minimum 289 °F (142.9) °C for 2 / 4 seconds

Shelf life – 6 to 12 months – any temperature

Packaging material is:

- Sterilized
- Maintained in a sterile region
- Filled with product
- Hermetically Sealed



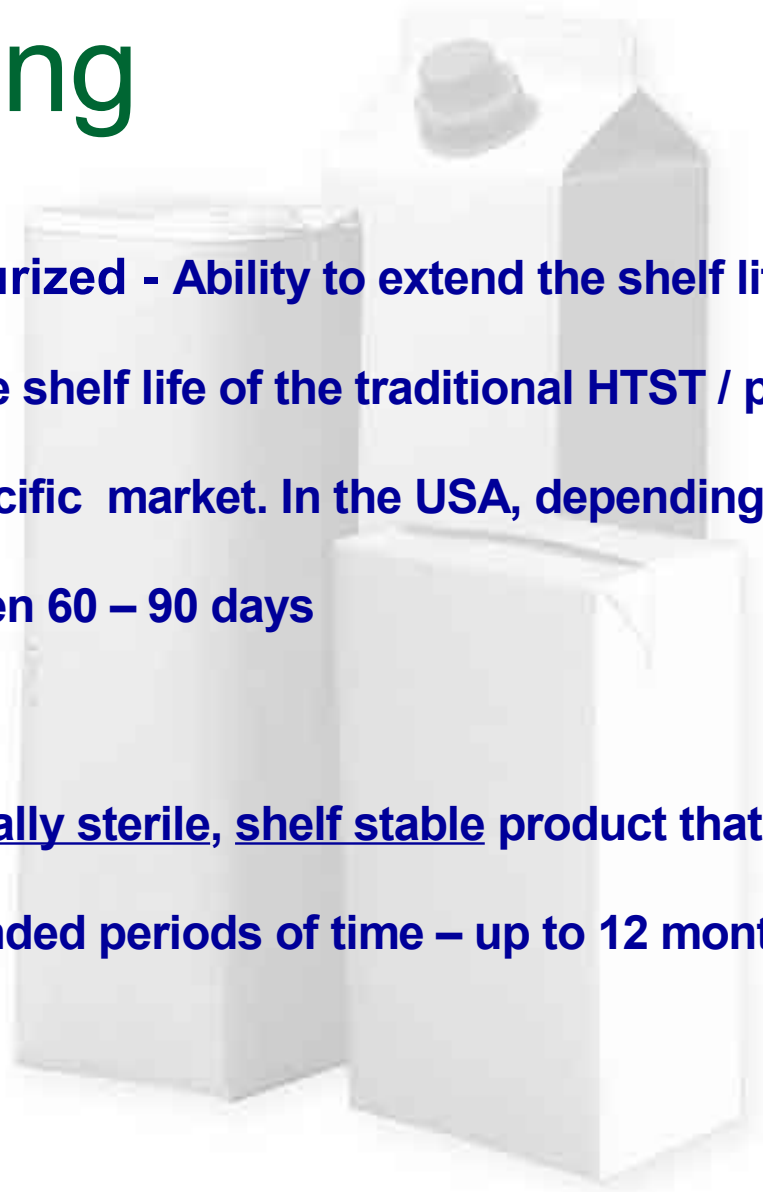
A continuous process where pumpable products are:

- Heated to a temperature sufficient for sterilization
- Held at that temperature for a specified period of time
- Cooled to filling temperature
- Delivered to an aseptic filling machine in a commercially sterile condition

