Fermentation and bioprocesses on vegetable matrices and quality control of biotechnological products

DOMAIN: Biotehnologii

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Abstract

This habilitation thesis presents the scientific and academic activity’s professional and research results in biotechnology domain starting with the moment of the PhD thesis presentation in February 2009, until the present moment, and development plans of my professional, scientific and academic career.

The habilitation thesis entitled “Fermentation and bioprocesses on vegetable matrices and quality control of biotechnological products” presents the most relevant personal postdoctoral research achievements, describing the recent significant results which were presented in 29 ISI scientifically papers, 65 indexed articles and 3 patent applications. Scientific activity consists in food engineering specific themes based on methods and modern systems applied in food industry processing, bioeconomy (fermentative industry waste and by-products revaluation) and quality (assessment of bioactive compounds of raw materials and fermentative products for obtaining new products with superior nutritional properties).

Following the introductive chapter, section B (scientific achievements) presents the main research directions of this thesis: (1) Methods and modern systems for processing in fermentative industries; (2) Advanced techniques applied for quality and authenticity assessment of alcoholic beverages; (3) Bioconversion of fermentative industries by-products.

Chapter 2.1 Modern systems and methods applied in fermentative industries, presents original studies related to functional food design by using non conventional fermentable substrates, new processes and modern techniques for functionality validation. The obtaining of innovative beverages or with improved properties, cannot realize by classic technology, which based on economical reasons, as specific consumption reduction and costs, limits the valorising the large potential of agricultural raw materials.

The first study presented here aimed the using of brown beer as fermentable substrate in order to obtain vinegar. This proved to be an efficient alternative for the capitalization of brown beer of bioactive compounds.

In the second study is presented the technology for utilizing of a vegetal matrix having prebiotic effect in development of a functional grape must based beverage with psyllium seeds, enriched in polyphenols, with beneficial effects to gastrointestinal tract.
Alcoholic beverages industry uses ethyl alcohol of agricultural origin as raw material. It represents a proper matrix for development of innovative products, which can valorise the low-cost agricultural products or condiments and aromatic herbs into value added products. The main aim of the third study was development of an alcoholic beverage, a liqueur, by using ethyl alcohol and pumpkin as raw materials. The proposed technology makes possible the industrial scale processing of this product.

Mint, tarragon and basil were used to obtain a digestive alcoholic plant based beverages, enriched in lycopene extracted from tomatoes peels. The results proved the proposed formula for production at industrial scale, which contributes to the development of a new value added product with beneficial health effects through its phenolic content.

**Chapter 2.2** Advances techniques for alcoholic beverages quality and authenticity testing, presents studies conducted to evaluate and certify the quality and authenticity of alcoholic beverages. Technology validation involves advanced analytical techniques.

In this chapter, by using advanced analytical tools, such as gas-chromatography coupled with mass spectrometry (GC-MS) and chemometrics, was defined the volatile profile of Romanian traditional alcoholic beverages originated from Transylvania. The HPLC-DAD-ESI(+) MS method was performed to identify the phenolic profile of aged distilled beverages. Based on identified biomarkers it was possible the sample discrimination to establish the quality, authenticity and origin of distilled beverages.

The assessment of distillation parameters on distilled beverages quality in order to reduce the content in compounds negatively affecting the sensory quality and security of distilled beverages, were monitored the major volatile compounds by gas-chromatography coupled with flame ionization detector (FID). The obtained results permitted the optimization of distillation process and reduction of the acetaldehyde and methanol contents.

**Chapter 2.3** Revaluation of fermentative industry by-products aiming to obtain functional ingredients and products, presents original studies based on potential of secondary products derived from fermentative industries (spent grain, spent hops, spent yeast) to be utilized as raw materials, in obtaining new functional ingredients and products. The revaluation of food industry by-products represents, from circular bioeconomy perspective, a European priority, which assumes the resources efficiency focusing to produce more economical value with the same or less resources. Spent grain and spent yeast were evaluated from nutritional, volatile compounds and phenolic profiles perspectives, in order to identify the compounds with high biological value, to be utilized in production in functional food.
Spent hop is a valuable by-product with high phenolic content with antimicrobial activity, which was capitalized in an extract used in the formulation of a hand sanitizer gel with application in food industry.

Research activity after PhD was quantified in 2 international publishing book chapters, 2 national publishing scientific books, 2 didactic books, 2 didactic books for practical courses, 23 in extenso ISI Web of Science indexed papers, 2 papers short communication published in Web of Science indexed journals and 41 BDI articles. 2 ISI papers were awarded by UEFISCDI.

Researches were materialized also in 3 patent applications, 3 research projects (1 PN II Capacities project, 2 PN III Cheques of Innovation projects). The value of the results was recognized by the awards at the International Salon of Invention (1 gold medal, 3 awards and 5 excellence diplomas).

Web of Science profile: 26 articles WoS; citations: 37; h = 4;
ORCID Number: https://orcid.org/0000-0003-2928-5137;

Google Scholar profile: 95 articles in IDB/ 213 citations/h-index: 6
https://scholar.google.ro/citations?user=SXrlG6kAAAAJ&hl=ro

In 2013 was firstly published in Cluj-Napoca, Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Food Science and Technology, where I occupied the Editor position until 2016. Today, the journal Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Food Science and Technology is indexed Web of Science.

In 2014 I was the scientific coordinator of two doctoral/postdoctoral international AUF students, their research results being disseminated in 2 papers indexed Web of Science and in 5 BDI articles.

In 2015 I was awarded by UASVM Cluj-Napoca, based on my academic, research and institutional performance, the Associate professor of the year.

The third part of thesis presents evolution and development plans of my professional, scientific and academic career. Development of my university career will follow two main directions: educational and research activities. University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca is an advanced research and education university. To accomplish all the challenges that activity in such an institution involves, and for continuous improvement, these directions are not independent, but correlated.
My career`s scientific development plan has as main objective the increasing of scientific quality, visibility and both national and international recognition of my researches. My further research activity will have two main directions:

(1) Modern processing systems in fermentative technologies for process optimization, specific consumption reducing and obtaining of functional food;

(2) Valorising the food industry by-products to obtain functional ingredients for increasing the nutritional characteristics of food.

Significant opportunities for achieving valuable results are identified by the extension of research team, which will involve new PhD students, accessing national and international funds to sustain the researchers, and by development of new industrial partnerships.

The further activity will focus the correlation of research and education activities with promoting the technological transfer for food production sustainability.