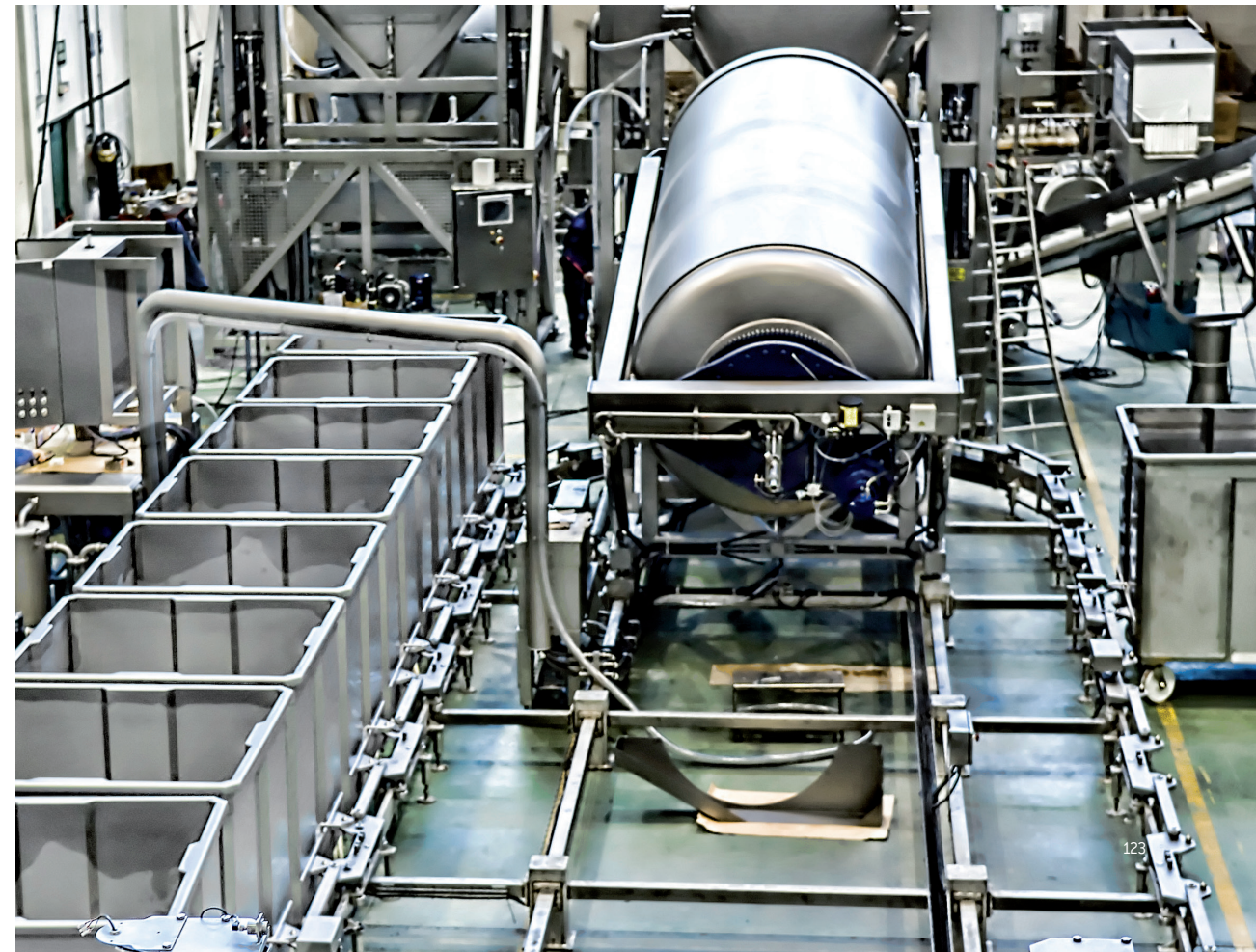


# Modernizing the industry

## Computerized massaging of meat

Marta Xargayó and Josep Lagares



The authors explain the basics of vanguard computerized massaging systems for cooked meat products and demonstrate the competitive advantages that these systems offer the processor.

INTRODUCTION

Taking into account that all the massaging characteristics [see art 9: Manufacturing process for whole muscle cooked meat products III: Massage] show that massaging is necessary to achieve water holding capacity and the binding of muscles in cooked products, therefore it is necessary, when choosing a massaging line, to be very familiar with the possibilities offered, above all, the system's effectiveness and versatility in processing a variety of products, since each product will require a special massaging cycle, which can be altered considerably according to the finished product category.

In any case, the attainment of a technologically correct cooked meat product is not fruit of chance and the massaging phase has an important role in achieving this goal. The equipment responsible for the above-mentioned process has to be able to face up to an important number of variables, which will define each and every meat product, as distinctly as an ID card. The compliance with these specifications will lead to a standard product with a defined quality and will give meat producers a rigorous control of their processes, while minimizing any production risk.

