

Agricultural processing brochure

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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: Deboned ham

Deboned ham is a pickled whole muscle meat product made from the hind leg of a pig. Both the skin and fat can be removed, or both can be retained, or only the skin removed.

The bones are carefully removed with the minimum damage to the meat. The meat is then reshaped into any desired shape. The deboned and reshaped ham can be packaged in a casing and cooked to produce a ready-to-eat product.

Although the *shoulder* of the pig can also be cured and smoked in much the same way as the leg, the description of this product does not include the word "ham".

Yield: The yield is largely affected by the efficiency with which the bones are removed. A 10% weight gain of the deboned meat can be expected during curing. Smoking on the other hand causes significant weight loss (8-10%).

Process description: Deboned ham

Raw meat processing

The condition of the pork meat prior to curing has a great influence on the final product. The meat of stressed pigs tends to be pale, soft and watery with reduced water-holding capacity. Exhausted pigs produce dark, firm and dry meat which is also undesirable since the meat has a high pH value (>6.2) and enlarged fibres which restrict the penetration of curing agents. The pork carcass should be cooled to 4 - 5°C directly after slaughter and dissection.

Deboning of meat joints for ham

It is preferable to debone meat prior to curing, although it can be done afterwards. The meat joints are skinned and defatted by hand using special deboning knives and chisels. The meat is loosened around the aitch bone. The aitch bone is then disjointed from the leg bone and removed. The meat is separated from the body bone with a half-round chisel. The shank bone is removed next and the body bone is pulled out from inside the ham. The deboned meat is now ready for curing.

Preparation of brine for meat

Dry salt mixtures can be obtained commercially and this requires minimum preparation prior to use. As an alternative, brine can be prepared by selecting, weighing and mixing specific ingredients such as those listed below.

Ingredients	Purpose/Action
Salt	Improves taste, acts as preservative, enhances solubility of meat proteins *
Nitrate / Nitrite	Colour development, taste development, preservative**
Polyphosphates	Water binding, buffer systems **,*
Sugars	Balance saltiness, stabilise colour *
Citrates	Water binding, buffer system **
Non-meat proteins	Water binding, texture improvement *,**
Gums	Water binding **
Sodium ascorbate	Colour fixing **
Flavourings	Taste improvement **
Starches	Water binding **

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

** Requirements of the regulations published under Act 54 of 1972 must be adhered to.

There are a few general rules that should be kept in mind when preparing your own brine:

1. The water temperature must not exceed 10°C.
2. A high-speed mixer is the most effective way to dissolve brine components.
3. The phosphate must always be added before the salt. If the salt is added first, the phosphate will not dissolve.
4. If soy isolate is used as a non-meat protein, it must be hydrated with water before any other brine component is added. If salt is added before the protein, it may lead to incomplete protein hydration.
5. After all the above rules have been complied with, the other components may be added in any sequence.

The brine ingredients can also be applied dry, where it is rubbed on or mixed with meat cuts.

Traditional
Dry curing:
1 - 1½ days
per kg
of product at
2 - 4°C

**Injection
curing:**
Pumping
the meat with
**± 12 – 14%
brine,**
followed by a
2 – 3 days
immersion period,
without added
nitrate.

Curing of ham

Curing involves the application of salts, together with colour fixing ingredients and seasoning to the meat in order to attain unique properties. These properties include colour stabilisation, flavour modification, textural changes and a reduction of shrinkage during processing.

Several methods of curing meat are available. Traditionally, meat was preserved by covering it in heaps of dry salt (the so-called *dry cure* method). The curing agents are solubilised in the moisture naturally present in the meat and penetration is as a result of diffusion (1 – 1½ days per kg of product at 2 - 4°C). This method is rarely used today since it involves long periods of curing, drying and maturing. (See report on *Dry-cured ham* for more information).

The first major departure from the traditional dry cure method was the introduction of a solution of curing salts, called a *brine* or *pickle*, in which the meat was immersed (tank curing or *Wiltshire curing*). This method of soaking whole meat cuts in brine solutions overnight greatly speeds up the curing process while reducing the quantities of salt required. Small-scale operations most often use the immersion method, where the meat is rubbed with salt prior to a 4 – 14-day immersion period at 4.4°C.

The traditional Wiltshire cure has greatly been replaced by the *sweet cure*, which produces a blander flavour due to a lower salt content and added sugar. Sweet cure is widely used in conjunction with reshaped hams.

The curing process is even further shortened by injecting the brine into the meat. *Injection curing* involves pumping the meat with approximately 12 - 14% brine, followed by a 2 - 3 day immersion period in brine without added nitrate. This ensures more uniform diffusion of brine. Injection can be done with a single needle (small-scale production), or multi-needle mechanical injectors (large-scale operations). Injectors make use of a process called "**stitching**" or "**pumping**" whereby the brine is injected at pressures of no more than 4 bar. Manual injection is very effective when carried out by a skilled operator. Automatic multi-needle injectors are specially developed for highly uniform injection of meat cuts of similar weights.

