Manufacturing process for whole muscle cooked meat products IV: **stuffing and moulding**

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In continuation with the series of articles on the manufacturing processes for whole muscle cooked meat products, we shall now focus on the next phase of the process, which is stuffing and/or moulding.

Starting with the processing point at which the previous article ended, we had a meat mass which had been injected, tenderized, massaged and matured in accordance with the requirements of the product to be manufactured.

The mass of meat, following the maturation phase, must be placed in receptacles or moulds that will give the cooked product a particular shape, to be selected in accordance with market demands and technological possibilities (cook-in products).

MOULDS

Moulds are used to unite the different muscles during cooking and give the product an aesthetically pleasing shape. They can be of various types and materials.

Individual Moulds

Individual moulds have been used traditionally, and almost exclusively until recent years. Each mould can hold only one piece, be it a ham, a whole shoulder, or simply a reconstituted product. These receptacles allow for the moulding of pieces whose weight usually ranges from 3 to 10 kg.

These moulds can be made of different materials:

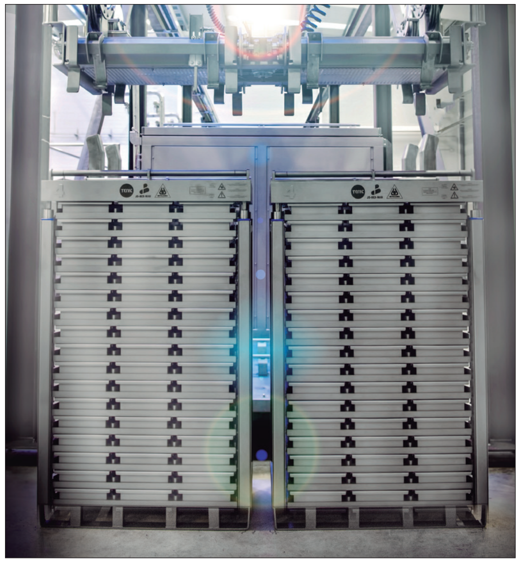
- Cast aluminium: relatively cheap but heavy, not very smooth and therefore difficult to clean.

- Stainless steel: easy to clean and resistant if the proper thickness of metal is used, but very expensive. Insufficient metal thickness produces deformations which lead to poorly-fitting covers and consequently deformations in the finished product.

Tower moulds

In recent years, these have come into use, to the detriment of individual moulds. Towers are less costly, in terms of initial investment, are easy to handle and eliminate the need for individual pressing of the pieces. They also allow for maximum optimization of space in the boiler or cooking oven, as well as greater moulding and demoulding flexibility, whether manual or automatic.

Towers are constructed in layers, in which the base of each mould serves as the cover for the mould below, and the cover of the last mould at the top is fastened by screws or any other device that exerts pressure on the entire assembly. They offer a variety of possibilities in regard to format and piece sizes, the most common shapes being square or rectangular due to design simplicity (Photo 1).



▲ Photo 1: Multimould Press Tower.

PLASTIC MATERIALS

Whatever the material of the mould, it must have an inner protective layer of polyethylene, for reasons of hygiene and to prevent the meat from sticking to the mould if the product is to be repackaged after cooking. If it is a cooked-in-the-bag product, the same shrinkable or thermoformed plastic acts as protection.

Thermoshrinkable plastic

This is the material most commonly used in the industry for stuffing cook-in meat products. It is a multilayer plastic material that retracts when exposed to thermal treatment. This retraction allows the plastic to mould itself perfectly around the product, exerting pressure on it that is essential for obtaining a product with zero cooking loss.

The pieces stuffed with this material can then be cooked with or without a mould. When a mould is not used, the plastic itself serves as such, thanks to the pressure it exerts on the product during contraction.

Depending on the stuffing process, the material can be in the format of individual bags or plastic rolls, which comes in various forms:

- roll of pleated material
- cartridge of corrugated material
- roll of instantly thermosealed material

The pieces to be cooked in a mould must be stuffed loosely so that the product can adapt to fit the mould, whereas the pieces to be cooked without a mould must be more tightly and firmly stuffed, so that the plastic material itself can give shape to the product by the pressure exerted.

