PPI

Processing & Product Innovation

Edible Meat Powders and Extracts

Beef extracts and powders have been produced for many years as a by-product of the meat canning industry. Canned corned-beef processing involves the precooking of beef in salt solutions—producing a meaty liquor as a by-product.

Meat extracts and powders from the canning process

Although the meat is subject to an extreme heat process in the steam retort to commercially sterilise the can's contents, the meat is also required to be precooked to release some of the fat content prior to canning. This precooking also binds any internal moisture prior to sterilisation so that separation of liquid and solid phases is less likely to occur within the can. If this separation is allowed to occur, it can create a visually unattractive product.

When the brine-pumped meat is cooked in water or a salt solution, the drained product develops the required colour and flavour characteristics of corned beef. However, in doing so, much of the brine salts and many of the soluble meat proteins remain in the cooking water along with a number of fine meat particles creating a salty meat soup. As the canning process generally recycles this cooking water between batches, the solution becomes more concentrated during the processing shift.

This material is high in fat, Biological Oxygen Demand (BOD), Total Dissolved Solids and Total Suspended Solids. As a result it can create major difficulties as a waste stream. Most corned-beef canneries recognise this problem and the value of this semi-concentrated 'stock' as a source of meat protein, tallow and flavour components.

The stock is allowed to stand to let the free tallow float off and be recovered. The coarse meat solids are removed by filtration and the remaining suspended and dissolved solids become the feed material for the meat extract or powder process.

Depending on the fat content required, the stock may be passed through a centrifugal separator to reduce the fat level to a minimum. The watery phase is then passed through a Double, or Triple, Effect Evaporator—to flash off moisture under vacuum and increase the solids content. The multiple effect evaporator can increase the solids content to about 30–40% solids before the solution becomes too viscous to flow readily through the evaporator tubes, under gravity, without fouling the surface. The ultimate solids content of this concentrate will be dependant on a range of factors including salt content, cooking time, fat content and possibly meat species.

The 30–40% solids concentrate from the evaporator is then further concentrated in a pan evaporator until it is stable at room temperature. These are similar to the evaporation pans used at abattoirs to concentrate gall. Evaporation continues over an extended period of many hours as low heat is applied to prevent burning. This secondary concentration continues until the solids concentration is around 70%. The final solids content will depend on, primarily, the salt content of the extract.

Alternatively the concentrated product can be dried instead of secondary concentrating. This is generally done only if the fat and salt content is low. Either a spray or drum drier is used, utilising standard milk-processing equipment. Concentrates high in fat cannot be successfully dried and must be secondary concentrated to extracts. The presence of high fat contents will make the powder produced clump during drying with the potential for overheating and self-combustion. Powders that are high in salt will be very hygroscopic. During further handling, packaging and storage, they will reabsorb moisture and become clumped and hard.

This process continues at meat-canning plants producing a range of valuable extracts and powders for use in soups, beverages, sandwich spreads and as general purpose meat flavour enhancers.

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Meat extracts and powders from meat

The preparation of meat extracts and powders is not limited to the by-products of meat canning. Meat extracts and powders can be prepared directly from muscle meat. Figure 1 shows the process for preparing meat extracts and powders from muscle meat.

While this process has traditionally been used to produce beef extracts and powders, the process is equally relevant to sheep meats or meats from other species. Either freshly boned meat or frozen, boxed manufacturing meat can be used for the process.

Meat preparation

Frozen product is first tempered to allow it to be prebroken and minced to a small size. The finer the grind size the greater is the release of fat and soluble protein from the muscle structure. A grid size of 2–3 millimetres is ideal although this is difficult to achieve. A larger grind size is acceptable, particularly if the main focus of the process is the production of a meat extract, or powder, that is high in insoluble solids. Larger grind sizes normally result in more solid phase and less liquid phase—giving a high yield of meat powder and reduced yield of extract. Most users of extracts and meat powders are seeking high levels of soluble solids which require maximum level rupturing of the meat structure.

After particle-size reduction the meat is slurried with water to allow for adequate mixing and heat transfer during cooking. Meat-to-water ratios are normally between 1:1 and 1:1.5. Maximum meat-to-water ratios are targeted as the higher the ratio, the less the water that requires to be evaporated later in the process.

Cooking

The cooking conditions play a major part in the ratio of soluble solids to total solids in the extract, and the split between solid and liquid fractions ie the final yields of powder and extract. A process that is designed to produce a meat powder with extract as a secondary product will operate at cooking temperatures as low as 90°C for as short as 30 minutes to one hour. The proteins will have suffered minimal hydrolysis and the resultant flavours will be mild and meaty.