The ham is generally **pumped 12 - 14%** above its weight with **a 72° Salometer** (salinity of the brine) brine containing 17 - 22% salt, 0.1% sodium nitrite and 2% sugar. Spices are occasionally added to improve flavour. The cured hams are stored in stainless steel containers that are resistant to corrosion.

The curing temperature also has a great influence on the duration of curing. Traditionally curing takes place at 3 - 5°C. The process can however be accelerated at 15°C, but this requires very careful control over bacterial growth.

Tumbling and massaging of ham (optional)

In the case of injection curing, the brine is not immediately diffused evenly in the meat. Brine equilibration can be achieved by simply storing the meat for a few days (diffusion storage) so that the process can take place naturally, as in the case of bone-in-ham products.

Brine diffusion can also be hastened by tumbling and massaging equipment that are specially designed for this purpose. Massaging and tumbling are only suited for deboned ham.

A *massager* is a free-standing container with rotating bar and oars inside. The meat is placed in the massager with about 5% free brine. The duration of a typical massaging treatment is about 18 hours. Each one-hour cycle comprises of:

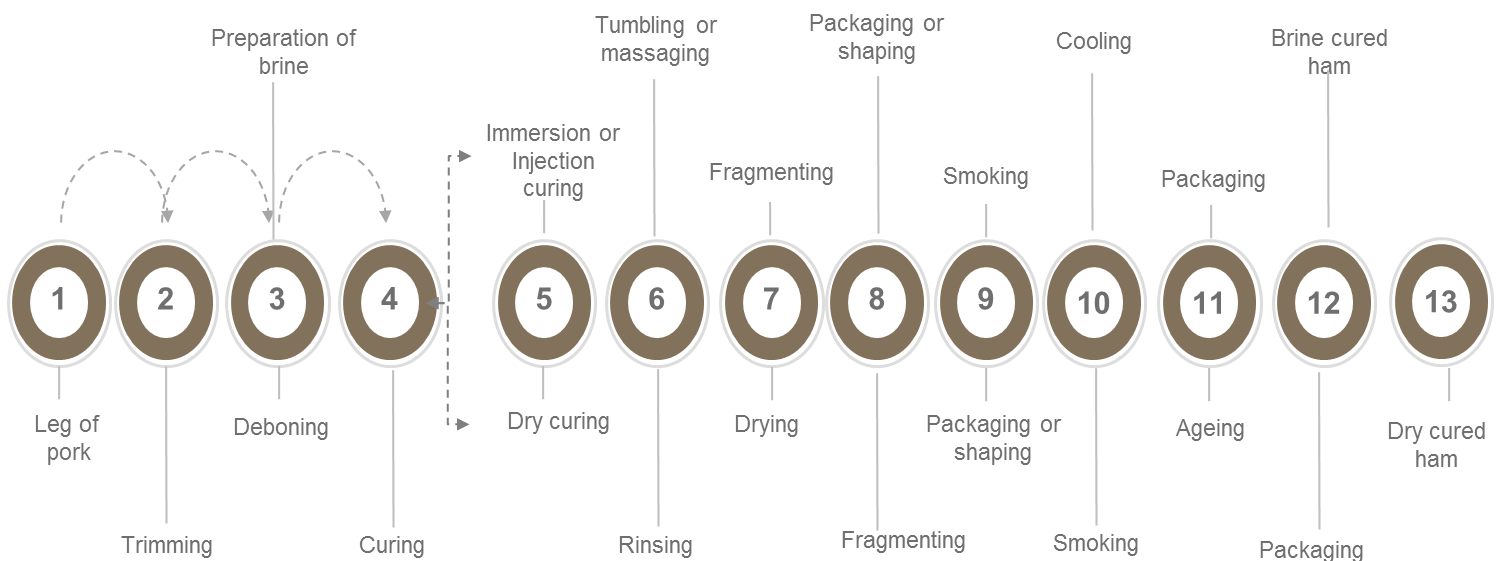
- 20 minutes rotation clockwise
- 20 minutes rotation anti-clockwise
- 20 minute resting period

A *tumbler* is a rotating stainless steel container that tumbles head over heels. During the tumbling action the meat is constantly falling from top to bottom. It is thus a far more drastic process compared to massaging. The duration is usually shorter than massaging while the rest period is longer. Some companies tumble continuously for 1 - 2 hours followed by a 12-hour rest period, followed by a further tumbling cycle of between 30 minutes and 2 hours.

