

Agricultural processing brochure

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Processed meat groups:

- **Whole** meat products
- **Minced** meat products
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Yield:
0.541 kg lean meat will yield approximately 1 kg of Frankfurters.

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: Meat products

The deregulation of the meat industry has provided opportunities for livestock farmers to slaughter, process and market their own animals. Abattoirs on farms are quite common these days.

Alternatively, approved meat can be brought in for processing. Meat is a very versatile food substance, with a wide variety of processed product possibilities.

Processed meat products are classified into three broad groups, based on the size of the meat particle used:

- **Whole meat products** – muscle tissue is still clearly recognisable and defined in the end product (e.g. ham, bacon, pressed pork or beef);
- **Minced meat products** – meat structure has undergone a degree of breaking up for example in a

mincer and the meat is no longer in a fibre form, but particle form (e.g. salami, fresh sausage, hamburger patties, meat balls etc.); and

- **Emulsified meat products** – the muscle tissues have been finely minced and are not recognisable any more in the fibrous or particle form (e.g. frankfurters, viennas, polonies and meatloaves).

Product description: Frankfurters

Frankfurters are cooked, smoked sausages that can be cured. A 60% beef and 40% pork mixture is made into a thick sausage with skin removed. Other smoked sausages include Viennas (which are just a thin variety of the Frankfurter), Bologna, knackwurst and Mortadella. All these sausages are related with regards

to manufacturing techniques and differ mainly with regards to their composition.

All of these products are good examples of "value-added" processing, where relatively ordinary meat cuts and trimmings are tenderised by grinding or chopping, and may have salt, spice and other ingredients added before cooking,

smoking, drying or other finishing processes. The result is a product with a unique texture, aroma and flavour. Each step in the process can be achieved in a number of ways (different chopping/mincing methods, spice blending, smoking and cooking processes, etc.) with the result that there are hundreds of varieties of luncheon meats available.

Process description: Ingredients for Frankfurters

Meat: A mixture of lean and fatty meat is used (40% pork and 60% beef). If the meat is too lean, fat can be added.

Fat: When additional fat is required, lard can be added provided that it is not older than 3 days and contains no skin.

Ice and water: Ice or water is included into the formula to control the temperature during mincing. The quality of the water used both as an ingredient in any meat product, as well as a cooling agent, is of major importance. Potable water is defined as water free from suspended matter and from substances that

could be harmful to the products or to human health, must be used. In addition, the water should be treated (by flocculation, filtration, chlorination or other acceptable processes) to ensure compliance with the following microbiological requirements:

- Total count shall not exceed 100 per ml;
- Coliform organisms shall not exceed five organisms per 100 ml, and
- Faecal coliform shall not be detectable in 100 ml of the water

Edible offal (where permitted) such as heart, liver, tongue and kidney must be limited to 5% by

mass of the product and must be declared in the ingredient list on the label when used.

Casings: Both natural and synthetic casings can be used. Natural casings are produced from the cleaned intestines of sheep, pigs and cattle. Sheep intestines are generally used for thin sausage while pig intestines are more suitable for thick sausages. Pig and sheep intestines are sold in bundles of about 100m, packaged in dry salt. These intestines are stored at 4°C and rinsed in cold water prior to use. The casings are allowed to soak for 45 minutes at room temperature. Natural casings are delicate and

easily broken during stuffing or linking and could therefore be substituted by edible collagen casings. Natural casings are permeable to moisture and smoke, and thus shrink during processing, thereby remaining in close contact with the surface of the sausage.

Other manufactured (synthetic) casings can also be used and include the following:

- Cellulose - close to natural casings, but must be removed before consumption
- Inedible collagen - very strong
- Plastic casings are not suitable since they are impermeable to smoke

Other ingredients:

Ingredient	Reason for inclusion	Inclusion levels
Salt	Taste, preservative, solution of salt soluble meat proteins, texture and adhesion	0 - 5%*
Nitrate/Nitrite	Colour development, taste development, preservative	100 - 160 ppm**
Polyphosphate	Water binding, buffer systems	0.2 - 0,5 %**, *
Sodium ascorbate	Reduction of curing time, colour stabiliser - only in minced/chopped products	500 ppm**
Citrates	Water binding, buffer systems	0.006 - 0,1%**
Non-meat proteins	Water binding, texture improvement	2.0 - 3,5 %**, *
Gums and starches	Water binding	2.0 - 3,5 %**
Flavourings	Taste improvement	
Sweeteners	Improve water retention and taste	0.5 - 1,0%**
Natural binders	Improve water retention, water binding and texture improvement	8%*

* Requirements of the South African Standards specification must be adhered to.