Thermoformable plastic

This consists of two multilayer plastic films which will be thermosealed once the meat mass is contained inside. The lower film, of greater thickness, is first thermoformed and then filled with the meat mass, which is then vacuum thermosealed to the upper film. This system, which can also be used in combination with a rigid mould, gives the finished product a less regular shape than that obtained with a rigid mould or with shrinkable plastic, since thermoformed plastic has little power of retraction but is suitable for products in which a more traditional look is desired.

Fibrous casing and net

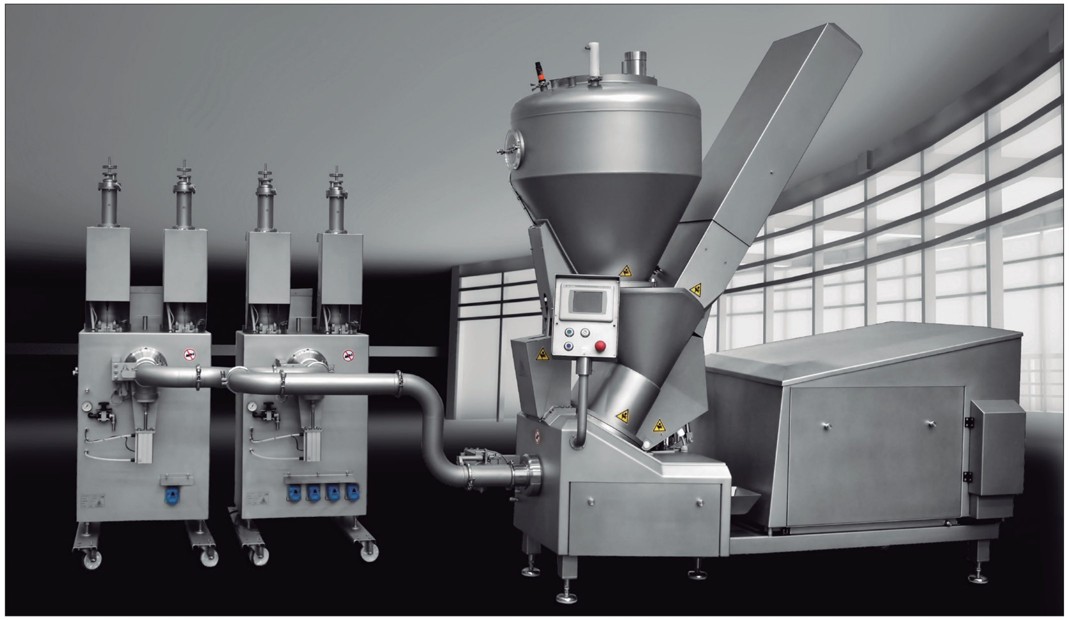
Used in smoked products when a traditional appearance is desired. The permeable fibrous casing, which can be made of cellulose or collagen, gives the product a cylindrical shape. The netting leaves a pattern marked on the meat surface and can have more convex shapes.

SHAPES

In regard to the shapes used, they can be divided into four basic types:

- Shapes which resemble the original shape of the natural ham: These include moulds of the mandolin, guitar, pear and leg types. These shapes are appropriate for reconstituted ham as well as whole hams since they allow a more or less uniform pressure to be exerted on the piece, as the morphology of the piece adapts itself to the mould. They have the inconvenience of presenting parts of different thickness, so that slices of different sizes are obtained when the piece is sliced.

- Tunnel-like shapes: These could be included in the group of shapes above but we shall list them separately since their utilization for whole ham pieces demands a much more careful moulding, since the uniform distribution of pressure on the entire piece is made more difficult.



▲ **Photo 2:** Continuous stuffer TWINVAC with accessories for thermoformer feed VOLTERM.

• Rectangular or elongated cylindrical shapes: Suitable for sliced products, allowing most of the entire piece to be used in the slicer (Photo 2).

• Irregular shapes: These are usually destined for low-yield products in which a traditional appearance is desired. We could include in this group the pieces made in thermoformed plastic without rigid mould, and those produced with fibrous casing and net.

