

# DEVELOPMENT OF AN OBJECTIVE METHOD TO PERFORM QUALITY CLASSIFICATION OF COMMINUTED POULTRY MEAT

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**Abstract – Deboning of meat is an important technology to improve yield and sustainability of meat production. Mechanically separated meat (MSM) is generally considered to be of inferior quality, and its use is subject to strict regulations. Manually deboned meat is accepted as regular meat, and not subjected to the same restrictions. Today, the development of the technology for mechanical meat-bone separation enables production of a meat raw material that cannot be distinguished from regular meat mince. MACSYS is a Seventh Framework Programme granted under the theme Research for the benefit of SME's. The overall objective is to overcome scientific and technical barriers associated with the development of efficient and objective solutions for the quality classification of comminuted poultry meat. Therefore, the project focuses on new, efficient and objective solutions through collaboration between 4 RTD, 4 SME and 1 end-user partners. The expected outcome of the project is a fast-track equipment for at-line meat quality classification and an automated image analysis software for assessment of muscle fibre degradation, based on a commonly accepted histochemical method.**

**Key Words** – MSM, muscle fibre structure, image analysis, spectroscopy.

## I. INTRODUCTION

Mechanically separated meat (MSM), or mechanically recovered meat, is a topic of debate within the EU as to whether it should be considered as meat preparation in QUID terms (Quantitative Ingredient Declarations). The current regulation states that all types of MSM must be declared on the label. Production of chicken meat for retail involves removal of primal cuts (e.g breast fillets), leaving residual meat on the carcass. The meat industry has over the years become more mechanized, often using machines instead of butchers for meat-bone separation. The machines or the manual workers involved are required to cut the meat away from the bone to avoid getting bone splinters in the product. This aspect, together with the production of large meat volumes, means that there is a considerable amount of good quality meat remaining on the carcass. This valuable meat may be carefully removed and used for meat products in order to reduce meat waste. The meat remaining on the carcass after deboning can be removed using a machine which does not involve a cutting action but a squeezing or rubbing action.

Different types of technologies are available, and all involve the removal of the meat from the bones under pressure, often by a filter or sieve or

mesh. The level of pressure used to remove the residual meat can be adjusted to obtain different yields and qualities. The process uses one or two stage technologies:

One-stage technology: removal of meat from bones under low pressure to produce deboned meat.

Two-stage technology: the first stage includes removal of the meat under low pressure using a first machine. The resulting product contains pieces of sinews, bones, cartilage and other hard matters, originating from the bones. The second stage consists of reprocessing the meat product obtained at the first stage by using a separating machine equipped with filter, sieve or mesh openings of small diameter that removes sinews, bones, cartilage and other hard matters under higher pressure.

In both technologies, one- or two-stages, it is possible to reprocess the coproduct in using a high pressure separator. The resultant product is considered typical MSM and generally has a softer consistency with the appearance of a smooth paste.

The definition of MSM as defined in Regulation (EC) No. 853/2004 consists of different parts relating to method of separation, raw material like bones or poultry carcasses, and “loss or modification of the muscle fibre structure of the meat thus recovered by reason of the use of those processes” Furthermore, this regulation also sets down different rules for MSM produced by techniques that do not alter the structure of the bones and those that do. This is based on whether the product has a calcium content that is not significantly higher than that of minced meat, for which a limit is set down in Regulation (EC) No. 2074/2005. The complexity of the regulation over MSM has led to inconsistent interpretation in different EU member states, until a recent judgement of the European court (C453/13, 16.10.2014) was released. In this judgement, it has been made clear that “the product obtained by the mechanical removal of meat from flesh bearing bones after boning or from poultry carcasses must be classified as ‘mechanically separated meat’ -

since the process used results in a loss or modification of the muscle fibre structure which is greater than that which is strictly confined to the cutting point, irrespective of the fact that the technique used does not alter the structure of the bones used.”

