Maturation: optimisation of the beef ageing system based on selecting the most suitable raw materials and real-time monitoring of the chamber conditions

Summary

The production of aged meat involves using the natural ageing process to obtain meat with high added value. In this operational group we have worked in a transversal way to achieve a final product suitable for the needs of the customers. We have worked on the improvement of ageing cows' body condition in order to obtain an optimal raw material for ripening, while looking for the best conditions of time, temperature and humidity to achieve dry aged beef meat with optimal sensory qualities. Moreover, the operational group has allowed to develop new tools such as low cost NIRS and predictive microbiology, which allow to control the ripening process rapidly and effectively.

Objectives

The main objective is to obtain beef with a high sensory quality by means of an innovative production system for aged meat that enables the environmental technical parameters to be monitored in real time.

The specific objectives of the project are:

1. Identify the optimal ageing conditions.
2. Optimise the raw material selection process.
3. Optimise a dry ageing system based on a prototype designed to monitor the technical parameters of the process in real time.
4. Apply predictive microbiology tools to minimise the risk of growth of pathogenic microorganisms.
5. Develop an integrated information system that facilitates decision-making during the process.

Description of the actions carried out in the project

The following specific actions were taken to achieve the objectives:

- **Action 1: Identify the optimal ageing conditions and the raw material selection criteria.** To set the most appropriated strategy for each participant company to produce aged meat, a search was carried out on the bibliography and the existence of similar products in the market.

This strategy determined the characteristics that raw material should meet in order to be able to age in proper conditions, the methods of ageing, and the technical environmental conditions of the maturing chamber.

- **Action 2: Optimise the selection of the most appropriate culled cows for their use as raw material in the process of dry ripening**. An initial characterisation of the cows was done according to their origin and race (meat or dairy aptitude). With these results, we designed an improvement plan which monitored their body condition and feeding in order to obtain cows that met the minimum fattening requirements for meat ageing. Finally, a validation of the chosen profile was done, considering feeding, genetic type, age and body condition. Meat characterisation was carried out taking into account parameters such as instrumental colour, pH, instrumental texture and sensory panel.
- **Action 3: Optimise the system of dry ripening from a prototype designed to control the parameters of relative humidity, temperature and weight, while incorporating a system of monitoring of these parameters in real time.** The dry ripening process is basically influenced by the raw material, the time and the humidity and temperature conditions of the maturing chamber. Along the project we realised pilot tests to determine the optimal conditions of maturation for this type of raw material. We used different temperature and humidity ranges, and different ageing days up to 60 days. Along the project we tracked the pieces taking note of the weight, the colour, the pH, the water activity and the instrumental texture. At the same time the tracking was taking place, the pieces were measured with a pocket NIRS. These spectrums have been correlated with the data of water, humidity and texture in order to obtain prediction equations for the evolution of these parameters linked to a determined piece along the ripening process in a non-invasive manner.
- **Action 4: Apply predictive microbiology to minimise the chance of proliferation of pathogenic microorganisms**. As the alimentary security of aged food is a key point, we have worked with predictive microbiology tools that allow to predict the level of alimentary security of the aged meat from the data on pH, water activity and conditions of humidity and temperature of the maturation chamber.
- **Action 5: Develop a system that allow to obtain information from all the process and the decision making.** We identified the purchasing preferences of MAFRICA and JANÉ BERTRAN's customers through surveys. These data, together with the rest of the data obtained along the project, have been integrated in order to obtain a selection standard for the raw material and a ripening system that result in a meat of high sensory quality which satisfies the demands of the potential customers of the participant companies.

Final results and practical recommendations

The set of tasks that have been realised in this operational group has allowed to define the most suitable strategy to produce aged meat from cows that have ended their productive or reproductive cycle.

The action 1 has allowed to define this strategy both in terms of the facilities and in terms of the selection of animals, carcasses and meat.