ESL / Utrapasteurized vs UHT Processing

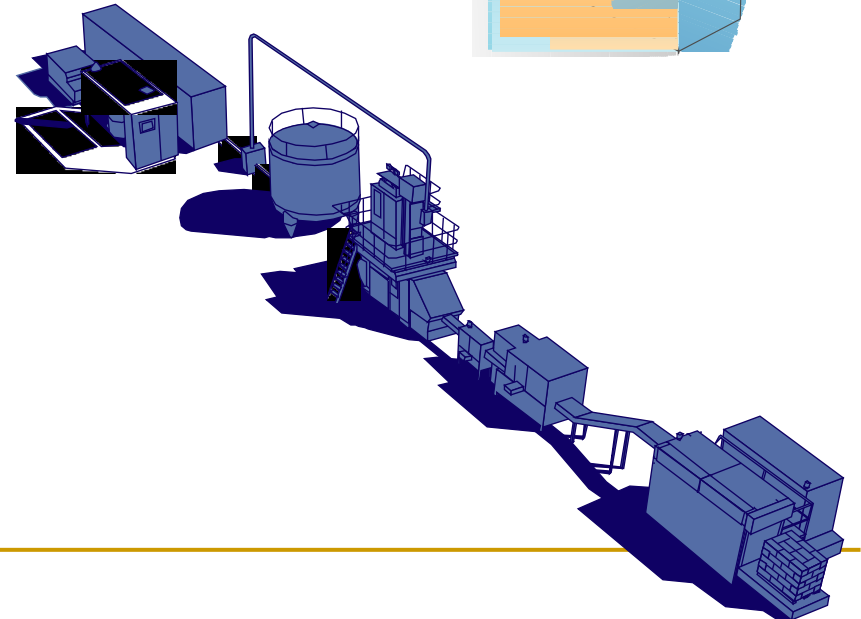
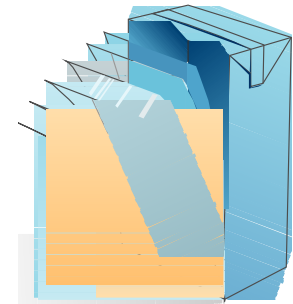
ESL / Utrapasteurized - Ability to extend the shelf life of a chilled distributed product beyond the shelf life of the traditional HTST / pasteurized equivalent in a specific market. In the USA, depending on the product type this could mean between 60 – 90 days

UHT – A commercially sterile, shelf stable product that maintains product freshness for extended periods of time – up to 12 months - under ambient distribution

