

Cheddar Cheese:

Agricultural Processing Brochure

South African farmers facing current economic realities are searching for new options to maintain and 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



Cheddar is categorised as a *cultured dairy product*.



Product description:

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. Mature cheddar has a minimum fat in dry matter content of 45 % and a minimum dry matter content of 64%.



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 proceeds.



Milk preparation for the manufacturing of cheese

Clarification of milk

Clarification is the removal of solid impurities (dirt particles, white blood cells and cells of udder tissue) from the milk, prior to further processing. Clarification is achieved through filtration.

Thermisation of milk (optional)

Thermisation is a sub-pasteurisation heat treatment used to treat raw milk at a dairy or processing plant if it cannot be processed immediately. The milk is heated to $60 - 66^{\circ}\text{C}$ for 5 - 20 seconds in a plate heat exchanger. This heat treatment destroys psychotropic bacteria, with the result that milk can be held at 4°C for 2 - 4 days without any significant spoilage organisms growing.

Fast facts:

Fresh milk should be cooled to: **4°C**

Prior to separation the milk is heated to: **$45 - 60^{\circ}\text{C}$**

Pre-heating of milk for separation

Prior to separation the milk is heated to $45 - 60^{\circ}\text{C}$ 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.

Separation and standardisation of milk for cheese

Separation: The cream fraction of raw milk is separated from the

skim milk by passing pre-heated raw milk ($45 - 60^{\circ}\text{C}$) through a conventional or hermetic centrifugal separator.

Standardisation follows directly after separation and involves adjusting the fat content of milk to obtain a product with a defined, guaranteed fat content. Cheese is mostly classified according to its fat on dry basis. The **dry matter** in **cheese** contains proteins, butterfat, minerals, and lactose (milk sugar), although little lactose survives fermentation when the cheese is made. A cheese's fat content is expressed

as the percentage of fat in the **cheese's dry matter**, which excludes the cheese's water content

Homogenisation of milk for cheese (optional)

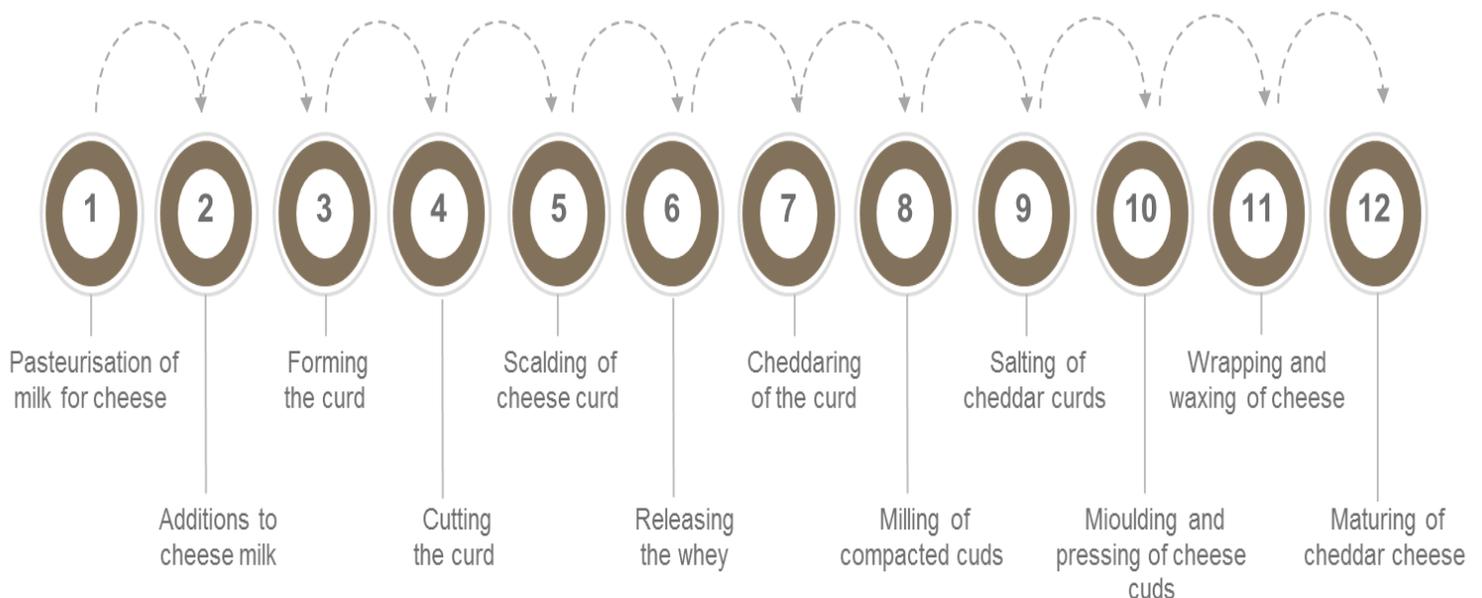
Homogenisation is the process where the fat globules in the milk are finely distributed to prevent fat separation. Homogenisation is accomplished by forcing the milk through a small opening at high velocity to cause disruption of the large fat globules to form small, stable fractions. Homogenisation is most effective when the milk is slightly heated ($60 - 70^{\circ}\text{C}$) and can be done partially or completely.