Massaging machines or reactors have evolved in response to the needs and demands of the products and the market. Nowadays, practically all machines have a vacuum system but they are still very limited in versatility and automation, which makes factory production difficult.

Automation of massaging is important in order to avoid unnecessary waste of time and, above all, to prevent human errors by storing all the massage data in the memory of a computer, which will

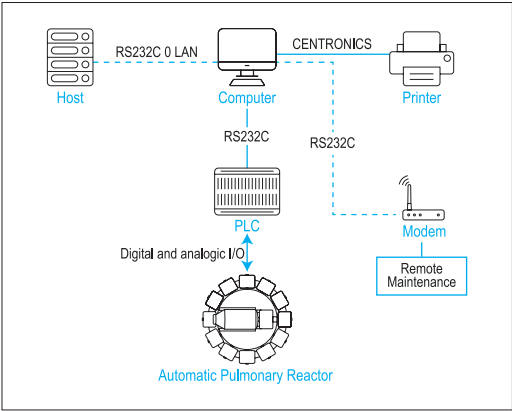
regulate the machine's operation throughout the 24 hours of a day.

Because of the wide range of products and, as mentioned above, the different requirements of each one, it is important to select a system model which can cover all these possibilities, not only for the products manufactured at the time of purchase but also with foresight for possible changes in the market.

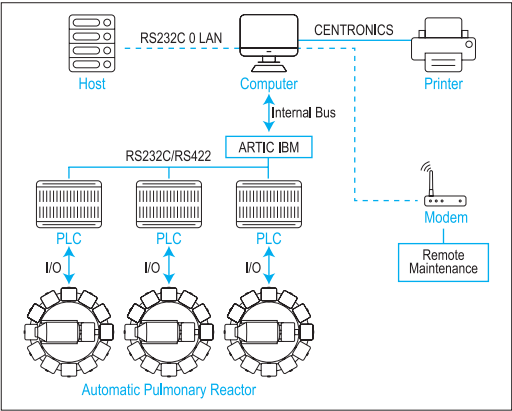
COMPUTERIZED MASSAGING

In recent years, meat processing machinery has evolved to benefit from the multiple advantages that vanguard electronic research offers to the industry. The massaging process of meat products is not an exception, and automation and computerization have made their way into this field. This has resulted in fully computer controlled systems without operator assistance.

The operation of these machines, Automatic Reactors, is controlled by means of Personal Computers (PC) and Programmable Logic Controllers (PLC) placed in the production control rooms. In schemes 1 and 2 examples of Hardware architecture for two of these computerized systems are shown. Special structural characteristics, such as connection utilities to a Local Area Network (LAN), are also shown in said schemes.



▲ Scheme 1.



▲ Scheme 2.

The different parameters which define every specific meat product are stored in the memory of a computer that transmits/receives them to/from a PLC by means of a connection (ETHERNET). The PLC is in charge of the real time operation and control of the reactor with a never-ending input and output of digital and analogical data.

These systems usually have a carrousel surrounding the reactor where, after the injection phase, maturation tanks containing the different meat products to be massaged are placed. Once a maturation tank has been placed in the carrousel, an input confirmation is required to inform the machine of the kind of meat available in each tank. The information about each product, previously introduced into the memory of the computer, will allow the system to do the rest of the work.

The multiple parameters or variables, define every massaging phase are as follows:

- **Massaging time:** The longer the massaging time applied, the greater the effect on the meat because increased solubilization and extraction of myofibrillar proteins will be obtained. But said time must be regulated because an excess of massaging time can produce results contrary to those desired, affecting the water holding capacity as well as the appearance of the slice.

- **Massaging model:** Depending on rotation direction of the reactor, the machine can produce an impact effect or tumbling, or a friction effect or massage upon the meat.

**Impact effect or tumbling:** In this case, the pieces of meat are lifted, by baffles, up to the upper part of the machine. From there, they fall, striking the meat mass below and producing an intense mechanical action, suitable for high-yield products. This type of massage results in a great cellular breakage and therefore optimum solubilization and extraction of proteins.

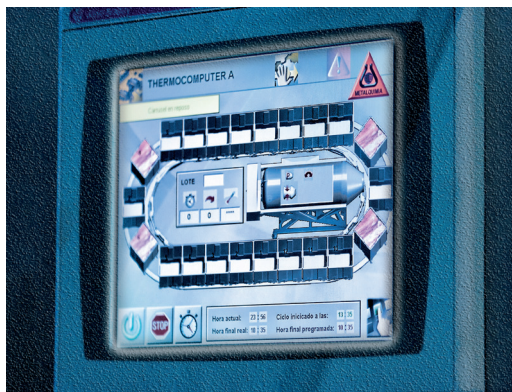
**Friction effect or massage:** The mechanical action is through friction between different muscles, with the walls and baffles of the massaging machine, producing a much gentler effect than the tumbling model. This type of massage is very suitable for products in which, the pieces and the muscular structure, must be kept intact, but with the feature of achieving sufficient solubilization of proteins for muscular binding.

