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Animal Health Matters.
For Safe Food Solutions.

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Federal Department of Economic Affairs,
Education and Research EAER
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Establishment of a risk-based food safety control system in the Ukrainian dairy value chain

Refrigeration and pasteurization: their role for the control of food safety hazards

Training of Trainers (ToT), focus: transporters and MCP

Activity 3.1.1.2

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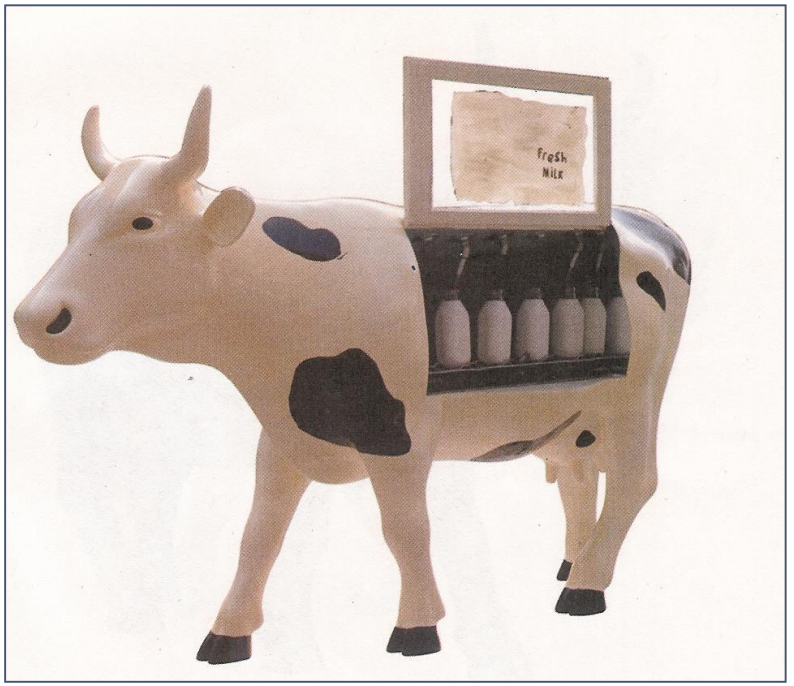
Milk: a major nutritional resource

Composition of 1L of milk (approximate)

Water	902
Sugar - Lactose	49
Fat content - **Lípids** - Phospholipids - Liposoluble components	39
Nitrogen components **1. Proteíns** **Caseíns** **Soluble proteins** 2. Nitrogen (non protein)	33
Salts	9
Biocatalizers Vitamins e Enzimas	
Dissolved gas	5% vol. of milk

Dry matter total → 130 g/l (density at 15ºC ± 1.030)



Why should milk be refrigerated?

- Raw milk, from healthy animals, usually has a very small number of microrganisms (1000 /ml) i.e. *It is not necessarily sterile*. Most commonly: *Micrococcus, Staphylococcus, Streptococcus e Corinebacterium* spp

- Spoilage of any food article depends on:

1) Nutrients
2) Water activity (aw)
3) Temperature of storage
4) pH

- **Milk is cooled to ensure that nutrition and compositional losses are minimized and hygienic qualities maintained for direct sale of milk, or its value-added products**

Milk spoilage: what is the process behind it?

Lactose (sugar) → Glucose and Galactose → Lactic acid → pH ↓

Lactic acid producing bacteria
(lactococci and lactobacilli)

Proteins coagulation and acid liquid whey to form on top

Spore forming bacteria (ex. Bacillus) – production of proteolytic enzymes – break down of milk proteins

