International Conference on Quality and Management Sciences

BOOK OF ABSTRACTS

EDITORS:
Krzysztof Juś
Daniela Gwiazdowska

INSTITUTE OF QUALITY SCIENCE

POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS

13th – 15th September 2021

POZNAŃ, POLAND

Scientific Committee

Organizing Committee

ISBN: 978-83-960669-0-9

INSTITUTE OF QUALITY SCIENCE
POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS
al. Niepodległości 10, 61-875 Poznań
Tel. +48 (61) 856-92-14
Address for correspondence: al. Niepodległości 10, 61-875 Poznań, Poland

TABLE OF CONTENTS

OPENING AND KEYNOTE LECTURES

QUALITY 4.0: STATE-OF-THE-ART, DEFINITION AND DEVELOPMENTS

Paulo Sampaio

University of Minho, Portugal
paulosampaio@dps.uminho.pt

The development of disruptive technologies enables rapid advances in organizations. However, technology is not the only element in a broader transformation. Quality 4.0 is an important dimension of the digital transformation process that is taken place in worldwide organizations, promoting a way for quality to become a leading force in this transition. At a global scale, organizations have been looking to accelerate their digital transformations and recognize that Quality 4.0 can create substantial value for their processes.

This presentation will be focused on the Quality 4.0 topic, namely, current state-of-the–art, definition and future perspectives.

Keywords: Quality 4.0; Digital Transformation; Quality

CONSUMER SENSORY STUDIES FOR FOOD COMPANIES: CHALLENGES AND TRENDS

Esther Sendra

Centro de Investigación e Innovación Agroalimentaria y Agroambiental, CIAGRO, Escuela Politécnica Superior de Orihuela, Universidad Miguel Hernández, Orihuela (Alicante) 03312, Spain
esther.sendra@umh.es

Sensory analysis is a powerful tool for the food industry. Consumer sensory studies are useful to validate the acceptability of a product and to provide valuable data for new product development, reformulation, and improvement of existing products or comparison to products from other brands. The industry also needs trained sensory panels which maybe their own trained sensory panels or external ones. Trained sensory panels should be internal when they are needed in a regular basis, as an example when used to evaluate the quality or suitability of raw ingredients, for decision making on the blend of materials from different origins (coffee, chocolate…), for routine checking during manufacturing and, for many other needs of the research and development department. Food companies may also need the support of external trained panels, mainly for que qualification of products included in quality brands (Protected Designation of Origin PDO and others) or for the investigation of complaints by food distribution companies or customers. The functions of trained and consumer panels are completely different, only consumer studies provide information on the acceptability of food products.

What can we offer from academia to food companies? Planning and running consumer studies, training company and other professional panels (PDO), selecting panellists within the company, validating trained panels, and acting as an external expert panel, among others. What are the challenges that we face? Running sensory analysis studies in COVID-19 situation - being consumer studies especially difficult-, communicating with certain groups of consumers (kids, elderly) and others. In this presentation an approach from the experience of our research group will be provided, together with trends in sensory consumer studies.

Keywords: sensory science, food quality, consumer, food preference

VALIDATED ECO-INNOVATIVE SUSTAINABLE SOLUTIONS FOR THE SEAFOOD PRODUCTION AND PROCESSING

António Marques

Division of Aquaculture, Seafood Upgrading and Bioprospection
Portuguese Institute for the Sea and Atmosphere (IPMA), 1495-165 Lisbon, Portugal,
amarques@ipma.pt

Seafood has been recognized as a high quality, healthy and safe food item. Still, the majority of European consumers, especially children, young adults and elderly people, do not meet the dietary recommendations of eating two portions of fish per week, of which one should be fatty fish. Additionally, the European seafood production is insufficient to cope with consumers demand, with the vast majority of seafood being imported. European consumers are also worried about quality, safety, sustainability, frauds and health-related claims regarding seafood. Therefore, it is critical to increase and diversify seafood production, improve the utilization of existing seafood resources, make available innovative cost-effective and environmental-friendly seafood processing technologies, and strengthen market availability of tailor-made seafood products. This has been the aim of activities developed by recognized experts from 35 industry and innovation institutions from 16 European countries in the H2020 SEAFOOD^{TOMORROW} project (http://www.seafoodtomorrow.eu/). This project has demonstrated and validated eco-innovative solutions and mitigation strategies to enhance resilience to perceived threats, to preserve seafood quality and safety, to promote seafood consumption in a healthy diet, and to facilitate the access to business opportunities in seafood production and processing sectors. The solutions include a wide range of tools for the seafood consumers of tomorrow, such as functional aquafeeds, fortified seafood, diversified integrated multitrophic aquaculture, improved microbiological and virus management, seafood gene bank, optimized fast screening methods for seafood contaminants, low salt seafood, nutritionally adapted seafood-based meals, contaminant reducing strategies, energy and water reducing strategies, benchmarking tools, consumer benefit-risk tool, digital traceability tools and e-learning tools. The presentation will focus on the successful validation of the different strategies and on strengthening the need to ensure the broad utilization of such eco-innovative sustainable solutions along the seafood trade chain. This will enhance consumer confidence and strength the competitiveness and economic effects of producers of seafood products in Europe.

Keywords: seafood, aquaculture, fisheries, processing, H2020

FOOD PACKAGING: MAIN CONCERNS REGARDING ITS SAFETY

Raquel Sendón, Letricia Barbosa Pereira, Ana Rodríguez Bernaldo de Quirós

Department of Analytical Chemistry, Nutrition and Food Science, Faculty of Pharmacy, University of Santiago de Compostela, Santiago de Compostela, 15782, Spain, raquel.sendon@usc.es

Food packaging is essential in protecting food from deterioration; however, the food-packaging interactions (that in some cases are desirable, e.g., active packaging) could compromise the food quality, safety and even its shelf life. The chemical migration from the packaging to the food is one of the features that can affect food safety.

Migration is a mass transfer phenomenon where chemicals from the packaging (usually called migrants) are transferred to the food. Several factors can influence migration, including the type of material, the food itself (e.g. physical state, fat content), physico-chemical properties of the migrant and time and temperature of contact conditions, among others.

Special attention should be paid to the numerous substances used in the manufacture of food packaging materials, that variate according to the material. In plastic materials, numerous additives are used (plasticizers, antioxidants, lubricants, dyes and pigments, etc) but in metal food contact material (e.g., metal cookware) the migration of inorganic species should be monitored. Experimental migration testing using food or food simulants is the usual procedure for evaluating the safety of a food packaging material measuring, these compounds using different analytical techniques.

Despite paying attention to the harmful substances that can reach the food, these substances can also have a negative impact on the organoleptic properties of the packed food.

In this context and considering the number of compounds potentially migrants, establishing legislation to protect consumer health is difficult. Plastic legislation is the more implemented in Europe at this moment.

Some of the food-packaging related contaminants as well its analytical methods will be commented on. A brief scheme of the actual legislation in Europe will be also presented and some episodes related to the safety of the food packaging materials will be regarding.

Keywords: food safety, food packaging, migration,

RAPE SEED PROTEINS: POTENTIALS AND PERSPECTIVES IN THEIR BIO- AND TECHNOFUNCTIONAL PROPERTIES

Harshadrai M. Rawel

University of Potsdam, Institute of Nutritional Science, AG Instrumentellen Analytik in der Ernährungswissenschaft, Arthur-Scheunert-Allee 114-116, 14558 Nuthetal OT Bergholz-Rehbrücke, Germany
rawel@uni-potsdam.de

Rapeseeds
19-24% protein

oil-free cake
37 - 41% Protein

Fractionation
up to 60% Protein

World production of canola / rapeseed (about 43% oil and 19-24% protein content) has steadily increased in recent years, reaching about 70 million tons in 2015/16. The degreasing process increases the protein content in the residue to 37 - 41% in the oil-free cake. Higher protein contents can be achieved in various ways (up to 60%). Concentrates (>70%) or isolates (>90%) can be produced by protein extraction. The functional properties of rape seed proteins represent a direct manifestation of the physicochemical properties of protein molecules and the surrounding/associated molecules and are largely affected by processing or storage conditions. In the present contribution, the solubility and adsorption behavior characteristics at the interface (liquid or liquid air) needed in the creation of protein stabilized emulsions and foams will be reported. Furthermore, the gelation properties and the formation of thin films (film formation/coatings) are discussed to illustrate the involvement in the development of potential food applications. On the other hand, the reported contributions on the bioactivities (antioxidant, antihypertensive, antifungal, antiviral, blood sugar reducing or cell growth promoting properties) of peptides derived from canola protein allow to reaffirm the need for action in terms of establishing a value chain for "canola proteins". Crucial to further development is a deeper understanding of the structural nature of the storage and structural proteins of canola in the various semi-finished products (protein-enriched flours, concentrates and isolates) for optimal utilization in nutritional and non-food applications. Potential applications of canola proteins can therefore be derived for the food and feed as well as for the chemical-technical, cosmetic or pharmaceutical industries.

SENSING TECHNOLOGIES AND BIG DATA - THEIR ROLE IN SUSTAINABLE FOOD CHAINS

Daniel Cozzolino

Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, St Lucia, 4072, Queensland, Australia
d.cozzolino@uq.edu.au

Agri-food supply and value chain markets have become increasingly complex due to the evolving changes in consumers demands for healthy, nutritious and sustainable foods, the developments and complexity in food standards associated with food safety, security and quality, advances and incorporation of technology (e.g. big data, machine learning, sensing technologies), external disruptions (e.g. COVID-19; climate change) and the inherent changes in the structure of the food industry. Recent issues related with food security involving authenticity, adulteration, fraud, mislabelling, traceability, and provenance have added a new dimension and pressures to consumers' concerns, the food industry and to the regulatory bodies.

The incorporation of sensing technologies (e.g. optical sensors, lab-on-chip, green technologies) combined with data analytics (e.g. big data techniques, including machine learning), are determining a paradigm shift in the direction of which food ingredients and foods are both evaluated and monitored in both the food supply and value chains.

The utilisation and combination of data analytics (e.g. machine learning, classification, modelling) with rapid, non-destructive sensing technologies to address issues related with food authenticity, adulteration, fraud, traceability and provenance in the food supply and value chains will be presented. Specific examples from the grain, natural products, meat, and wine supply and value chains together with advantages and limitations on the use of these tools will be also discussed.

Keywords: sensing technology, big data, sustainability, food supply chain

EOQ – TRANSFORMING INTO THE DIGITAL ERA

Ulf Gustavsson

European Organization for Quality, EOQ, Brussel, Belgium,
ulf.gustavsson@eoq.org

European Organization for Quality (EOQ), like many other organizations, is facing a changing environment that requires new ways of working. During this presentation you will hear about the ongoing work to rebuild EOQ to better fit the need of the future. The following questions will be answered: 1) What strategic focus areas are identified for EOQ? 2) What is digital transformation? Based on the experience from IKEA, among others; 3) What kind of leadership is needed?

For EOQ the work to develop more up to date strategies started many years ago. The organization was lacking the ability to go from planning to implementing the strategies. In this case the strategies who wasn't implemented wasn't worth more than the paper it was written at. Since a year back the strategies have been implemented through a clear and straightforward approach.

The approach has been to set everything in its context. EOQ has a very clear vision as a long-term direction. It became clear that something more was needed, so EOQ decided to have a five-year ambition. With the ambition statements it became more hands on and not so abstract. With the mission statements the organization had everything that was needed to choose the right strategies. The result was five strategic focus areas: 1) Members, partners and markets; 2) Attractive offer for our members; 3) Marketing and communication; 4) Organization; 5) Digital transformation.

Under each of the strategic focus areas we have clear descriptions of the overall frame of the focus area. Each of the focus areas also have clear prioritized actions. It is very hands on and very clear what is going to be delivered and easy to follow up. Resources is then allocated to the actions as well. Then the full scope is connected, and we make sure that everything we do is in line with the vision, ambition and mission.

EOQ is an organization for our members by our members. To guide us right we have also identified our core values. Based on our values we can see and understand the organizations culture. The four core values that EOQ stands for is: 1) Togetherness – all parts of the business, everyone counts, everyone contributes; 2) Simplify – all we do, who does what, strategies and plans; 3) Pragmatic – don't reinvent the wheel, dealing with things realistically, focus on goals; 4) We make things happen! – We deliver!

Digitalization sometimes asks for a full disruption of an organization and the connected business offer. That is for sure not always needed. It might be enough to be a digital Darwinist and evolve just as much as needed. One of the most important learnings in a digital transformation have been to get moving. Even the longest journey starts with a first step. To start the transformation, it requires self-confident leaders and managers that dare to make decisions. The biggest difference in leadership is that you must get use to act within the unknown and with a great deal of sense of urgency. There is five critical Success Factors to succeed with a digital transformation: 1) Think first; 2) Top management support; 3) Know what you don't know; 4) Involvement; 5) Leadership.

In an ever-changing world we need an Interdependent leadership culture. Our leaders need enable collaboration on all levels and across all functions, need to give our co-workers a high-level direction and need to enable people to learn how to learn.

Keywords: Digitalization, transformation, strategy, quality, leadership

WILL CONFERENCES REMAIN AN ESSENTIAL PART OF EVERY SCIENTIST'S LIFE?

Zenon Foltynowicz

Department of Non-Food Products Quality and Packaging Development,
Institute of Quality Science, Poznań University of Economics and Business,
Poznań, Poland,
zenon.foltynowicz@ue.poznan.pl

Public speeches and discussions of scientists were known since ancient times. Over time, they transformed into schools, seminars, conferences, symposia, and congresses. Their form has evolved with the development of scientific research. These meetings have always been an opportunity to present philosophical views or research results. Scientific conferences are usually staid affairs. Presenters share their latest findings to polite audiences, receiving short-lived applause. But some talk can leave a lasting scientific mark. Unfortunately, the conference programs have been increasingly overloaded recently and the time for discussion is limited.

During the live conference, the focus for sharing science and discussions, shifts toward networking, all of which have been value drivers for in-person conferences in the past. Interactions between presenters and attendees facilitated networking that makes building connections easy among all those participating, especially young scientific workers. Most often the discussions took place during poster presentations. Most often the discussions took place during poster presentations. Posters were the first victims of changes caused by electronic media, and more and more often, instead of on stands, they have an electronic form. Conference tours and conference dinners are important, inseparable elements of each scientific meeting event.

Conferences have changed dramatically since the lockdowns began a year ago. Live meetings have been transformed into virtual meetings as online or where possible into a hybrid.

In this paper, the actual and potential effects of this transformation will be presented as well as the advantages and disadvantages of the different approaches.

Virtual meetings can provide a wide audience around the world. They will also lower participation costs by eliminating travel and accommodation expenses. CO_2 emissions will undoubtedly fall. But what's the future for conference centers? What will be the appropriate pricing models for conference fees organized in person, virtual, or hybrid? Let's consider whether virtual presentation replaces live ones? Conference tours will be available for free in a previously impossible way due to Virtual reality technologies, but for now, we won't be able to attend conference dinners in this way!

Let us hope that the scientific conferences, regardless of their form, will remain an essential part of every scientist's life.

Keywords: scientific conferences, live conference, virtual meetings, scientist's life

ORAL PRESENTATION

SESSION 1. CONSUMER DRIVEN PRODUCT DEVELOPMENT

HOUSEHOLD FOOD WASTE: THE MEANING OF PRODUCT'S ATTRIBUTES AND FOOD-RELATED LIFESTYLE

Andrzej Szymkowiak[1], Barbara Borusiak[1], Bartłomiej Pierański[1], Pavel Kotyza[2], Luboš Smutka[2]

[1]Poznań University of Economics and Business,
[2]Czech University of Life Sciences in Prague
andrzej.szymkowiak@ue.poznan.pl

Increasing volume and value of food waste must be considered as a huge threat for achieving sustainable development, food market stability, human population growth, and people's well-being. Consumers are responsible for food waste to a large extent. The objective of the current study is to look at the problem of household food waste both from the perspective of food products attributes and consumers lifestyle perspective and is formulated as follows: how people differing in terms of food-related lifestyle, value product quality attributes in the context of food disposal inclination. Total Food Quality Model was applied to describe product attributes (taste, health, process, and convenience) whereas food-related lifestyle was measured with: innovativeness/novelty, information about products/health, convenience, price, taste, local/organic food, and social events. The Choice-Based Conjoint Analysis method was used to assess the importance of individual attributes and levels. The study was conducted using the mTurk platform; a total of 958 people took part in the study, 753 responses were used. To analyze the collected data, we used the R environment. Clustering was carried out to identify people with similar preferences: conducting elbow method and Silhouette value maximisation three customer segments were identified. To investigate the distinct characteristics of the these clusters related to food wasting, one-way multivariate analysis of variance (MANOVA) was conducted. The obtained research confirms that consumers with a similar approach to the importance of the attributes of disposed of products differ in each of the dimensions of the approach to food-related life style.

