

Buttermilk:

Agricultural processing brochure

South African farmers facing current economic realities are searching for new options to maintain or expand their businesses. One of the many opportunities to grow markets, turnover and profits is by adding value to farm produce. Options need to be selected carefully based on sound information and knowledge of the opportunities presenting themselves, taking into account the strengths and weaknesses of individual farms.



Introduction:

Product group: Dairy products

Dairy milk is one of the most versatile products available to the processor. Processing options include fermenting, concentrating, drying, freezing and many more methods of preservation. Processed dairy products are divided into five groups:

- Concentrated dairy products
- Cultured dairy products
- Frozen dairy products
- Liquid dairy products
- Powdered dairy products



Buttermilk is categorised as a *cultured dairy product*.



Product description:

Buttermilk (Cultured milk)

Cultured buttermilk is the by-product of the butter-making process. Due to its short shelf life and rapid changes in taste due to oxidation, buttermilk is usually fermented to improve the keeping quality and to stabilise the flavour.

Cultured buttermilk is not only made from fresh buttermilk but due to the lack of a consistent

supply of fresh buttermilk, skimmed milk is now also being used as the basis for cultured buttermilk.

Cultured buttermilk is a viscous liquid with a mild lactic acid flavour, and is consumed as a refreshing drink or used as an ingredient in various baked products.

Yield: 1kg cultured milk from 1 kg of buttermilk or skim milk.

Storage of raw milk for processing

Milk is a highly perishable product that may turn sour if left at room temperature.

Milk is cooled to improve its quality and stability. Milk leaves the cow at $\pm 37^{\circ}\text{C}$ and must be cooled within 3 hours to 4°C . During cold storage, the milk must be stirred gently to prevent a cream layer from forming on top (cream separation by gravity).

Raw milk is thus kept in large vertical tanks at the factory or processing plant, which is fitted with one or more propeller agitator(s) until further processing starts.

Milk preparation for the manufacturing of cultured buttermilk

Clarification of milk

Clarification is the removal of solid impurities (dirt particles, white blood cells and cells of udder tissue) from milk, prior to further processing. Clarification is achieved through filtration. Milk may be filtered through a perforated strainer, fine-wire mesh or woven cloth ("melkdoek") in small dairies. Medium and large dairies use replaceable in-line filters situated before the heat exchanger.

Pre-heating of milk for separation

Prior to separation the milk is heated to 45 - 60 °C to ensure effective separation of the skim milk and cream phase. Heating also inactivates the enzyme lipase that is responsible for the development of rancidity in fats. Pre-heating guarantees the highest possible cream quality, i.e. the lowest amount of free fat in skim milk. Heating takes place in a batch vessel or in a plate heat exchanger.

Separation of milk

The cream fraction of raw milk is separated from the skim milk by passing pre-heated raw milk (45 – 60°C) through a conventional or hermetic centrifugal separator. The skim milk is used to prepare cultured buttermilk and the cream is collected for other uses.



Fast facts:

Fresh milk should be cooled to:

4 °C

Prior to separation the milk is heated to:

45 - 60 °C

Cultured buttermilk process

1. Pasteurisation of buttermilk and skim milk

The skim milk or buttermilk obtained from the butter factory is pasteurised to improve the keeping quality of the product. Pasteurisation is a mild heat treatment that destroys all vegetative pathogens and heat sensitive enzymes so that the phosphatase test gives a negative result. Various pasteurisation methods are available.

Batch pasteurisation: This method is suitable for small operations with less than 2500 litres of milk per day. The milk is pumped into an open vat or jacketed vat fitted with an agitator where it is heated. The milk is held at least 30 minutes at 85.5°C followed by cooling within 30 minutes to 43 - 45°C.

Continuous pasteurisation: Large processing plants make use of a continuous High Temperature Short Time (HTST) method. Milk is heated quickly to 90 - 95°C

for 15 - 40 seconds in a plate heat exchanger. This is a compact, simple, easily cleaned and economic heating device since it uses the hot pasteurised milk to pre-heat the incoming cold milk (and vice versa), i.e. makes use of energy regeneration. The pasteuriser consists of series of stainless steel plates mounted vertically, supported by cylindrical bars, and are tightly packed and sealed together. The plates have waffle-like indentations that provide a large heat transfer area and a turbulent flow of the liquids.