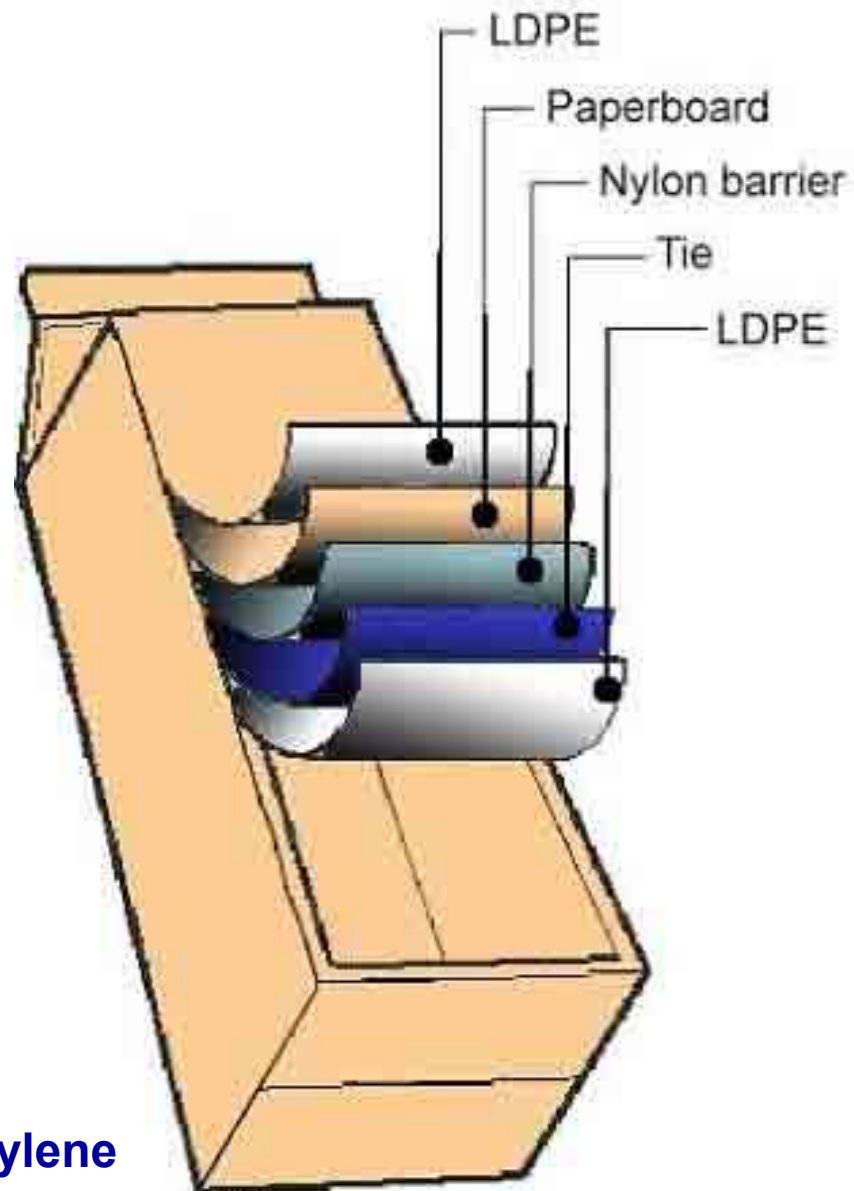


Shelf Stability Begins With Sterile Processing, But Also Requires A Sterile Package, A Sterile Environment

- Producing a commercially sterile liquid food product
- Filling into sterilized package
- Within the confines of a sterile environment