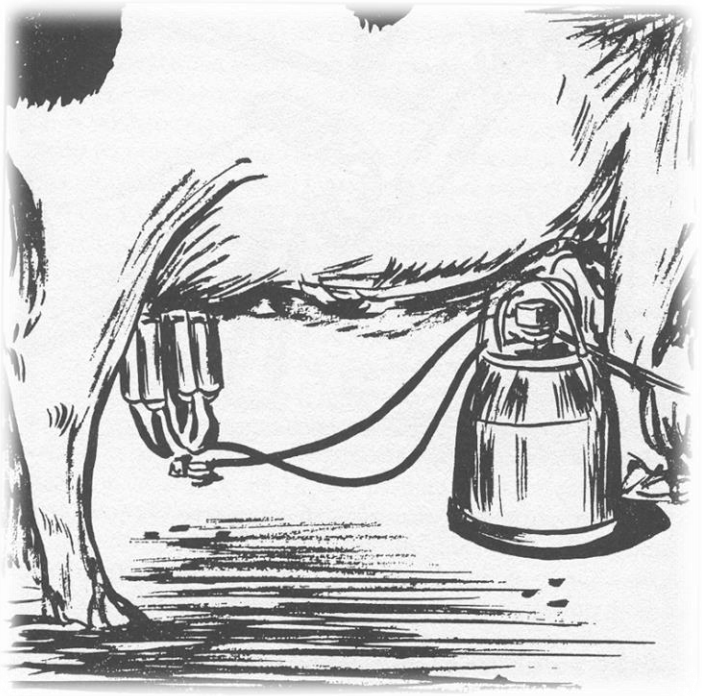
MILK COOLING

- Warm fresh milk should be preferably cooled immediately after milking to preserve quality and prevent spoilage
- Cooling to 10° C within two hours of milking and to 4° C within three to four hours is essential, but more rapid cooling is much preferred

2.8° C – 4.2° C

Milk temperature treatments

«**Raw milk** is the secretion produced by the mammary gland, **not** submitted to a temperature treatment above **40°**, or other of equivalent effect»



THE cold chain: how important and long!

