

ABSTRACT

The habilitation thesis, entitled *Research on food quality and the use of bioactive compounds with antioxidant and antibacterial potential from vegetable matrices in the processing of products of animal origin* presents the relevant results of the scientific and academic activity, from the time of the defense of the doctoral thesis, June 2006, until present.

The habilitation thesis has the following structure:

- (i) Summary
- (ii) Scientific and professional achievements
- (iii) The teaching career and research activity development plan
- (iv) Bibliography

After an introductory chapter, the *Scientific and Professional Achievements* section presents the main research directions that were the basis of this thesis, namely: (1) Research on the effect of plant ingredients with a high content of bioactive compounds with antioxidant and antibacterial potential used in the obtaining of animal origin products, (2) Studies on the quality, innocuousness and sanitation of products of animal origin, (3) Research on the dynamics of some quality indicators in the processing of animal products in the context of the bioeconomy.

Chapter 2.1. Research on the effect of some vegetable ingredients with a high content of bioactive compounds with antioxidant and antibacterial potential used to obtain products of animal origin, presents studies focused on the benefits of using some ingredients of vegetable origin (edible mushrooms, vegetable extracts, essential oils, aromatic plants, vegetable protein derivatives) and their effects in the processing of food of animal origin.

The first study in this chapter refers to the chemical composition and bioactive compounds identified in some wild edible mushrooms. The most studied mushrooms were *Agaricus bisporus* and *Boletus edulis* in terms of chemical composition and bioactive compounds. The mushrooms studied proved to be rich sources of proteins, carbohydrates and ash also containing different bioactive compounds.

Another study aimed to determine the antioxidant and antimicrobial activity, total phenols and total flavonoid content as well as the profile of trace elements of some wild edible mushroom species from Romania. The experimental results showed that regardless

of the mushroom species, potassium had the highest concentration among the metals identified, followed by Mg, Ca and Na. Regarding total phenolic compounds, the content of flavonoids and the antioxidant activity identified in *Boletus edulis* far exceeded the other mushroom species.

Another study aimed to investigate the effects of some extraction solvents on the polyphenol content and antioxidant properties of *Boletus edulis* and *Cantharellus cibarius* mushrooms, in order to optimize the extraction process. The obtained results showed that the type of solvent significantly influenced the total content of polyphenols and the antioxidant activity of the mushroom powder, but insignificantly influenced the total content of flavonoids.

In addition our research group aimed to determine the chemical composition and antibacterial activity of two types of essential oils extracted from plants belonging to the *Lamiaceae* family (mint and oregano), as well as their beneficial impact on the biochemical and microbiological changes occurring in fresh curd during storage. The study demonstrated that the incorporation of essential oils of mint and oregano can enhance the antimicrobial properties of fresh cheese during storage, leading to the natural preservation of the product.

Another study by our research team aimed at developing a new product with a high intake of biologically active compounds, namely goat's milk spreadable cheese with the addition of Aloe Vera and essential oils. The research focused on testing and optimizing the manufacturing recipe by adding essential oils to the fresh cheese in order to ensure its stable quality during storage, followed by the incorporation of Aloe Vera gel through the microencapsulation technique.

A study by our team followed the beneficial impact of *Agaricus bisporus* and *O. majorana* essential oil on the shelf life as well as the nutritional changes that occur in pork liver pâté during storage.

Another study by our team revealed the influence of marinating *Black Angus* beef with herbs and cold-pressed oils. According to the results of this study, both aromatic herbs and cold-pressed oils enriched the aroma and flavor of the meat, positively influencing its texture (mainly tenderness and juiciness) especially after a longer marinating time.

Also, our research team studied the influence of vegetable protein additions on the quality of the finished product in the manufacture of some semi-smoked salami assortments. The purpose of the study was to establish the influence of functional soy

protein concentrates used in different proportions compared to the finished products in the manufacture of an assortment of semi-smoked salami.

Chapter 2.2. Studies on the quality, safety and healthiness of products of animal origin, refer to the qualitative assessment of raw materials, semi-finished products, finished products from an organoleptic, physico-chemical, microbiological point of view, as well as their safety for obtaining healthy finished products.

A first study aimed at assessing the quality of milk, the raw material used in the manufacture of cheeses. The investigations carried out had in mind the evaluation of the organoleptic properties, the density and the main physico-chemical components (fat, casein, lactose) of milk.

Another study aimed to assess the physico-chemical and microbiological quality of the scalding brine used in the manufacture of cheeses. The purpose of the investigations was to study the physico-chemical (salt concentration and temperature) and microbiological aspects (NTG, coliform bacteria, *E. coli*, *Stafilococcus aureus c.p.* and *Salmonella spp.*) of the scalding brine in the manufacture of Dalia, Rucăr, Penteleu cheeses. The obtained results showed that all the studied parameters had values within normal limits.

