

Research at the Faculty of Food Technology

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Abstract. Active scientific work has been done at the Faculty of Food Technology during the last decade. Many teaching staff members and PhD students are involved in different national and international research projects providing good basis for further development of the research. The main research areas in food science and technology deal with food in all its aspects starting with raw materials, analysis and development of processes and technologies, and ending with safety, healthiness and quality of ready-to-eat food products. Food packaging has become one of the most interesting sectors in this research area. The new research field – riskology – has developed in close relation with the food safety. The identification of factors influencing the development of catering industry is one of the research problems studied by the young researchers of the Faculty. Through support from various European funds and other financial resources, modern equipment and measuring devices have been purchased. It is envisaged that, in the future, development and results of the scientific research activities will largely depend on the scientific material resources and facilities available for the researchers.

Key words: food safety, quality, packaging, hospitality management.

Introduction

The basic task of the Faculty of Food Technology is educating of knowledgeable food scientists and technologists for food industry, public catering, hotel management, and research. It is known that real progress in education and food production is impossible without research. During the last decade the teaching staff as well as postgraduate, master and bachelor students of the Faculty of Food Technology have been carrying out intensive scientific work. These years have been very important also due to active start of the international cooperation. A number of the Faculty staff and post graduate students have had a possibility to be involved in different projects and workshops, to participate in conferences, study courses, and short-term on-site training programs. Many young researchers have defended their theses which have been supported by the European Social Fund grants allowing attendance at international conferences and workshops. It should be mentioned that during this period there was a unique situation, which has never happened before and is not likely to happen again, when four young staff members from the same office simultaneously were writing their theses. The close cooperation between PhD students and their supervisors (e.g., prof. L. Dukaļska and S. Muižniece-Brasava, prof. V. Kreicbergs and E. Straumīte and I. Grāmatiņa) facilitates success of the young researchers. The experience and advice of the supervisors have helped the young researchers prepare high-quality doctoral theses in due time. The continuous development of research activities is the basis for new research facilities, improvement of education quality, and long-term cooperation with international partners.

The aim of this review is to show the development of the research activities in food science and technology at the Faculty of Food Technology.

The research in food science and technology is mainly related to the following issues:

- new food products from the raw materials of plant and animal origin and their production technologies;
- safety of food products;
- food packaging and optimization of food storage conditions.

New Food Products from Raw Materials of Plant and Animal Origin and Their Production Technologies

The research on new food processing technologies and new products is still very topical, especially regarding healthy food and methods of its providing.

During the last ten years, several doctoral theses made at the Faculty of Food Technology have been closely connected with issues of food quality and processing. E. Straumīte defended her promotion work "Research on baking properties of rye flour produced in Latvia" where she had studied dynamics of the formation of reducing sugars

in the rye flour scalds. I. Grāmatiņa made her research on possibilities of enlarging the use of oat flakes in a diet (Gramatina et al., 2006; 2008). The aim of her research work "Oat hydrolysates in food" was to work out a new technology for obtaining hydrolyzed oat flakes and to determine the chemical composition of soluble and insoluble fractions of hydrolyzed oat flakes. Special attention was devoted to distribution of soluble fiber β -glucan between soluble and insoluble fractions. F. Dimiņš can be regarded as the leading researcher in honey quality studies in Latvia. His promotion work "The indices of honey quality determination" expanded and improved the already carried out research on this theme (Dimins, Kuka, 2007; Dimins et al., 2006; 2008a; 2008b). The research of I. Beitāne's promotion work deals with properties of prebiotics and their use in production of new functional food products, which allows supplementing dairy assortment with new fermented products.

The research within project No. 5 of the State Research Program in agrobiotechnology "Innovative technologies for obtaining added value, safe and healthy food products from genetically, physiologically and biologically diverse raw materials of plant and animal origin" is being carried out at the Faculty of Food Technology. The title of the project is "Production technologies of new food products rich in functional components". The aim of the project: development of the production technologies of new food products rich in functional components from traditional and non-traditional raw materials of plant and animal origin.