Keywords: household food waste, product's attributes, food-related lifestyle, conjoint analysis

CONSUMER ATTITUDES AND IMPORTANCE OF PRODUCT DESIGN DURING SHOPPING FOR SELECTED NON-FOOD PRODUCTS. CONSUMER STYLES BY DESIGN

Ľubica Knošková, Petra Garasová

Department of Marketing, Faculty of Commerce,
University of Economics in Bratislava, 852 35 Bratislava, Slovakia,
lubica.knoskova@euba.sk, petra.garasova@euba.sk

Glass products are an everyday part of consumers' lives. There is ample evidence about the influence of the "container" on the perception of the drink, taste, aroma and quantity of the drink. Although many authors deal with the design of glasses and its impact on the drink, few authors deal with the marketing perception of design, and consumer preferences when buying wine glasses. The aim of our research was to identify the importance of design of wine glasses in consumer decision-making and to specify consumer segments according to perception of design. Consumer survey using structured questionnaire was applied to unhide consumer attitudes and importance of product design during shopping. We surveyed 389 respondents living in Slovakia by means of on-line questionnaire on social networks. Cluster analysis was used to create consumer segments reflecting the importance of wine glass design. Five consumer styles were identified, (1) design enthusiast, (2) thrifty design fan, (3) prudent consumer, (4) economical consumer, and (5) passive consumer. The largest consumer segment (51.2%) are design enthusiasts, who find product design very important and are willing to pay extra for a product they like. The next segment (19.2%) are thrifty design fans who also find design very important, but are not willing to pay extra for a product they like. They are followed by prudent consumers (17%) who search for balance between design and price and give them relatively high importance. Economical consumers (7.2%) appoint medium importance to design but are not willing to pay extra for a product they like. For passive consumers (5.4%), design is not important and they are not willing to pay extra. The results of the survey unhide consumer values and life-styles which allow proper customizing the offer, and easier targeting. The limitation of the research is the structure of the sample composed mainly of young people due to the data collection on social networks.

Keywords: wine glasses, consumer decision-making, design, segmentation, consumer styles

CONSUMERS' OPENNESS TO CIRCULAR BUSINESS MODELS IN FASHION INDUSTRY

Małgorzata Koszewska

Department of Department of Production Management and Logistics, Faculty of Management and Production Engineering,
Lodz University of Technology, Lodz 90-924, Poland,
malgorzata.koszewska@p.lodz.pl

The limitations of the linear model are particularly evident in the textile and clothing industry. However, its transformation towards a circular economy model requires knowledge, awareness and commitment on the part of enterprises, legislators and consumers. The role of consumers is extremely important. It is their attitudes and choices regarding the number and quality of purchased clothing, openness to new business models of enterprises, and the way of handling used products that will determine the speed and success of implementing circular economy assumptions in business practice.

The aim of the article is to assess the degree of the openness of Polish clothing buyers to circular business models. Quantitative studies carried out on a representative group of adult citizens of Poland (PESEL random sample) using the CAPI method (computer-assisted face-to-face interviews) indicated that almost 76% of respondents would not be interested in the clothing rental offer at all. The remaining 24% would be interested in such an offer only to a small extent (score on a scale of 1-7, where 1 means not at all, and 7 very interested, was 1.67). Polish buyers would be even less interested in clothing leasing offer which is gaining more and more popularity in Western European countries: 78% of respondents declare a complete lack of interest in this type of purchasing model (the average score on a scale of 1–7, was 1.59). A comparison of these quite pessimistic research results with the results of other research on similar aspects which gave more optimistic picture, suggests that a significant impact on the degree of openness of clothing buyers to circular business models may have factors such as: age (differences in the age groups of respondents), active use of the Internet (research method - CAWI against CAPI), awareness and ecological sensitivity of buyers (emphasizing in the question the fact that the intention of implementing this type of additional forms of purchase by clothing brands is the desire to become more environmentally friendly) as well as cultural factors.

Keywords: consumer behavior, business models, circular economy, fashion

CONSUMERS' PERCEPTION OF LABELLING IN GLUTEN-FREE PRODUCT DESIGN

Maria Sielicka-Różyńska

Department of Food Quality and Safety, Institute of Quality,
Poznań University of Economics and Business, Poznań 61-875, Poland,
maria.sielicka@ue.poznan.pl

Designing a perfect label seems to play crucial role when launching a food product for retail. It must grab the attention of the consumer within seconds and convince them to buy. Gluten-free products are not only popular among those who have celiac disease and other gluten-related disorders but also self-diagnosed individuals who voluntarily adopt a gluten-free diet. Due to diversified target audience, broad research is needed to understand the mechanism of consumers' perception of labelling of gluten-free products.

The main aim of this research was to evaluate the perception of labels of gluten-free cookies of consumers who are on a gluten-free diet as well as those who are not. The research consisted of three separate studies: a questionnaire survey, an eye-tracking study with a support of questionnaire survey and sensory study. The results showed that one third of those on the diet claimed that the products were not labelled properly. The visual attention to claims (nutrition, health and gluten-free) increases with the higher number of claims on cookies' label, but it doesn't lead to higher purchase intention. The respondents paid more attention to verbal gluten-free claims than to nonverbal ones on packaging. No difference in the visual attention to different information on packaging between the followers and non-followers of the diet was found. The sensory study confirmed that the presence of gluten-free statement has no impact on liking of cookies. The outcomes suggest that considering the information architecture on label may help strengthen consumers' attitudes towards gluten-free products and impact buying behaviour.

Keywords: consumer perception, food labelling, gluten-free, cookies

SESSION 2. DESIGN, QUALITY AND SAFETY OF NON-FOOD PRODUCTS

DETERMINATION OF OXYGEN TRANSMISSION RATE OF PACKAGING MATERIALS USING DYNAMIC ACCUMULATION METHOD

Wojciech Kozak

Institute of Quality Science, Department of Industrial Products and Packaging Quality, Poznań University of Economics and Business, Poznań,61-875, Poland,
wojciech.kozak@ue.poznan.pl

Barrier properties are one of the most important features of packaging materials from the point of view of the protective function of the packaging. This feature may relate to the degree of gas, water vapor or other factors, e.g. light permeability. It determines the exposure of the packed product to these external factors, and thus directly affects the protection and maintenance of product quality. For this reason, the aim is to achieve the best possible barrier properties of the packaging materials used, especially those based on polymers, which by their nature may have different barrier properties. To achieve this goal, more and more new types of polymers are used, or modifications are made to the ones used so far by combining them with other materials or using additives, e.g. fillers or chemical reactions and thus obtaining composite materials. However, these treatments require control in order to be able to establish their effectiveness. It is also necessary and important during the use of already used materials as part of periodic quality control.

Among the factors that may penetrate the packaging material, apart from water vapor, oxygen is of particular importance, as it contributes to many unfavorable changes (e.g. oxidation) in the packed products, especially food products. The parameter most often used to determine the degree of oxygen permeation through the packaging material is the so-called oxygen transmission rate (OTR). Various methods and devices are used to determine it.

The paper presents one of the newest methods of measuring OTR, namely the so-called dynamic accumulation method, which uses the phenomenon of selective fluorescence to measure the amount of oxygen permeated. The measurement methodology, equipment, sample measurement results and comparison with other OTR measurement methods used so far were presented.

Keywords: oxygen transmission rate, OTR, dynamic accumulation method, packaging, barrier properties, packaging materials quality

THE GROWING IMPORTANCE OF SUSTAINABLE PACKAGING DESIGN

Jana Gondárová, Malgorzata A. Jarossová

Department of Marketing, Faculty of Commerce,
The University of Economics in Bratislava, Bratislava and area code, Slovakia,
jana.gondarova@euba.sk

Plastics are a major element of the modern economy with countless applications in the industrial and consumer area. They are a cheap, lightweight, durable and widely used material in many industries. Plastics are most widely used in the EU as packaging material (e.g. yoghurt jars, water bottles, fruit protective packaging). Packaging represents approximately 40% of plastics production and 61% of all waste generated from plastics. Plastic packaging is also the type of packaging with the lowest recycling rate in the EU (42%) compared to other materials. This current state of use of plastics and their negative impact on the environment has led to the creation of a European strategy for plastics, which aims to reduce the production and dissemination of plastic waste to protect the planet and citizens, as well as to raise awareness of greater responsibility of companies. The design of the packaging is crucial for the recyclability of plastic packaging. The article aims to show the strategy of selected companies to the circular economy as well as to identify new sustainable packaging introduced by these companies in the field of food, cosmetics and cleaning products. The methods of analysis and synthesis were applied to obtain theoretical backgrounds on this issue. Using these methods, we analysed information gained from domestic and foreign scientific sources, European legislation and websites of companies. Based on the analysis of examples of changes in the packaging used in various industrial sectors, we can conclude that creating and introducing sustainable packaging to the market is now one of the strongest trends, but at the same time, an opportunity to gain a competitive advantage between companies, as consumers begin to notice non-ecological behaviour among producers and they prefer products in packaging that care for our planet.

Keywords: food safety, quality

DISTRIBUTIONS OF RANDOM VARIABLE IN QUALITY ASSESSMENT OF MODERN NONWOVEN PRODUCTS ON THE EXAMPLE OF THICKNESS MEASUREMENT OF FIBERS

Michał Puchalski, G. Szparaga, I Krucińska

Institute of Material Science of Textiles and Polymer Composites, Faculty of Materials Technology and Textile Design, Lodz University of Technology, Lodz 90-924, Poland, michal.puchalski@p.lodz.pl

Nonwovens are textile materials which are used in many areas of life. Nonwovens can be used in agriculture as materials for mulching plants, in medicine as implanted materials, and recently during COVID-19 pandemic as filtering materials in personal protective equipment.

Useful properties of nonwovens depend on their physical structure, where we classify thickness, mass per unit area, porosity, orientation of fibres in the web and fibre thickness. One of the characteristic parameters is fibre thickness, which in case of nonwovens formed by direct methods from polymer depends on technological parameters, and in case of nonwovens formed in finished fibres, on the thickness of raw material used. Independent on the technology of nonwoven fabric production, the thickness of fibres determines the physical properties of the product and is one of the most important parameters in product quality assessment.

The presentation will show the fibre thickness distributions and their statistical analysis on the example of selected nonwoven technologies used in innovative textile industry.

Keywords: quality, size distribution, nonwoven, fiber, SEM.

SUSTAINABLE CONSUMPTION OF FILTERING FACEPIECE RESPIRATORS DURING COVID-19 OUTBREAK

Pasquale Giungato[1]*, Roberto Leonardo Rana[2], Leonardo Lella[3], Nicole Nitti[1], Cosima Cavallari[1], Caterina Tricase[2]

[1] *Department of Chemistry, University of Bari, Taranto district, Italy*
[2] *Department of Economics, University of Foggia, Foggia, Italy;*
[3] *SS Annunziata Hospital, Taranto, Italy;*
pasquale.giungato@uniba.it

International outbreak of SARS-CoV-2 infection has pushed pressure on governments in finding immediate solutions to shortage of filtering facepiece respirators (FFRs) and other protective equipments. Italian government, to avoid the stringent quality standards imposed on FFRs that could slow the production, issued a ministerial decree to allow manufacturers to accelerate the production. Starting from a hypothetical composition and design, we calculated the carbon footprint (CF) of a KN95 type FFR manufactured in Taranto, comparing two different materials, PET (polyethylene terephthalate) and PP (polypropylene). The results showed that production of textile non-woven sheets composing the mask and disposal, were the main contributors to CO_2-eq. emission followed by packaging and transportation. FFRs made in PET have a higher CF than PP masks. To reduce carbon footprint both minimizing textiles area (by smart shaping) and right choice of raw materials result in the best options.

Keywords: SARS-COV-2; facial respirators; KN95, carbon footprint; PET, PC, Taranto

SESSION 3. DESIGN, QUALITY AND SAFETY OF FOOD PRODUCTS

EVALUATION OF STARCH, PROTEIN AND LIPID CONTENTS IN DOMESTIC DURUM WHEAT GRAIN FROM INTEGRATED CULTIVATION SYSTEM BY ITS ELECTRICAL PARAMETERS

[1]Banach J.K., [2]Majewska K., [3]Grzywińska-Rąpca M., [4]Żuk-Gołaszewska K.

[1]Institute of Management and Quality, Faculty of Economics
[2]Department of Food Plant Chemistry and Processing, Faculty of Food Science
[3]Department of Market and Consumption, Faculty of Economics
[4]Department of Agrotechnology and Agribusiness, Faculty of Agriculture and Forestry
University of Warmia and Mazury in Olsztyn, Poland
katarzyna.banach@uwm.edu.pl

The global growth trend in the consumption of products manufactured from durum wheat grain and the required application of integrated agricultural grain cultivation practices contribute to the modification of technological quality of the produced grain. On the other hand, the evaluation of the qualitative characteristics of grain using non-destructive, non-invasive and environmentally friendly electrical methods is a current challenge for scientists. Therefore, the aim of the research was to evaluate, using electrical parameters, the total starch, protein and lipid contents in hard wheat grain grown in an integrated system.

The experimental material included grain of spring durum wheat (moisture 14±0.5%), originating from the field experiment differentiated by nitrogen fertilization dose (0, 80 or 120 $kg \cdot ha^{-1}$) and growth regulator use (Medax 350 SC, with/without). The analyses of the chemical composition (starch, protein and lipid contents) and electrical measurements of the impedance (Z) and electrical capacity (C_p, C_s) at the frequency of 1kHz-1MHz using the LCR meter were performed.

The cultivation of durum wheat grain under the above-mentioned agrotechnical variants differentiates its technological quality related to the basic chemical composition. The highest contents of starch and fat in wheat grain were be obtained under the cultivation variants with and without retardant and without nitrogen fertilization, while the highest protein content with the retardant and nitrogen fertilization with 120 $kg \cdot ha^{-1}$, respectively. Statistical analysis showed that the method of grain cultivation limits the applicability of electrical parameters to assess the contents of protein, starch and lipids. The parameters Z, C_p, C_s over the frequency range used (1kHz-1MHz) can be applied for the evaluating of technological quality of durum wheat grain grown without retardant only.

Key words: durum wheat grain, integrated cultivation system, quality assessment, electrical parameters

QUALITY AND FOOD SAFETY MANAGEMENT SYSTEMS IN OFFICIAL STATEMENTS OF SELECTED FOOD SECTOR ORGANIZATIONS OPERATING ON THE POLISH STOCK MARKET

Piotr Kafel, Paweł Nowicki

Department of Quality Management, Institute of Quality Sciences and Product Management, Cracow University of Economics, Rakowicka 27, 31-510 Cracow, Poland,
kafelp@uek.krakow.pl

The main goal of the conducted researches is to get knowledge and analyze the official information on fulfilment of food safety and quality management systems aspects provided by the polish food organizations listed on the Polish Stock Exchange. This study followed an explorative approach. In order to answer the research questions, the research team performed a content analysis of reports of the management board on the company's activities issued by food organizations coming from Poland. The reports were published in accordance with the requirements of Directive 2014/95/EU with regard to disclosure of non-financial and diversity information by certain large entities and groups, the key non-financial performance indicators related to the entity's operations and information on employee issues and the natural environment should be publish by organizations. Only food industry organizations were selected for the purpose of this study. The total number of analysed companies was 18, of which 14 are from the main market and 4 coming from the new connect market. Due to small population of food companies listed on the Polish Stock Exchange, the whole sample was analysed. Consequently, there were no restrictions in sample selection taking into consideration such items as its size, type of activity or others. As a result, it can be concluded, that the supplier standards such as BRC and IFS are more commonly mentioned by organizations that quality and food safety management systems based on ISO management standards. Moreover, the TQM philosophy is not any more a concept that is advertising by food sector companies. Considering the risks with relation to the quality or safety of products, it can be concluded, that generally food sector organizations that are listed on the polish stock market are well aware of that risks and usually mention it in the nonfinancial statements directly or indirectly.

Keywords: stock market, food safety, management systems, nonfinancial statements.

THE EFFECT OF FAT CONTENT ON QUALITY OF NATURAL YOGHURT

Jacek Lewandowicz

Department of Production Management and Logistics, Institute of Logistics, Poznan University of Technology, ul. J. Rychlewskiego 2, 60-965 Poznań, Poland
jacek.lewandowicz@put.poznan.pl

Yoghurts are an important constituent of human diet, and their annual consumption in Poland is estimated at 6 - 8 kg per person. Consumers are favourable towards innovations developed on the yoghurt market, the most desired products are those with new uncommon flavours or health-promoting properties. Moreover consumers seek for low calorie products, especially those produced on the basis of skimmed milk without addition of sucrose and/or milk powder. Therefore the aim of the work was to evaluate the effect of fat content on physicochemical and rheological properties of natural yoghurt.

The experimental material consisted of natural yoghurts prepared on basis of skimmed milk 0%, 0.5%, 2.0%, 3.2%, whole milk 3.8% and evaporated milk 5.0%. Rheological properties were studied using RotoVisco1 (HAAKE) rotational rheometer. Universal texture profile (TPA) was analyzed using TA.XT2 texturometer (Stable Micro Systems). Moreover, investigated products were evaluated in terms of acidity (°sh), pH and syneresis.

It was found that the content of fat used for production of natural yoghurt considerably affects its rheological properties. Other physicochemical properties are affected to significantly smaller extent. Obtained results show that production of low calorie yoghurt with desired sensory properties may be limited, thus indicating that use of additives such as modified starch that can act both as a rheology modifier and emulsion stabilizer can be beneficial.