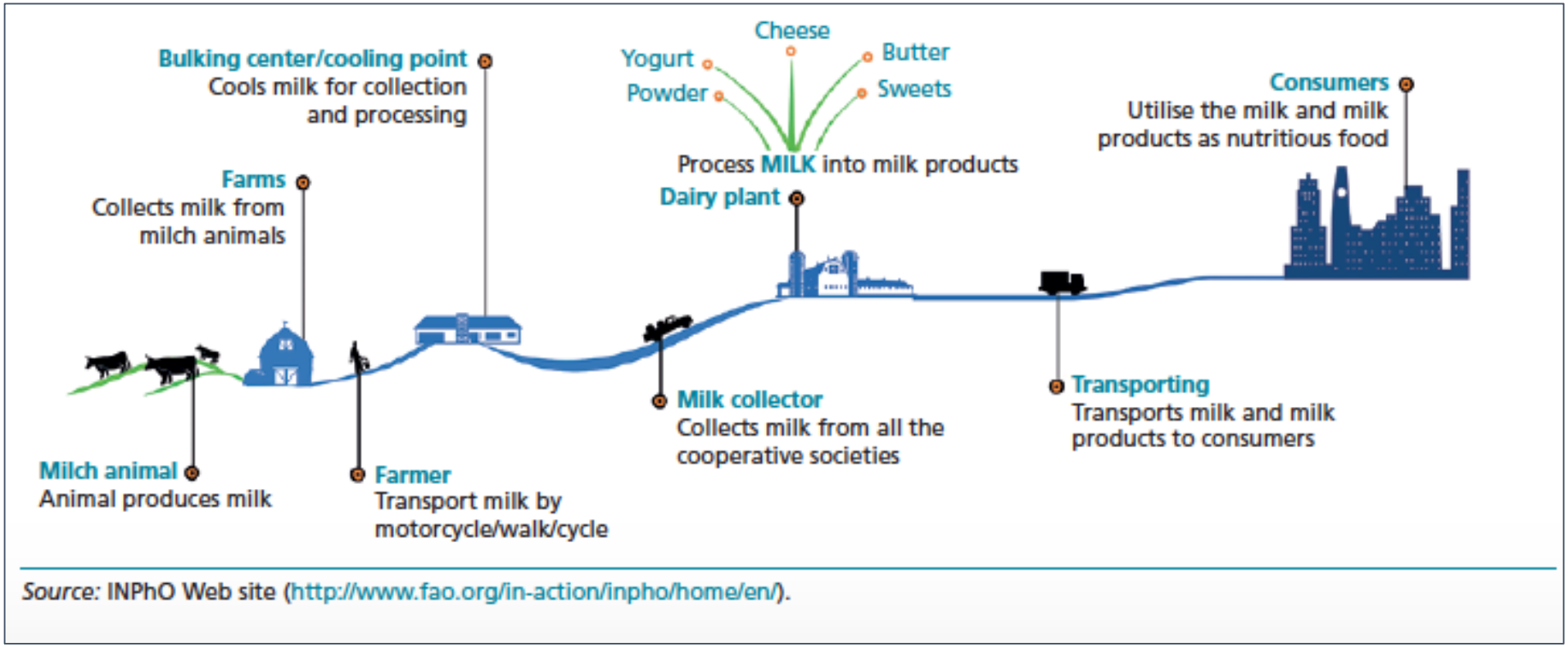
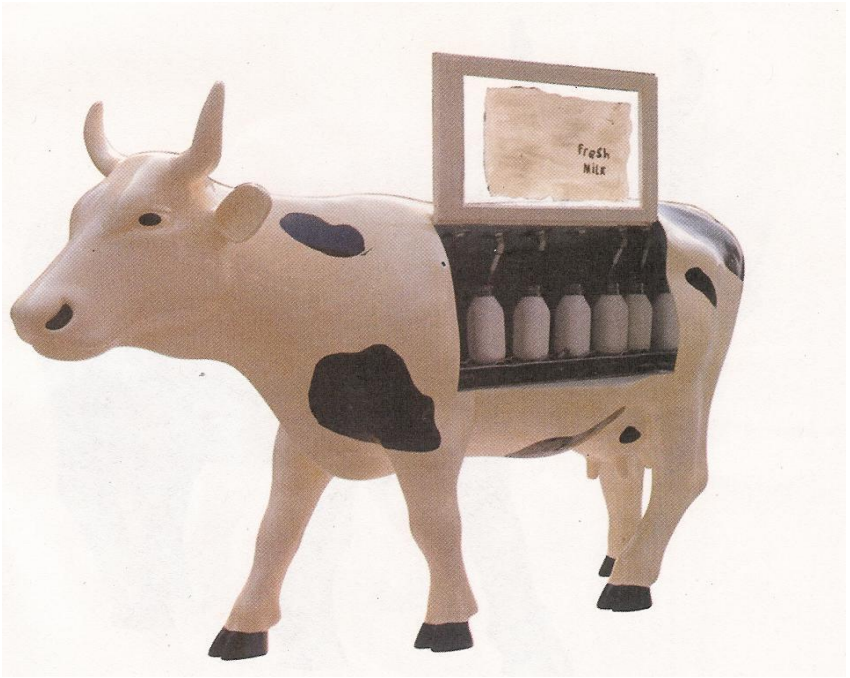


Fig. *in* FAO "Technical and investment guidelines for milk cooling centres" (2016)

Milk temperature treatments

Termization

- It does not replace pasteurization
- Goal: to reduce microbial count, including the psychrotrophic microorganisms
- Before being stored at temperatures bellow 7° C, milk is submited to **64-68° C**, during **10-15** seconds. Other possible temperature/time combinations: 63-68° C/25 sec.; 68° C/40 sec.; 70° C/15 sec.; 60° C/16 sec.; 65° C/2 sec.
- None of these treatments is enough to denaturate phosphatase



Milk temperature treatments

- **<u>Pasteurization</u>:**

- designed to provide a minimum temperature and time combination needed to inactivate the most heat-resistant, non-spore forming, disease causing organism (s) commonly associated with raw milk.
- initially the target was the bacterium that causes tuberculosis (*M. bovis* or *M. tuberculosis*); In the 1950`s, the minimum pasteurization temperature was increased to destroy heat resistant *Coxiella burnetti* (Q-fever).