Cheddar cheese process

- 1. Pasteurising the milk:** Pasteurisation is a mild heat treatment that destroys all vegetative pathogens and heat sensitive enzymes so that the phosphatase test gives a negative result. The milk is heated to 72°C, followed by rapid cooling. Although cheese made from unpasteurized milk is considered to have a better flavour and aroma, cheese milk is pasteurised to eliminate microbial competition for the starter culture and to prevent some common defects during ripening. Various pasteurisation methods are available, depending on the size of the processing plant.
- 4. Additions to cheese milk:** Calcium salt (calcium chloride or calcium phosphate) is added to assist the curd formation ($\pm 0,2\%$) and ensure the formation of a good quality curd. Without it, the curd could be too soft, while overdosing will make the coagulum too hard to cut. Nitrite (Saltpetre) is added to inhibit butyric acid bacteria that cause fermentation problems. Colorants may be added to correct the seasonal variations in the colour of milk. The added ingredients are blended with the milk to ensure uniform distribution of all components.
- 5. Forming the curd:**
 - Bacterial culture is added to the milk in the vat at 29 °C to acidify the milk. The bacterial culture introduces 'good' bacteria, which plays an important role throughout the manufacturing process. The temperature creates ideal conditions for the bacteria to grow, and the acidic environment helps prevent foreign bacterial contamination.
 - Rennet is added to the milk when it reaches a certain pH. This causes casein protein in the milk to coagulate and separate from the liquid whey.



Process overview





4. **Cutting the curd:** When the coagulum is firm – it shows a clean break when tested – cutting blades stir through the coagulum to cut it into small pieces. Cutting the curd allows more whey to escape and lowers the moisture content of the final cheese. The cubes of curd and whey are gently stirred to prevent lump formation. Some whey may be removed at this stage.
5. **Scalding of the cheddar cheese curd:** Scalding is a heat treatment given to cheese curds to regulate the texture and acidification of the curd. Steam or hot water (39 - 40°C) is pumped into the jacketed cheese vat to cause slow heating of the curds and whey. Rapid heating should be avoided as it causes case hardening of cheese curds. The increase in temperature accelerates the whey separation and further reduces the moisture content of the curd.
6. **Releasing the whey:** Draining aims at removing excess free moisture from the product by gravitation force to obtain partial drying of the product surface. The whey and curd have separated due to cutting, stirring and scalding. The whey is now drained off.
7. **Cheddaring of the curds:** Cheddaring is the special type of manipulation of the curd to develop the required texture in cheddar cheese. During this process the curd is manipulated to consolidate, fuse and convert the curd from a rubbery mass to a firmer structure with the affinity to tear. The curd is cut into blocks and stacked 2 or 3 blocks high and turned regularly (\pm 15 minutes). This ensures the fusion of the curd particles. This process is allowed to continue until the titratable acidity is 0,65 - 0,75 % (pH 5,2 - 5,3).

Cheddaring is the special type of manipulation of the curd to develop the required texture in cheddar cheese.

8. Milling of the compacted curds: The blocks of compacted curd are milled into "chips" prior to salting.

9. Salting of cheddar curds: Approximately 2 % salt (NaCl) is added to the milled curd. Thorough mixing takes place to ensure uniform distribution. The salt is then allowed to dissolve completely before the curd is further processed. Salt retards undesirable acid production during storage which facilitates curd fusion through solubilisation of the proteins and improves the colour of the end product.

10. Moulding and Pressing of cheese curds: The curd particles are filled into moulds that represent the desired final shape of the cheese where after it is usually subjected to pressing. This final pressing process is necessary to provide the desired shape and texture while expelling the remaining whey. Pressing lasts 24 - 36 hours.

11. Wrapping and waxing of cheese: The pressed curd is treated with a wax layer or plastic wrapping to protect it against moisture loss and

mould growth during storage. Traditionally, the round shaped cheeses were wrapped in bandage pasted with a flour water mixture containing preservatives (sorbate/pimaricin) or waxed by dipping the bandaged cheese into a bath of melted wax to prevent mould growth.