Keywords: natural yoghurt, fat, rheological properties, texture profile analysis

OPTIMIZATION PROTOCOL FOR THE EXTRACTION OF ANTIOXIDANTS FROM *NIGELLA SATIVA* USING SINGLE- AND MULTI-RESPONSE SURFACE METHODOLOGY

Małgorzata Muzolf-Panek

Department of Food Quality and Safety Management, Faculty of Food Science and Nutrition, Poznan University of Life Sciences, Poznań 60-637, Poland,
malgorzata.muzolf-panek@up.poznan.pl

Phenolic content and the antioxidant activity of black seed (Nigella sativa) have been previously determined in different extraction systems (time/temperature, solvent type and concentration), thus it is hard to compare data on extraction efficiency.

Therefore, in this study, response surface methodology (RSM) with a central composite plan was used for the experimental design and identification of optimal conditions to maximize the phenolic content and the antioxidant activity of black seed (*Nigella sativa*). The complete factorial design consisted of eight cube (factorial) points, six star points and five center points. The whole experiment was performed in 3 replicates. The effects of unexplained variability in the observed response due to extraneous factors were minimized by randomizing the order of experimental runs. Lack-of-fit and pure error parameters were used for the evaluation of model accuracy The independent variables were as followed: temperature (T, 22.9 – 66.1ºC), time (t, 31.7 – 208.2 min), and methanol concentration in water (c, 5.9 – 94.1% v/v), while response variables were as followed: total polyphenol content (TPC), total flavonoid content (TFC) and the radical scavenging activity measured by DPPH and ABTS methods.

Based on the results, solvent concentration was crucial parameter for the extraction of phenolics and other antioxidants from *Nigella sativa* and it was noticed that the alcohol concentration in water for maximizing the TPC was 28% and for TFC and the radical scavenging activity was 50% which is in agreement to other studies on the extraction efficiency in plant material. Desirability function coefficients (from single-response function) were high and equalled to 0.92 for TPC and DPPH and 1 for TFC and ABTS. The optimal conditions derived from multi-response desirability function were as followed: time 120 min, temperature 56°C and methanol concentration 50% with high desirability function coefficient of 0.83. Under the optimal conditions *Nigella sativa* extract amounted to 6.8 mg gallic acid equivalent/g TPC, 3.2 mg quercetin equivalent/g TFC, 36.8 µmol Trolox/g ABTS and 12.6 µmol Trolox/g DPPH. Good agreement between the experimental and the predicted values confirmed the suggested model's validity for all response variables.

Keywords: *Nigella sativa*, optimal extraction conditions, response surface method

SESSION 4. YOUNG SCIENTISTS

RESEARCH ON CONSUMER PREFERENCES RELATED TO FOOTWEAR USED BY PEOPLE PRACTICING SKATEBOARDING. STATISTICAL ANALYSIS AND SELECTED QUALITATIVE ASPECTS

Adam Miratyński

Department of Quality and Safety of Industrial Products, Faculty of Commodity Science and Product Management,
Cracow University of Economics, st. Rakowicka 27, 31-510 Kraków, Poland,
amiratynski@wp.pl

Skateboarding as an extreme sport has been gaining popularity over the previous years. This is strongly impacted by two major factors: the fact that skateboarding is now recognized as an Olympic sport and was scheduled to be in the 2020 Tokyo Olympics and secondly due the unfortunate pandemic circumstances where individual sports have been gaining more interest. The expanding amount of skateboard users creates a excessive demand for skateboard gear including skateboarding shoes, which are crucial for safety and comfort.

The following presentation will focus on technical and design aspects of shoes dedicated for skateboarding. Moreover it will introduce and analyze the results of a survey carried on a group of 108 skateboarders who agreed to answer several questions regarding their skateboard shoe preferences. Respondents had been asked to point out the main features and details of shoe construction and design, which they consider most important.

Using methods of statistic analysis on achieved results, the research led to conclusions that there are strong connections between particular groups of skateboarders and their preferences in choosing a specified type of shoe.

Furthermore this study proves that specific zones on skateboard shoes (on the shoe upper as well as outsoles) are more exposed to abrasion and damage than others. In regard to frequent use and various evolutions performed on a skateboard this information is crucial to understanding modern skateboard shoe design and technological innovations.

This fact creates a need for more research on material quality and differences amongst separate shoe manufacturers and their model assortment.

The conducted study leads to knowledge about customer preferences among skateboarders and it can also be an important impulse to develop new technological solutions or improve those existing.

Keywords: footwear, sport, quality, consumer, design

CHEMICAL MODIFICATION OF CHITOSAN

Dominik Sikorski, Zbigniew Draczyński

Institute of Textile Materials and Polymer Composites, faculty of material Technologies and Textile Design
Technical University of Lodz, Lodz, ul. Żeromskiego 116, 90-924, Poland,
dominik.sikorski@dokt.p.lodz.pl

Chitin - one of the most common polysaccharide in the natural environment. It can be found in marine invertebrate shells, insects and fungi. It was isolated from mushrooms in 1811 by H. Braconnot, and its structure was described by A. Hofmann in 1930. Chitosan is a biopolymer, which is a derivative of chitin, widely available in various forms in various industries. Obtained by chemical or enzymatic deacetylation. There is a difference between chitin and chitosan in the degree of deacetylation. From chitosan it is possible to create a variety of forms with various structures such as membranes and sponges. Considering the use of chitosan in various materials, the greatest threat to it is biodegradation, ultrasound degradation, thermal degradation and photodegradation.

Chitin and chitosan modification products are one of the main directions of research on biodegradable polymers conducted in the team of the Institute of Textile Materials and Polymer Composites of the Lodz University of Technology.

The purpose of this work was to produce and perform physicochemical characterization of chitosan salts as derivatives of formic acid, acetic acid, propionic acid. The implementation of this goal can be used for obtaining chitosan salts in the form of fibers without exposing them to the process of dissolving in water during the formation of the appropriate acid salt. A new, more accurate method was then developed to determine the degree of deacetylation of chitosan using alkacimetric analysis. The physical and chemical properties as well as the rate of chitosan degradation processes depend on the degree of deacetylation and the molecular weight of this polymer. Analysis of the chemical composition of the derivatives obtained confirmed that there is a relationship between the salt formation rate and the chemical structure of organic acid.

Keywords: chitosan, natural polymer, food package, bacteriostatic

NATURAL SUNSCREEN PREPARATIONS - A NEW QUALITY ON THE COSMETICS MARKET

Monika Engler-Jastrzębska, Aleksandra Wilczyńska

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia 81-225, Poland
m.engler-jastrzebska@sd.umg.edu.pl

Growing ecological awareness of consumers and increased interest in natural products is causing the market of natural cosmetics to develop very dynamically. The trend associated with a healthy lifestyle, responsible use of natural resources and respect for the environment, supports the development of the natural cosmetics market. This category of products has recently recorded enormous growth. The reports on research and analysis of the cosmetics market as well as the results of scientific studies show the increasing popularity of natural cosmetics and the growing interest in this type of products. The slogan "back to nature" has recently become one of the driving elements for the cosmetics market. This is due to the new needs and interests of modern society and the growing concern for the natural environment.

In response to the changing needs of consumers on the cosmetics market, sunscreen preparations called "natural", have started to appear. These products are based on substances of natural origin, contain mineral sunscreens and are often enriched with antioxidants and ingredients of natural origin with proven photoprotective properties. The quality of natural sunscreen preparations is controlled and certified by international certification organizations, which also guarantee: environmentally friendly production and processing processes, responsible use of natural resources, respect for biodiversity.

The aim of this study is to draw attention to the new developing category of sunscreen preparations, to show new product solutions and to present selected raw materials and substances with proven radioprotective properties, used in natural sunscreen preparations.

Keywords: cosmetics market, natural sunscreen preparations, photoprotective substances.

ART IN MANAGEMENT

Bożena Filas

Department of Management, University of Economics in Katowice, Poland
bozenafilas@gmail.com

The conditions of uncertainty and the dynamic environment, which are nowadays becoming the norm for entrepreneurial activities, generate the need to improve management processes by using non-standard elements from other fields.

The aim of the article is to determine the legitimacy and possible benefits of including non-standard elements from the field of art into the management processes inside and outside the organization. The analysis will allow the identification of selected elements from the area of art, the creative process, as well as meta- abilties connected with creativity (imagination, intuition, emotions, mindfulness) and using them in specific processes of managing an organization in a complex reality. The role of elements associated with art will be defined, among others in developing innovation, in gaining a competitive advantage, in managing crisis and unpredictable situations, using improvisation and adaptation, building trust-based relationships between members of the organization, creative management of uncertainty, creative perception of the environment (including creating dynamic capabilities, recognizing and taking entrepreneurial opportunities.

The article will also discuss the impact of using non-standard elements in the field of art in management, on extending the interdisciplinary competences of organization participants, generating creative, non-schematic solutions and innovative ideas with the use of heterogeneous knowledge, implemented in accordance with the principles of sustainable development. The adopted research method will be a critical literature review.

SELECTED MICROBIOLOGICAL HAZARDS OF UNPASTEURISED AND UNFILTERED CRAFT BEERS. PRODUCT QUALITY AND SAFETY MANAGEMENT

Michał Świtalski, Jadwiga Stankiewicz, Agnieszka Rybowska

Department of Management and Quality Science,
Faculty of Management and Quality Science,
Gdynia Maritime University, Gdynia 81-225, Poland
michal.switalski@sd.umg.edu.pl,

Observed over the last five years a significant increase in the number of "beer premieres" and new breweries established in Poland, creates the need for increased attention to safety and quality of craft beers. Particular attention should be paid to unpreserved, ie unpasteurised and unfiltered beers, among which a greater probability of the undesirable microflora occurrence is observed. The analysis of the aspects related to the safety and quality of such products was undertaken in this paper.

The aim of the study was to analyze selected microbiological properties of unpreserved beers available on the Polish market. Microbiological tests with the use of inoculations on solid and liquid media were performed. VRB, MRS agar, YGC, nutrient agar and media composed of lactose, bile and brilliant green were used as culture media. 25 beer samples from 14 breweries were tested. The presence of saprophytic and pathogenic microflora in the beer available on the Polish market were determined. In 21 of 25 samples *Lactobacillus acidophillus* were found. The pathogenic microflora were found in 15 of examined beers. Additionally, the possibilities of limiting and preventing undesirable microorganisms in unpasteurized and unfiltered beers were discussed. Attention was paid to proper hygiene and control of the production process, meeting sanitary requirements for the process, product and employees, appropriate conditions for storing raw materials and the final product, as well as control of yeast used in the process. The study also analysed the possibility of using various food safety and quality management systems that may be helpful in counteracting this type of threat. The results of the research carried out may provide significant knowledge for producers of unpreserved beers and draw their attention to the possibility of occurrence of undesirable microflora in their products.

Keywords: unpreserved beer, microbiological contamination, food quality and safety systems, craft beer revolution

DIRECTIONS OF USING THE KANO MODEL TO IMPROVE THE QUALITY OF PRODUCTS AND SERVICES

Natalia Kłopotek, Przemysław Dmowski, Agata Szkiel

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia, 81-225, Poland
n.klopotek@au.umg.pl

The Kano method (Kano model) is one of the quality management methods used to improve the quality of products and services. Using the assumptions of this method it is possible to answer the question: How does the fulfillment / non-fulfillment of a given requirement (attribute) of a product or service influence the satisfaction / dissatisfaction of a consumer / customer. Moreover, using the Kano method enables assigning attributes of a product / service to 6 categories, proposed by the inventor of the method (Noriaki Kano), such as Must-be, One-dimensional, Attractive, Indifferent, Questionable and Reverse. The purpose of this paper is to present the applicability of the Kano method in improving services, industrial products and food products.

As a result of literature analysis, it has been found that the Kano method has been applied mainly in improving the quality of catering, hospital, educational, aviation, cosmetic and delivery services. It has been implemented in assessing the attributes of these services and the impact of their fulfillment / non-fulfillment on customer satisfaction / dissatisfaction and total service quality. The Kano model has also been adopted in the improvement of industrial products such as cell phones, baby carriages and automobiles. In contrast, limited application of the Kano model has been observed in food product quality improvement. The results of the study focused on food product packaging, the use of food additives, and the improvement of food products in general.

Keywords: Kano model, quality, product, service, improvement

COMPARISON OF THE QUALITY PARAMETERS OF SELECTED TYPES OF ORGANIC CRISPBREAD

Maciej Świtalski, Millena Ruszkowska

Department of Department of Management and Quality Science, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia, 81-225, Poland, maciej.switalski@sd.umg.edu.pl

The aim of the study was to evaluate the quality parameters of selected types of extruded breads made from raw materials originating from organic farming. The research material consisted of 6 types of organic crispbread and the zero product - corn crisps. The research methodology included the determination of water content and activity, determination of water absorption and water solubility indexes, measurement of colour and texture profile (TPA). Based on the study, it was found that the evaluated products were characterized by different levels of water content and activity. The highest water content was observed for product III - quinoa crispbread. Water activity of the tested extrudates did not exceed the value of 0,6. On the basis of color evaluation it was found that the products were characterized by different value of parameters (L*), (a*), and (b*). The highest value of ΔE parameter, showing the colour differences, was observed between product VI, being the extrudate with the darkest colour, and the other products. The tested products were characterized by the value of WAI in range of 461,4-578,36 and WSI ranging from 1,93 to 10,28. Product II (chestnut bread) and product IV (bread with green lentils) were extrudates with the highest hardness. The lowest values of cohesion, chewiness and gumminess were observed for product III. On the basis of research carried out significant differences in the studied parameters were found between the extrudate produced from corn grits and products made of other structure-forming raw materials.

Keywords: WSI, WAI, TPA, extrusion

PERCEPTION OF NUTRITION CLAIMS, AND THE ORIGIN OF FOOD PRODUCTS

Marcin Antoniak, Andrzej Szymkowiak

Department of Commerce and Marketing,
Poznań University of Economics and Business, 61-875 Poznań, Poland,
marcin.antoniak@phd.ue.poznan.pl

An inadequate and poorly-balanced diet has been a serious problem for decades. Hence, addressing this multi-causal challenge requires extensive action to achieve comprehensive and sustained progress in the long term. In order to prevent health problems resulting from improper, and often unhealthy nutrition, countries and organizations around the world have introduced a number of changes to their legislation concerning food products. By modifying requirements regarding the content of food labels, they help customers make better purchasing decisions. These changes have also resulted in the creation of the idea of Nutrition and Health Claims (NC, HC). This has also led, especially in developed countries, to changes in the popularity and perception of meat alternatives as an option for a better and more balanced diet and a way to reduce the negative human impact on the environment and animal welfare. As a consequence, the purchasing behaviour of food consumers has also changed. In the light of these trends, the present study aims to investigate the perception of nutrition claims, net weight and the origin (animal vs. plant) of products included on the front of pack (fop) labels of burger patties. For this purpose, an online survey has been conducted on a group of 522 respondents. The study has revealed that the perception of products depends on the information placed on the fop label, including, albeit not always, nutrition claims. The conclusions drawn from the study are liable to provide accurate information not only to researchers, but also to manufacturers willing to improve the design of their food packaging. In addition to discussing the research results, the present article will describe its limitations and strengths, as well as possible directions for future research.

Keywords: Consumers' perception, meat alternatives, proteins, nutrition claims (NC)

SESSION 5. QUALITY CONTROL IN INDUSTRY 4.0 ERA

MESH CELL-FTIR SPECTROSCOPY TO ASSESS VIRGIN OLIVE OIL STABILITY UNDER REAL MARKETING CONDITIONS

D. L. García-González[1], Ana Lobo-Prieto[1], Ramón Aparicio-Ruiz[2], María Teresa Morales-Millán[2], Noelia Tena[2]

[1]Instituto de la Grasa (CSIC), Seville, 41013, Spain.
[2]Departmento de Química Analítica, Universidad de Sevilla, Seville, 41012, Spain
dlgarcia@ig.csic.es

Virgin olive oil producers are demanding today more effective methods to guarantee that virgin olive oils from extra virgin category remain in this high-quality category during all the distribution period until the product reaches the consumers. That entails the development of new strategies to control virgin olive oil stability. Most of the available methods implement drastic temperature conditions to assess virgin olive oil oxidative stability. The information provided by these methods may have certain degree of inaccuracy when it is correlated with the real conditions given during the marketing of the product. A method based on mesh cell-Fourier transform infrared (FTIR) spectroscopy has been optimized for evaluating virgin olive oil stability. This method provides information of different spectral bands (assigned to hydroperoxides and alcohols, among other chemical species) that show variation during oxidation processes and consequently inform on the oxidative stability. A study has been carried out to evaluate the differences of the stability between samples, and the changes found in a sample during a real storage experiment. Thus, fresh samples of monocultivar virgin olive oils were initially characterized and subsequently subjected to a real storage experiment (27 months) in which light and temperature were controlled. The samples collected every month of storage were incubated in mesh cell for 576 hours and the composition in antioxidant and prooxidant was also determined as well as their physical-chemical properties. The mesh cell incubation was carried out under two different moderate conditions with the aim of evaluating the effect of light (400 lx and 23 ºC) and light and temperature (400 lx and 35 ºC). The comparison between different incubation times allowed the identification of changes in the stability of the samples as they aged and the study of the rest of chemical parameters allowed an interpretation of the different sensitivities to oxidation.

Keywords: FTIR, virgin olive oil, shelf life, storage, stability, oxidation.