STUFFING - MOULDING

We define stuffing/moulding as the process of placing the meat mass inside the mould which will give it shape during cooking. The shape of the mould will depend on whether one wishes to reconstitute the original shape of the ham in the product, with its muscular constitution intact, or if the muscles will appear with no special arrangement in the finished product. Another factor which conditions the shape of stuffing/moulding is whether the product will be packaged in the same wrapping in which it will be sold, or must be repackaged after cooking.

In any case, a determining factor in the quality of the finished product will be the appearance of large muscles of ham or shoulder in the slice, so that the filling of the mould must be done with care to leave the muscular structure as intact as possible.

Stuffing can be done manually or automatically. Within these options there are variables that will depend on the type of finished product desired.

Manual Stuffing/Moulding

There are different types of manual stuffing, depending on whether the product is to be with cooking loss, cook-in or smoked.

• Products with cooking loss: In this case, stuffing and moulding of the product takes place simultaneously. The ham must be moulded manually, reconstituting its natural shape in a mould protected by a layer of polyethylene, or in the plastic shaped in the thermoformer.

▲ **Photo 3:** Rotary vacuum clippers with 4 chambers.

The tanks containing the meat mass after the processes of injection and massaging are emptied onto a moulding table. There, the moulders select the muscles to be used in each piece, carry out the final trimming to eliminate the remains of tendons, aponeurosis and fat, place these muscles inside the mould in an ordered way, making sure the mould is filled uniformly so that when the cover is secured, pressure will be uniformly exerted on the entire piece.

When whole pieces are used, each piece is simply placed in a mould. In order for the pieces to fill the mould uniformly, it is necessary to have moulds of different sizes adapted to the various weights that may be used.
Once the moulds have been filled, they must be put through an air removal or pre-vacuum process in order to eliminate the air occluded between muscles. This produces a greater compactness of the piece, improving intermuscular binding in the finished product, and eliminating the spherical orifices which are produced by the expansion of occluded air during cooking. The total time of this process is 7-9 minutes, with vacuum values of above 95%. To facilitate this process, multiple chambers or revolving pre-vacuum chambers can be used. With this system, up to 9-10 pieces per minute can be obtained, depending on the size of the piece and the shape of the mould.

As they come out of the pre-vacuum system, the operator who collects the moulds proceeds to place the upper part of the polyethylene sheet in its correct position, then closes the cover with the help of a pneumatic press (manual or automatic), taking care that the pressure is uniformly distributed and the cover in a perfectly horizontal position. Once the moulds have been closed, they are placed in the tanks or containers of the cooking system to be used, ready to pass on to this next phase of processing.

If moulding has been done in a thermoformer, after the filling process the next procedure is thermosealing of the upper film under vacuum. In this case, a prolonged phase of air removal does not exist. This process, which can give satisfactory results in ham of very low injection, is less satisfactory in ham of higher yield in which the above-mentioned spherical orifices tend to appear. After the vacuum thermosealing, the film is cut in the same thermoformer, the piece separates and is then ready to go on to the cooking phase.

• Cook-in products: If the product is to be cooked in the same packaging in which it will be sold, the meat mass must be introduced into a flexible plastic under vacuum, which may or may not then be placed in a rigid mould.

In the case of using thermoformed plastic, the filling process will be the same as that described in the above section, although once the product has been vacuum thermosealed it usually requires placement in a rigid mould.

If thermoshrinkable plastic is used, this normally comes in bags thermosealed or clipped by the manufacturer. The filling of these bags must be done with the help of a funnel or a pneumatic stuffing machine. With this machine, the moulder reconstructs the ham in the cavity available for this purpose and places the bag around the output tube. Once the ham has been reconstructed, a pneumatic plunger introduces the meat into the bag without altering the arrangement of the muscles.

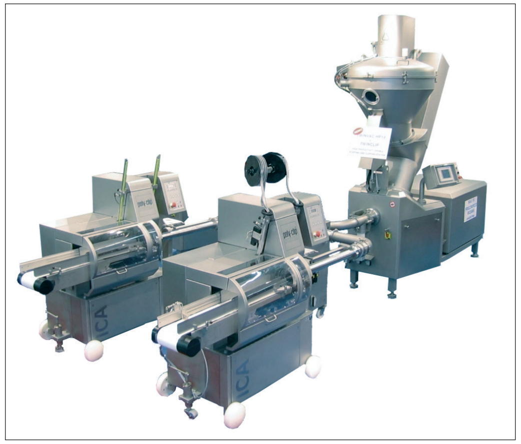
Once the meat is inside the bag, it must undergo an air removal process similar to the one described above. The only variation is that whatever vacuum chamber is used, it must be equipped with some system to keep the bags in a vertical position.