Another study published with my colleagues' revealed at the origin, influence and levels of nitrites and nitrates in meat products. The research was carried out on 77 samples of meat preparations (summer salami, Rose sausages and frankfurters produced by three processing units). The obtained results show variations in the content of nitrites in meat products from one processor to another and within the same processor from one type of product to another, one of the units having for 30.43% of the number of samples analyzed values recorded between 7.5 and 9.6 mg/100 g (maximum limit: 12 mg/ 100 g). In conclusion, although it is necessary to use these additives in the production of meat preparations, it is desirable to use quantities that do not exceed the maximum values allowed by the legislation.

Another study by our team followed the evolution of nitrite and nitrate content during the processing of milk in scalded cheeses. The objectives of our research were to evaluate the level of nitrites and nitrates in the milk processed for cheeses and their retention in the finished product. Another study looked at heavy metal and arsenic content in scalded cheeses. The aim of the study was to determine the content of heavy metals (mercury, lead, copper, zinc, selenium, cadmium) and arsenic in 3 types of cheese (Dalia, Rucăr, Penteleu). A number of 120 cheese samples (40/assortment) were analyzed. The

concentrations of heavy metals and arsenic in the studied samples were below the maximum allowed limit or were even absent.

Another published study looked at the content of organochlorine pesticides in raw milk used to make scalded cheeses. The aim of the research was to determine the level of organochlorine pesticides in raw milk processed into cheeses, coming from 5 units of production.

Chapter 2.3. Research on the dynamics of some quality indicators in the processing of animal products in the context of the bioeconomy includes interdisciplinary research focused on the evolution of some quality indicators in the processing of curd in cheeses with scalded paste, the optimization of the cutting operation of *Black Angus* beef and the changes that take place in meat during preservation and ripening. Consumer behavior was also studied under the pressure of restrictions on the global movement of people, goods and services, as well as the measures taken to reduce the spread of COVID-19.

A study published by our collective evaluated the curd used in the manufacture of scalded paste cheeses through sensory and physico-chemical analysis. 100 curd samples collected seasonally (25 samples per season) were analyzed.

Another published study followed the evolution of some physico-chemical indicators during the processing of the curd used in the manufacture of scalded paste cheeses. Samples were taken for analysis at three stages of the process: after the ripening of the curd, during the ripening of the cheese obtained after scalding the curd, and when the finished product was stored.

A published study followed the variation of microbiological parameters during curd processing in scalded paste cheeses. Samples were taken in four stages of the processing flow: during curd ripening, in scalded and kneaded curd, in cheese after churning and in cheese during ripening. 60 semi-processed samples/variant (in total 240) from five milk processing factories specialized in cheese production were analyzed.

Another published study aimed to highlight the qualitative and hygienic aspects of finished cheeses. 60 samples were analyzed. Microorganisms that are indicators of sanitary quality, such as coliform bacteria, *E.coli* and micromycetes were present in cheese samples at relatively high levels during the summer. The results of this study underline that high summer temperatures influenced the microbial load. Due to the risks that these microorganisms represent for public health, it is necessary to improve hygiene practices

during the warm season, starting from the reception and continuing during the manufacturing process.

Another study aimed to optimize the slicing variant of *Black Angus* beef intended for the HoReCa chain. This type of slicing results in varieties of beef with high added value: sparrow + muscle + bone (T-bone), steak with bone (cowboy steak), brisket, ribs (short ribs), flank, which are sold at much more advantageous prices on the HoReCa market than on the commercial market through the store network, making better use of the casing. It also results in a lower proportion of bones, 17% of the total *Black Angus* carcass, compared to 22% bone in the native breeds (Bălțata românească, brună de Maramureș).

Results were published regarding the dynamics of some physicochemical changes in quality I beef during the salting and aging process. Samples of semi-finished products (minced and salted beef, immediately after mincing-salting and after 24, 48, 72 and 96 hours of maturation at 2-4°C) were taken and examined from a physico-chemical point of view. Following the study on the quality of beef semi-finished products (used in the technology of processing meat preparations), it was found that during the salting process, the meat undergoes changes in terms of water content, pH, total nitrogen, amino nitrogen and ammoniacal nitrogen influenced by the nature of the meat subjected to the salting process and by the actual salting process.

The scientific research and publishing activity after completing the doctoral thesis can be presented as follows: One published scientific book, 1 chapter in a scientific book, 13 didactical manuals (of which 2 are with eISBN) and 6 practical work guides. As main author/correspondent or co-author, I wrote 12 ISI/ISI proceeding articles and 34 BDI articles. I also coordinated 2 research projects and was member in 12 research projects.

The third part of the thesis briefly presents the *Plans for the evolution and development of my professional, scientific and academic career*. The development of the personal university career will be done in three main directions: personal development, educational and research activity and the development of the academic discipline.

The first objective of the personal scientific career development plan is to increase the scientific quality, visibility and national and international recognition of my own research. The educational activity will focus on the training of young professionals (engineers or researchers) in the food industry, and the research activity will focus on: optimizing technological processes, obtaining and developing animal products and new functional products using vegetable matrices with potential bioactive, the development of innovative technologies and the technological transfer of research results.