A rubber-seal between the plates keep them about 5 - 8 mm apart. The liquids leave the plates through holes in the corners of the plates. Open and blind holes route the liquids to the correct plate processing area. Five stages of heat exchange can be identified:



- **Regenerative heating:** The incoming milk is pumped to the regeneration section of the heat exchanger where it is heated to 55 - 65°C by heat transfer from freshly pasteurised milk. Up to 92% of required heat can be recovered in this way. Milk may leave the pasteuriser at this stage to be homogenised and return to the next section.
- **Heating:** Milk is further heated indirectly with hot water, vacuum steam or saturated steam at atmospheric pressures to the required temperature (90 - 95°C).
- **Holding:** The hot milk is held at the required temperature in a chamber or a holding pipe for the required period of time (15 - 40 seconds). The dimensions of the holding pipe must be sufficient to ensure the required residence time and flow rate of the milk. The stainless steel holding pipe slopes upwards and excludes trapped air. The temperature at the end of the pipe is continuously monitored to ensure sufficient pasteurisation. If the required temperature is not maintained for long enough, the milk is returned to the heating and/or holding sections via the flow diversion valve.
- **Regenerative cooling:** The hot milk from the holding section goes to the regeneration section where it is cooled to 50 - 60°C by heat transfer to the incoming milk

Fast facts: Small operations: **Batch** pasteurisation

Large operations: **Continuous** pasteurisation

- **Cooling:** Milk is further cooled to 43 - 45°C, first with cold water and finally with chilled water or refrigerant (brine or polyalcohol solutions). The higher the fat content of the milk, the higher the final temperature of the cooled milk will be. This prevents the milk from thickening, resulting in clogging of pipelines and filling problems. The mechanical action involved in pumping and filling thick, cold milk could also cause damage to the fat globules.

Take note: It is required by law in South Africa that processors keep thermographic recordings of the temperature of pasteurisation for at least four weeks; and that apparatus used must be calibrated monthly to ensure the correctness of the pasteurisation process.

2. Inoculation and incubation of buttermilk

Inoculation is the addition of starter cultures to a food substance to initiate fermentation reactions.

The warm milk/buttermilk (23 – 25°C) is pumped into the fermentation tank and inoculated with a 1% starter culture.

A mixture of various cultures may be used, depending on the taste and viscosity desired. Some of the bacteria cultures are responsible for the production of lactic acid and others are responsible for flavour development. The milk and starter culture is mixed to ensure even dispersion of the culture in the milk.

The inoculated milk is incubated for 12 - 16 hours at 22°C to allow fermentation to take place. Fermentation is stopped when the lactic acid content reaches 0.7 – 0.8%.

Fermentation is defined as the conversion of the milk sugar (lactose) into simpler substances such as acids by the action of the starter culture and enzymes. The fermentation tanks are insulated to ensure that an even temperature is maintained throughout the incubation period.