** Requirements of the regulations published under the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972 must be adhered to.



3 mm
die

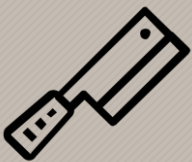
Mincing of meat for Frankfurters

The lean meat (containing a maximum of 20% fat) and the rest of the fat is separated before mincing. The lean meat is passed through a 3mm die (aperture size of final sieve plate in mincer).

The temperature of the meat should be kept below 5°C for mincing to ensure a clean, neat cut without smearing. The meat should be free from bone chips; gristle, cartilage and excessive amounts of connective tissue since

these would damage and block the sieve plate.

The rest of the fat is minced separately and also passed through a 3mm die.



Chopping is halted when the mixture reaches a temperature of

8.5°C

Chopping of ingredients for Frankfurters

The finely minced meat is transferred to a bowl cutter for the next processing step. The fat is not added at this stage. Half of the ice water together with the salt is added and chopping commences. The water dissolves the salt to form a brine with a concentration of 7 - 8%. The salt soluble proteins are

extracted the mixture is while chopped at high speed.

Chopping is halted as soon as the mixture reaches a temperature of 8.5°C. At this point the mixture should be a uniform, sticky mass. Temperature, rather than time, is used as a guide for chopping.

Ice water is necessary to keep the temperature down for protein extraction since chopping creates mechanical energy that is converted into heat. High temperatures would prevent protein extraction and even cause protein coagulation and emulsion destabilisation.

De-aeration of the Frankfurter mixture (optional)

De-aeration is the removal of trapped air or gasses present in a product due to processing or natural causes.

The Frankfurter mixture is transferred to a vacuum chamber or vacuum mixer to remove trapped air and thus prevent fat oxidation. The air

bubbles may also contain impurities and be a possible source of micro-organisms that may cause spoilage of the product. De-aeration also ensures a firm, uniformly stuffed product.

Although this is an optional process for small-scale operations

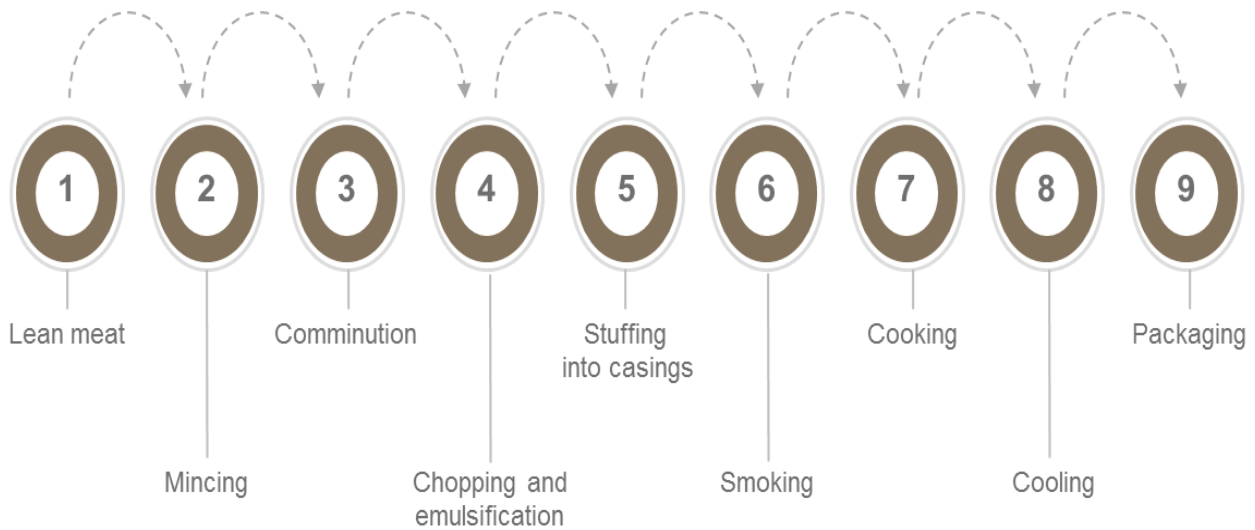
due to extra costs involved, it is considered necessary for large-scale operations which have access to such equipment.