APPLICATION OF NEAR INFRARED HYPERSPECTRAL IMAGING FOR ANALYSIS OF TEXTURIZED VEGETABLE PROTEINS

Giacomo Squeo [1], José Manuel Amigo [2,3], Davide De Angelis [1], Antonella Pasqualone [1], Francesco Caponio [1], Carmine Summo [1]

[1] Department of Soil Plant and Food Sciences, University of Bari Aldo Moro, Bari 70126, Italy,
[2] IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain
[3] Department of Analytical Chemistry, University of the Basque Country UPV/EHU, P.O. Box 644, 48080 Bilbao, Basque Country, Spain
giacomo.squeo@uniba.it

In recent years, an increasing interest in vegetable proteins has been observed both from the consumers side and from the industrial one. This is demonstrated by the conspicuous investments for the plant-based sector which reached 3.1 billion dollars in 2020. Texturized vegetable proteins (TVP) are quantitatively the most important ingredient for the production of plant-based products. TVP imitate the fibrillar structure of meat muscle and strongly affect the nutritional and textural properties of the final product. Considering the increasing usage of TVP for a wide spectrum of applications in the industrial context, a critical aspect regards the development of suitable and convenient methods for quality control. Proximate composition is the first mandatory aspect to be monitored but is a demanding task which requires time, polluting solvents, and resources. By contrast, near infrared spectroscopy (NIRS) has been proven to be an efficient technique for rapid and non-destructive analysis. Furthermore, when NIRS is coupled with imaging techniques, a comprehensive spatial and spectral information of the product under study could be achieved. In this regard, Hyperspectral Imaging (HIS) has been recently suggested as a promising non-destructive technique for evaluating the quality of TVP and plant-based products.

In this framework, this work is aimed at studying the feasibility of NIR-HSI for the analysis of TVP chemical composition.

Four different TVP have been produced in duplicate by a low-moisture extrusion process, combining different protein sources and analysed for total protein content, total fat and ashes. NIR hyperspectral images were collected in reflectance mode by using a spectrometer (Headwall photonics model 1002A-00371) working in the wavelength range of 1009-1694 nm with a spectral resolution of 4.85 nm and spatial resolution of 30 μm. After acquisition, the spectral images were processed in Matlab environment by using the PLS_toolbox and HYPER-Tool. Data were explored using PCA and then subjected to regression analysis by PLS1 algorithm. The figures of merit of the regressions in calibration and cross-validation showed excellent performance of the developed models, with values of R^2 always higher than 0.90 and low values of RMSE. Prediction of external test set confirms these results.

Keywords: food analysis, non-destructive methods, plant-based products, chemometrics, regression.

SPECTRAL FINGERPRINTING AND CHEMOMETRIC ANALYSIS IN FOOD QUALITY ASSESSMENT: A STUDY OF FRUIT JUICES

Katarzyna Włodarska, Ewa Sikorska

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland, katarzyna.wlodarska@ue.poznan.pl

The food quality assessment involves a comprehensive evaluation of various product characteristics, which requires the use of many conventional analytical methods to determine them. Most of conventional methods are time consuming, costly, and destructive because usually require sample preparation. The methods used for routine quality control of food products should enable rapid measurements of a large number of samples, preferably in a non-destructive way, and in the place of their occurrence. In order to ensure effective control of the quality of fruits and their products, traditional analytical methods are replaced by spectroscopic techniques coupled with chemometric analysis.

The application of spectroscopic techniques is based on measurements of non-selective signals characterizing the product, which may be considered as its unique fingerprint. The analytical information can be obtained by the application of the chemometric analysis of such fingerprints. Currently, optical spectroscopy involving infrared, visible and ultraviolet regions is widely used as a fingerprinting method in quality assessment of various food products. Using different ranges of electromagnetic radiation provides information about the different properties of the product.

The objective of the study was to explore the feasibility and compare performance of different optical spectroscopic techniques to determine the quality parameters (soluble solids content, titratable acidity, pH, phenolic content) of apple and strawberry juices from fruit and juice spectra. The multivariate data analysis included pre-processing, variable selection and modelling with the use of partial least squares (PLS) regression.

The reported results demonstrate the usability of optical spectroscopy and chemometric analysis for assessing the quality of apple and strawberry juice. The results can contribute to development of effective methods for rapid analysis, especially in-line quality assessment of fruit juices. Application of optical spectroscopic techniques may be valuable alternative to traditional, laboratory methods, which enable simultaneous determination of several quality parameters in a more environmentally friendly way. The use of these methods at different stages of the food production chain reduces the consumption of reagents and energy and supports sustainable development.

Keywords: apple juice, strawberry juice, optical spectroscopy, multivariate calibration

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

AUTOMATING AUTHENTICATION WITH ABSORBANCE-TRANSMITTANCE EXCITATION-EMISSION MATRIX (A-TEEM) SPECTROSCOPY

Adam M. Gilmore

HORIBA Instruments Incorporated,
Piscataway, NJ 08822 USA
adam.gilmore@horiba.com

Authentication and quality assurance/quality control (QA/QC) applications for many industrial products including foods, beverages, dietary supplements and pharmaceutical products often relies heavily on complex chromatography and mass spectroscopy. This study describes the A-TEEM method which is rapid (s-min), column-free and requires minimal sample preparation yet exhibits high-sensitivity for many compounds down to sub ppb levels. The patented A-TEEM method corrects for fluorescence inner-filter effects to facilitate linear model responses needed for sensitively calibrating both regression and classification models. The A-TEEM has the both ability to discriminate low-concentration materials from much higher background component concentrations as well as recognize the presence of unknown materials. The study describes how the A-TEEM can be readily applied in an industrial setting using a new multivariate model prediction toolbox. The new toolbox facilitates model calibration, validation and maintenance with an administrator level while facilitating routine model application with a simple operator interface that yields reports compatible with laboratory information management systems. Key application examples of the A-TEEM described include 1) discrimination of legal and illegal hemp varieties based on the concentrations of cannabidiol and tetrahydro-cannabinol, 2) discrimination and quantification of key adulterants in cranberry derived dietary supplements, 3) quantification of major phenolic and anthocyanin compounds in wine and grape juice as well as measurement of key basic wine chemistry parameters, 4) characterization of extra virgin olive oil adulteration and age related effects and 5) evaluation of fluorescent labelling efficiency for adeno associated virus capsids. In conclusion we discuss how the A-TEEM can facilitate effective authentication and QA/QC measurements in a field or laboratory setting with minimally supervised operation suitable for these and other industrial applications.

Keywords: adulteration, contamination, forensic investigation, food safety

SESSION 6. MANAGEMENT FOR SUSTAINABILITY

BIOECONOMIC ASPECTS OF THE PRODUCTION, DISTRIBUTION AND USE OF BIO-BASED PRODUCTS FROM BIO-WASTE AND AGROBIOMASS

Małgorzata Krzywonos

Department of Process Management, Faculty of Management,
The University of Economics and Business, 53-345 Wrocław, Poland
malgorzata.krzywonos@ue.wroc.pl

The traditional way of using agrobiomass and by-products (e.g., residues from sugar production, such as molasses and beet pulp) uses them as a raw material for producing energy carriers (biogas and bioethanol) and as animal feed. Compared to traditional plants, an integrated biorefinery offers technical and economic benefits, including energy balance and mass flows and higher profitability. This study aims to examine bioeconomic production, distribution and use of bio-based products from bio-waste and agrobiomass.

Nowadays, agrobiomass and by-products are often used in an innovative, economically and ecologically justified way. As a result of physical, chemical or biological treatment, bioproducts obtained on a mass scale are partly derived from plant, tree or animal biomass. The processing of bio-waste and agrobiomass into bio-based products with added value (fine chemicals such as amino acids, vitamins, polymers and industrial enzymes) by innovative methods can be a source of economic, social and environmental benefits. Understanding the economic potential of other than traditional and popular directions of using by-products is particularly interesting due to the prospects of obtaining valuable products with added value (i.e., pectins, uronic acids, enzymes, furfurals). It is worth adding that some of the bioproducts, e.g., furfurals and their derivatives, which reach PLN 2,580 per 10 ml), can be used as biocomponents used to produce biofuels sustainably.

Keywords: bioeconomy, bioproducts, bio-waste, by-product, agrobiomass, innovation.

This work was supported by the project financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

MUNICIPAL SOLID WASTE ANAEROBIC DIGESTION AS A COMPONENT OF THE CIRCULAR ECONOMY

Przemysław Seruga

Department of Bioprocess Engineering, Faculty of Production Engineering, Wroclaw University of Economics and Business, Wroclaw 53-345, Poland, przemyslaw.seruga@ue.wroc.pl

One of the most important problems related to the production of every goods, is the management of the generated by-products. This applies to both, the industrial and the communal spheres. Thus, there is a need to transition to more sustainable systems. To address sustainability issues, the concept of the Circular Economy has recently gained importance.

In case of municipal solid waste (MSW) significant growth in the importance of material and energy recovery from it has been noticeable over the last few decades. As a solution for MSW handling, waste-to-energy (WtE) technology has been considered, where energy production has been identified as a potential source to replace fossil fuels. The main concern related to the treatment of MSW is the biological stabilization of the biodegradable fraction, which content is within 50% of the total weight.

The aim of this study is to present the possibilities of energy recovery from municipal solid waste *via* anaerobic digestion (AD) process in terms of the component of the circular economy.

The technology of AD of the biodegradable fraction from MSW in Poland is relatively young. Most of the existing facilities in Poland were built in the last 10 years. The advantages and disadvantages of AD; the possible benefits, and exploitation data of selected plant were analysed.

Based on the research results, it can be concluded that MSW is still a reservoir of renewable energy. This recovery should be carried out before the waste landfilling. Due to the introduction of nationwide selective collection standards, an increase in the amount of collected biowaste is expected. The methane fermentation of source segregated biowaste seems to bring greater benefits and be less cost-intensive compared to the fermentation of biodegradable fraction from municipal solid waste practiced in Poland. Regarding the environmental benefits, AD brings odour and greenhouse gas emissions reduction. The AD may also ensure material recovery. The digestate derived from biowaste fulfils the required levels for agricultural usage. It should also be mentioned that the material recovery impacts the biogas plants' financial balance. The revenues from biofertilizer sales might replace the disposal costs. It can be stated that municipal solid waste, mainly biowaste, anaerobic digestion, fits the circular economy.

Keywords: biogas, energy recovery, fermentation, sustainability

RECYCLER'S AUDIT WITHIN CIRCULAR ECONOMY APPROACH

Paweł Nowicki, Piotr Kafel

Department of Quality Management, Institute of Quality Sciences and Product Management, Cracow University of Economics, Rakowicka 27, 31-510 Cracow, Poland,
pawel.nowicki@uek.krakow.pl

The Circular Economy (CE) is now a very popular concept promoted by the EU authorities as well as by many companies around the world. Currently, the use of waste as raw materials is increasingly becoming a standard that does not require the implementation of incentive legislative tools or building social awareness and awareness of market participants themselves. Circular economy has evolved to a level where recycling of material streams should, of course, be remembered already at the product design stage, but we must not forget to reuse as much waste available on the market as possible. One of the elements to help to meet the requirements of the circular economy and, at the same time, lead to greater transparency of the waste market is the audit of recyclers. Pursuant to the Act on the management of packaging and packaging waste, an obligatory audit of recyclers has been in force since 1 January 2016. The Act of 13 June 2013 on the management of packaging and packaging waste introduces the obligation to conduct an annual external audit, carried out by an accredited environmental verifier. This obligation applies to entrepreneurs who recycle or recover packaging waste other than recycling, processing more than 400 Mg of packaging waste per year, as well as entrepreneurs who export it or make intra-Community deliveries of this waste weighing more than 400 Mg per year.

The purpose of this article is to present the statutory requirements for auditing packaging waste recyclers in the context of the circular economy concept. Based on the analysis of the available source materials, it is concluded that the audit of recyclers greatly facilitates the transformation of entrepreneurs from a linear economy to a circular economy. In addition, according to the authors, the effective implementation of the recycler audit process enables the fulfillment of individual requirements in the 9R circular economy concept.

Keywords: circular economy, recyclers audit, packaging waste, 9R concept.

RECYCLING OF PLASTICS – CHALLENGES IN CLOSING THE LOOP OF A CIRCULAR ECONOMY

Patrycja Wojciechowska[1], Miriam Podlewska

[1]Department of Industrial Products and Packaging Quality, Institute of Quality Science, Poznań University of Economics and Business, Poznań, Poland,
patrycja.wojciechowska@ue.poznan.pl

Recycling, as one of the pillars of a circular economy concept, is constantly gaining in importance. According to the European Strategy for Plastics it is a meaningful option for post-consumer plastic waste management enabling to save the non-renewable resources such as fossil fuels. Apart from environmental impact or economic implications, technicalities of the recycling are key factors considering the ability of plastic materials to be converted using this method of closing the loop. In the literature, there are numerous reports describing the influence of recycling on the performance properties of plastic products. However, studies analysing technical aspects of recyclates application within the real-time production, are still limited.

In this paper we describe the example of a recyclate implementation in the pilot-scale production of plastic products using injection moulding line. Challenges in quality assurance, as well as factors affecting the manufacturing process, are in detail discussed.

Keywords: recycling, circular economy, quality assurance, recyclate, plastics

POSTER PRESENTATION

CONSUMER DRIVEN DEVELOPMENT

DEMOGRAPHIC, ECONOMIC AND HEALTH STATUS IN THE CONTEXT OF HOUSEHOLD FOOD WASTE IN POLAND

Magdalena Ankiel, Urszula Samotyja

Poznań University of Economics and Business, Poznań 61-875, Poland
magdalena.ankiel@ue.poznan.pl, urszula.samotyja@ue.poznan.pl

Food waste is currently a major ethical, economic and social problem worldwide. In the European Union, more than 80 million tonnes of food are wasted each year. In the context of the above, it is important to diagnose consumer behavior in households that contribute to throwing away food, which is a premise for the implementation of solutions reducing this phenomenon. Among the listed causes of food waste Poles indicate: food expiration, lack of certainty if the food is still fit for consumption related to poor understanding of the 'best before' and 'use by' dates, poorly planned shopping, purchase or preparing excessive amount of foodstuffs, lack of visual attractiveness, food spoilage and no desire to eat.

In the article, the authors present the results of a study on consumer behavior regarding food waste in households in Poland (N = 1070). The focus was on the analysis of the frequency of throwing out purchased food and on identifying the causes of throwing out food in households in Poland in relation to segment variables. The main emphasis was put on issues related to the economic status of households, the number of children and seniors in households and the presence of people who have health problems such as food allergies or diet-related diseases.

This study was supported by the National Science Centre (Narodowe Centrum Nauki), Poland [grant number 2017/27/B/HS4/00805].

PROBIOTIC FOOD IN RATIONAL NUTRITION IN CONSUMERS' OPINION

Bożena Borycka, Monika Grabowska

Department of Product Management and Quality,
Faculty of Chemical Engineering and Commodity Sciences,
Kazimierz Pulaski University of Technology and Humanities in Radom, Poland
bozena.borycka@uthrad.pl

Rational nutrition is nowadays one of the most important factors of modern pro-healthy lifestyle of a human being. Universality of this concept is connected with the fact that it concerns the whole human population, and that a significant part of the modern society pays more and more attention to the health quality of food products it chooses. New types of food are part of trends related to the composition of a rational diet for each generation. Functional foods are an element of modern nutrition and new foods that differ from those commonly consumed, not only in health-promoting nutritional properties and functional qualities, but also in technology and the way of obtaining raw materials. Probiotic foods, as an example of this, undoubtedly have such qualities.

The aim of this study was to analyze consumer behavior on the market of biotic food. The study shows that consumers quite often consume such food during antibiotic therapy, but they also support themselves with probiotic preparations purchased at the pharmacy. However, a relatively small number of respondents consume such products prophylactically.

Keywords: probiotic food, rational nutrition, consumer

RE-USE OF FOOD IN HOUSEHOLDS IN THE OPINION OF PODKARPACKIE VOIVODSHIP RESIDENTS

Izabela Cichocka, Jan Krupa, Andrzej Mantaj

Department of Management, Faculty of Management,
The University of Information Technology and Management, Rzeszow 35-225, Poland,
icichocka@wsiz.edu.pl

Nowadays most societies are characterized by the attitude of consumerism, whose income is a derivative of the growth of consumption and not the increase in production. This phenomenon contributes to the overproduction of food its wastage. In Europe 100 million tonnes of food products are thrown away each year. Almost 9 million tons of food are wasted on a Polish scale. According to national statistics, one-third of purchased food items are wasted. The aim of this article is to present the respondents' opinions on the frequency and reduction of the amount of perishable food purchases and the universality of its re-use.

The study of the analyzed phenomena was based on the results of the survey conducted among 486 people from the area of south-eastern Poland, mainly from the Podkarpackie Voivodeship. Non-parametric significance test $\chi 2$ was used for statistical verification. A non-parametric significance test (Pearson's chi-square) was used to statistically evaluate the differentiation of respondent' opinions. Food wastage resulted from unsatisfactory quality of food products related to changes taking place in it during storage. Consumer errors (too much food purchased, too large portions of prepared meals, not paying attention to the use-by date) also contributed to food wasting. Moreover, the research has shown that more than half of the surveyed people attached significant importance to the re-use of food. In most cases, the re-use of food products was based on their use in cooking dishes. These activities were most limited by such factors as: unsatisfactory organoleptic quality of prepared dishes, lack of time and ideas for meals and the burden of their preparation. Statistically significant degree of re-use of products increases with the increase in the number of people in the household. Moreover, it was higher among respondents coming from smaller towns. The inconvenience of the re-use of food decreased with the age of the respondents and deterioration of the material situation. It seems reasonable to undertake actions aimed at improving the food system. Taking into account factors that make it difficult and predisposing to re-use of food, one should strive to develop sustainable local consumption.