The project covers the following activities:

- evaluation of the qualitative and quantitative properties of physiologically active compounds of *Origanum vulgare* L. and *Thymus ssp.* L. collected during the research expeditions;
- study of qualitative and quantitative changes in spices harvest depending on the clone of the spice and the growing conditions, evaluating the content and composition of volatiles as well as of the antioxidant and microbiological activity;
- determination of the most suitable flaxseed varieties for oil production, and development of new production technologies for preserving active compounds using natural components from the plants grown in Latvia;
- improvement of the production technology of bread with increased nutritional value using cereal varieties rich in functionally active substances and bred in Latvia;
- evaluation of the content of functional components (vitamins, resistant starch, etc.) in potatoes, assessment of the changes in amino acid composition and reducing sugars in potatoes during their thermal treatment, and working out of recommendations for optimum thermal treatment parameters which would preserve the most of functionally active compounds;
- development of new processing technologies of non-traditional raw materials of animal origin in order to increase the value of these products and extend their shelf life.

One of the parts of the mentioned research program is analysis of herbs grown in Latvia. In the promotion work of Z. Krūma "Plant family *Lamiaceae* herbs for rapeseed oil aromatization", suitability of basil, oregano and thyme, grown in Latvia, for production of aromatized oil has been studied (Galoburda et al., 2008; Kruma et al., 2007; 2008). The volatile and phenolic compounds of the herbs grown in Latvia as well as conditions necessary for aromatization have been investigated.

Ostrich breeding has been recently started in Latvia, therefore processing of ostrich meat has become an urgent issue. One of the research topics is "Quality of ostrich meat and its products". The chemical composition of ostrich meat has been analyzed and compared to that of beef and poultry. Various physical and chemical parameters (pH, colour, texture, microbiological indices, and microstructure) of ostrich meat and beef have been analyzed. It has been found that beef is similar to ostrich meat regarding its chemical composition. A new technology for preparing marinated ostrich meat using *sous vide* treatment has been developed, and the optimum technological parameters have been established. Study of ostrich meat is currently the research topic of PhD student J. Ķīvīte.

The major research directions and several promotion works associated to bread technology are: possibilities for improvement of wheat bread nutritive value and development of new technologies for added-value bread production using oat and buckwheat flour (D. Kjava), biologically activated grain (T. Rakčejeva), fermented whey (E. Sturmoviča), as well as studies on baking properties of wholegrain flour made

from different cereals (Kozlinskis et al., 2008; Kunkulberga et al., 2007; Rakcejeva et al., 2008a; Zagorska et al., 2008). The "bakers' team" (including D. Kunkulberga, T. Rakcejeva, D. Kļava, E. Straumīte, and I. Grāmatiņa) has good collaboration with several enterprises, for example "JLM group" Ltd, "N. Bomja maiznīca Lielezers" Ltd, the State Institute of Cereal Breeding, Priekulji State Institute of Plant Breeding, JSC "Rīgas Dzirnavnīeks", and company "Jelgavas Dzirnavnīeks".

Optimization of the storage conditions of fresh, chilled and frozen fruits, berries and vegetables grown and harvested in Latvia, as well as their processing products and the factors and tools of the quality preservation is another major research area at the Faculty of Food Technology (Bluka, Čakste, 2007; Mūrniece et al., 2008; Seglina et al., 2008). Its scientific novelty is related to the use of new freezing and storage parameters for improvement of sensory properties of fruits and berries and for preservation of their quality, development of a chemical protective layer and a new treatment method for fruit preservation, and study of physical and chemical properties of frozen desserts (promotion work of S. Kampuse). Further research will deal with possibilities of chilled storage of foods, factors influencing the storage of refrigerated and frozen fruits and vegetables, as well as factors influencing the storage of frozen fruits and berries. Practical importance of that research is based on the use of optimum parameters in various freezing stages taking into account the type of the product. The developed recipes and technologies are used in production enterprises.

The Safety of Food Products

One of the researchers' study objects at the Faculty of Food Technology is food safety, which is closely related to the development of the new research field – riskology (Rakcejeva et al., 2008b; Stumpe-Vīksna et al., 2008a; 2008b). Within the scope of the project "Risks in agriculture and private forestry", a research was conducted on hazard analysis in food and catering industry. Based on the obtained results, PhD student A. Melngailė worked out a promotion work on microbiological risk factors in public catering. As a result, risk management models were developed for technological processes of the production of high doneness semi-products and ready-to-eat products. Currently, a study on hazard analysis of technological processes in the catering industry is being conducted on the processing of game meat (deer and beaver meat). During establishment of safe process parameters, the quality and sensory properties have been especially emphasized.