For processes designed to maximise the yield of soluble proteins in extract or powder, cooking will normally be atmospheric boiling or possibly boiling under slight pressure to raise the temperature to about 110°C. Cooking times in this instance could be as long as 10 hours depending on the rate of hydrolysis and protein solubilisation and the solubles content required. Specifications of up to 50% of the protein content being solubilised, or in suspension, are not uncommon for some markets.

Separation of phases

Separation of liquid and solid phases is normally carried out in a horizontal bowl centrifuge (decanter) although a dewatering press may be suitable in some applications. Tallow is separated from the liquid phase stream in a centrifugal separator with fines returned to the solid phase stream. Alternate techniques, such as gravity settling, may be suitable if a higher fat content is required in the final extract.

Extract preparation

If fat has not been separated from the liquor by using a separator then it will need to be filtered to remove large insoluble solids that are not in suspension. The liquor is then concentrated, as for extract from a cannery by-product, using a Multiple Effect Evaporator to flash off moisture under vacuum and increase the solids content. Again the multiple effect evaporator is limited to a solids content of about 30–40% solids before the solution becomes too viscous to flow readily through the evaporator tubes without fouling.

Salt, or other materials, may be blended into the concentrate at this stage prior to further concentration in a pan evaporator. This secondary concentration continues until the solids concentration is around 70%, or until the extract is stable at room temperature. The final solids content will depend on, primarily, the salt content of the extract. Other materials added can include malto-dextrins—to impart additional and unique flavours through reactions with the soluble proteins during the final evaporation process.

Extract is normally packed, as a thick paste, in 20-litre plastic pails or 200-litre plastic-lined drums.

Powder preparation

The decanted, dewatered or filtered solids are dried in a suitable drier. Due to the semi-particulate nature of the material, spray drying is normally not appropriate. Depending on the moisture content, texture and, in particular, the particulate nature of the material, it may be dried in a fluidised bed drier or a disk-type drier. It may even be dried on a roller drier if the material is more sludgy than particulate. Carriers are often added to minimise the clumping effect of fat and to maintain a free-flow powder. After drying to around 5% moisture content, the material is milled and screened to an appropriate size.

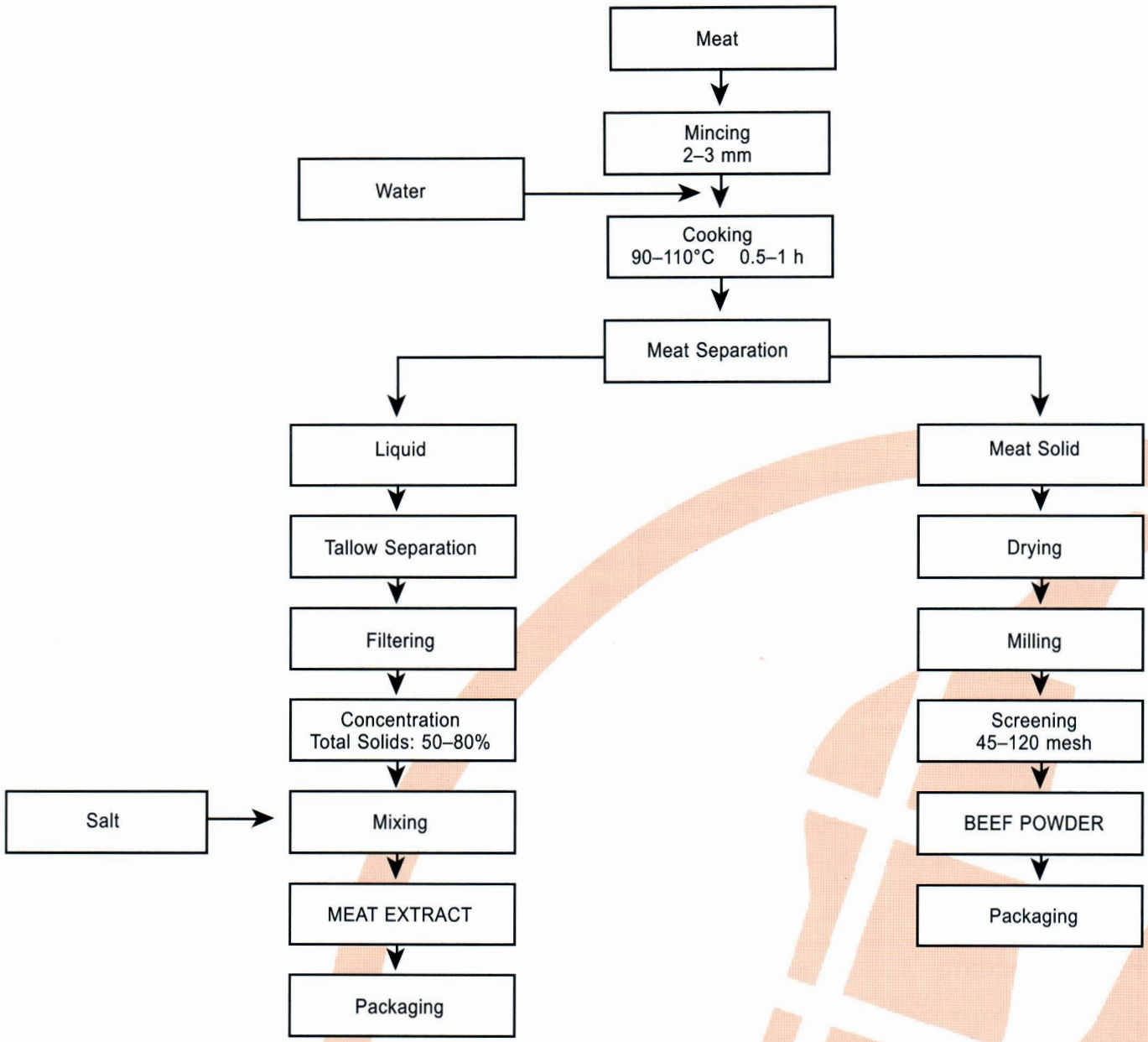
As many powders will be for resolubilisation or resuspension, their specifications call for small particle sizes so that screening through as fine a screen as 120 mesh may be necessary. This is only achievable with low-fat powders. The powder is packed in plastic-lined 20-kg multi-wall bags or in bulk units as required.