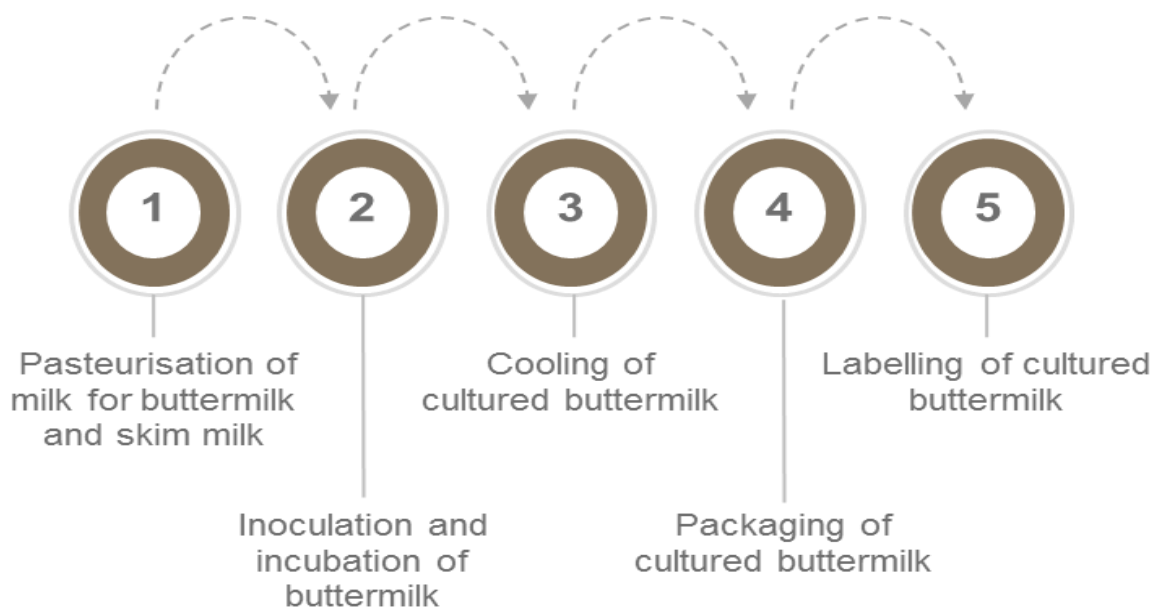
3. Cooling of cultured buttermilk

The cultured buttermilk is cooled to 15°C as soon as the required acidity is reached. Cooling retards further acid development. Batch cooling is usually done in the fermentation tanks by replacing the heating medium with cold water. The tanks are equipped with slow speed agitators that scrape the walls of the tank to speed up heat exchange. Continuous cooling may take place in tubular coolers or plate coolers that are able to cool high viscose liquids.

4. Packaging of cultured buttermilk

Cultured buttermilk is filled into suitable containers and hermetically sealed. Filling takes place at 15°C due to the high viscosity of the cooled product. Laminated cardboard boxes or plastic tubs with foil caps are generally used. The packaged product is placed in cold storage rooms to reduce the temperature to below 5°C.

Process overview



5. Labelling of dairy products

The containers are labelled with the necessary information. The label information and presentation must be in accordance with the requirements set out in the relevant Regulations.

Labelling

Labelling in South Africa is controlled by legislation. Anyone who wants to use the information provided in this document must familiarise him/herself with all the applicable laws that apply to the producing, processing, manufacturing and storage of the products referred to in this document.



Other processing options – Cultured dairy products

Listed below are other processing options not covered in this report, but available from Eskom.

- **Gouda** is a close textured, mild cheese. It is classified as semi-hard.
- **Kefir** is a smooth, viscous, fermented dairy drink with a fresh acidic taste and contains lactic acid, alcohol ($\pm 1\%$) and gas (carbon dioxide).
- **Processed cheese** is made from a variety of natural cheeses that are ground and blended together with emulsifying agents. Various other additives may also be added. The mixture is heated and packaging in laminated films.
- **Ricotta** is a cheese prepared from whey. Ricotta is a low fat, soft cheese with a maximum fat in dry matter content of 10% and a minimum dry matter of 20%.
- **Set yoghurt** is prepared from high or full fat pasteurised milk inoculated with a specific starter culture. Fermentation takes place in the final retail container under controlled conditions. The yoghurt has a firm, gel-like consistency and a clean surface is apparent when the yoghurt is cut.
- **Stirred yoghurt** is a fermented milk product with a thick, smooth consistency and may or may not be flavoured. It is incubated in tanks, stirred, flavoured and cooled before packaging.
- **Drinking yoghurt** is essentially stirred yoghurt with a lower solids content and broken coagulum. It may be pasteurised and/or aseptically packaged to extend the keeping quality.
- **Cheese spread** is a blend of hard cheese with added emulsifying salts. The mixture undergoes a heat treatment that increases the shelf life. Cheese spread has a relatively high moisture content ($\pm 55\%$) and a pH of 5,7 - 6,3.
- **Cheddar cheese** is defined as the product obtained from coagulated milk from which the whey has been removed. The coagulum or curd has undergone ripening to a greater or lesser extent. Cheddar is classified as a high fat, hard cheese.
- **Feta** is a pickled cheese with a clean, acidic salty taste. It is packaged in a brine solution to prevent drying out and to preserve the cheese.
- **Cottage cheese** is the product obtained from coagulating milk. It is a soft, unripened cheese containing about 80 % moisture.
- **Cultured (sour) cream** is the product obtained from cream that has been inoculated with a starter culture to allow for the development of lactic acid and flavour compounds under controlled conditions
- **Maas (cultured milk)** is manufactured by inoculating pasteurised milk with a specific bacterial culture. The end product has a firm texture, no gas bubbles and no separation of whey from the coagulum. It has pleasant sour taste with a slight bite/prickliness on the tongue.

Energy Advisory Services

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- Understanding their energy needs
- Understanding their electrical systems and processes
- Investigating the latest technology and process developments, including electric infrared heating and drying systems
- Analysing how to reduce energy investment costs
- Optimising energy use patterns in order to grow businesses and industries

Call 08600 37566, leave your name and number and request that an Energy Advisor in your region contacts you. Alternatively, e-mail an enquiry to advisoryservice@eskom.co.za.

Alternative funding:

Five alternative funding product offerings are available to help reduce your investment costs for new agro-processing or agro-beneficiation business or expand/improve an existing agro-processing or agro-beneficiation business.

For more info visit: <http://www.eskom.co.za/sites/idm/Business/Pages/Alternativefunding.aspx>

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