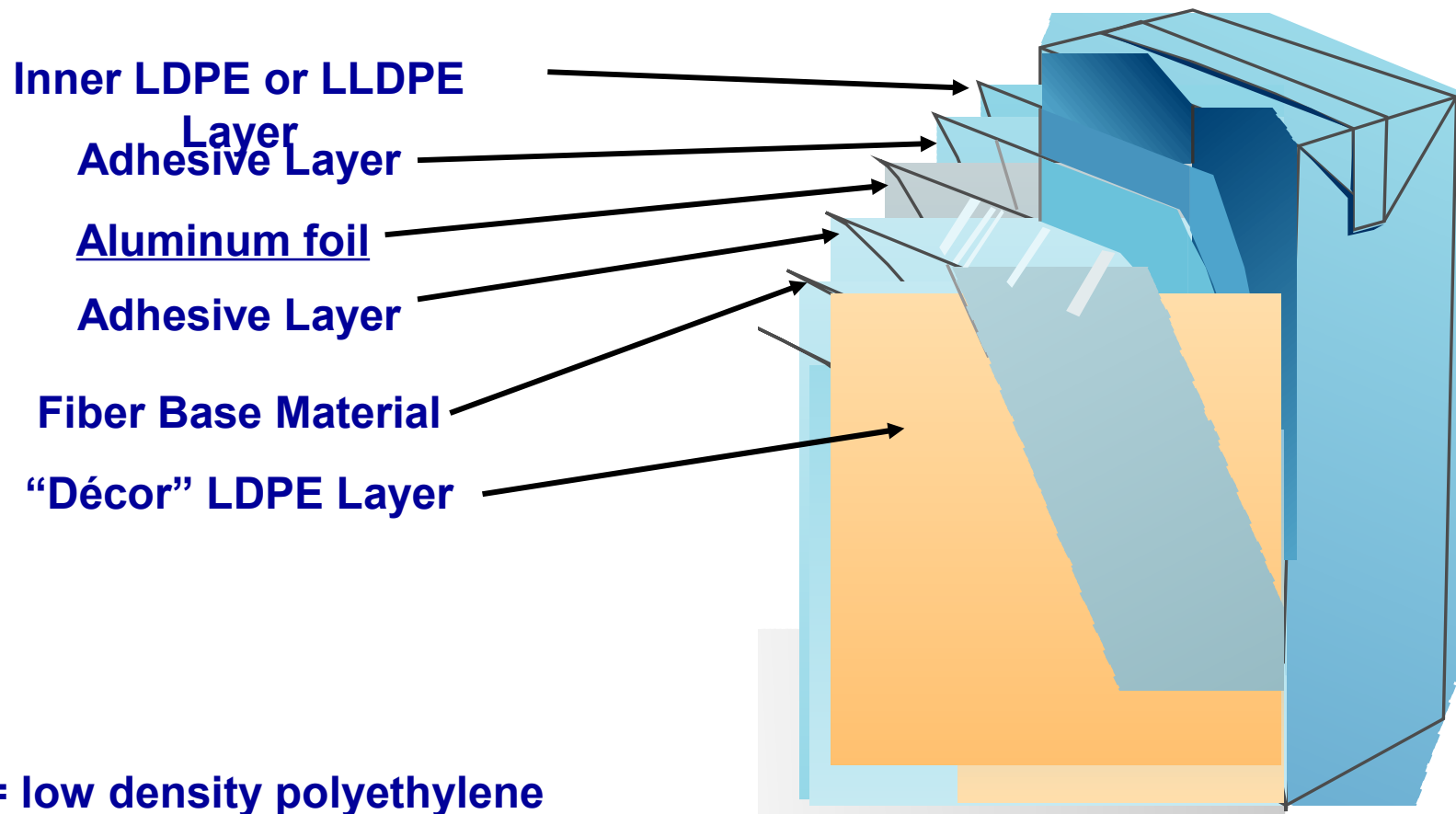


Composition Of A Non-Shelf Stable Package



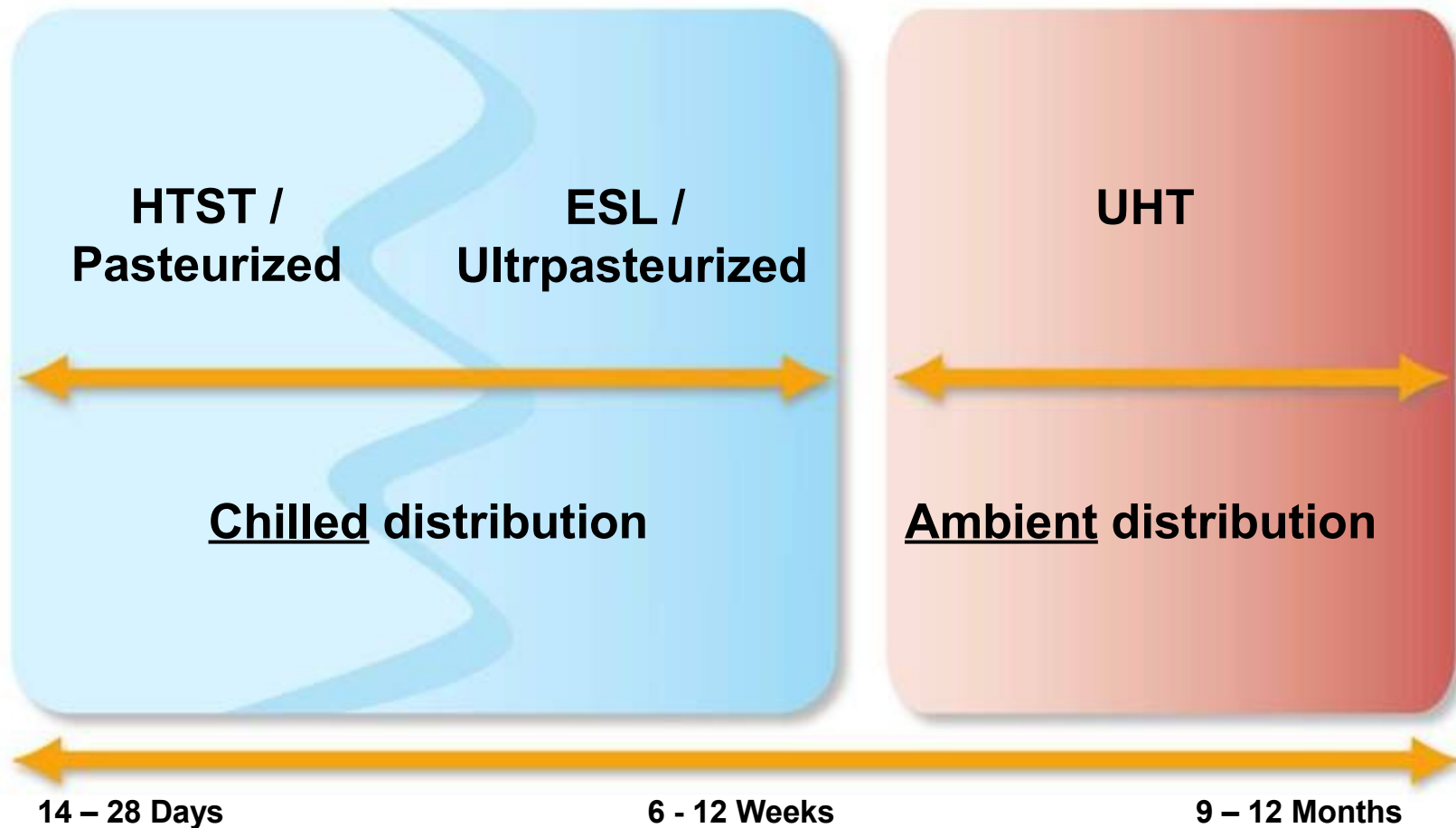
LDPE = low density polyethylene

Composition of A Shelf Stable Package

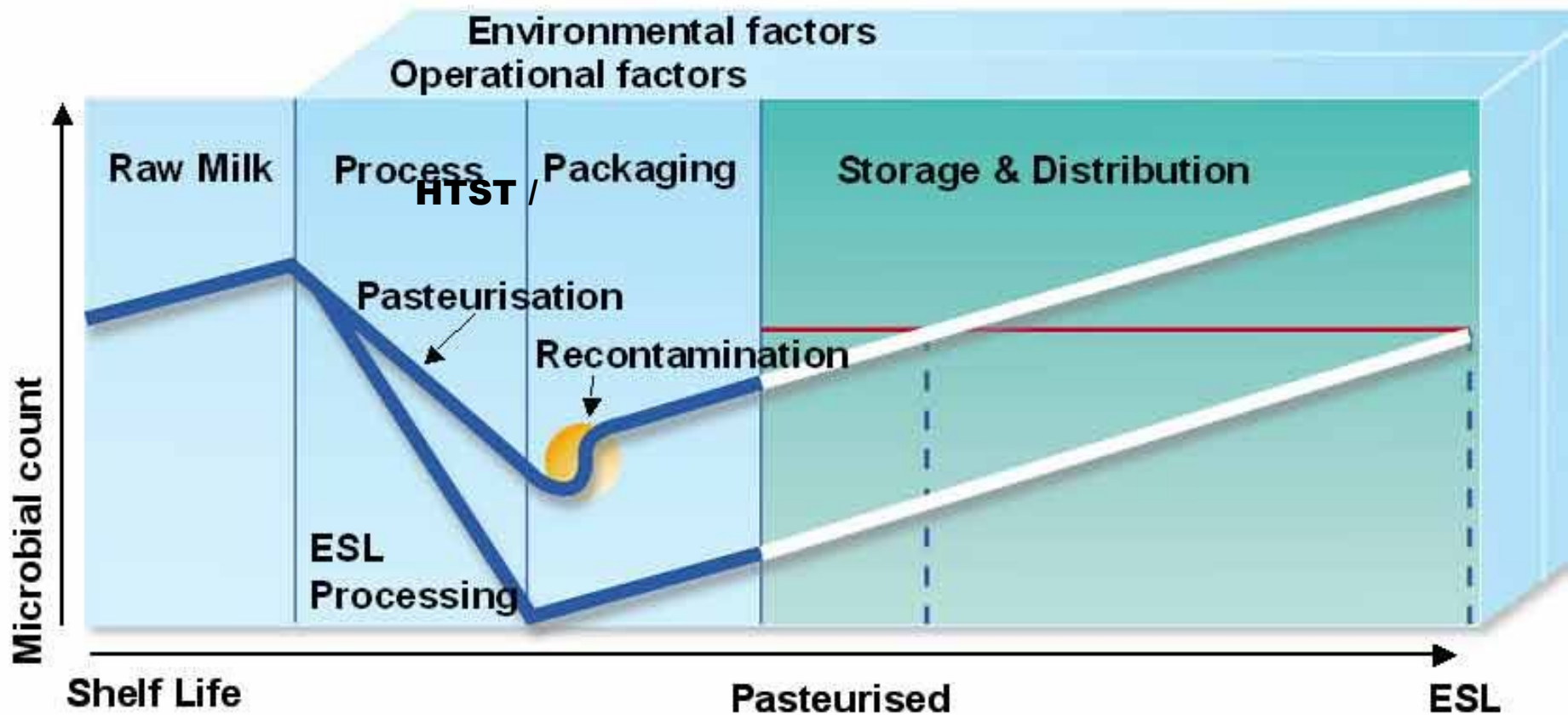


LDPE = low density polyethylene
LLDPE = low low density polyethylene

Shelf Life Expectations

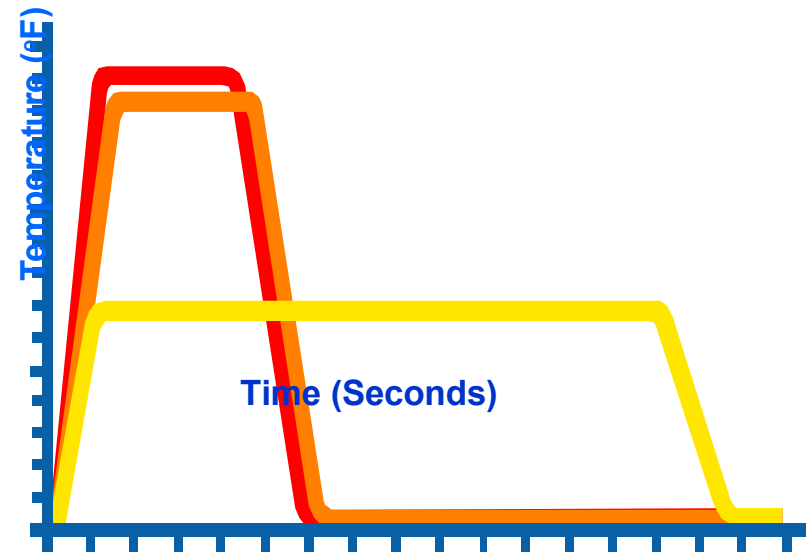


Why ESL / UHT Results In Longer Shelf Life Than HTST / Pasteurized Under Chilled Distribution



Why UHT Results In A Longer Shelf Life Than ESL / Utrapasteurized – And No Refrigeration Is Necessary

- A very high temperature process (UHT), for a short time results in a commercially sterile product
- Packed into a sterile package
- Under sterile conditions
- The result is a product in which the nutritional quality has been preserved
- And which allows the convenience and lowered cost of ambient distribution!



Choosing A Processing Solution

- HTST / Pasteurized (Chilled Distribution)
 - ❑ Simple, commodity products with low differentiation
 - ❑ Shorter, local transport distance
 - ❑ Direct, established chilled supply chain
- ESL / Ultrapasteurized (Chilled Distribution)
 - ❑ Longer, regional transport distance
 - ❑ Direct, established chilled supply chain
- UHT (Shelf Stable / Ambient Distribution)
 - ❑ National transport distance
 - ❑ Indirect supply chain
 - ❑ Established ambient supply chain / or chilled chain could be used