Once air removal is completed, the bag must be vacuum sealed, either by a clipping system or thermosealing. Compared to thermosealing, the clipping system offers the fundamental advantage of producing far fewer pieces with defective sealing since thermosealing requires the bag to be very clean in the area to be sealed, producing a defective seal in points where bits of meat or juice remain.

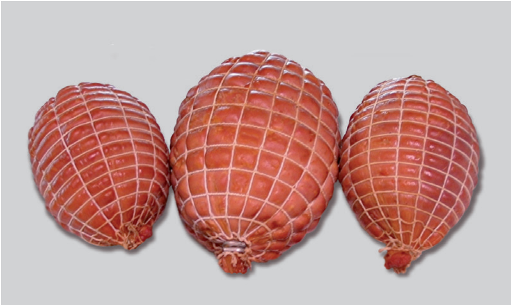
In either case, sealing must be carried out in a vacuum chamber. Vacuum time during the sealing process must be sufficient to eliminate all air which could become occluded between the sealing zone and the meat mass. To optimize the vacuum clipping process, there are rotary clippers that have various chambers (Photo 3). These machines have been designed to work in tandem with the above-mentioned rotary vacuum chambers, so that production is adapted to the 9- 10 pieces per minute they offer.

Once sealed, the pieces are placed in rigid moulds and the covers closed with the help of a pneumatic press, to be sent on to the cooking process.

• Products stuffed in fibrous casing and net to be smoked: The same stuffing process can be applied to products stuffed in fibrous casing and net, although these products are not usually submitted to the air removal or vacuum clipping phases, but rather small holes are usually made in the fibrous casing so that occluded air is eliminated through the holes when the casing is tensed during clipping or tying.
In products stuffed in netting, a layer of collagen or cellophane is usually added between the net and the meat, to prevent the net from becoming stuck



▲ Photo 4: Dual Stuffing / Clipping System: TWINVAC + TWINCLIP.



▲ Photos 5 and 6: Products of varying qualities, shapes and formats stuffed in a continuous line.

to the meat during cooking and the resulting loss of meat when the net is removed. If collagen is used, since it is a natural product, it can be consumed and does not need to be removed. In contrast, if a layer of cellophane is used, it must be removed before sale of the product.

Automatic stuffing of whole muscles

In recent times, manual stuffing has been relegated to the production of more traditional products in which the desired aim is to preserve the meat piece's natural morphology. In contrast, for more commercialized products, where productivity and cutting down on manpower are key factors, the stuffing process is usually carried out automatically. Contributing to this change is the fact that automatic stuffers have been developed that allow for the continuous stuffing of large meat pieces without damage to their morphology and without air pockets, and which are capable of obtaining products that resemble hand-moulded ones, but with the advantages of automation.

As will be seen below, these processing lines have various accessories that can adapt to any type of process, be it with clipping or thermoforming, individual bags or continuous film, pieces from 400 gr up to an unlimited weight, etc.

For an automatic stuffer to be capable of stuffing whole muscle meat products, it must have the following characteristics:

• Maximum respect for muscular structure, that is, the portioning system must not cut or destroy large muscles and must not produce bottlenecks, displacements or rotations. This necessarily rules out stuffers with portioning systems using vanes or screws and designed basically for stuffing emulsions. The suitable system for whole muscle products is one with a volumetric cylinder, where the meat is moved toward the outlet tube by pressure alone. This tube must be wide enough for large muscles to pass through and arrive at the outlet with the same appearance with which they entered, without damage to their surface or formation of intermuscular paste. In this way, the finished product will have clearly defined muscle contours.
• Portioning regularity, in order to obtain a finished product with regularity of weight.
• High production that allows for cutting down on labor costs.
• A vacuum system that eliminates air bubbles from both the internal and external areas of the piece.
• Great compacting between muscles in order to obtain a good muscular binding and maximum reduction of losses in the slicing line.
• Easy cleaning and sanitation. To this end, the machine must be easy to disassemble in such a way that provides access to all internal parts.
• Mechanical reliability to guard against production stoppages that may result in economic losses.