12. Maturing of cheddar cheese: Cheddar is matured at 4 - 8°C and controlled humidity conditions. Mild cheddar is matured for 3 - 6 months, while mature cheddar is left for 6 - 12 months.

Labelling of Cheddar cheese:

The wrapping is labelled/printed with the necessary information.

Labelling of cheese

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. Please also refer to the disclaimer on the last page.



Other processing options – Cultured dairy products

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

- **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.
- **Cottage cheese** is the product obtained from coagulating milk. It is a soft, not matured cheese and contains about 80% moisture.
- **Kefir** is a smooth, viscous, fermented dairy drink with a fresh acidic taste and contains lactic acid, alcohol ($\pm 1\%$) and gas (carbon dioxide).
- **Long life, set dessert** is a cultured dairy product similar to yoghurt that has undergone a heat process to extend the keeping quality. Set long life dessert is fermented in the final retail container and has a gel-like consistency. It may or may not be flavoured.
- **Long life, stirred dessert** is a cultured dairy product similar to yoghurt that has undergone a heat treatment to extend the keeping quality. Stirred long life dessert is produced in large batches prior to packaging in the final retail container.
- **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.
- **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 packaged 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.
- **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.
- **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.
- **Cultured buttermilk** is the product obtained from milk that has been inoculated with a starter culture to produce a viscous liquid with a mild lactic flavour. It is consumed as a refreshing drink or used as an ingredient in various baked products.

Energy Advisory Service

Eskom's role is to aid the client with basic information in the decision-making process. Thereafter the Eskom Advisor will fulfil the role of energy advisor as part of the team that the farmer selects.

Optimise your energy use

Eskom's Energy Advisors, in regions across South Africa, offer advice to business customers on how to optimise their energy use by:

- 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, email 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>

Literature sources

- Catsberg, C.M.E. & Kempen van Dommelen, G.J.M. 1990. Food Handbook. New York: Ellis Horwood.
- Dairy Processing Handbook. 1995. Tetra Pak Processing Systems. Sweden.
- Early, R. 1992. The Technology of Dairy Products. London: Blackie.
- Fellows, P. 1988. Food Processing Technology: Principles and Practice. Chichester: Ellis Horwood, Ltd.
- Lombard, S.H. 1975. Kaasvervaardiging. South African Journal of Dairy Technology, Vol. 7, No. 3, pp.163 - 166.
- Robinson, R.K. 1994. Modern Dairy Technology. Vol 2. Advances in Milk Products. 2nd ed. London: Chapman & Hall.
- Rosenthal, I. 1991. Milk and dairy products: properties and processing. Basel : VCH.
- South Africa - Agricultural Products Standards Act (No 119 of 1990) and regulations. Pretoria: Government Printers
- South African - Foodstuffs, Cosmetics and Disinfectant Act (no 54 of 1972) and regulations. Johannesburg: Lex Patria
- Varnan, A.H. & Sutherland, J.P. 1994. Milk and Milk Products: Technology, chemistry and microbiology. London: Chapman & Hall.



Disclaimer

The reader's attention is drawn to this notice which contains a limitation of risk or liability of Eskom, and constitutes an assumption of risk or liability by the reader or an indemnification of Eskom. The reader acknowledges that he/she has made him/herself aware of this disclaimer and is aware that the disclaimer limits the liability of Eskom.

The aim of this document is solely to provide the reader with some basic information on agro processing in order to understand the extent of the operations involved.

The reader should familiarise him/herself with all applicable laws that apply to the product growing, storage, processing and manufacturing. This information concentrates on the sequence and steps involved in the processing of the selected product and explain the reason and necessity of each step. It is not a complete reference document on which calculation and design shall be based, nor was it ever intended to be.

While Eskom has made every attempt to ensure that the information contained in this brochure has been obtained from reliable sources, Eskom does not accept any responsibility or liability for the accuracy, content, completeness, legality, or reliability of the information contained in this brochure, and the readers or users are required to also make their own independent enquiry, before relying upon same. All information in this brochure is provided "as is" with no warranties, promises and/or representations of any kind, expressed or implied, as to the nature, standard, accuracy or otherwise of the information provided in this brochure nor to the suitability or otherwise of the information for a purpose. Computer generated images, walkthroughs and render images used in this brochure are the artist's impression and are an indicative of the actual designs. The imagery used in the brochure may not represent actuals.

Eskom shall not be liable to the reader for any loss or damage of whatever nature (direct, indirect, consequential, or other) incurred by the reader as a result of any action or omission related to the information provided in this brochure. The reader shall indemnify Eskom against any claim or action instituted by a third party as a consequence of the actions taken in relation to the contents of the brochure, emanating from any area of law.

For more information on Eskom's solutions and services visit the website - www.eskom.co.za/idm