Keywords: food wastage, food re-use, households, surveys

PURCHASING PREFERENCES OF CRAFT BEER CONSUMERS BEFORE COVID-19 AND COVID-19 DRIVEN CHANGES

Leszek Matuszak

Department of Product Marketing, Institute of Marketing
Poznań University of Economics and Business, Poznań, Poland
leszek.matuszak@ue.poznan.pl

The aim of the publication is to present the purchasing habits of craft beer consumers, as well as to analyze changes in distribution methods in 2018 and in 2021, taking into account "post-epidemic" changes.

When analyzing the product of craft beer, which has been present in Poland for about 10 years, first of all, its definition should be consider – there are different definitions of craft beer – according to American Brewers Association (ABA) craft brewery are craft brewery as being "small","independent," and "traditional.". According to Polskie Stowarzyszenie Browarów Rzemieślniczych (Polish Association of Craft Breweries) defines it as "small", "quality oriented", "independent" and "known from people responsible for product" (eg. brewer). Definition is fuzzy because it doesn't include regional breweries like Browar Fortuna from Miłosław (beer series Fortuna, Komes, Miłosław – including Fortunatus series) and Browar Kormoran (brand Kormoran, known for one of best Baltic porter style beer all over the world).

Group of over 800 beer consumers were examined – they were recruited from beer festivals, personal interviews with employees of craft breweries and ordinary consumers of craft beers from leading fan pages. There were also used data from "Piwna Zwrotnica" (http://www.zwrotnica.com.pl/) webpage – most reliable page monitoring craft beer market in Poland. There were also analysed online offer of most micro/craft breweries in Poland.

Main conclusions of paper was difference between "hard" craft beer consumers – before COVID-19 pandemic situation they were buying and consuming craft beers in multitaps (craft beer pub with wide range of selection of craft beers). In 2020 and 2021 new sales channel were created.

Introducing lockdown of pubs and restaurants induces changes in business models for craft breweries – some of them invented new way of selling beers online, some of them change philosophy of business (way of designing products, way of distribution). Its results were visible in financial and production results of 2020 – some of breweries breaks their top records, some of them were closed. Micro/Craft breweries sector adapts to changes - some companies undertook different strategies in area of distribution, product design and general business philosophy.

Keywords: consumer preferences, distribution strategy, craft beer, product strategy, pandemic time

CHANGES IN THE USE OF MICROWAVE OVENS DURING THE COVID-19 PANDEMIC BY HOUSEHOLDS OF POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS STUDENTS

Krzysztof Melski

Institute of Quality Science, Department of Natural Science and Quality Assurance, Poznań University of Economics and Business, Poznan, Poland,
k.melski@ue.poznan.pl

The pandemic COVID-19 drastically changed the way of live for many people, by forcing them to stay at home, whether as part of remote work/learning or having to stay in isolation temporarily. Staying at home longer than before and limited access to restaurants, bars and food stores had to affect consumers' culinary behaviour. Taking into account that majority of households posses microwave ovens, this phenomenon should be reflected in changes in the frequency and use of microwave ovens as a part of modern human lifestyle. The main topic of the study was the identification of changes in the use of microwave ovens by a select group of consumers during the first year of the pandemic COVID-19. This work presented results of inquiry carried out among households of students of Commodity Science and Management and Production Engineering, Poznan University of Economics.

In general, a quarter of respondents say the frequency of microwave oven use has increased. The vast majority declare a slight increase in frequency while less then 2 % of them declare much more frequent use. The greatest increase in the frequency of use of microwave ovens was recorded in terms of defrosting food and heating pre-prepared meals. The results obtained indicate a moderate change in the frequency of microwave use with the stable profile and distribution of applications.

Keywords: microwave oven, COVID-19, household,

CONSUMERS' PREFERENCES ON LOW-LACTOSE ICE CREAM MARKET

Agnieszka Palka, Paulina Tołczyk

Department of Quality Management, Faculty of Management and Quality Sciences, Gdynia Maritime University, 81-225 Gdynia, Poland,
a.palka@wznj.umg.edu.pl

Frozen desserts are one of the many kinds of desserts available on the market. Due to the growing interest in this type of desserts, producers introduce newer and better versions to the market, which are designed to meet the requirements of various consumer groups. They also introduce innovative improvements to obtain profits from sales throughout the year, and not only on summer days with higher temperatures. The features that can distinguish such products may include the presence of easily digestible protein derived from whey, the content of vitamins, natural ingredients or also low calorie compared to other desserts, sweets and snacks. Lactose-reduced ice creams are made mainly for people who are lactose intolerant. The most popular substitutes for "traditional" ice cream for consumers excluding lactose from their diet may be ice cream made on the basis of soybean extract (soy ice cream) or rice (rice ice cream). However, these products, due to lower interest and higher prices, are products that are difficult to find on the market. A popular lactose-free product on the market of frozen desserts in the world are sorbets, which do not content milk. Milk-based ice cream are still popular, which is why the paper deals with the assessment of consumer preferences towards frozen desserts with reduced lactose content. The aim of the study was to assess the preferences of the respondents towards lactose-free ice cream and ice cream with reduced lactose content, as well as to analyze the most common objections of the respondents towards lactose-free and reduced lactose ice creams. On the basis of the obtained results it was concluded that lactose-reduced frozen desserts were consumed occasionally. The surveyed consumers treated them as a seasonal product, moreover, they showed little interest in frozen desserts with a reduced lactose content. The decisive factor in the selection was the taste and price of the product, not its composition. The lactose content in frozen desserts was mainly noted by consumers over 50 years of age, which could have been caused by the disappearance of the enzyme needed to digest lactose in the elderly.

Keywords: ice cream, lactose intolerance, lactose-reduced ice cream, consumer preferences, survey

NUTRITIONAL LABELLING –HOW TO EXPLORE THE INFORMATION USING AI TOOLS AND KNOWLEDGE

Katarzyna Pawlak-Lemańska[1], Michał Klincewicz[2], Paulina Pobłocka[2]

[1]Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, Poznań, 61-875, Poland, katarzyna.pawlak-lemanska@ue.poznan.pl
[2]Wisebase sp. z o.o., Syndigo Company, ul. Szpitalna 8a/3, Warsaw, Poland

Today's societal challenges are increasingly analyzed from a data-driven perspective, while the universal pervasiveness of food and its inherent multidisciplinary nature enable it as an accessible window into every culture and time period. Food is also central to many countries' economies (employment and production) and cultural heritage. The ability to research quality clarity of food information presented on labels can help us address the challenges of sustainable and healthy eating in diverse cultural.

In this study, we encourage an interdisciplinary approach to the exploration of nutrition data and consumer knowledge and information. We highlight challenges and opportunities of using AI solutions to analyze the food domain through food product descriptions, information presented on the labels and present use cases that form the basis of a collaborative movement to provide a multifaceted and data driven analysis of nutrition and consumer driven factors (diets, health instructions). First, we explore issues around collecting and integrating food, nutrition, and market needs data. Second, we propose the NLP and other AI methods currently employed in linking and analyzing these data sources. We shortly presented how such techniques can be used to engage and translate food challenges to stakeholders and forecast possible future applications such as recommender systems that meet expectations of today's consumer.

Keywords: food labelling, quality, attributes, AI, information

Grant POIR.01.01.01-00-0533/19-00 from the Polish National Center of Research and Development, is gratefully acknowledged.

SPROUTS AS A VALUABLE NUTRITION ADDITIVE – ANALYSIS OF CONSUMERS' AND PRODUCERS' OPINIONS

Agnieszka Anna Pilarska

Department of Plant-Derived Food Technology, Faculty of Food Science and Nutrition, Poznań University of Life Sciences, Wojska Polskiego 28, 60-637 Poznań, Poland, pilarska@up.poznan.pl

Vegetable sprouts play an important role in human nutrition. They provide numerous essential nutrients, including specific vitamins, unsaturated fatty acids, dietary fibre, amino acids, potassium and magnesium. Sprouts are also a rich source of antioxidants, which prevent the development of cancer, among other diseases. Specific growing conditions affect their quality and microbiological safety. The room temperature and high humidity in which sprouts are cultivated foster the development of pathogenic microflora (including a strain of *Escherichia coli*) and fungi generating mycotoxins. Microbiological contamination may occur at any stage of sprout production, from seed treatment to transport and storage.

The following study was based on an interview with consumers and producers of vegetable sprouts, conducted by means of the author's questionnaire and oral interview. The information obtained allowed, among other things, to identify the frequency of consumption and the level of consumers' knowledge about the properties and types of sprouts. Moreover, the study aimed to obtain practical information on methods and procedures related to the cultivation of sprouts and key factors determining their quality and safety.

The results of the survey proved that regardless of the respondents' place of residence, vegetable sprouts are an unpopular and moderately available nutritional product. It was found that respondents in a better financial position, particularly women, are more likely to purchase this product, regardless of where they live. On the other hand, individuals with a university degree possess the greatest knowledge about the properties of sprouts. The most popular are sunflower, lentil, beet and cress sprouts. Manufacturing enterprises are required to hold a BRC (*British Retail Consortium*) or an IFS (*International Food Standard*) certificate. The production takes place according to the hygiene requirements for manufacturing sprouts and seeds for sprouting specified in the ESSA hygiene guideline, which has been registered in the Official Journal of the European Union No. 2017/C220/03.

Keywords: vegetable sprouts, nutritional value, quality, consumption safety, production

SECOND-HAND CLOTHING CONSUMPTION AMONG MILLENNIALS: UNDERSTANDING PURCHASE DETERMINANTS

Natalia Raszka

Department of Commerce and Marketing, Institue of Marketing,
Poznań University of Economics and Business, Poznań 61-875, Poland,
natalia.raszka@ue.poznan.pl

The fashion industry promotes consumerism, which enhances especially by the fast fashion market. Overconsumption is negatively influencing the environmental, economic and social situation. Nevertheless, there is visible growth of sustainable fashion consumption among millennials. It leads to reflection on what determines consumers behaviour towards buying second-hand clothes. Understanding the antecedents of purchase such garments is crucial for promoting sustainable consumption.

The main goal of this study is to examine what factors determining millennials consumers behaviour towards buying second-hand clothes.

Quantitative research was based on the questionnaire designed in the Google survey tool. Analyzing data from a survey with 1 000 respondents led to the identification of three purchase motivation factors cohorts: hedonic, economic and environmental. EFA (exploratory factor analysis) CFA (confirmatory factor analysis) was applied for data analysis.

The research presents that environmental factor is the strongest determinant for second-hand shoppers. Millennials declare ecological awareness and willingness to protect the environment and minimize waste consumption through used garments purchasing. Economic and hedonic factors are crucial but have no such impact as environmental on buying behaviour.

Keywords: second-hand clothing; sustainable consumption; millennials

EUROPEAN STRATEGIES FOR SALT REDUCTION IN FOOD

Iga Rybicka[1,2]*, António Marques[1,3], Amparo Gonçalves[1,3], Helena Oliveira[1], Maria Leonor Nunes[1]

[1]Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Terminal de Cruzeiros do Porto de Leixões, Av. General Norton de Matos, S/N, 4450-208 Matosinhos, Portugal,
[2]Institute of Quality Science, Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań,
[3]Portuguese Institute for the Sea and Atmosphere, Division of Aquaculture, Upgrading and Bioprospecting, Av. Alfredo Magalhães Ramalho 6, 1495-165 Lisboa, Portugal
**iga.rybicka@ue.poznan.pl*

Reducing salt (sodium chloride, NaCl) intake has been identified as one of the most cost-effective measures that can be taken to improve health of worldwide population. The excessive salt intake is associated with increased blood pressure, which can cause several cardiovascular diseases. Therefore, in 2007, the World Health Organization (WHO) established an Action Network on Salt Reduction in the Population of the European Region, which was signed by 29 Member States. It set a global target of a 30% reduction in salt intake by 2025 (compared to 2010 levels), which is predicted to save 40 million lives over 30 years. Thus, the objective of the study is to provide an overview of different strategies proposed for NaCl reduction. Such strategies were identified from existing reviews and from searches of the literature and relevant websites.

Political strategies for salt reduction include governmental polices, co-operation with food industry, social campaigns and intake monitoring. The number of countries with these salt reduction initiatives doubled from 2010 to 2015 (75 in 2015). Nowadays, most programs include consumer education, industry engagement to reformulate products and interventions conducted by public institutions. Less popular are establishing salt content targets for foods and front-of-pack labelling products with high/low content of sodium. Legal and fiscal policies are also available, but in a limited number of countries. So far, salt reduction legislation has been introduced in Belgium, Greece, Hungary, the Netherlands and Portugal. The majority of WHO members continue to rely on voluntary measures and most technical initiatives (salt reduction, salt replacement and use of alternative technologies to preserve food) have been applied in processed food, ready-to-eat products or served meals, especially in schools and nurseries. In terms of particular food products, they primarily apply to bakery products (bread), snacks and cheese.

Generally, Member States of WHO European Region (53 countries) are in a good position to accelerate national initiatives to reduce salt intake at the population level. It is assumed that one dollar spent on salt reduction efforts can save 19 dollars as a result of reduced disability and mortality in high-income countries.

Keywords: food, health, nutrition, salt, reduction

IDENTIFICATION OF SOCIO-DEMOGRAPHIC MARKET SEGMENTS OF SELECTED FOOD PRODUCTS – THE CASE OF POLAND

Julia Szutowska[1], Daniela Gwiazdowska[1], Julia Gwiazdowska[2]

[1]Department of Natural Science and Quality Assurance, Institute of Quality Science,
[1]Poznań University of Economics and Business, Poland
[2]Adam Mickiewicz University, Poznań
julia.szutowska@ue.poznan.pl

The concept of market segmentation based on observable variables, like demographic, social and geographic factors, is basic strategy which involves the division of a large market into segments of consumers with various needs and characteristic. Despite its simplicity, it is one of essential tools used by enterprises to gain the competitive advantage.

The purpose of the present research was to identify the socio-demographic market segments that are the most appealing to producers due to the high consumption of vegetables preserves and juices based on fruits and vegetables. The research problem was contained in the following question: what is the relation between socio-demographic characteristics and the consumption of vegetable preserves and juices?

The research employed secondary data provided by Polish Statistical Office through the online database. In order to compare the variance in the group means within a sample the one-way ANOVA was used and it was followed by Tukey post hoc tests. The spatial scope of the research encompassed Poland. The time scope was determined as 2010 – 2018.

In the case of fruit and vegetable juices the marketing efforts should primarily be directed to well-educated marriages with one child doing non-manual workers or being self-employed and consumers living in cities over 500 thousand citizens. In the case of vegetable preserves, dry vegetables and mushrooms preparations they should primarily be directed to retirees, households without children and individuals having higher education as well as to consumers living in the cities from 200 to 499 thousand citizens.

The research may constitute a general basis for the market segmentation performed by the companies offering fruit and vegetable juice and vegetable preserves, dry vegetables and mushrooms preparations, as it indicates the market segments in which individuals consume the most of the above products. The paper fills the research gap concerning the lack of studies on the consumption of fruits and vegetables on the Polish market through the lens of market segments.

Keywords: market segmentation, food products, Poland, fruit and vegetable juices, vegetable preserves

THE PHENOMENON OF FOOD WASTE AMONG CONSUMERS OF GENERATION X, Y, Z

Romuald Zabrocki, Nikola Ferenc

Faculty of Management and Quality Science, Department of Quality Science,
Gdynia Maritime University, 81-225 Gdynia, Poland,
r.zabrocki@wznj.umg.edu.pl

In the era of sustainable development, food waste is a significant problem in the global food economy. It is determined by the sheer scale of the phenomenon, as well as its negative economic, social, environmental and energy consequences. Food waste occurs at all links in the food chain. The entities largely co-responsible for wasting food are its buyers who follow numerous market trends, including consumerism. Consumers' approach to the issue of food waste may be determined by a number of factors, including belonging to a specific generation. The age of consumers and related experiences on the food market may differentiate the rationality of their purchasing behavior and the scale of food waste.

With the above in mind, the aim of the study was to determine the impact of belonging to a specific generation X (60+), Y (31-59 years old) and Z (18-30 years old) on the attitudes and behavior of respondents towards the phenomenon of food waste. The survey was conducted in 2021 using the survey method, among 165 people from the Pomeranian Voivodeship. The research results showed that belonging to a generation differentiates the attitudes and behavior of respondents in most of the analyzed areas of the study. The knowledge of the respondents about food waste was the highest in generation X and usually fragmentary in generation Z. The greatest scale of food waste was found in generation Z. Respondents from generation Z and Y saw the negative consequences of food waste more often than the representatives of generation X. Attempts to manage (process) uneaten food were mainly made by the representatives of the oldest generation (X). Poor planning as the reason for wasting food was indicated by twice as many young respondents from Generation Z as respondents from Generation X.