Other advantages of tumbling and massaging are:

- Applied energy increases extraction of proteins, which leads to better binding during cooking.
- Mechanical action causes limited muscle/tissue damage that improves protein solubility and consequently water absorption. This leads to increased cooking yield due to reduced water loss.
- It improves the fragmentation of the end product (if desired).
- Smaller pieces of meat can be used. These can then be pressed into different shapes and sizes for the convenience of the consumer.

Process Overview



Fragmenting and reshaping of deboned ham (optional)

The deboned, cured and tumbled ham is laid on a working table with the inside facing upward. The muscles are separated and “butterflied” by hand (preferably without the help of knives). After the ham has been fragmented, the inside muscle is folded down and placed alongside the shank. The ham is then tightly rolled up and stuffed in a fibrous casing.

This optional method of fragmenting, splitting and folding the muscles of hams ensures a uniform diameter and places the most desirable inside muscle next to the least desirable cut, the shank. If the muscles have not been cut and the ham is stuffed very tightly into the casing, there is no problem with the rebinding of muscles during cooking.

Smoking deboned ham (optional)

Smoking is an optional extra process to enhance the flavour of the ham. The smoking process 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. Smoke is then carried into the smoke chamber by fans. Smoke can be given an electric charge and electro-statically deposited on the meat surface as well. Cold smoking is used with smoked meats combined with other techniques such as salting and drying.

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 critical since it influences oxygen supply, temperature and humidity.

A typical smoking cycle can be 2 hours of intense smoking at 50°C followed by another 2 hours of low intensity smoking between 55 and 66°C. An alternative is to set the smoke room at 57°C and to smoke the ham for 18 - 24 hours, until the internal temperature reaches 52°C. Considerable weight loss (8 - 10%) can be expected during the smoking process.

The recent interest in alternative methods of smoke application arose from the consumer's demand for healthier food. Air pollution, 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 mixture 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.



A typical
smoking cycle

is **2 hours**

of intense smoking

at **50°C**



Fragmented and reshaped hams require special pressure **packaging** prior to smoking. The reconstructed ham is tightly rolled up and stuffed in a fibrous casing and then clipped by mechanical devices. The casing is usually pricked to free air bubbles and excess moisture that might be trapped in pockets. The product is then placed in stockinettes for smoking. The product is hung by a hanger attached to the stockinette or processed between spring loaded screens to create a square shape. It is very important that the product should not be hung from the inner casing, since this will result in separation of the meat from the casing at the top and this undesirable phenomenon is known as "necking". Stockinettes therefore ensure a better final appearance for both hung (round) and pressed (square) reconstructed hams.

Cooling of smoked, reshaped hams

Products are removed from the smoking cabinets and left to cool at room temperature for 2 hours before it is further cooled under cold water showers. Prolonged showering could however cause leaching of salt. The product is then allowed to dry.



Packaging of deboned hams

Vacuum packaging is used for raw deboned and reshaped ham products. The reshaped products are removed from their moulds and stockinettes and can be dipped in a gelatin solution and inserted in a cellulose or plastic casing for retailing. The casing is tightened and sealed. If the products are sold in bulk, no special packaging is required.



Labelling meat products

The products 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 applicable laws that apply to the producing, processing, manufacturing and storage of the products referred to in this document.

Other processing options

Listed below are other processing options for *whole muscle meat* products not covered in this report, but available from Eskom. Other processed meat products are also available from Eskom.

- **Bone-in ham** or Gammon is the pickled whole hind leg of pork. The skin and fat can both be removed, or both are retained or only the skin removed. Smoking of the ham is optional.
- **Canned bacon** is Wiltshire or sweet cure bacon that may be sliced or chopped into pieces and canned with or without added ingredients.
- **Canned corned meat products** are cured beef or mutton cuts that are cooked and canned and may contain seasonings and added starchy ingredients.
- **Cooked ham** is usually deboned and reshaped ham that is cooked to coagulate the meat proteins and retain the new shape, although bone-in-ham can also be marketed as cooked ham



- **Corned meat** products include beef and mutton cuts that have been adequately cured, and prepared as a cooked vacuum packed product.
- **Dry-cured ham** is manufactured using the traditional curing method whereby the meat is covered with dry salt. The salt and other curing agents are solubilised in the natural moisture present and penetration is as a result of diffusion.
- **Kassler ham** is a cured, whole muscle meat product that is made from the pork fillet.
- **Sweet-cure bacon** is the boned rib and loin chops of pork with no fat removed. It may be either dry salted or brined and then smoked. It is sold raw and sliced. The meat to fat ratio should be no less than 3:1.
- **Wiltshire bacon** is the generic term given to traditional tank cured bacon.

Energy Advisory Services

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 is selected.

Optimise your energy use

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

- Understanding their energy needs.
- Understanding their electrical systems and process.
- 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 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](http://www.eskom.co.za/sites/idm/Business/Pages/Alternativefunding.aspx).

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