Food products obtained in organic agriculture are becoming increasingly more popular among the customers. J. Zagorska in her research project (later concluded with a thesis) searched for an answer to the question whether safe organic milk is comparable with the milk obtained in conventional agriculture (Zagorska, Ciprovica, 2008a; 2008b).

PhD student A. Veršilovskis developed a doctoral thesis on the subject "Development of sensitive analytical methods for determination of carcinogenic mycotoxin sterigmatocystin in food systems" (Veršilovskis et al., 2008a; 2008b; 2009).

Food Packaging and Optimization of Food Storage Conditions

Because of its continuous development, novel information on the new materials, and up-to-date technologies, food packaging has become one of the most interesting sectors in food chain. Food technologists are concerned about the influence of the new biodegradable materials on food quality during its storage. In comparison to conventional materials there are a few studies available on interaction between biodegradable materials and different food products; therefore this is an area of research interest to a group of the Faculty's young researchers (Straumite et al., 2008).

Assistant professor S. Muižniece-Brasava defended her PhD thesis on the use of environmentally friendly plasticized biodegradable polyhydroxybutirate (PHB) material and its influence on packaged food quality during the storage time. Part of the study deals with the influence of controlled modified atmosphere on fruit respiration rate during the storage time. The research was carried out using the newest and most perspective locally grown apple and pear varieties in order to preserve their quality and increase the storage time using up-to-date packaging technologies and combining them with active packaging. The experiments on application of new environmentally friendly packaging materials to fresh fruit packaging were done, and the optimum parameters for storing the fruits grown in Latvia as well as optimum modified atmosphere packaging (MAP) environment for retail packaging were defined. At present, a research on the development

of new technologies for production of frozen high-doneness foods and thermal processes during the storage is going on.

The study on the influence of a protective gas mixture on the storage of fruits and vegetables included evaluation of the changes in the fruit and vegetable respiration rate during their storage. Quality changes in the fresh vegetable and vegetable salad mixes have been studied during the MAP storage, and changes in the biochemical, physical and chemical parameters, colour intensity, content of starch, vitamin C, and carotene have been analyzed.

Hospitality Management and Education

Identification of factors influencing the production processes in catering industry is one of the research problems based on detailed analysis of the operation and management of a catering enterprise. The solving of topical industry questions will help employees understand the operational processes in catering enterprises. One of the most relevant aspects, which are being studied at present, is the quality of personnel. This topic is closely connected with the development of tourism education policy.

Disappearance of the time and distance barrier has brought global co-operation and competition instead of national segregation. Global markets, international agreements and transnational companies have an ever-increasing influence on public co-operation principles. The networking between countries, enterprises and people has become a very popular operational model with hundreds of partners involved. Therefore communication plays an extremely important role nowadays. Knowledge is a major driving force of development in any field. Various competences such as foreign languages, communication, and computer skills and practice are the most important prerequisites for a successful start in labour market. In order to develop skills and competences necessary for catering employees it is important to integrate the theoretical knowledge into industrial practice.

International Cooperation in Food Science Research

In the last five years, the teaching staff of the Faculty of Food Technology has gained significant experience whilst accomplishing several European-funded projects side by side with researchers from various institutions of European countries. The topics of the already completed European projects were mainly associated with collecting and analysis of information, but today new horizons open up due to the well-equipped laboratories where experimental research on food quality and safety can be carried out.

During 2002-2005, the Department of Food Technology was among the first participants from LLU being involved in two comprehensive studies – EcoPac QLRT-2001-01823 "Recyclable and biodegradable eco-efficient packaging solutions for the food packaging", and PackTeck G1RTC-CT-2002-05068 "Assimilation and standardisation of environmentally friendly packaging technologies within the food industry"; Latvian coordinator of the projects was professor L. Dukaļska. The main tasks of the projects were dissemination of information within participating countries on the problems related to the influence of used packaging on the environmental pollution, educating of consumers about packaging materials of the new generation and their introduction into market, and the present recycling technologies of used packaging.

The national coordinator of another two projects, mentioned below, was professor D. Karklina, head of the Department of Food Technology. The aim of the project SafeFoodNet FOOD-CT-2004-513988 "Chemical food safety network for the enlarging Europe" (realized in 2005-2006) was to gather information on the level of chemical contamination of the foods in European Union and the role of surveillance institutions in its detection. The project 104934-CP-2-2003-1-PT-ERASMUS-TN "Integrating safety and environmental knowledge into food studies towards European sustainable development" involved participants from nearly all the universities dealing with research and education in food science in Europe. The main objective of the project was comparing and unifying the study programs in food science. The project was prolonged several times and is still active.