- High Temperature for a Short Time (HTST) (at least **72° C, during 15 seconds**)
- Batch or Vat pasteurization (at least **63° C, during 30 minutes)**
- Any time/temperature combination that leads to an equivalent effect

  (negative reaction to the alcalin phosphatase test)

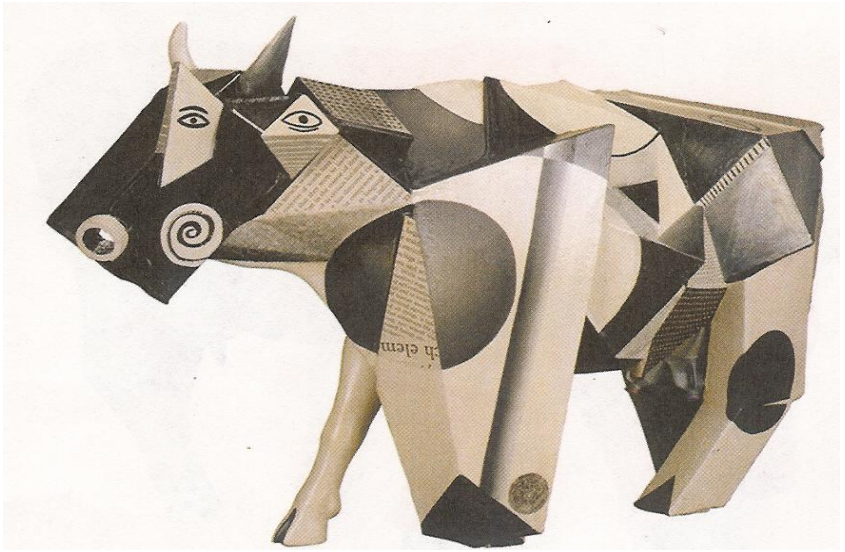
- **What about milk powder?** Milk passes into an evaporator where about a third of it`s water is removed (lower moisture content=longer shelf-life) ; During the evaporation process, the milk is pasteurized...

  Are there bacteria that can survive in powder milk? Yes: Example: *Cronobacter (*formerly called *Enterobacter sakazakii);* can be found naturally in the environment, and can surive in very dry conditions.

Milk temperature treatments

- **Sterilization**:

  more "drastic" heat treatment, meaning a temperature around **130-140° C, for a few seconds.** After cooling and packaging, the product is again heated up to **110-120° C**, for 15 minutes.



Pasteurization and *S. aureus* toxins...

Staphylococcus spp

S. aureus

!!Toxins!!

Staph. Coag. Neg.

Does pasteurization destroy all bacteria?

- **Thermoduric bacteria**: those that survive pasteurization

  (ex. *Microbacterium, Micrococcus, Lactobacillus, Bacillus, Clostridium*)

- Most bacteria natural to the cow (skin, teats) as well as most mastitis-causing bacteria are not considered thermoduric
- Thermoduric bacteria are most commonly associated with some contamination source
- **Laboratory Pasteurization Count (LPC)**:

➢ Test that can determine the # of thermoduric bacteria in milk

➢ Simple; Indicates effectiveness of farm sanitation and hygiene

Laboratory Pasteurization Count

- Mimics batch pasteurization
- Sample of milk (5 mL) – 62.8°C – 30 min – immediately cooled
- Bacteria that can survive (*thermoduric*) are enumerated using the Standard Plate Count (SPC) procedure
- *Most* thermoduric bacteria are *not* capable of significant *growth* under raw milk storage
- Not a good indicator of shelf-life, because it does not distinguish bacteria that can and cannot grow under refrigeration

Causes of High Laboratory Pasteurization Count

- Often associated with chronic/persistent cleaning failures within the milking system:

✧ leaky pumps

✧ old, cracked inflations and other rubber parts

✧ milk stone deposits

✧ pipeline dead-end

✧ build-up of milk residue due to poor cleaning

✧ significant levels of contamination from soiled cows

Key messages:

- Raw milk is a highly perishable product that must be collected and cooled within a few hours to reduce losses due to spoilage and preserve quality
- Thermic treatments are very important and useful, but do not destroy all the microorganisms
- Efficient hygiene procedures at MCP and an appropriate cold chain are essential, to preserve safety and quality

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Thank you for your attention

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