The Quality Remains The Same



Same Milk – Just Different Processes / Different Packaging



Advantages Of Longer Ambient Shelf Life

- Product safety – regardless of storage temperature
 - Free from bacteria and contaminants without preservatives
- Retention of nutritional value
- Increased distribution area
- Extended usage occasions
 - End of term
 - Field trips....etc
- Ease of use
 - Portable and lightweight
 - Shatterproof
 - Easy to open and drink from
 - Easy to dispose



- **Variety** – in both product and flavor!

Effect of Heat on Milk Products

■ Scorching

- Some of the whey proteins (β -lactoglobulin and α -lactalbumin) denature and ppt to form a thin layer of protein on the bottom.
- This protein gradually undergoes the Maillard reaction with lactose, leading to scorching.

■ Scum formation

- denatured protein molecules join together
 - evaporation of water from the surface (increasing the concentration of casein and salts)
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Effect of Heat on Milk Products

- Casien is quite resistant to ppt when heat is applied, but severe heating can cause it to form a curd at pH 7.

Fermentation of Milk

- All fermented milk contains lactic acid
- Undesirable (spoiled products)
- Desirable (buttermilk, yogurt, cheese)

streptococcus lactis initiates the process with *lactobacilli* spp. continuing the fermentation

Increased thickness due to the association of casein micelles, often accompanied by β -lactoglobulin.

Drying of Milk

- Dry milk products
 - whole dry milk powder (WDM)
 - nonfat dry milk (NFDM)
 - dry butter milk
 - dried whey
 - dry cream
 - malted milk powder
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Evaporation & Canning of Milk

■ Evaporated milk

- sterilized canned milk that has been concentrated to about half its original volume by evaporation under a partial vacuum.
 - 25% total milk solids including $\geq 7.5\%$ milk fat
 - high temp canning may give cooked flavor (methyl sulfide)
 - storage at high temp for long time may develop off-color (Maillard reaction)
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Evaporation & Canning of Milk

- **Sweetened condensed milk**
 - 15% sugar is added after concentration of whole milk through evaporation
 - total CHO concentrations of approx. 56% which is sufficient to prevent spoilage by microorganisms
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Milk Foams

- Milk can form gas-in-liquid foams because the milk proteins have
 - low surface tension - easier to spread the liquid proteins into thin films
 - low vapor pressure - reduces the evaporation
 - In fluid milk, the protein concentration is too low to produce a foam with any stability
 - Foams can be formed in evaporated milk or dried milk solids.
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