The international project involving all Nordic and Baltic countries at a national level is supervised by professor I. Ciproviča, dean of the Faculty of Food Technology. The aim of the project is to generalize the knowledge and research results on the changes in fat, protein, and carbohydrates in the processes occurring in cheese maturation. Within the project various workshops for PhD students, conferences and symposiums for exchange of experience, as well as training in partner institutions have been organized. One of the

latest projects is the international EUREKA project "Application of antimicrobial lactic acid sourdough in bread production"; project leader – assistant professor D. Kunkulberga.

Research Facilities at the Faculty of Food Technology

During the last decade, modern equipment and measuring devices have been purchased thanks to the support from various European funds and other financial resources.

The financing from the European Regional Development Fund (ERDF) was obtained for arrangement of the Packaging Material Property Testing Laboratory, and the official opening of the renovated and well-equipped laboratory was held in May, 2005. In LLU it was the first laboratory which was arranged and modernized with the support from ERDF and the European Social Fund (ESF). The Faculty staff appreciates greatly such a benefit which allows performing research at an advanced and up-to-date level. The Laboratory was created with the aim to modernize the process of PhD studies in food science, and is mainly used by PhD students in their research work.

The Microbiology Research Laboratory is another newly equipped facility arranged thanks to the support from the Ministry of Economics of Latvia within the project "Establishment of laboratory of material radioactivity and hygiene". The Laboratory is suitable for studies in two directions: evaluation of microbial contamination of various foods, and studies in food microstructure.

The internal projects of LLU support the improvement of its infrastructure, and the recently installed Laboratory of Bread Technology is one of the examples. The main initiators of the establishment of this laboratory were assistant professors D. Kunkulberga and D. Kjava. In the Department of Food Technology, "a bakers' team" is created – five young researchers joined their efforts to do extensive research into bread quality and related topics.

The Sensory Laboratory is in use already for several years, and its organizer is assistant professor E. Strautniece. Always when research is dealing with the development or storage of a new product, sensory analysis is applied. In the Laboratory, sensory evaluation is done by undergraduate, Master degree and PhD students whenever their studies relate to taste, flavour or texture of a product.

The Department of Chemistry received a contribution from the State of Nordrhein-Westfalen in Germany – the Laboratory of Water Analysis which is provided with modern analytical equipment (UV/VIS spectrometer, photometer-microprocessor, thermoreactor, CSB-COD reactor, pH-ionometer, turbidimeter, pH-mV meters, conductometer, oxymeters, etc.). In the Laboratory it is possible to determine more than 40 different chemical and physico-chemical parameters of water: content of different ions, pH, redoxpotential, conductivity, turbidity and colour, content of oxygen, the chemical and biological oxygen demand, and contamination with organic substances. The laboratory equipment can also be used for quality evaluation (composition, physico-chemical parameters and their changes during storage) of different food products and drinks.

Besides, thanks to the funds obtained from the EU and LLU projects, the Department of Chemistry purchased and improved the Scientific Laboratory of Chemistry of Natural Substances by equipping it with modern analytical equipment, of which the main and most relevant is the high pressure liquid chromatograph. As a result of the work of researchers and young scientists, several methodologies have been created for determining various parameters (e.g. carbohydrate content in honey, juices, beer, etc.) in food products using a high-pressure liquid chromatography, the content of hydroxymethylfurfural (HMF), vitamin B₂ content in bread, beer, etc., as well as vitamin E content in oils. To determine the content of various vitamins in food products, the fluorimeter is used, but the proline content, activity of invertase and amylase in honey are determined with the spectrophotometer. The refractometer is used to determine the dry matter of juices and to assess the water content in honey; the polarimeter is used for analysis of different sugar solutions. Laboratory equipment (gas analyzer) allows assessing the content of different gases (O₂, CO₂) in soft drinks.

Conclusions

The research results of the last decade have shown that there are many young knowledgeable and talented researchers at the Faculty of Food Technology.

The European Social Fund grants, the purchased modern equipment and measuring devices, creative cooperation between PhD students and their supervisors, as well as

international research projects promote and favour the research activities taking place at the Faculty and are a prerequisite for further successful achievements in the local and international research space.

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