Keywords: food, waste, consumer generations X, Y, Z

DESIGN, QUALITY AND SAFETY OF FOOD PRODUCTS

POSSIBILITIES AND LIMITATIONS OF THE USE OF ELECTRICAL CONDUCTANCE PARAMETERS TO ASSESS THE CONCENTRATION OF SKIM-MILK

[1]Banach J.K., [1]Żywica R., [2]Kiełczewska K., [3]Pietrzak-Fiećko R.

[1]The Faculty of Economics, Institute of Management and Quality
[2] The Faculty of Food Sciences, Department of Dairy Science and Quality Management
[3] The Faculty of Food Sciences, Department of Commodity Science and Food Analysis
University of Warmia and Mazury in Olsztyn, 10-917 Olsztyn, Poland
ryszard.zywica@uwm.edu.pl

The condensation of the dry matter constituents is one of the milk preservation methods, thanks to which it is possible, among others, to manage the raw material surplus and to supplement its shortages. Due to the fact that the process of milk condensation influences the changes in the proportions between water-soluble constituents of milk, the aim of the research was to assess the suitability of the electric method for determining the degree of concentration of skim-milk using conductance parameters.

The quality of condensed milk with different dry matter content (10-50%, in steps of 10%) was assessed on the basis of pH, viscosity and protein content, as well as macro- (Mg, Ca, Na, K) and microelements (Mn, Fe, Zn, Cu) content. Measurements of electrical parameters of milk samples (impedance, conductance) were made by means of the type E4980a LCR meter at the frequency of 100Hz.

It was observed that as the concentration of mineral salts and protein increased with the milk condensation, the pH of milk decreased and its viscosity increased. The change in the proportions between the water-soluble components of milk also affected the electrical parameters of milk, i.e. increased the impedance and decreased the conductance. Correlation analysis proved that the impedance is the most useful for the assessment of skim-milk concentration determined on the basis of changes in pH ($r = 0.787$), the protein content ($r = -0.648$) and microelement content ($-0.635 \geq r \leq -0.688$). Due to the resulted moderate levels of correlation and the limited usefulness of conductance parameters, it was found that in further research on the application of electric methods for milk condensation measurements, the scope of used parameters should be expanded to include the dielectric parameters.

Key words: skim-milk, milk condensation, electrical conductance, physico-chemical parameters

OLEOGEL IN FOOOD– THE PERSPECTIVES OF APPLICATIONS AND HEALTH ASPECTS OF STRUCTURED LIPIDS

Karol Banaś[1], Joanna Harasym[1,2]

[1.] Department of Biotechnology and Food Analysis, Faculty of Production Engineering, Wrocław University of Economics and Business, Poland
[2.] Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics and Business, Poland
karol.banas@ue.wroc.pl; joanna.harasym@ue.wroc.pl

Background
In recent years, there has been an increase in interest in the oleogelation method, which allows for changing the physical form of vegetable oils and giving them some properties of solid fats while maintaining the valuable nutritional profile characteristic of liquid oils. This process is advantageous in the absence of unfavourable saturated fatty acids and lipids with the trans double bond configuration. The oleogelation method involves forming a gel by the oleogelator and trapping the oil in it, partly as an emulsion. In the literature, you can find various gelling substances currently used to create oleogels, e.g. high-molecular-weight Oil Gelator (HMOG), which include polysaccharides, such as alginates xanthan gum, pectins and carob gum.
Discussion and conclusions
Oleogels may in the future eliminate unfavourable saturated fats and fats with the trans double bond configuration from food products and allow for the production of low-fat products and thus contribute to the reduction of ecological damage caused by the excessive use of palm oil in food. Natural polysaccharides used to formulate oleogels, thanks to their origin, will not arouse negative associations among consumers. Additionally, the increasing functionalisation of food means that producers are looking for new solutions and improvements to their products to attract more and more aware consumers who focus more on the food they buy. Innovative solutions in the use of biopolymer-based oleogels would consist of introducing them into the food matrix and replacing fats completely or creating mixtures containing the source of fats and the addition of oleogel. Currently, there are no foods containing oleogels available in the trade of food products despite the promising results of oleogelation methods.

Keywords: oleogel, organogel, structured lipids

AGAR-RAPESEED OIL OLEOGELS - CHARACTERISTIC OF THE OLEOGEL TEXTURE

Karol Banaś[1], Joanna Harasym[1,2]

[1.] Department of Biotechnology and Food Analysis, Faculty of Production Engineering, Wrocław University of Economics and Business, Poland
[2.] Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics and Business, Poland
karol.banas@ue.wroc.pl, joanna.harasym@ue.wroc.pl

Background
In the last decade, the interest in oleogelation methods of oils has increased significantly due to their potential use in the pharmaceutical, food and biotechnology industries. Oleogelation may in the future become the leading technique for converting liquid vegetable oils into fats similar in properties to solid fats. In the oleogelation method, the oil is trapped by the oleogelator, partly in the form of an emulsion. Agar is a polysaccharide that may be used in the future as an oleogelator. Agar swells when cold, while in water at a temperature above 90° C, forms a viscous, gelatinous colloidal solution, which, when cooled to a temperature of about 35-50 ° C, solidifies to form a gel. Agar is used as a thickener, stabilizer and emulsifier. It is commonly used in the food industry as a gelatin substitute, e.g. in sweets (jams, jellies).
Discussion and conclusions
In this work, it was proposed to use agar as a cross-linking agent (oleogelator) and selected texture parameters of the produced oleogel with rapeseed oil were examined. The texture study was performed using the texture profile analysis (TPA) method on a texturometer. The obtained results showed significant differences in the texture parameters of the obtained oleogels depending on the agar hydration and the oleogel storage time.

Keywords: oleogel, organogel, structured lipids

HERBAL MEDICINE IN THE TREATMENT OF COVID-19

Alfred Błaszczyk

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics & Business, Poznań, Poland
alfred.blaszczyk@ue.poznan.pl

Currently, the number of confirmed cases and deaths of COVID-19 worldwide continues to rise, receiving great concern from the international community. All the waves of the pandemic have seriously changed not only the economies of countries around the world, but also the health of the population. Laboratories around the world have been involved in the fight against the pandemic to develop vaccines and drugs to help the body fight the coronovirus. During the first COVID-19 pandemics, in the absence of drugs to prevent and treat COVID-19, China and South Korea widely used Traditional Chinese Medicine (TCM) recipes to treat infected patients. The benefits of TCM herbal formulations in the treatment of COVID-19 are mainly reflected in the following three aspects: they are effective in relieving symptoms, delaying disease progression from mild and moderate to severe and critical, and reducing mortality in severe and critical ill patients. TCM herbal recipes have been shown to block the development of Covid-19, ease symptoms of infection and speed up recovery time. To date, several TCM herbal recipes have been tested in the literature to treat Covid-19 symptoms. There are a few TCM prescriptions recommended from the Diagnosis and Treatment Protocol for COVID-19 of China, including Maxing Shigan (MXSGD), Qingfei Paidu (QFPDD), Dayuan (DYD), Huashi Baidu (HSBD), Shufeng Jiedu (SFJD), Lianhua Qingwen (LHQW), Huoxiang Zhengqi (HXZQ), Jinhua Qinggan (JHQG) and Toujie Quwen Granules (TJQW). TCM herbal mixtures are also used in the prevention of viral infection and the recovery of patients after illness. This review highlights the latest advances of traditional Chinese medicine, focusing on the active compounds and potential mechanisms, clinical application of herbal composition applied for the treatment of COVID-19.

Keywords: TCM, herbs, SARS-Cov-19

COMPARATIVE ASSESSMENT OF THE QUALITY ALOE VERA AND ALOE JUICE

Beata Borkowska, Paulina Bialkowska

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia, 81-225, Poland
b.borkowska@wznj.umg.edu.pl

The aim of the study was to compare the quality of juice obtained from aloe leaves and aloe juices purchased at retail. An attempt was made to verify the differences in certain physicochemical parameters between individual products.

The research material consisted of two aloe juices from selected producers and a juice prepared from aloe leaves. The aloe vera juices of two producers (A, B) and the aloe vera juice were subjected to laboratory tests in order to determine selected physicochemical indicators and to verify the research hypotheses based on the obtained test results and statistical analysis. The research material was subjected to the following physicochemical analyzes: determination of total acidity by titration method, vitamin C content by Tillmans method, total extract by refractometric method, chloride content by Mohr method, crude fiber by Scharrer-Kurschner method, color parameters by colorimetric method, antioxidant activity and polyphenol content by spectrophotometric method.

In order to check whether the tested factor, which was the process of obtaining aloe vera, had a significant influence on the mean values of the tested physical and chemical discriminants, a single analysis of variance test was carried out.

The conducted research shows that the prepared aloe juice obtained a higher antioxidant activity compared to juices purchased at retail sale.

As a result of the research, it was found that the content of raw fiber in aloe vera juice was ten times higher than in the aloe juice produced by the manufacturer A and B. The individual parameters during the color determination using the colorimetric method showed that the juice obtained from the aloe leaves prepared alone was characterized by the most intense coloration. When determining the antioxidant activity and vitamin C content, significant differences were noticed in the results obtained in the producer's juices (A and B) compared to the juice produced by us.

Keywords: aloe vera, aloe juice, quality

PRODUCT INNOVATIONS ON THE EXAMPLE OF COFFEE

Przemysław Dmowski, Maria Śmiechowska, Wiktoria Eliasz

Department of Commodity Science and Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, 81-225 Gdynia, Poland, p.dmowski@wznk.umg.edu.pl

Innovation is considered to be an important factor in the competitiveness of enterprises. In theory and in business practice, innovations can be divided into product, process, organisational, marketing and ecological innovations. Examples of the product, process and ecological innovations include the products made with the use of by-products from coffee brewing.

Hence, the aim of the article was to present the possibilities of using coffee and coffee processing by-products as a material for the design and production of innovative utility products. The research tool was an electronic questionnaire in the form of a Google document, posted on Polish and English language websites. The subject of the pilot research was a group of the students from Polish universities (80) and a group of 10 students participating in the ERASMUS program.

From the obtained results, we can conclude that the number of innovative products in the countries inhabited by respondents is small, while the development opportunities are average both in Poland and abroad.

Keywords: innovation, coffee, product od safety, quality

HOME-MADE ALCOHOL PRODUCTION IN POLAND

Karolina Doba, Jacek Stefanowicz, Wojciech Zmudziński

Department of Food Quality and Safety, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland
karolina.doba@ue.poznan.pl

The alcoholic beverages market in Poland is constantly developing. Consumers are open to new types of beers and wines. A wide range of products is also provided by home production of alcoholic beverages, which is constantly popular in our country. The main purpose of the research was to analyse the topics of home alcohol consumption and production in Poland. The knowledge of legal regulations regarding home alcohol production was also examined. First of all, checking the understanding of the term "production for own needs". The aim of the survey was also to find out about the place and circumstances of alcohol consumption by consumers, as well as the perception of trade fairs with niche alcohol. The research method was the CAWI (Computer Assisted Web Interview) technique. A total of 600 responders took part in the study. The most common home-made alcohols were wines (66%), tinctures (63%), beer (16%), cider/perry (14%), liqueur (12%) and mead (8%). About 27% of home-made alcohol production was at least once based on the production of distillate. Despite the fact that a large number of people who are knowledgeable about the legal provisions in force in Poland regarding home production of alcohol for personal use, this knowledge is still insufficient. The growing demand for alcohol coming from artisanal producers can lead to great alcohol revolution in the future, such as the beer revolution and may contribute to the development of craft vodka production.

Keywords: alcohol beverages, craft alcohols, home-made alcohols

COMPARISON OF SORPTION PROPERTIES OF WHITE (*SINAPIS ALBA*) AND BLACK (*BRASSICA NIGRA*) MUSTARD SEEDS WITH DIFFERENT DEGREE OF COMMINUTION

Anna Flis

Department of Quality Management, Faculty of Management and Quality Sciences, Gdynia Maritime University, Gdynia 81-225
a.flis@wznj.umg.edu.pl

Spices and spice herbs have been widely used in human nutrition since time immemorial. Among the popular domestic spices, it is worth paying attention to mustard seeds, which are used by consumers to prepare meat or fish dishes and to prepare salads and sauces. From the consumer point of view, an indispensable element in the selection of spices is their high quality, which consists of a number of factors. Among them, hygroscopic properties are extremely important because they determine the safety and storage stability of the product. At the same time, it is an important factor in the process of production planning, transport and distribution.

The aim of this study was to evaluate the sorption properties of white and black mustard of different degree of comminution, perceived as a factor determining its storage stability. In order to achieve the aim of the study, water sorption isotherms were determined for selected mustard types using the static-desiccator method at a temperature of 20°C, within the environmental water activity range from 0.03 to 0.98. The Brunauer, Emmett and Teller model was used to describe the water sorption isotherms.

In the course of the research, it was found that both tested mustard types were characterized by similar hygroscopic properties. Their different degree of comminution did not differentiate the sorption properties of the tested material. Black mustard was characterized by a higher water content in the monolayer than white mustard, and based on the size of the sorption specific surface area, it was found that black mustard seeds were a more hygroscopic product.

Keywords: sorption isotherm, BET model, white mustard, black mustard, sorption specific surface area

POLYPHENOL CONTENT IN COMMERCIAL APPLE JUICE DETERMINED USING HPLC

Anna Gliszczyńska-Świgło, Katarzyna Włodarska

Institute of Quality Science, Department of Technology and Instrumental Analysis, Poznań University of Economics and Business, 61–875 Poznań, Poland, anna.gliszczynska-swiglo@ue.poznan.pl

Apples juices, because of their relatively high consumption, are important dietary sources of a wide variety of polyphenolic compounds with antioxidant, anti–inflammatory, antimicrobial, anticancer, and cardiovascular system-improving capacity. The market for apple juice segment is expected to show a volume growth of 3.4% in 2022 and is expected to amount to 6,076.6 ML by 2025. The average volume per person is expected to amount to 0.7 L in 2021. The main phenolics identified in apples and apple juices are phenolic acids (chlorogenic acid, neochlorogenic acid, *p*-coumaroylquinic acid, caffeic acid, *p*-coumaric acid and its esters), flavan-3-ols (catechin, epicatechin, and procyanidin B2), flavonols (quercetin and its glycosides), and dihydrochalcones (phloridzin and phloretin xyloglucoside), which distinguishes apples and their products from other fruits. In the study, the content of polyphenols in commercially available apple juices of different brands and from three production batches were determined using high performance liquid chromatography (HPLC) using photodiode-array and fluorescence detectors.

It was found that commercial apple juices significantly varied depending on type of juice (clear from concentrate (CFC), cloudy from concentrate (CDFC), not from concentrate (NFC), and unpasteurized fresh (F)), brand or production batch. The profile of polyphenolic compounds identified in tested juices was typical for this kind of product with chlorogenic acid, epicatechin, procyanidin B2, phloridzin, and phloretin xyloglucoside as the main compounds. The total concentration of phenolics was: 70.8-267.9 mgL^{-1} for CFC (n=21), 133.5-216.3 mgL^{-1} for CDFC (n=6), 74.4-689.2 mgL^{-1} for NFC (n=21), and 50.5-418.4 mgL^{-1} for F (n=6). Taking into account appearance of juice, clear or cloudy, the concentration of polyphenols was 109.9–172.7 mgL^{-1} for clear juices, and 152.2–459.0 mgL^{-1} for cloudy juices indicating the latter ones as better source of beneficial health-effect polyphenol compounds than clear juices.

Keywords: apple juice, phenolic compound, HPLC, food quality

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

THE EFFECT OF DIFFERENT CONCENTRATIONS OF ESSENTIAL OILS ON THE *FUSARIUM GRAMINEARUM* GROWTH AND MYCOTOXINS CONTAMINATION IN CEREALS GRAIN

Daniela Gwiazdowska[1], Krzysztof Juś[1], Katarzyna Marchwińska[1], Agnieszka Waśkiewicz[2], Romuald Gwiazdowski[3], Pascaline Aimee Uwineza[2]

[1]Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznań, Al. Niepodległości 10, Poznań, Poland
[2]Department of Chemistry, Poznań University of Life Sciences, Wojska Polskiego 75, Poznań, Poland
[3]Department of Pesticide Investigation, Institute of Plant Protection-National Research Institute, Władysława Węgorka 20, Poznań, Poland
daniela.gwiazdowska@ue.poznan.pl; Krzysztof.jus@ue.poznan.pl

One of the biggest problems in agricultural production are *Fusarium* fungi and their toxic metabolites – mycotoxins. The occurrence of filamentous fungi in crops, including in particular cereals, pose significant economic losses in food production related to the reduction of the quantity and quality of the obtained crops. The presence of toxicogenic filamentous fungi on crops reduces the safety of agricultural products, posing a direct threat to the life and health of humans and farm animals. Among many methods of plant control used in agriculture the greatest interest is focused on biological methods that involve the use of natural factors for pests control. These methods are an important element of integrated pest management and help to achieve the objectives of sustainable development. Essential oils, with their rich chemical composition, possess high biological activity, including fungistatic properties. Therefore these volatile complex substances exhibit great potential as biological plant protection factors. The aim of this study was to evaluate the effect of different concentrations of three essential oils on the growth and mycotoxins biosynthesis of *Fusarium graminearum* in cereal grains. The obtained results confirm that concentration of tested EOs affects on their antagonistic activity against *F. graminearum* and on the level of mycotoxins reduction in wheat and corn grains. It is worth underlining, that the effect of EOs concentration depends mainly on its type, but also on the used matrix and applied research method. There is a need for further research on biological activity of natural substances for decontamination of food and feed products and on process optimization to increase the efficiency of sustainable agricultural production.

