First Virtual Workshop on the Developments in the Italian PhD Research on Food Science, Technology and Biotechnology

Palermo 14/15 Settembre

Technological approaches to improve the nutritional value of meat products and development of spectroscopic methods for quality assessment

Michela Pia TOTARO (michela.totaro@uniba.it)
Dept. Soil, Plant and Food Science, University of Bari "Aldo Moro", Bari, Italy
Tutor: Prof. Carmine Summo Co-tutor: Dr. Giacomo Squeo

Introduction

The project aims to the improvement of the nutritional value and the development of spectroscopic methods for quality assessment of meat products. Vegetable extracts from wastes, agri-food by-products and innovative plant resources have been included in the formulation of ripened and fresh meat products to replace nitrates and nitrites, respectively, and to reduce the formation of **heterocyclic amines (HCAs)**. The inclusion of the extracts in natural coating (Fig. 1) has been also studied. The research activities have been performed on meat products obtained from closed-chain cycles, characterized by high unsaturated fatty acids content, and thus more prone to the oxidative degradation. The development of spectroscopic methods for the quality assessment of the meat and meat-based products has been also studied.

State of the Art

Fig.1 Experimental trials for the production of ripened sausages enriched with olive leaves extract.

Meat and meat products play an important role in human nutrition (National Health & Medical Research Council, 2006). At the same time, medical and scientific studies (Turner et al., 2017, Molognoni et al., 2019) correlated the consumption of these products to the development of various diseases, particularly on the cardiovascular system, and to an increase in the risk of cancer against the colon-rectal tract.

There is evidence that this risk might be linked to high-fat intake, and/or carcinogens generated through various cooking and processing methods. For example, the formation of heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs) during high-temperature cooking and the development of N-nitroso compounds, because of the addition of nitrate and nitrite in the meat products formulation (Jian et al., 2019). The addition of vegetable extracts in the formulation might reduce the cancer risk (Gassara et al., 2016).

Furthermore, the sector needs suitable technological tools for guaranteeing and monitoring quality, authenticity and origin of meat products and raw materials. These quality aspects are, in general, of a documentary nature and the analytical techniques currently available to assess them require time and resources (Prieto et al., 2017). For this purpose, the application of spectroscopic methods have been tested as rapid and non-destructive techniques.

PhD Thesis Objectives and Milestones

The project will be developed considering the following activities (A) and sub-activities scheduled as reported in the Gantt chart.

A1) Bibliographic search

A2) Use of natural extracts in ripened meat products: the aim of this activity is the inclusion of natural extracts rich in antioxidant and antimicrobial functional molecules from wastes, agri-food by-products such as olive leaves and vine shoots and stems and innovative plant resources, such as Salicornia (*Salicornia europaea* L.), in ripened meat product, also considering their inclusion in natural coating.

A3) Use of natural extract in fresh meat products: the objective of the activity is the introduction of the same vegetable extracts in fresh meat products to limit the development of HCAs during different cooking methods.

A4) Development of spectroscopic methods for the quality assessment: the feasibility of rapid, non-destructive analytical methods (e.g., NIR) to retrieve information about the quality of meat and meat products, such as the origin of meat, the system of animal husbandry, the quality characteristics of the raw material (animal breed, freshness), the presence of antibiotics and/or ingredients not allowed will be the focus of this activity.

A5) Drafting reports, scientific articles, and PhD thesis

Activity/ Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1)																								
A2)																								
2.1 Production and characterization of natural extracts																								
2.2 Formulation of ripened meat products																								
2.3 Characterization of the obtained meat products																								
A3)																								
3.1 Set up of analytical procedures for the qualitative-quantitative determination of HCAs																								
3.2Formulation of fresh meat products																								
A4)																								
4.1 Set up of sample preparation procedures and fine-tuning of the spectral acquisition method																								
4.2 Retrieval of samples, classification, and spectra acquisition																								
4.3 Development of calibration model																								
4.4 Validation of models with external test-set																								
A5)																								

Gassara F, Kouassi AP, Brar SK, Belkacemi K (2016) Green Alternatives to Nitrates and Nitrites in Meat-based Products-A Review *Crit Rev Food Sci Nutr* **56**:2133-2148.
Jian SH, Yeh PJ, Wang CH, Chen HC, Chen SF (2019) Analysis of heterocyclic amines in meat products by liquid chromatography - Tandem mass spectrometry *J Food Dru Anal* **27**:595-602.
Molognoni L, Daguer H, Motta GE, Merlo TC, Lindner JDD (2019) Interactions of preservatives in meat processing: Formation of carcinogenic compounds, analytical methods, and inhibitory agents *Food Res Int* **125**:108608.
National Health and Medical Research Council (2006) *Nutrient reference values for Australia and New Zealand* Department of Health and Ageing.
Prieto N, Pawluczyk O, Dugan MER, Aalhus JL (2017) e Meat, Fat, and Meat Products A Review of the Principles and Applications of Near-Infrared Spectroscopy to Characteriz *Appl Spectrosc* **71**:1403-1426.
Turner ND, Lloyd SK (2017) Association between red meat consumption and colon di cancer : A systematic review of experimental result *Experimental biology and medicine* **242**:813-839.