Some of the larger bowl cutters are equipped with a vacuum facility, which is very useful since it eliminates the need to transfer the mixture after emulsification.



vacuum mixer
removes trapped
air

Process overview



Emulsification of Frankfurte mixture

Emulsification involves stabilising a mixture of two liquids by adding an emulsifying agent that reduces the interfacial tension and creates a barrier to droplet coalescence.

An emulsion is created when the minced fat is added to the lean meat mixture in the bowl cutter and chopped until a homogenous mixture is formed (around 12 - 16°C).

It is particularly important that the meat extenders and starches should be added after protein extraction has taken place, since they are hygroscopic and will absorb a lot of moisture, making it less suitable for the solubility of proteins.

Emulsification involves stabilising a mixture of two liquids

Stuffing and shaping of Frankfurtes

The meat emulsion is transferred from the bowl chopper or vacuum mixer to the sausage filler. The selected casings are placed over the sausage filler funnel. Collagen casings are stuffed dry, while natural casings are rinsed in water and

stripped of all the excess moisture prior to stuffing. As the casings fill with meat, they are supported and allowed to slide off the stuffing horn at a pace that ensures maximum filling while eliminating air pockets. The ends of the casings are knotted to retain the meat.

A great variety of sausage fillers are available, varying considerably in capacity. Hand-driven models generally offer from 5 to 15 liter capacities, while fully automated hydraulic stuffers can accommodate from 50 to 500 liters.

Continuous fillers are also available and although very expensive, the best option for large-scale operations because of their versatility. Continuous fillers can be equipped with additional equipment such as portioners, link twisters or casing clipping units.

Linking of Frankfurters (optional)

Linking involves twisting the length of sausage at specific intervals to create a partitioned product. This can be done manually or

mechanically, provided the casings are of good quality. Mechanical linking is more accurate and uniform and time efficient but is only justified for large-scale

operations. Linking facilitates handling, packaging and sale. The length of the link depends on the demand and end use.

Tempering of Frankfurters (optional)

Tempering involves allowing the product to stand to allow certain reactions to take place. In the case of Frankfurters in natural or collagen casings, tempering

facilitates surface drying prior to smoking. It also provides time for colour development by curing agents.

The linked sausages are hung on racks at

room temperature for a few hours. Alternatively, the process time can be reduced to 20 minutes in drying cabinets at 50 – 55°C and very low humidity.

Linking involves twisting the length of sausage at specific intervals to create a partitioned product

Smoking of Frankfurters

Smoking enhances the flavour of the sausages but does not cook the meat. Traditionally, meat was smoked in barrels over burning wood. Today, smoking is a much more controlled process that requires a smoking cabinet where smoke can be generated by controlled combustion of moist sawdust or a rapidly moving steel plate against a log. The smoke is then carried into the smoking chamber by fans. Smoke can be given an electric charge and electrostatically deposited on the meat surface. Oxygen is one of the factors which needs

careful control during smoking since it has a definite effect on the amount of smoke generated and thus the colour and flavour of the meat. Other important process parameters are the temperature of smoke and the humidity inside the smoke cabinet. Air circulation is also critical since it influences oxygen supply, temperature and humidity.

The sausages are hung over bars and placed in the smoking chamber. The temperature can be kept at 54 - 60°C for 10 - 20 minutes to attain surface drying of the sausages. Smoke

is then introduced and the temperature is slowly raised to 72 - 75°C and kept there until the internal temperature of the product reaches 60 - 73°C.