Processing equipment

A continuous process designed to favour the production of meat powders is possible for processes with short cook times. The equipment is similar to that used in a low-temperature rendering process but constructed and operated to edible standards.

For processes with long cook times, designed to favour the production of meat extracts and powders that have high solubles content, a batch process is required. For extract production, equipment similar to that used in the dairy industry is suitable for the concentration step. Evaporation pans, similar to those used in some confectionery processes, are

Figure 1. Schematic layout of meat extract and powder process.



readily available items for the final concentration stage.

Product specifications

Meat extracts and powders are generally produced to an individual client's specifications with a significant variation in physical attributes and composition possible for both product types. Typical product attributes are given in Table 1.

Enzyme solubilisation

The solubilisation of the meat protein content—by extended cooking—is an extremely variable process with significant batch-to-batch process variations required to achieve a consistent minimum soluble-solids content. This variability, along with the extended process time required, makes cooking a limiting step to the production of extracts and powders with high solubles content.

Table 1. Typical Meat Extracts and Powders

Meat Extract	
Appearance & Odour	Dark viscous paste with strong cooked-beef smell
Total Solids	68% +/– 2%
Protein	46% +/– 2%
Salt	10% +/– 2%
Fat	8% +/– 2%
Coliform	Negative
Total Plate Count	< 100 cfu/gram
Dried Beef Powder	
Appearance & Odour	Dry brown powder with mild slightly meaty odour
Moisture	< 5%
Fat	< 10%
Coliform	Negative
Total Plate Count	< 1000 cfu/gram

A range of proteases has been used to shorten the solubilisation time. When using enzymes the process is varied to include a short enzyme-activation step followed by a heat-inactivation step. Enzymes are added once the meat is slurried with warm water and the temperature adjusted to that desired for optimum enzyme activity. Enzyme activity is generally allowed to occur over a 20–30 minute period at 25–50°C during which the meat slurry is gently agitated. The time and temperature is established for the particular enzyme (or enzyme blend) that is used and the degree of solubilisation required. Enzyme suppliers can provide reliable data on enzyme usage levels and optimum processing conditions.

After the desired level of enzyme activity has been achieved, the slurry is heated to boiling point to inactivate the enzymes. The slurry may need to be held at this temperature for a short time to fully release fat from the meat structure prior to separating the slurry into the solid and liquid phases.

Papain, bromelain and proteases produced by microbial fermentation have all been used with good effect to solubilise meat protein for extract or powder production. The choice of enzyme is dependent on the required flavour profile of the finished product. Many of the enzymes produced by bacterial fermentation are severe in their activity resulting in strong, burnt notes in the product's flavour profile. Naturally occurring enzymes, such as papain and bromelain, are generally less likely to produce burnt notes but do produce variations in meaty and other flavour notes.

Whenever enzymes are used in this way, it is important to pre-select the correct enzyme for the flavour profile required and to strictly control both temperature and time of enzyme activity. Consequently a batch process may be more appropriate to maintain the correct level of control.

Further reading

Further information on this topic is available from the following project funded by the Meat Research Corporation.

- Project STR.008: Co-products Development

Further detail is available from the final project report for this project which is available from Meat and Livestock Australia.

Related information is given in the following MLA Co-products brochures.

- Preparation of bone stock
- Stickwater recovery

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