These two models of massaging correspond to very different types of products and there are many others to which an intermediate process, or a combination of the two, must be applied. The selection of the most appropriate combination between these two options will be required when introducing the specific data of each product, into the memory of the computer.

- **Rotation speed of the reactor:** Apart from the different effects produced by the above-mentioned types of massage, its effectiveness will be influenced by the velocity at which the machine spins. Obviously, a higher speed will result in greater solubilization of proteins, but also in greater breakage of the muscles. For this reason, it is necessary to find a point of balance for each product. These machines allow for the selection of an energetic, gentle or very gentle action depending on the rotation speed of the reactor.

- **Internal environment:** The internal massaging environment can also be selected from these





different options: High Quality Vacuum (less than 1 mm Hg) and Atmospheric Pressure.

- Meat temperature:** The mechanical action produced by massaging tends to increase the meat temperature and, although efficiency of massage is greater at higher temperatures, there is also a risk of bacterial contamination. These systems incorporate a cooling jacket (circulation of a cooling agent through coils around the reactor) that guarantees the meat will come out of the massage at the required temperature, avoiding contamination risks and allowing the operator to work more comfortably during the injection phase. Said systems control temperature of each individual batch by a special sensor that reads the temperature of the incoming meat. The computer adjusts the necessary cooling time to keep the meat temperature within a range of  $\pm 0.50^{\circ}\text{C}$  around the desired maturation temperature and throughout the entire maturation process.
- Maturation periods:** The combination of massaging and maturation will produce the desired extraction and solubilization of proteins. It is important that the maturation time be a minimum of 24 hours in order to obtain good results in massaging and color distribution. The combining of a certain massaging time with several hours of repose has given excellent results, allowing the solubilization of proteins, which form the exudate.

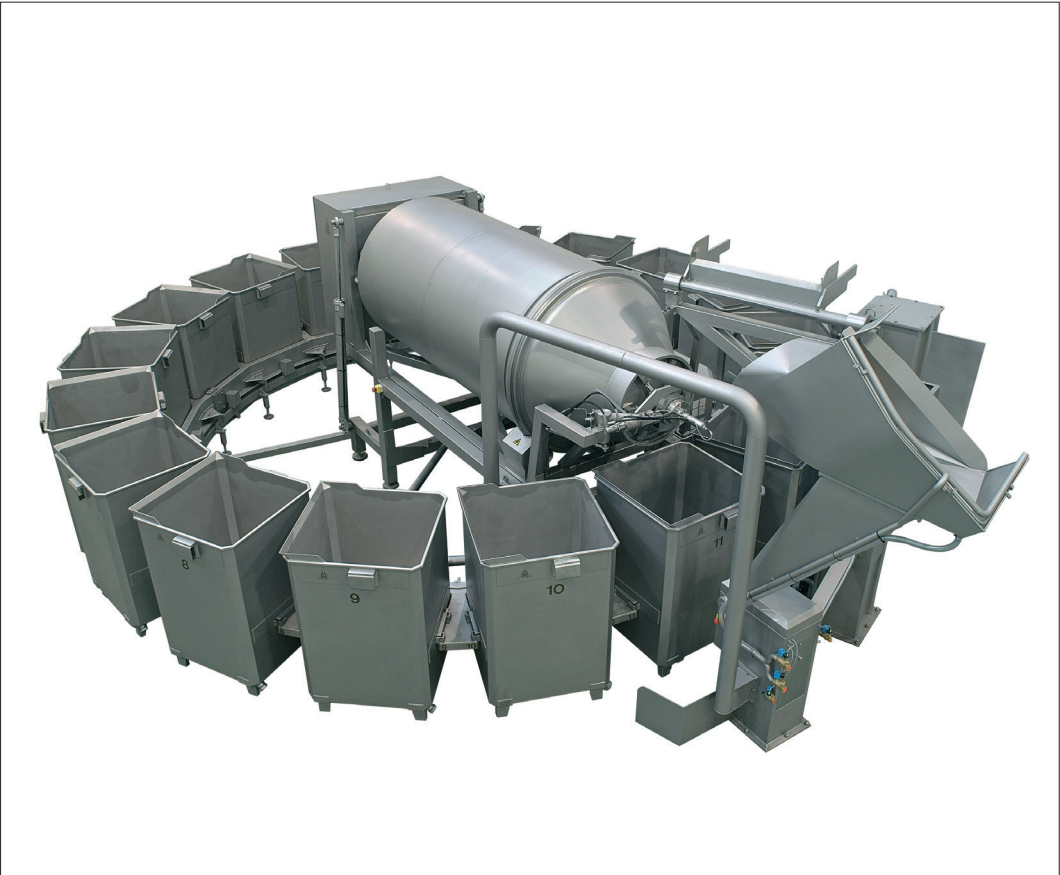
- Batch/load size:** The number of maturation tanks forming each batch that will be loaded automatically into the reactor can be programmed (one, or two, or three depending on the model). The result of the massaging process (mainly in the case of strong massage or tumbling) will depend on the height from which the meat falls, so that the size of the batch in the machine should be a factor taken into consideration when carrying out a massage. This means there are more opportunities to be able to apply, the necessary massage for each product, with different effects, in the same machine. With all these parameters playing a role in the definition of the final product, the meat technologist will have a broad spectrum from which to select and adjust according to each specific product.
- Software utilities:** In addition to the production facilities explained in the above paragraphs, these computerized systems allow for working with powerful massaging programs, which provide a very good complement to the massaging process. The users of these systems have available, among others, the following software utilities:
- Daily production programs:** These include the optimised generation of chronograms, schedules and daily production reports. The computer can send information to the main factory computer [See schemes 1 and 2].
- Real time control of operation and processes:** Control is carried out by using, for each individual product, its specific program, which is stored in the memory of the system, and can be easily adjusted for batches of less than 900 Kg. Each program contains the information on the massaging parameters and also a list of incompatible products (the incompatibilities may be in terms of different curing brines, variable seasoning or flavourings, meat origin, etc.). Access to all these data is usually protected by a password system, which makes the product information available to only those in charge of the production centre, avoiding in this way errors on the part of operators.