Keywords: antifungal activity; biological plant protection; cereals quality; essential oils; food chain safety; *Fusarium* spp.; mycotoxins

The part of this research was funded by NCN, grant number 2018/31/B/NZ9/03485.

DETECION AND PREVENTION OF PHYSICAL CONTAMINATION IN FOOD PRODUCTS

Paweł Haręża, Wojciech Zmudziński

Department of Production Management and Logistics, Faculty of Management and Production Engineering, Lodz University of Technology, 90-924 Lodz
pawel.hareza@p.lodz.pl

In recent years, food safety defined as the physical and economic availability of food, has become a significant issue on the global food market, like ensuring the health safety of food products. The qualitative aspect of food safety realize the assumptions of the health and nutritional value of food, and also compliance with the norms and standards. Following the assumptions included in legal acts, normative acts and the standards, allows control and minimize the risk of food quality deterioration in the entire food chain, starting from sourcing raw materials, through production, processing, storage, ending with trade. It needs to be highlighted that, that the health safety of food products, gives equal attention to the issue of chemical, physical as well as microbiological contamination of food. Despite the enormous technological advances, the risks related to the possible occurrence of physical contamination existing in food are still unavoidable. From 2015 to 2019, the number of physical threats reported to the RASFF system (Rapid Alert System for Food and Feed) ranged from 3,0 % to 5,6 %, which is on average 4,4 % of all notifications in the analysed period. It is important, because any potential threat may affect not only health, but also the lives of consumers.

In this publication, analyzed the data of physical contaminants in food. It was indicated, what kind of physical hazards exist in food and presented changes occurring as physical hazards over the analyzed period. For this purpose, used reports from 2015 to 2019 generated from the RASFF system, which included notifications from all members countries. In terms of identifying and counteracting physical hazards to food products, the final, but extremely important part of this publication is the presentation of devices used to detect and prevent the presence of physical contaminants in the final product offered to consumers.

Keywords: food safety, physical hazards, RASFF, contaminants detection

QUALITY OF PLANT-BASED MEAT ALTERNATIVES

Iwona Jasińska-Kuligowska[1], Maciej Kuligowski[2]

[1]Department of Food Quality and Safety, Institute of Quality Science, Poznań University of Economics and Business, Poznań, Poland,
[2]Department of Food Technology of Plant Origin, Faculty of Food Science and Nutrition, Poznań University of Life Sciences, Poznań, Poland
iwona.jasinska-kuligowska@ue.poznan.pl

The trend to avoid meat consumption for health or ethical reasons is increasing in modern western societies. Both the food industry and scientists are looking into varieties of meat alternatives. The use of food products of animal origin, especially ruminant meat, is one of the causes of progressive environmental degradation. The United Nations report indicates that more beneficial for the planet is the use of protein from sources of plant origin. In the plant kingdom the soybean seeds are one of the richest sources of protein. The water, fossil fuel and phosphate requirement, as well as land use are several times higher for meat protein production than for soybean-based protein. Many research indicates that dietary change is an effective approach to reduce greenhouse gas emissions. Soybean seeds are also sources of isoflavones and other polyphenol components with pro-health activity. Among the other reasons, health concerns, animal welfare and ethical issues are important to many consumers who excluded meat from their diet. Consumption of red meat is positively associated with mortality, in particular due to cardiovascular diseases and cancer. Consumers prefer to eat less meat or completely exclude it from their diets. Therefore, the EAT-Lancet commission has formulated the definition and assumptions of the healthy reference diet that would provide major health benefits, and also increase the likelihood of attainment of the Sustainable Development Goals.

The objective of this study was to determine the quality of selected soy-based meat alternatives available in Poland. Chemical properties including the determination of protein, fat and total polyphenol content were evaluated. In addition, current trends, challenges and perspectives, especially in the context of meat alternatives and plant rich diet in sustainable consumption, were discussed.

Keywords: food quality, meat alternatives, sustainable consumption, soy products

ANTIMICROBIAL ACTIVITY OF COMMERCIAL NARROW-LEAVED LAVENDER (*LAVANDULA ANGUSTIFOLIA*) EXTRACTS AS AN ALTERNATIVE TO DISINFECTANTS IN FOOD INDUSTRY

Krzysztof Juś, Szymon Frąk, Daniela Gwiazdowska, Agata Stolarczyk

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznań, Al. Niepodległości 10, Poland, krzysztof.jus@ue.poznan.pl

Microorganisms are still one of the most frequently identified hazards in food products. This is associated not only with a direct threat to the health and life of consumers, but also generates losses in the entire food industry caused, among others, by withdrawal of products from the market and their disposal or loss of confidence in the brand or product group. To counteract this phenomenon, it is necessary to constantly control microorganisms throughout the food chain, especially at the production stage. An important element in the microbiological safety management of products is the appropriate selection of disinfecting methods for abiotic surfaces in the production environment, which can be generally divided into chemical, physical, biological and mixed methods. According to assumptions of sustainable development, an increasing potential is seen in biological methods, which, thanks to the use of natural substances, are much less harmful to the environment. An increasing number of reports in the literature indicate the possibility of using natural substances of plant origin, such as essential oils and other extracts which, thanks to the rich composition of ingredients with antimicrobial activity, become a promising alternative as sanitizers in the food industry. The aim of the study was to verify and compare the antimicrobial activity of different type of commercial plant extracts obtained from the narrow-leaved lavender (*Lavandula angustifolia*). Two methods were used to determine antimicrobial activity: disc diffusion method and 96-well serial dilution method (in the range of concentration 0.4 – 25%) against six strain of microorganisms including bacteria and fungi. The obtained results indicate that the tested lavender extracts exhibit strong antimicrobial properties depending both on the type of extract and the type of indicator microorganism. The strongest inhibitory effect was observed for lavender CO_2 extract and for lavender oil (France) against following strains: *E. coli* and *S. saprophyticus* (23.0 - 34.1 mm inhibition zone). The MIC values ranged from 0.8 to 6.3% and the MBC/MBF value ranged from 3.1 to 6.3%. The obtained results confirm that commercially available plant substances from lavender are effective agents that inhibit the growth of microorganisms and may also play an important role in microbial infection preventing in, for instance, food or cosmetic industry.

Keywords: essential oils, CO2 extract, antimicrobial activity, food safety, microbial safety management, biological disinfection methods

CONTROLLING THE PROCESS OF MASKING THE BITTER TASTE IN FOOD PRODUCTS BY USING PHARMACOPHORE METHODS

Dariusz Kikut-Ligaj, Katarzyna Ruda

Department of Natural Science and Quality Assurance, Institute of Quality Science
Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland
dariusz.kikut@ue.poznan.pl

The composition of many food products can be modified based on information on the activity of its components. This has a huge impact on the perception of the quality features of food products by a potential consumer. The connection of the structural features of the constituent food products with their organoleptic activity is extremely important in shaping the quality of the final product. Prediction organoleptic features, including bitter taste can be performed using pharmacophore models. It's very important questions, because bitter taste is the basic modulator of the undesirable qualities of the foods. The techniques used in the analysis of taste activity are SPM (Simple Pharmacophore Model) and MPM (Multipoint Pharmacophore Model). This method consists in identifying the areas of the ligand molecule that are responsible for the taste stimulation. The recognized spatial characteristics are converted into taste activity by means of appropriate equations containing the number of active sites and representations that stimulate taste receptors. Studies with the use of pharmacophore models were carried out in the group of popular sweeteners such as sodium and potassium cyclamates, aspartame, acesulfame and sacrulose. The obtained results allowed to select the best sweeteners from this group (sacrulose), which does not cause a bitter aftertaste. This means that sacrulose is the best sweetener for application in food products.

Keywords: bitter taste, bitter aftertaste, pharmacophore model, sodium and potassium cyclamates, aspartame, acesulfame, sacrulose, food safety, food quality, acceptance of bitter taste in food products

QUALITY AND SAFETY OF SELECTED CONFECTIONERY PRODUCTS BASED ON THEIR FATTY ACIDS COMPOSITION

Dorota Klensporf-Pawlik, Pola Rolińska, Wojciech Zmudziński

Department of Food Quality and Safety, Institute of Quality Science, Poznań University of Economics and Business, Poznań 61-875, Poland, dorota.klensporf-pawlik@ue.poznan.pl

A healthy diet should ensure adequate nutrition and energy balance as a part of an overall healthy lifestyle. Therefore, the quality and safety of food products are of great interest of most consumers. Unfortunately, *trans* fatty acids (TFA) and saturated fatty acids, which are strongly correlated with the risk of chronic diseases, especially cardiovascular heart diseases, are still present in our daily diet. As the effect of global works on TFA limitations, on 25 of April 2019 the European Commission has published, regulation which envisages the limits on the amount of *trans* fatty acids, other than *trans* fatty acids naturally occurring in fat of animal origin. The regulation set the maximum limit for industrially produced *trans* fatty acids at 2 grams per 100 grams of fat in food intended for the final consumer. According to Commission Regulation 2019/649 food which does not comply with this, may continue to be placed on the market until 1 April 2021. The hypothesis of this work is that, the use of *trans* fatty acids in food has been sharply decreased, and the current intake of TFA is much lower than in previous years. However, there is a potential risk, that *trans* fatty acids could be replaced in various products with saturated fatty acids (SFA). Therefore, the objective of this study was to determine the TFA and SFA content in several confectionery products, recognized previously as a *trans* fatty acid sources. Products were commonly accessible brands, as well as brands of discount grocery shops. Products were divided into four groups such as shortbreads, wafers, chocolate bars and puff pastry. Wafers were the only group of confectionery products which had much higher concentration of trans fatty acids (11,67-32,57%) than maximum limit regulate by the EU, and the concentration of saturated fatty acids (34,68-45,58%) was lower than in other analysed products. Saturated fatty acids in chocolate bars, puff pastry and shortbreads reached almost half of all determined fatty acids, 49,57-64,98%.

Keywords: quality, safety, trans fatty acids, confectionery products

THE INFLUENCE OF JAPANESE QUINCE JUICE ON SENSORY QUALITY OF CLOUDY APPLE JUICE

Inga Klimczak

Department of Food Quality and Safety, Institute of Quality Science,
Poznań University of Economics and Business, Poznań 61-875, Poland,
inga.klimczak@ue.poznan.pl

Apple juice, after orange and flavour mix juices, is one of the most preferred by consumers. Recently, new plant materials have been searched for due to the competitive fruit juice market and growing consumer demands. Consumers are looking for food that tastes, looks attractive and provides nutritional benefits. Due to the valuable chemical composition (ascorbic acid, pectins, minerals, polyphenolic compounds) and attractive aroma, Japanese quince fruits (*Chaenomeles japonica* Thunb.) Lindl. ex Spach) can be interesting and valuable additions to fruit juices. When assessing the quality of juices, sensory testing has become a useful tool for evaluating these products.

The aim of the study was to evaluate the influence of Japanese quince juice on sensory quality of fresh, cloudy apple juice. Juices were obtained by mixing the appropriate amount of Japanese quince juice (reconstituted by dissolving the lyophilisate of quince in water) and apple juice. The sensory quality of juices was evaluated through descriptive tests with the aid of trained panel. Seven sensory descriptors were chosen by assessors. Beyond unitary characteristics, the overall quality was also assessed, which comprised a sum of all particular sensory quality factors taken into consideration in the assessment. Moreover, in all analyzed juices color parameters of juice (CIE *L*a*b**) were measured and total color difference (ΔE*ab) between the values for sample with quince juice and samples without quince juice was calculated.

Keywords: sensory quality, descriptive sensory analysis, cloudy apple juice, Japanese quince, color.

ADDITIVES USED IN THE FORTIFICATION OF SELECTED CEREAL FOOD PRODUCTS – A SYSTEMATIC LITERATURE REVIEW

Paulina Kozik

Department of Food Product Quality, Institute of Quality and Product Management Sciences, The University of Economics, Cracow, Poland,
kozik.paulina@gmail.com

Food fortification is considered an important part of nutritional strategies, whose most significant objectives are to reduce micronutrient deficiencies, enhance the nutritional quality of food and ensure benefits for public health. This process involves the deliberate addition of one or more nutrients to a food product.

The purpose of this article is to review approaches to food fortification in the scientific literature from recent years. A systematic literature review method was applied to assess the status of research on ingredients used for food fortification. Research papers in which cereal products were used as the carrier were searched for the analysis. Two electronic databases Web of Science and ScienceDirect were searched to identify relevant articles with the keywords: 'food fortification', 'food enrichment', 'fortified products', 'enriched products', 'cereal products' and 'flour'. The search covered two years: 2020 and 2021. For reporting, the scheme and guidelines of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) were used.

Based on the review of the available literature, a list of research articles was obtained on the use of various ingredients and finished products to enrich cereal products. It was found that research continues to be conducted on the enrichment of cereal products with traditional ingredients (vitamins, minerals). However, significantly more research is focused on finding new products and testing whether their use in food fortification will deliver positive results. Currently – fruits, vegetables, fungi, and even insects are mostly used as fortifiers.

The main conclusions drawn from this research were that the fortification of cereal products can be carried out with different additives, can lead to a significant improvement in the physical properties of the carriers, and thus contribute to the reduction of nutritional deficiencies.

Keywords: food fortification, food enrichment, additives, PRISMA, systematic literature review

INFLUENCE OF SELECTED FACTORS ON THE QUANTITY AND QUALITY OF WHEY SEPARATED IN THE PRODUCTION OF TVAROG

Jolanta Król, Aneta Brodziak, Joanna Barłowska, Monika Kędzierska-Matysek

Department of Quality Assessment and Processing of Animal Products
The University of Life Sciences, 20-950 Lublin, Poland
jolanta.krol@up.lublin.pl

The aim of the study was to assess acid whey separated during traditional manufacture of tvarog. Two variants of starter cultures were used in the study: starter variant 1, i.e. freeze-dried DVS starters used to directly inoculate milk with lactic acid bacteria (Flora Danica by Chr. Hansen, Denmark), and starter variant 2, a traditional working starter obtained using freeze-dried inoculants of pure cultures of mesophilic lactic acid bacteria. The tvarog was made from bulk milk obtained from two cow breeds (Polish Holstein-Friesian and Simmental) during two production seasons (spring/summer and autumn/winter). Forty whey samples were analysed. The following were determined in each sample: content of crude protein, fat, lactose, and dry matter (with the Infrared Milk Analyzer, Bentley Instruments), active acidity (pH), content of fat-soluble vitamins, i.e. A, D_3 and E, by reversed-phase high-performance liquid chromatography (RP-HPLC), and the content of calcium and magnesium by flame atomic absorption spectrometry (FAAS). The volume of whey obtained was determined as well. The breed of cow, season, and starter cultures were shown to influence the amount of whey separated as well as its chemical composition. The quantity of whey separated was significantly lower ($p \leq 0.01$), which is technologically more favourable, in the production of tvarog from the milk of Simmental cows and in the spring/summer, when the cows grazed in the pasture. The starter culture also significantly ($p \leq 0.05$) influenced the separation of whey, with less whey obtained when starter variant 2 was used. Whey obtained in the spring and summer, irrespective of the cow breed, had significantly ($p \leq 0.05$) lower protein and fat content, with higher ($p \leq 0.01$) content of vitamins and minerals. The starter cultures did not affect the composition of the whey.

Keywords: whey, tvarog, chemical composition

"Project financed under the program of the Minister of Science and Higher Education under the name "Regional Initiative of Excellence" in 2019 - 2022 project number 029/RID/2018/19"

EFFECT OF STORAGE CONDITIONS ON THE MICROBIOLOGICAL QUALITY OF SPIRULINA FOOD SUPPLEMENTS

Anita Kukułowicz, Victoria Dąbrowska

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University,81-87 Morska St., 81-225 Gdynia, Poland, a.kukulowicz@wznj.umg.edu.pl

The dietary supplement industry is made up out of a variety of products. In the present health food market, the *Arthrospira platensis*, has been widely used as a dietary supplement under the commercial designation "Spirulina". While it is a widely recognized health-promoting natural product (include for e.g., high quantities of proteins, large amounts of essential fatty acids, polysaccharide, vitamins, minerals), there are scarce data on the microbiological quality of commercially available of "Spirulina" supplements.

The aim of the study was to assess the effect of storage place and temperature on microbiological quality of spirulina food supplements. Tests were conducted on spirulina powder, spirulina in tablets and capsules, purchased from pharmacies and ecological stores. Spirulina was stored for 90 days in original pharmaceutical packaging (brown bottles) which can prevent ultraviolet light from damaging the potentially photosensitive contents. The tested products were divided into two groups. The first one consisted of spirulina was stored in a cabinet in room temperature of 21±2°C, while the second one was exposed to sunlight and different temperature. Spirulina was analysed on the day of opening, after 30 and 90 days of storage. Total counts of aerobic mesophilic bacteria (AB) and *Staphylococcus aureus* were measured.