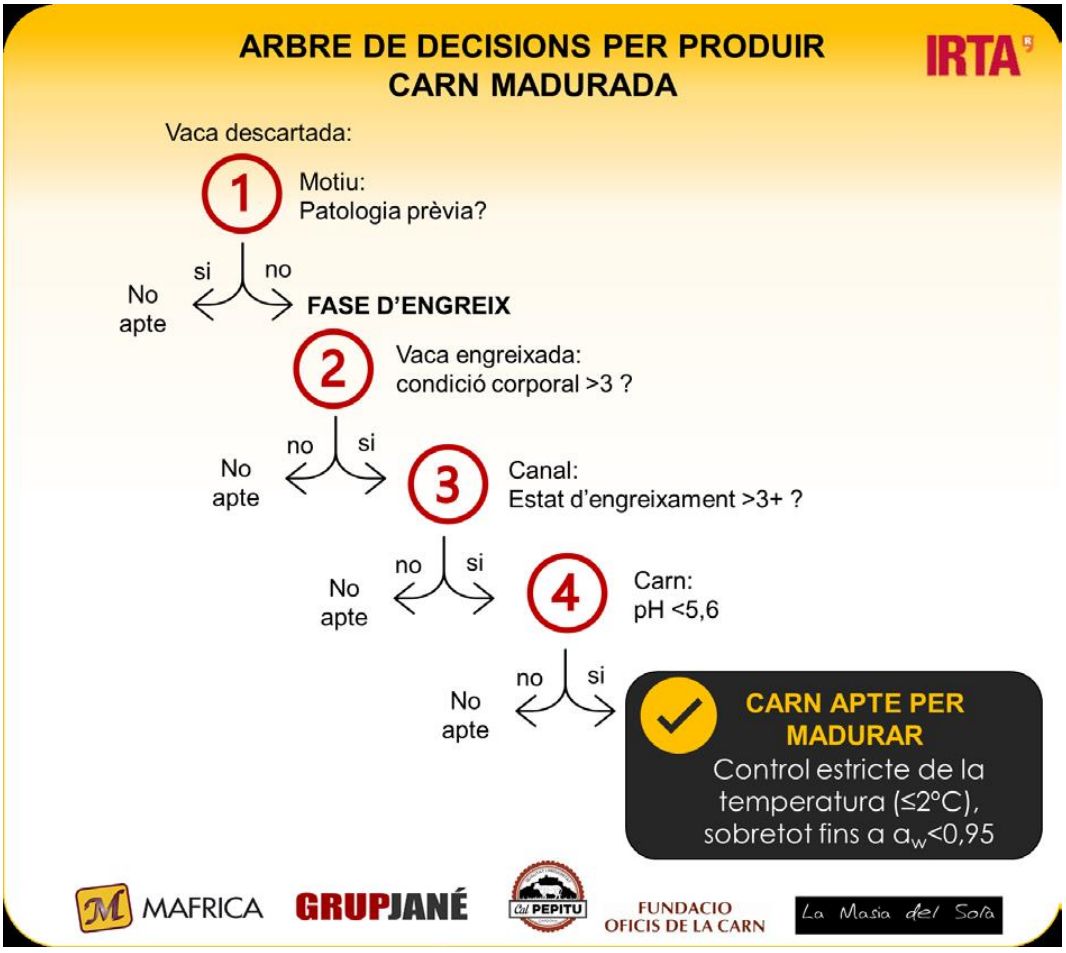
Obtaining a suitable raw material to produce aged meat is very important. That is why we realised a first search (action 1) in order to know other experiences of aged meat production from the animal typology that JANÉ BERTRAN has available. To finish delimiting the obtained theoretical information, it was realised a characterisation of the animals and the meat each company could provide and a cow fattening strategy was defined in order to achieve the needed characteristics to produce aged meat (action 2). The fattening stage allowed to obtain animals with a body condition higher than 3 and carcasses with a fattening state higher than 3+ (according to the slaughterhouse's own system of

channels classification). The values of these two parameters (body condition and fattening state) are considered as minimum and indispensable traits to decide whether a meat piece should be aged or not.

Regarding the facilities, the combination of a ripening period in carcasses followed by the dry ripening of the pieces in maturation chambers especially intended for each stage was the chosen option. In the action 3, the evolution of meat pieces was studied during almost 60 days in different environmental conditions for the purpose of knowing how the relevant parameters changed (weight loss, water activity, water content in meat pieces, pH, superficial colour, fat superficial colour, lean internal colour and instrumental texture. The spectrums obtained with pocket NIRS allowed to study the evolution of these parameters and to work on possible prediction equations. This way, the pocket NIRS could predict the mentioned parameters in a non-invasive manner.

The tracking of the aged pieces during almost 60 days of ripening and the study of the predictive models of microbial growth allowed to identify the scenarios where pathogenic proliferation is more probable, in the case it existed in the non-matured fresh meat initially. As a result of this action 4, we decided to discard those carcasses with pH > 5,6 to produce aged meat and noticed the necessity to properly control the temperature of the ripening chamber at least until the superficial water activity of the pieces reached values lower than 0,95.

Nevertheless, the operational group has allowed to design a decision tree to identify the most suitable pieces to produce aged meat and to establish tracking criteria for the pieces in order to produce quality aged meat in a secure manner.



Conclusions

The operational group GO-MADURACIÓ has allowed to design a decision tree to identify the animals, the CHANNELS, and the suitable meat to produce quality aged meat, as well as of establishing criteria for the disposal of the pieces in order to minimise the risks associated with security and to produce secure aged meat for the consumer.

The use of emerging methodologies as the pocket NIRS and the implementation of predictive models of microbial growth has allowed to work with non-invasive strategies to be able to track the meat pieces along the ripening process and to produce secure and quality aged meat for the consumer.

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Subject area(s) of application

☒ Livestock farming and animal welfare
☒ Food quality/processing and nutrition
☒ Supply chain, marketing and consumption

Geographical area(s) of application

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REGION(S): El Bages, El Berguedà, Osona

Project website and dissemination

www.mafrica.com

https://youtu.be/8em5dkCeLSM

More information on the project

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