Loading the meat into the automatic vacuum stuffer is done by suction from a pre-hopper into which

▲ **Photo 7:** Automatic Whole Muscle Stuffer: TWINVAC *SIGNATURE*.

meat coming from the massaging zone is dumped. A photoelectric cell located in the stuffer's vacuum hopper controls the meat level, regulating the opening and closing of the meat inlet valve (Photo 4).

• Automatic continuous stuffing

Automatic continuous stuffing of whole muscle meat products requires the use of an automatic double clipper in tandem with the stuffer. This combination provides numerous variables in regard to weights, finished product formats, types of stuffing materials, etc.

Continuous stuffing takes place without air getting into the product thanks to the special stuffing system design, which consists of two reciprocating hydraulic cylinders connected to a rotary valve that collects the product coming from one cylinder or the other, making for a continuous meat flow. The downward stroke of the cylinders is controlled by an encoder that allows for direct portioning of the product from the same stuffer without additional volumetric devices, resulting in high weight regularity. Operation is controlled by a PLC, which is coordinated with the clipping machine in such a way that once a piece is clipped, the stuffer receives a signal from the clipper and starts the next portioning operation, and so on successively. The production output of these lines will depend on equipment capacity and the size of the pieces being processed. It is possible to attach a device at the stuffer outlet that distributes the meat to two clippers, to take advantage of the clipping time of one of them to feed the other clipper, and in this way obtain a production increase with a single machine.

This type of stuffing is very suitable for products that are to be sliced, because it provides the means for producing long pieces (up to 150 cm) and reduces cooking loss in the slicing phase.

• Automatic piece-by-piece stuffing: If it is necessary to stuff piece by piece, without continuous clipping, a stuffing portioning device must be installed in order to fill the bags or moulds. The operation is very simple, since the bag is placed on the outlet tube of the device and, by means of a pedal, a pneumatic cylinder is actuated to empty the meat prepared by the portioner into the receptacle. Then the bag must be vacuum clipped or thermosealed, although some products require a pre-vacuum stage before being sealed.

If moulds are being filled, they are placed under the outlet of the device and the same procedure is followed. Then the moulds are sent to a vacuum chamber, as explained in the section on manual stuffing.

In both types of stuffing, skin can be added, with or without fat, to give the product a more natural appearance. When stuffing in bags, the skin must be placed on the outlet tube of the portioning device. The bag will wrap around the tube and the skin. When the piston is actuated, the pressure of the meat mass entering the bag will push said skin into the bag with the meat.

• Automatic continuous thermoformer feed: Another option available for modern stuffing lines is a thermoformer feeding system for whole muscle meat products. This consists of a volumetric portioner adapted to the outlet of a whole muscle vacuum stuffer for automatic thermoformer feed. Thanks to the vacuum existing in the stuffing machine's hopper, required vacuum time in the thermoformer can be reduced, thereby obtaining an increase in the equipment's production capacity (Photo 7).
After the filling and clipping/thermosealing phase, be it continuous or piece-by-piece, the rest of the process is identical to that described in the section on manual stuffing.

Having covered the different variants which exist in the moulding phase, it is important to emphasize in conclusion to this article the importance this phase of processing has in obtaining a product of genuine quality. In those products which are moulded manually, the final presentation of the product obtained will depend on the care, responsibility and experience of the moulders. Careless moulding can result in products with a high loss of juices during cooking and the appearance of cavities inside the piece which can lead to the rejection of the product. A badly-sealed mould can cause it to open during cooking, creating problems of poor binding between muscles and internal cavities. Another consequence may be the appearance of misshapen pieces due to a failure to place the covers in a horizontal position. Obtaining a product without spherical orifices of occluded air, free of air inside the bags when the product is cooked in the bag, uniform in weight and presenting the physical appearance of whole muscles when sliced, will also depend on the correct functioning of the automatic machines that are used. In cooked-in-the-bag products these properties will be of vital importance in preventing the release of juices during cooking. In short, as is true of all the other processing phases in the manufacture of cooked ham or shoulders, moulding will have a decisive impact on the quality of the finished product.