



# Pasteurisation: an overview

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## Part 1. Concept and methodology

Pasteurisation is attributed to a French scientist, Louis Pasteur. He applied heat treatment, followed by cooling, to milk in an attempt to extend the storage life of milk and prevent milk from transmitting potential disease to users. Raw milk was known to carry microorganisms that naturally sour the milk over time. This development spilled over to the preservation of many other foodstuffs and is not restricted to the application of heat.

A method called batch pasteurisation was initially employed. Milk in a container, which could be heated, was warmed to a specific heat below boiling point while being slowly agitated to expose all particles to the heated surface of the container. This heat was maintained for a specific period. Thereafter, the milk was cooled as rapidly as possible and stored refrigerated. This method is still applied for small batches, but obviously limits production time severely. To make the method efficient, a temperature of at least 62°C had to be reached and maintained for 30 minutes. This is also referred to as LTLT (long-time low temperature) pasteurisation.

Fortunately, continuous pasteurisation was developed. This shortened the process significantly and was later found to cause much less physical damage to the milk. Whereas batch-pasteurised milk typically browned and had a distinct cooked flavour, milk treated by the continuous process exhibited sensory characteristics very similar to raw milk. Today,

very little heat damage is caused to the nutrients in milk by continuous pasteurisation. By the early decades of the 20th century, pasteurisation of milk by heat treatment was already made mandatory in the USA. Mandatory exposure of milk to a temperature of at least 71,6°C for at least 15 seconds was legislated in the USA. This is also referred to as HTST (high-temperature short time) pasteurisation. However, conventional pasteurisation remains the preferred preservation method. Other methods such as irradiation and ultra-violet light treatment are rarely used owing to its inefficiency and negative sensory characteristics imparted to milk.

## Heat treatment technology

Various methods have been developed by which milk and other liquids can be pasteurised by heat treatment. The general description of the process is that of heat exchange. This implies that a heating medium is used to impart its energy to the treated food. It can be done in a non-contact manner, called indirect heat exchange, or by mixing the heating medium in intimate contact with the treated food, followed by extraction of that heating medium to prevent contamination or dilution of the treated food. The latter is called direct heat exchange.

A variety of apparatus have been designed for the heat treatment of milk. The oldest known indirect heat exchanger was nothing more than a pot used for cooking (the batch method). Initially, the container was only heated at the bottom, but heating on the sides made heat

transfer even more efficient. Nowadays, this is embodied in the double-sided or mantled (agitated) tank. The heating medium (i.e. warm water or a steam-water mixture) is circulated through the mantle to exchange heat across the inner barrier to the milk. Similarly, the hot water can be replaced by chilled water for the cooling cycle, or the warmed milk can be pumped through a chiller to a storage facility, which is then maintained at refrigeration temperatures (i.e. 5°C or below). New developments in this regard employ inner surface scrapers to prevent burn-on of the milk.

Continuous pasteurisation is performed by pumping raw milk through a series of spaced plates in a thin, flat stream. Using counter-flow, the heating medium (hot water) is also pumped through the same series of stainless steel plates. The heat exchanger is designed so that the milk and hot water flow through alternate, adjacent spaces and therefore do not mix. The number of plates in the pack determines the exposure time of milk to the heat transferred across the barrier. For large volumes, an extension of the plate pack becomes very space consuming. To counter this, the so-called holding section (for the 15-second exposure time) may be constructed outside the plate pack in the form of insulated tubes, normally situated overhead.

Direct heat exchange is done by steam infusion directly into the milk, with vacuum withdrawal afterwards. The process must be well designed and managed to prevent steam condensation, which could dilute the milk. Extremely clean and pure steam must be used to prevent microbial contamination (especially with bacterial spores – a survival form extremely resistant to heat) and to prevent carry-over of unacceptable flavours. This technology is normally used for ultra-pasteurisation or ultra high temperature treatment of milk, but also for cream pasteurisation (vaccreation) as alternative for plate pasteurisation.

## Part 2. A closer look at maintenance

### Introduction

The pasteuriser is normally found as one apparatus in a system containing a cream separator and a homogeniser. It is very energy efficient, as the same heat is utilised in all the equipment. In this issue, we focus on the plate-pack pasteuriser. Pasteurisation aims to destruct pathogens and microbes, with very little change to the milk itself. Pasteurisation is conducted in phases, as set out below.

### The process

- The plate pack is heated to at least 72°C by circulating water through the heating-medium plates and the introduction of steam. The product spaces are filled with water at this stage.
- Cold milk from the raw milk silo is fed into the plate pack. The balance tank ensures constant flow of milk. Milk replaces the water in the product spaces.
- Raw milk enters the pasteurising plate pack in the regeneration section where the process is interrupted to feed the milk to the separator and homogeniser. Cream separation and homogenisation is more effective at 55 to 60°C, as the fat globule is then more pliable.
- After returning from the separator and homogeniser and re-entry into the regeneration section, the mildly heated milk is fed to the heating section.
- Next, the milk enters the holding section where the temperature is maintained for at least 15 seconds. The flow diversion valve is situated at the end of the holding section.
- On completion of the holding process, the milk enters the cooling section. Ideally, the temperature of the milk is reduced to below 5°C (general practice being 2°C). **M&J**