71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

SMART PROCESSING IN THE MEAT INDUSTRY: CONCEPTUALISATION, TOOLS AND USE CASES

Elena Fulladosa*, Ricardo dos Santos, Israel Muñoz

IRTA. Food Quality and Technology. Finca Camps i Armet, s/n, 17121 Monells, Girona, Spain

*Corresponding author email: elena.fulladosa@irta.cat

I. INTRODUCTION

Quality, safety, and sustainability are the main challenges currently faced by the meat processing industry. A way to address these challenges is the optimization of the production processes through automation of the production lines. The implementation of sensors can provide relevant process and/or product information. In turn, the collection of process data enables the development of predictive algorithms and facilitates the construction of digital twins or process optimization tools, which can help transform the meat industry into a smart processing industry.
Recent technological and data analysis advances have represented a turning point for the industry, and have posed a challenge for companies to keep up with competitors. These advances can help to keep competitiveness and economic profitability of companies in an industry that typically struggles with low profit margins by optimizing resources (energy saving, reduced food waste, etc.) and the production planning.

This work aims to define the concepts of digital innovation and smart processing in the meat industry as well as outlining key examples that showcase how smart processing enhances product quality, safety, and process sustainability and efficiency.

II. MATERIALS AND METHODS

This work has been organized in three main sections: the first section introduces the concepts of digital innovation and smart processing; the second section presents an overview of the tools designed to address these challenges; and the third section outlines examples of smart processing in the meat industry.

III. RESULTS AND DISCUSSION

Smart processing consists in the use of different technologies to collect, process, and analyze data acquired during processing, enabling informed decisions to enhance quality, safety, and process efficiency (Figure 1). Smart processing implies that data is collected and analyzed at multiple points of the production process to be used in automated and intelligent decision-making. Therefore, the level of digital innovation in the meat processing industry will be crucial to achieving quality, safety, and sustainability challenges.

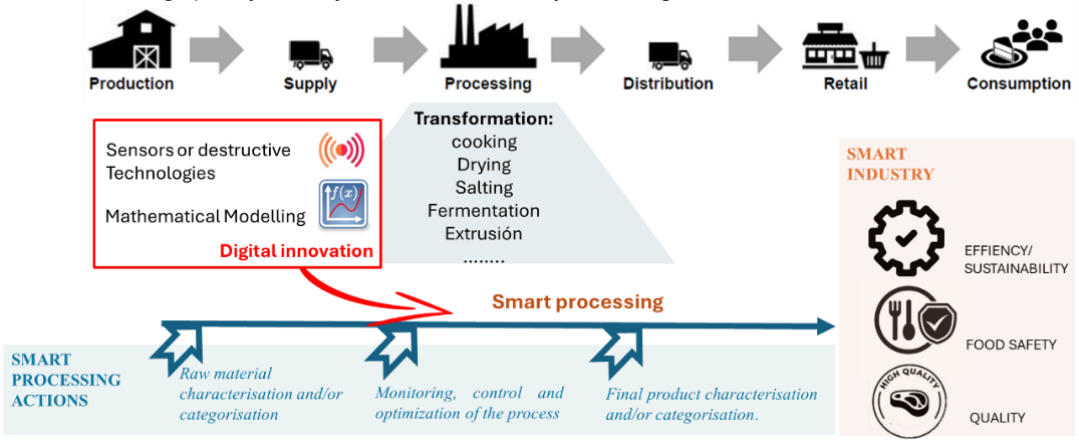


Figure 1: Concept of smart meat processing.

Although digital innovation can refer to many aspects of industrial production, and consider technologies such as blockchain technology, automation, and traceability, the present work focuses only on technologies intended for smart meat processing. Digital innovation during processing can be divided into four levels (Figure 2). The Initial level is the first step, where industries adopt certain basic digital technologies that enable a targeted quality control.

In the Exploring level, the industry adopts technologies to characterize and classify products which enable the optimization of certain processes. In the Competent level, there is an adoption of advanced technologies such as artificial intelligence or the Internet of Things to optimize the overall production processes and enable decision-making support tools. Expert level involves complete integration of data and systems during production.

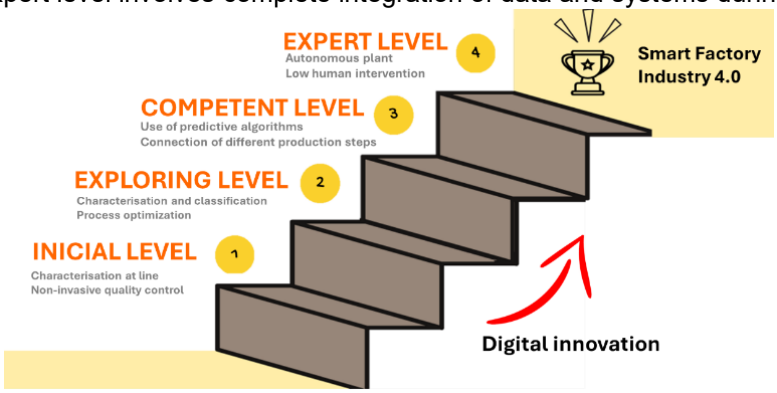


Figure 2: Digital innovation levels in smart processing.

There are lots of feasibility studies describing the use of sensors to monitor and control process parameters. However, the number of studies on their implementation in the food industry, showing their benefits in terms of quality, safety or sustainability, is scarce. One example is the use of low-cost non-invasive technologies, usually at line, to control the quality, composition or safety of meat products. Another example is the implementation in line of X-ray based technologies to predict fat and/or salt contents and adapt the processing conditions of dry-cured ham according to these parameters [1]. The use of at-line technologies, such as computed tomography together with predictive microbiology, can facilitate adjustment of temperature and duration of different steps of dry-cured ham production guaranteeing safety of production process [2]. The development and implementation of specific algorithms that enable the real time adjustment of drying processes in dry-cured ham and dry-cured meat sausage production exemplifies the possibilities of competent digital innovation levels.

IV. CONCLUSION

Smart processing is tightly linked to the digital innovation level of the industry, which offers different optimization opportunities. Although many articles study the feasibility of different sensors and non-invasive technologies, their implementation at the meat industry is less reported.

ACKNOWLEDGEMENTS

Project grant [PID2021-122285OR-I00] funded by MICIU/AEI/10.13039/501100011033 and by ERDF/EU. Ricardo dos Santos acknowledge grant [PRE2022-103798] funded by MICIU/AEI/10.13039/501100011033 and ESF+. Consolidated research group (2021 SGR 00461) and CERCA program from Generalitat de Catalunya.

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