The recent interest in alternative methods of smoke application arose from consumer demand for non-carcinogenic containing food products. Air pollution and time constraints and the need for more critical quality control were also contributory factors. Liquid smoke flavouring in the form of an aqueous or oil solution of natural hardwood smoke has been successfully

introduced into the market. Liquid smoke is available in various acid strengths - as the acidity increases, so does the smoke flavouring potency. It may be applied directly into the meat formula or used as a surface application. The penetration of surface applied liquid smoke is greatly enhanced at temperatures around 37°C. Although liquid smoke has its advantages, it is left to the processor to decide which method is preferred, and the product must be labelled correctly to ensure that the consumer is correctly informed regarding the origin of the smoke.

Cooking of Frankfurters

Cooking is necessary to coagulate the proteins and to fixate the desired shape and colour of the product. The Frankfurters are usually cooked in a steam cabinet or in

hot water. The simplest procedure is to set the temperature of the steam cabinet at 72 - 75°C and then to cook the product to an internal temperature of 68°C. This takes only a

few minutes. Cooking time depends on the weight and dimension of the product. Humidity is once again a crucial factor in the quality of the cooked product.

Cooling of Frankfurters

The cooked Frankfurters should be cooled immediately after being removed from the cookers to prevent overcooking and bursting.

The product is cooled with cold, potable running water until the internal temperature is reduced to 30°C. The Frankfurters are then placed in cold room

storage for further cooling.

The product should be handled carefully during and after cooling to prevent damage.

Skinning of Frankfurters (optional)

Products stuffed in natural casings are not skinned. Cellulose casings are removed since the casings are not edible. Skinning can be done mechanically, but mechanical peelers are only feasible in large-scale operations. The sausages are passed through warm water

and under a rotating blade that cuts the surface so that the casings can be rolled or blown off.

Small and medium operations skin sausages manually. Good skinning results rely on maintaining constant humid conditions and

air circulation rates during cold storage. Dehydration of casings causes skinning problems. Manual skinning has the disadvantage of providing ample opportunity for contamination of the sausages and thus premature spoilage.

Packaging of Frankfurters

Frankfurters are usually vacuum-packed in thick plastic films for retailing.

This preserves the product by reducing the chance of fat oxidation.

If products are sold in bulk, no special packaging is required for Frankfurters.



Labelling of meat products

The casings are labelled/printed with the necessary information. 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 laws that apply to the producing,

processing, manufacturing and storage of the products referred to in this document.



Other processing options

Below is a list of other emulsified products not covered in this report, but available from Eskom.

- **French polony** is a typical emulsified sausage product that is stuffed in

plastic casings for slicing purposes. It is the most basic type of luncheon meat and the basic polony mixture (with or without the colouring) and processing method

can be used as the basis for the manufacture of most other types of luncheon meats and loaves. These include olive loaves, egg loaves, pepper loaves, etc.

Alternative funding:

Five alternative funding product offerings are available to help reduce your investment costs for new agro-processing

or agro-beneficiation businesses or to 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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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, e-mail an enquiry to advisoryservice@eskom.co.za.

Literature sources

- Forrest, J.C et al. 1975. Principles of Meat Science. San Francisco: W.H. Freeman
- Nickerson, J.T.R & Ronsivalli, L.J. 1982. Elementary Food Science. 2nd ed. Westport: AVI
- Potter, N.N. & Hotchkiss, J.H. 1995 Food Science. 5th ed. New York: Chapman & Hall
- Price, J.F. & Schweigert, B.S. 1987. The Science of Meat and Meat Products. 3rd ed. Westport: Food & Nutrition Press
- Rust, R.E. 1976. Sausage and Processed Meat Manufacturing. American Meat Institute Center for Continuing Education.
- South African - Foodstuffs, Cosmetics and Disinfectant Act (no 54 of 1972) and regulations. Johannesburg: Lex Patria
- South African Standard Specification: Packaged meat products (processed or manufactured) SABS 885:1974. Pretoria: South African Bureau of Standards
- Varnam, A.H. & Sutherland, J.P. 1995. Meat and Meat Products: Technology, Chemistry and Microbiology. London: Chapman & Hall.
- Google free images: Product and other photos were sourced from Google images using a filter: Free to share and use commercially

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