- Automatic cleaning process - CIP:** The computer detects the incompatibilities between the contents of different maturation tanks and the CIP (Cleaning-In-Place) utility, which is usually installed in these systems, allows for automatic cleaning of the reactor. Normally, a cleaning process is always programmed at the end of an automatic maturation cycle.
- On-line meat temperature control:** An internal probe continually monitors and controls the temperature of the meat and, in accordance with the product's assigned temperature, recorded in the massage formula, will activate or deactivate the inlet of cooling agent into the cooling jacket.

It is good to have an alarm system so that if the temperature is not lowered in the prescribed time, the operator is alerted and can act accordingly.

- Maintenance assistant:** These vanguard systems usually work with sensors that count working hours. When any maintenance operation is required, for example hydraulic oil change of a certain part of the reactor, a message is displayed on the computer screen and printed in the daily production report. Also the maintenance assistant can be consulted for instructions of all maintenance operations. This information can be displayed on the screen or printed.

▼ Computerized Massaging Unit: THERMOCOMPUTER.



• **Alarm service:** The program is able to diagnose the causes of an incorrect machine operation. When this happens, an alarm message is displayed on the screen and a flashing light on the electric panel switches on. The system helps the operator by supplying additional information, including how to proceed in order to solve the problem.

## CONCLUSIONS

In recent years, meat massaging methods, techniques and systems have evolved towards a continuous improvement of massaging technologies, automation and computerization. New technological advances, automation and computerization confer to these systems competitive advantages, which will provide a better positioning in the market. These advantages include versatility, that is, a diversity of products can be manufactured with the same line, thereby assuring a perfect adaptation of the finished product to the demands of each specific market. Another advantage is operational reliability in the manufacturing process for cooked products. This means that the desired results will always be obtained. A process, which is irregular and unreliable, may produce some pieces that fall below the established norm, while others may exceed the norm. In both cases the system will have failed, since the established norms have not been met. In contrast, a system that performs with precision and reliability provides products that are constant in terms of quality and presentation, an attribute much appreciated by manufacturers as a bolster to their brand's image. Other important factors include productivity [highly efficient production lines, able to produce numerous products] and profitability [each of the above-mentioned characteristics has its particular impact on the profitability of the meat processing plant]. Finally, the high degree of automation achieved in this field has opened the door to the evolution of products towards a higher aesthetic and nutritional quality. Above all, it offers greater security to the investor, with considerable savings due to

optimisation of production and reduced labour costs.

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## ACKNOWLEDGEMENTS

We would like to thank Eng. Joan Puigferrer and Ms. Mercè Muñoz, Metalquimia Engineering Department and Ind. Eng. J.L. Franco, Adasoft Industrial Software Applications, for their kind suggestions and drawings. We would like to thank also Ms. Jennifer Sullens for her helping in the translation work.

