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Processing & Product Innovation

Restructured Meat using Bovine Plasma Products

Other brochures in this series demonstrate the importance of establishing domestic markets for large volumes of blood plasma. The potential viability of high technology extraction processes for the production of specific proteins and enzymes from blood, rely heavily on the industry's ability to produce plasma at a realistic price. This can only be done through the collection, and separation, of large volumes of edible blood to produce edible plasma and cell fraction.

The potential of the smallgoods industry to use large volumes of plasma can be seen from overseas experience. In Europe and North America, large volumes of plasma are produced and used in traditional smallgoods production. This has not been realised in Australia to date, due to anomalies in regulations allowing the substitution of meat proteins with cereal proteins, confusion with labelling, and poor consumer perceptions regarding the use of blood products in human foods.

Solving these issues will open up opportunities for increased plasma usage in traditional smallgoods, as well as allow for the development of other manufactured meats with characteristics based around the binding properties of plasma proteins.

Restructured meats

Restructuring of meat is not new technology. Current meat processing techniques, particularly in Australia, Europe and the USA, produce large quantities of cured meat products compressed after massaging and blending with cereal- or vegetable-based binders and gums. The addition of starches or vegetable proteins to these products is optional depending on the final texture and composition required. These products are generally not recognised as being prime cuts but, instead, manufactured meats.

With a trend over recent years towards increased demand by consumers for increased middle and prime cuts, there has been pressure to better utilise that portion of the carcase that is not in the middle- and prime-cut category, which makes up only 15–20% of the carcase. A preference for low-fat meats is another trend that is influencing possibilities for restructured meats. Comminuted and emulsified meats can now be produced with fat contents as low as 5%.

The opportunity with restructured meats is to transform shapeless carcass meat or trim, into meat products that resemble, and have the eating qualities of, the highly desired, but limited, middle and prime cuts. Restructured meat is simulated middle-cut portions composed of meat that has been reduced in size but not to the extent required to produce hamburgers. Restructured meats can be produced to resemble steaks, chops and roasts. Production of hamburger patties is strictly part of the restructured meats market but the product is recognised as being distinctly different from steak, chop or meat portions.

Conventional restructuring technology

Early technology for restructuring used the concept of flaking meat and using a combination of pressure and freezing to allow the meat flakes, with large surfaces, to interlock and bind. This process, patented by Urschel, is known as the Comitrol process. The process has not seen widespread application as the control of processing temperature is critical, with over-tempered meat producing a mushy texture in the final product.

More commonly, chunking and forming is the preferred method with particles minced to large size and irregular surfaces. These particles are interlocked and adhere with the aid of myosin released from the meat structure and added

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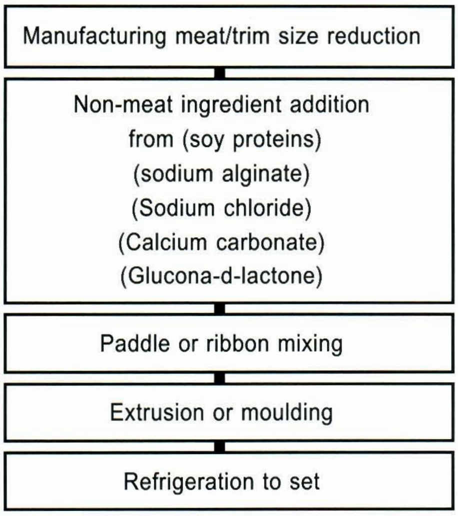
cereal binders and gels. The combination of these binding factors is enhanced as the final adhesion occurs when the meat and cereal blend is heated in a metal form or artificial casing. There is no doubt that quality products can be produced using these techniques. The process steps for this process are shown in Figure 1.

Figure 1. Restructured meat produced by addition of gums and non-meat proteins



The disadvantage of this process is that salt is required to extract the myosin and that starches and functional vegetable proteins are required to achieve adequate binding and fat emulsification. The addition of these binders is at the expense of meat protein.

Restructuring using plasma protein

Frozen boxed meat is tempered or thawed so that it can be passed through a coarse mincer. The minimum plate size on the mincer should be 14 mm to produce suitable particles to give a 'steak-like' structure rather than a fine mince. The 14 mm plate size has been identified as the optimum size to give the required appearance and a high level of 'bite tenderness'. Meat is not restricted by species and it is possible to blend meat from different species to obtain unique flavours and textures. However, if blending species, care must be taken in labelling the product to reflect the blend proportions.