Nevertheless, modern equipment for mechanical separation allows the operator to use much lower pressures to produce meat pieces from carcasses which are very similar to those removed by a blade or hand. For the MSM user, who in this case would primarily be a processor of meat products, this product would have a higher perceived quality compared with high pressure MSM in that it consists mostly of intact muscle. That could subsequently result in more efficient and cost-effective production of meat products with increased homogeneity and quality between the batches.

Although high pressure MSM has a functional and nutritional value for the consumer and is safe to eat, it is considered that the consumer should be informed that it is present in the product. For ethical reasons, waste reduction and efficiency, all useable parts of an animal should be recovered, and the benefits and production methods, safety of the product and reasons for using the machine recovery system need to be explained. This message is not being put across strongly enough to the consumer, so the result is that MSM is perceived as not acceptable by some consumers.

One of the discussion points in the MSM debate is whether the extent of damage to the muscle fibre structure can be quantified using histochemical or immunohistochemical methods. If the muscle fibre degradation can be quantified there might be a way to measure or grade MSM. That could lead to development of at-line measurements, which apart from level of degradation will include measurements of other more traditional quality traits.

An EU project under the theme “Research for the benefit of SMEs” - MACSYS – is addressing these points in a two year project. The overall objective of MACSYS is to overcome scientific and technical barriers associated with the

development of efficient and objective solutions for the quality classification of comminuted poultry meat. MACSYS aims at developing a software image analysis system based on different microscopy approaches to assess the muscle fibre damage as well as developing a fast-track device based on spectroscopy which can be implemented for quality classification at-line.

MACSYS started on January 1<sup>st</sup> 2014, and involves nine partners, including research institutions and companies from six EU countries. The project is financed by the European Union's Seventh Framework Programme and has received Euros 1,247,404 in funding.

## II. MATERIALS AND METHODS

Reference samples and commercial production samples of chicken MSM were included in the project to ensure a wide variation of product qualities. The Danish SME Robert Damkjaer A/S was responsible for the production and handling of meat samples. Samples were stored and distributed frozen to the corresponding partners.

The degree of muscle degradation was evaluated using the histochemical staining methods Hematoxylin-Eosin and Toluidine blue by Leatherhead Food Research, United Kingdom and Max Rubner-Institute, Germany. Immunohistochemical staining was made by Aarhus University using antibodies against Laminin and Meromyosin and the results were quantified using an automated image analysis software system.

Biochemical analysis for determination of protein, fat, moisture and mineral content was performed by Leatherhead Food Research.

The Spanish SME SoftCrits uses the histochemical and immunohistochemical results for development of an advanced automated image analysis system, which enables fast and objective classification of the degree of muscle degradation.

In addition, the results are used as reference measures by University of Copenhagen, who explores several spectroscopic techniques' ability to predict the different quality traits mentioned above. The most promising spectroscopic technique will be used by the Danish SME Carometec A/S for development of a fast-track prototype. The implementation of the prototype will be tested by users of MSM (e.g. Robert Damkjaer A/S) and producers of machinery processing MSM (e.g. LIMA from France and MAREL from The Netherlands).

## III. RESULTS AND DISCUSSION

The expected outcome of the project is summarized in Table 1.

Table 1. Expected outcome of MACSYS

| Result | Description  |
|--------|--|
| 1      | Preparation, handling, documentation and characterisation of standard meat samples |
| 2      | New antibodies and histochemical staining techniques                               |
| 3      | Common EU histochemical method to assess muscle fibre structure                    |
| 4      | Automated image analysis system  |
| 5      | Fast-track method for wide at-line industrial application                          |

A CEN workshop is under preparation and will aim at establishing a common agreement on the histological method to be used for classification of the degree of muscle degradation. The kick-off meeting for the CEN workshop is planned to take place in September 2015. From the public MACSYS homepage it is possible to sign up for the workshop.

The research results from the MACSYS project will be published early in 2016.

More information about the project can be obtained from the website: [www.macsysproject.eu](http://www.macsysproject.eu).

#### IV. CONCLUSION

Quality classification of machine separated meat from poultry is highly relevant in order to reduce waste in the production and to raise the value of the products. The results from the MACSYS project are expected early 2016 and will contribute to a validation of machine separated meat on a scientific background.

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