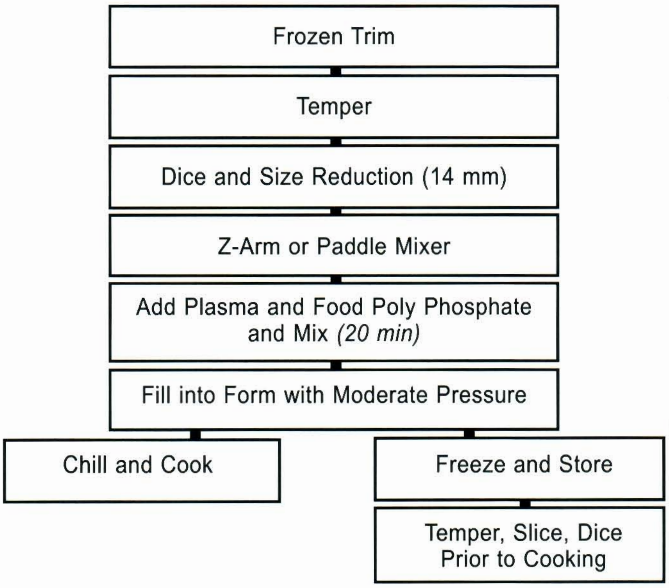
The liquid plasma is blended with the coarse mince in a Z-arm or ribbon mixer for up to 20 minutes to ensure adequate mixing and massaging of the meat particles. The use of plasma protein in the blending stage eliminates all need for vegetable protein extenders or gums and, at the same time, increases the meat content and yield by approximately 10% (the level of plasma added). Potassium poly meta phosphate added at the mixing stage has been shown to eliminate the need for salt (sodium chloride) to release the myosin from the meat tissue. The phosphate also raises the pH increasing the water-holding capacity of the product. Other food ingredients may be added to produce further improvements in physical characteristics but must be declared as additives. For example, milk protein isolates in combination with potassium poly meta phosphate enhances moisture retention during later thawing and cooking.

After mixing, the product is filled into a mould or casing. The cross section of the log produced can be round, square or irregular—such as a chop shape—to produce products suitable for a range of applications. The log is chilled or cooked in the mould or casing.

The log can alternatively be frozen and held until required. Processors using this option should be aware that this process involves freezing raw meat twice. Use of this option is not preferred and must be supported by strong HACCP-based process management to ensure temperature control and food safety for the final product. If this option is used, then the log will have sufficient cohesiveness, when thawed, to be tempered and sliced or diced prior to cooking.

The process steps for meat restructuring using plasma protein are shown in Figure 2.

Figure 2. Restructured meat using plasma protein



Bovine plasma functional properties

Bovine plasma protein has good gelling properties common with that of egg albumin (egg white). The substitution of egg albumin with plasma protein in the baking industry is a strong possibility. The gel formed by heating bovine plasma has no odour and a neutral taste provided it is not added to food products above 15% as liquid plasma.

In meat batters the bovine plasma protein has strong emulsifying properties when used on its own. Interestingly, adding more plasma, with increasing levels of fat, does not improve emulsification. Optimum emulsification occurs at a level of 15–20% plasma addition. When potassium poly meta phosphate is added, a further marked improvement in emulsification can be achieved.

It has been shown that the addition of 10% plasma to restructured meat increases the overall moisture of the product by about 10% while reducing drip loss to almost zero.

Restructured meat portions should have the ability to withstand a certain amount of shear, and not fall apart at chilled holding temperatures and during, or after, cooking. Plasma provides sufficient cohesiveness prior to cooking, and its ability to coagulate on heating overcomes the problem of disintegration on cooking.

Restructured meat quality

Tissue binding is a critical factor in restructuring meat. If binding is too strong then the product will be chewy or rubbery. However, a high degree of binding is required for restructured meat that is to be further processed at high temperatures (such as canning), or for extended times (as in meat pie production). The level of plasma used, and the mixing time, can manipulate the degree of binding.

The content of connective tissue also affects the quality of the restructured meat. Essentially restructured meats are more tender than middle cuts because the muscle cell orientation is random. However, if the collagen (or connective tissue) content is too high, the restructured meat will distort on cooking. Some connective tissue can be handled without loss of quality but any collagen that protrudes from the surface may produce unattractive wart-like structures on the surface during cooking. Meat with excessive amounts of connective tissue—such as tendons, paddywhack or diaphragm membrane—must be comminuted finely if it is to be included.

Restructured meats containing plasma protein have been shown to have a longer frozen shelf life, than those without plasma. Parameters for determining unsaturated fat oxidation and fat breakdown showed that liquid plasma on its own appeared to significantly reduce fat degradation over four months frozen storage. However it appears that this effect may not occur with spray-dried plasma and the inhibitory effect with liquid plasma may be destroyed in the presence of poly meta phosphate.

Similarly, restructured meat containing plasma has been shown not to discolour during frozen storage. Discolouration over a four-month storage period has been found to be minimal. Similar products containing gums and vegetable proteins tend to discolour rapidly during frozen storage.

Commercial opportunities

Restructured meat has the advantage over middle and prime cuts that a consistent cross-section can be produced making portion control, for food service applications, an easy option. It can be pre-prepared as logs, slices and chunks or even as a meat batter ready for inclusion into cooked smallgoods such as frankfurters.

Restructured meats can be held in a chilled or frozen state ready for inclusion in further-processed meat products. These items can be produced to a fixed protein fat and moisture content giving enhanced consistency for further processors.

As well as the potential for restructured products being produced directly for food-service or domestic use, a further industry sector could be established producing restructured, all meat, plasma-based products for inclusion in other food stuffs.

Further reading

This information is a summary of information from the following project funded by the Meat Research Corporation:

- Project UNSW.007: Restructured Meat Using Bovine Plasma Protein.

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 MLA Co-products brochures:

- Recovery of specific proteins and enzymes from blood: Parts 1 and 2
- Manufacture of Serum Albumin.

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