The lowest number of the total counts of aerobic mesophilic bacteria were found in spirulina tablets after opening (1.72 ± 0.34 log CFU/g), and the highest (5.21 ± 0.11 log CFU/g) in suplements stored in a cabinet after 90 days. The lowest (1.35 ± 0.49 log CFU/g) and the highest (2.33 ± 0.04 log CFU/g) number of *Staphylococcus aureus* was found in the spirulina in capsules after opening and after 90 days of storage, respectively. The storage time had a significant effect on the number of the test microorganisms, but the form of the supplement and the place of its storage didn't significantly differentiate the average total number of microorganisms.

Keywords: spirulina, dietary supplement, *Staphylococcus aureus,* contamination, storage

ANTIOXIDANT ACTIVITY OF *CENTELLA ASIATICA* EXTRACTS

Dobrawa Kwaśniewska, Justyna Kiewlicz

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland
dobrawa.kwasniewska@ue.poznan.pl

Centella asiatica plant known and used for its properties for thousands of years, it was first used in Indian Ayurvedic practice. In chemical terms, *Centella asiatica* is a source of over 70 bioactive ingredients, it seems that the most important among them are triterpenes and their derivatives. In addition, *Centella asiatica* is a rich source of flavonoids: quercetin, kaempherol, catechin, rutin, apigenin and naringin. It is also estimated that volatile and fatty oils constitute a significant share of *Centella asiatica* mass. The richness of the active ingredients caused noticed that the healing properties of *Centella asiatica*. It has been found that it affects the ability to learn and memory, lowers blood glucose levels, and has cardioprotective effects. In the past, *Centella* was used in the treatment of leprosy, while modern dermatology is believed to have the potential to stimulate wound healing. In addition, the reduction of transepidermal water loss, improved hydration of the epidermis and antioxidant properties make *Centella asiatica* increasingly used in cosmetic products. All this meant that the authors made an attempt to assess the antioxidant activity of cosmetic components from *Centella asiatica* available on the Polish market. Total phenolic content (TPC) and ferric reducing antioxidant power (FRAP) of three commercially available cosmetic components from *Centella asiatica* for self-production of formulations were evaluated in this study. The obtained results show that the highest TPC value had water-glycerin liquid *Centella asiatica* extract, and it was 416 mg GAE/L. The highest ferric reducing properties exhibited both water-glycerin liquid *Centella asiatica* extract and powdered *Centella asiatica* extract (respectively, 2.3 mmole Fe^{2+}/L and 1.89 mmole Fe^{2+}/L). The lowest antioxidant activity demonstrated infusion of *Centella asiatica*.

Keywords: antioxidant activity, *Centella asiatica*, cosmetics, phenolic compounds

MICROBIOLOGICAL QUALITY CHANGES DURING SPONTANEOUS AND CONTROLLED FERMENTATION OF CURLY KALE POMACE

Katarzyna Marchwińska, Daniela Gwiazdowska, Katarzyna Czerniewicz

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznań, Al. Niepodległości 10, Poland, katarzyna.marchwinska@ue.poznan.pl

The problem with organic waste, especially originated from agriculture and industrial processing, is increasing each year. Depending on waste type and its composition, different methods of utilization or transformation can be used. A significant group of residues is fruit and vegetable waste including, among others, high amounts of pomace generated during processing. Pomace may imply difficulties with their storage, however the high amount of bioactive compounds makes them a valuable material to transform and reuse. Fermentation is a process leading to many changes in the profile of bioactive compounds, therefore may be used as a waste utilization process to obtain new, valuable products. However, different factors, including method of fermentation - spontaneous or controlled with selected microorganisms, may affect the course and result of the process.

The aim of the presented work was a comparison of the microbiological quality changes of curly kale pomace during spontaneous and controlled fermentation taking into account different degrees of substrate hydration. In the first step *Lactiplantibacillus plantarum* L04 was isolated from haylage and selected on the basis of its properties such as rapid growth, high cell concentration and high amounts of lactic acid production. The selected strain was identified by MALDI-TOF mass spectrometry and sequencing of the 16S rRNA gene. Fermentation of curly kale pomace was processed by spontaneous lactic acid fermentation and by starter dependent fermentation with *Lb. plantarum* L04 in two variants of hydration, ratio 1:9 and 1:1 pomace with distilled water. During the process microbiological quality and pH control were determined.

The results showed that hydration degree and fermentation method affect the microbiological quality of pomace. The differences between spontaneous and controlled processes were more pronounced in samples with 50% hydration.

Keywords: circular economy, curly kale pomace, fermentation, waste management

BIOACTIVE POTENTIAL OF FROZEN BROCCOLI OUTGRADES AS A PART OF FOOD SUSTAINABILITY

Joanna Markowska, Magdalena Wróbel-Jędrzejewska, Elżbieta Polak

Prof. Wacław Dąbrowski Institute of Agricultural and Food Biotechnology - State Research Institute, Frozen Food Technology and Refrigeration Department, Pilsudskiego 84, 92-202 Lodz, Poland
joanna.markowska@ibprs.pl

Broccoli (*Brassica oleracea* var. botrytis italica) offers many health beneficial effects due to its high content of bioactive compounds. Poland is the fourth European producer of broccoli (6.5-7.0 thousand ha). The new objective all over the world is increasing the production scale of nutritious and healthy food products based on innovative technologies through the utilisation of fully valuable vegetable outgrades. These outgrades have so far constituted a waste material, generating storage costs and expenditures for its disposal, as well as further source of greenhouse gases emissions.

The quality of frozen broccoli (vegetables) and broccoli outgrades (Larson, Portheon and Titanium cultivars) produced by the company UNIFREEZE Sp. z o. o. Poland in 2019-2020 was evaluated. Investigation results presented in this paper are a part of results obtained in the BIOSTRATEG3/343817/17/NCBR/2018 The development of an innovative carbon footprint calculation method for the basic basket of food products.

The physicochemical analysis was carried out by determination of the following parameters, for example: total solids content, total acidity, pH, colour (CIE L*a*b*), vitamin C, total phenolic compounds (TPC), antioxidant activity (ABTS) and the amount of protein, carbohydrates, fat and fibre. Microbiological parameters were also determined.

Outgrades have turned out to be a good source of fibre (2.5-3.0 g/100g), vitamin C (19.8-57.2 mg/100g) and TPC (24.3-52.9 mg/100g), as vegetables. The colour of vegetables and outgrades samples, was typical for these kind of products. The total number of bacteria in the outgrades were 4.3×10^4-1.8×10^5 CFU/g bacteria and coliforms 7.0×10^1-2.2×10^2 CFU/g. The total number of bacteria in the vegetables were 6.0×10^3- 4.7×10^4 CFU/g bacteria and coliforms <10-7.0×10^1 CFU/g. *Listeria monocytogenes* has not been identified.

It was shown that frozen outgrades were a valuable raw material as well as frozen vegetables and can be used in food research and the development of functional foods. The research data and growing consumer awareness of the health benefits of broccoli and their outgrades provide motivation for their regular consumption as part of a balanced diet.

Keywords: frozen broccoli, outgrades, quality, nutrients

CENTRED BIOLOGICAL PROPERTIES OF FROZEN CUT BEAN (PHASEOLUS VULGARIS L.) OUTGRADES

Joanna Markowska, Magdalena Wróbel-Jędrzejewska, Elżbieta Polak

Prof. Wacław Dąbrowski Institute of Agricultural and Food Biotechnology - State Research Institute, Frozen Food Technology and Refrigeration Department, Pilsudskiego 84, 92-202 Lodz, Poland
joanna.markowska@ibprs.pl

Phaseolus vulgaris, also known as the common bean and French bean, is an herbaceous annual plant grown worldwide for its edible dry seeds or unripe fruit. Common cut bean is commonly consumed legume worldwide for their fleshiness, flavor, and sweetness. From a nutritional point of view, this is good source of vitamins, fibers, and antioxidant compounds. The new objective all over the world is increasing of the production scale of nutritious and healthy food products based on innovative technologies through the utilization of fully valuable vegetable outgrades. These outgrades have so far constituted a waste material, generating storage costs and expenditures for its disposal, as well as further source of greenhouse gases emissions. That's why the quality of frozen cut beans (vegetables) and outgrades (green cut bean Rimember and Oportune cultivars; cut bean Orinoko and Golden Goal cultivars) produced by the company Unifreeze Sp. z o. o. Poland in 2019-2020 was evaluated.

Investigation results presented in this paper are a part of results obtained in NCBR project - the BIOSTRATEG3/343817/17/NCBR/2018 "The development of an innovative carbon footprint calculation method for the basic basket of food products".

The physicochemical analysis of vegetables and outgrades was carried out by determination of the following parameters: total solids content, total acidity, pH, colour (CIE L*a*b*), vitamin C, total phenols, antioxidant activity (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid - ABTS) and the amount of protein (Kjeldahl method), carbohydrates (calculated by the following formula: total solids content-protein-fat-ash-fiber, in 100 g of sample), fat (Soxhlet method) and fiber (AOAC Method 991.43/AACC method 32-07.01).

Outgrades and vegetables have turned out to be a good source of fiber (2.93 - 5.04 g/100 g), vitamin C (4.39 - 15.94 mg/100 g). Total phenols content ranged from 16.74 mg/100 g to 29.88 mg/100 g. ATBS mean values ranged between 122.04 and 224.69 µg/100 g green cut bean and between 175.63 and 254.31 µg/100 g yellow cut bean. The color of vegetables and outgrades samples, was typical for these kind of products.

Our study highlights the potential of using outgrades cut bean cultivars in the development of food and as functional ingredients in diets designed for disease prevention and treatment.

Keywords: frozen cut bean, outgrades, quality, nutrients

THE SIGNIFICANCE OF SAPONINS IN SHAPING THE SENSORY AND HEALTH QUALITY OF FOOD PRODUCTS MADE FROM BEETROOTS

Katarzyna Mikołajczyk-Bator

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznań 61-875, Poland, katarzyna.mikolajczyk-bator@ue.poznan.pl

Food products from a red beet have been gaining a growing interest among consumers because of their health properties. A red beet is a raw material considered to be production specialization of Polish agriculture. Currently in Poland in COBORU (Research Centre for Cultivar Testing) 25 red beet varieties are registered which differ as regards qualitative and quantitative composition of natural substances including betalain pigments, polyphenolic compounds and triterpene saponins.

Quality of grocery products is to a large extent determined by ingredients used for their production. Health properties of red beets stem from the content of biologically active substances, mainly the presence of betalain pigments and polyphenol compounds. Another group of natural compounds found in red beets is constituted by triterpene saponins, the biological activity of which has not been acknowledged and described in the literature. The aim of the study was to determine the influence of bioactive compounds on the sensory and health quality of red beet products. In this study the bioactive activity of saponins isolated from red beets was determined. Moreover, conducted sensory analysis of saponins isolated from different varieties of red beet roots and products obtained from these varieties.

The results indicate that varieties of red beets differ as regards saponin profile and the level of their content which influences various health quality of obtained products. During thermal treatment metabolite profile of saponins changes which influences bioactive properties of ready-to-eat beet food products. Saponins as compounds responsible for bitter taste in red beets have impact on sensory quality of final products. The results of this research presented the application potential of different beetroot varieties as regards their suitability for the production of food products.

Keywords: shaping the quality of food products, products of beetroot, bioactive compounds

APPLICATION OF ARTIFICIAL NEURAL NETWORKS TO THE QUALITY ASSESSMENT OF PORK MEAT DURING REFRIGERATED STORAGE

Małgorzata Muzolf-Panek, Anna Kaczmarek

Department of Food Quality and Safety Management, Faculty of Food Science and Nutrition, Poznan University of Life Sciences, Poznań 60-637, Poland,
malgorzata.muzolf-panek@up.poznan.pl

During the shelf life meat undergoes a number of processes that negatively affect the final quality and safety of the product. Recently, increasing attention has been paid to proteins as the target of oxidation in meat. Temperature and time of storage were shown to be crucial to the final quality of meat. To monitor and manage meat quality changes during shelf life a predictive approach is used.

The aim of this study was to establish predictive models of protein oxidation (expressed as thiol content) of raw ground pork with the addition of 13 spice and herb extracts during 13 days of storage at different temperatures. The models were developed using data mining techniques such as artificial neural networks (ANNs).

In this study, the dataset was divided into learning (70%), testing (15%) and validating (15%) subsets. Multilayer feed-forward connected ANNs using multilayer perceptron (MLP) and radial basis function (RBF) networks have been trained with the Broyden-Fletcher-Goldfarb-Shanno learning algorithm (200 epoch). In total, 20 ANNs were evaluated and the best five were retained. Time and temperature as quantitative predictors, and plant extract type as a qualitative predictor were introduced into the models.

The ANNs built for thiol content changes in raw ground pork with extract showed very high accuracy (above 0.95) in learning, testing and validating steps. Based on the values of adjusted determination coefficient (R^2) and RMSE (root-mean-square error) the best network was MLP 16-10-1 with R^2 = 0.999 and RMSE equalled to 3.0. For all determined models, the external validation was performed. The verification of the models (combined all five best networks) was discussed based on R^2, RMSE and CV (coefficient of variance) values, all calculated from residuals. ANNs showed high accuracy in predicting thiol content changes in raw pork with R^2 = 0.94, RMSE = 5.8, and CV = 4.6%.

Concluding, ANN models showed realistic prediction of data with low relative dispersion of data around the mean in the modelled dataset. To maintain high quality of the products during shelf-life the important issue is to have appropriate tool for monitoring the quality changes. This could be realized by using ANN predictive models.

Keywords: artificial neural network, quality prediction, pork meat

HERBS AND SPICES WITH IMPORTANT ANTI-INFLAMMATORY PROPERTIES

Joanna Newerli-Guz

Department of Quality Management, Faculty of Management and Quality Science
Gdynia Maritime University, Gdynia 81-225, Poland,
j.newerli-guz@wznj.umg.edu.pl

Inflammatory processes, which take place in the human body are a normal and healthy response to injuries or attacks by chemical, biological and physical factors. Inflammation symptoms can be healed and even stopped. Very important in this case is a diet rich in anti-inflammatory products, such as: yellow, red vegetables, citrus, berries and others. Special in this group are herbs and spices, which can be useful in this diet, especially in case of the table salt replacement. Those herbs and spices have been used in ancient and modern medicine. They also fit in a plant-based diet, opting for seasonal, locally produced and organic products with special health benefits, important in Environmentally Sustainable Food Consumption (ESFC).

The main goal of this study was to select and indicate herbs and spices with anti- inflammatory effects with special attention to the country of origin and the possibility of local sourcing.

It was indicated that the spices grown in Poland, such as oregano (*Origanum vulgare*), fenugreek (*Trigonella foenum-graecum* L.), basil (*Ocinum basilicum Ocimum* L.), common thyme (*Thymus vulgaris* L.) and especially rosemary (*Rosmarinus officinalis* L.) have anti-inflammatory properties and their use in the treatment of different illnesses is known. Among Polish vegetables used as spices - onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) are those with anti-inflammatory potential.

The most important foreign spices with anti-inflammatory properties are ginger (*Zingiber officinale* Rosc.), turmeric (*Curcuma* L.), cinnamon (*Cinnamomum verum*), nutmeg (*Myristica fragrans* Houtt.), cloves (*Syzygium aromaticum*), chilli (*Capsicum*) and bay leaf (*Laurus nobilis*).

In Polish folk medicine, herbs such as oak bark (*Quercus* L. *cortex*), feverfew (*Tanacetum parthenium* L.), comfrey (*Symphytum officinale* L.) are those with big anti-inflammatory potential.

Now popular in herbs mixtures available on Polish market are those recommended as anti-inflammatory herbs in Ayurveda: Sallaki (*Boswellia serrata* Roxb. ex Colebr.) and Ashwagandha (*Withania somnifera* L.). Also used is Sophora japonica (*Styphnolobium japonicum* L.), and its dried flower and buds (Huaihua).

Presented herbs and spices are very helpful in the fight against the effects of chronic inflammation, influenced by genetics, a sedentary, stressed lifestyle, and exposure to environmental toxins. They are very close related to ESFC, because of their use, which makes it easier to reject refined, processed and manufactured food.

Keywords: spices, herbs, anti-inflammatory properties

QUALITY ASSESSMENT OF RED FRUIT JUICE USING FT-NIR SPECTROSCOPY

Przemysław Nowak[1], Katarzyna Włodarska[2]

[1] Department of Spectroscopy and Magnetism, Faculty of Chemistry, Adam Mickiewicz University in Poznań, 61-614 Poznań, Poland, nowapr@gmail.com

[2] Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland

The near-infrared (NIR) spectroscopy is used intensively in the food quality evaluation and nowadays is one of the basic tools in the routine food analysis and process control. NIR spectroscopy has been successfully used to evaluate different aspects of the quality of various food products. Juices produced from berry fruit are an important group of beverages with high content of macro- and micronutrients, high amounts of dietary fiber (cellulose, hemicellulose, and pectin), vitamins A, C, and E, vitamins of the B group, and some of the essential micronutrients including phenolic compounds. Therefore the consumption of the red fruit beverages may be an important element of a healthy diet.

The objective of the present study was to explore the feasibility of NIR spectroscopy to determine the soluble solids content of red fruit juice. A total of 80 berry beverages commercially available on the Polish market were evaluated in this study and included juices, nectars and syrups produced from blackcurrant (*Ribes nigrum*), chokeberry (*Aronia melanocarpa*), strawberry (*Fragaria × ananassa*) and raspberry (*Rubus idaeus*). The spectra of juices were measured using a FT-NIR spectrometer and were collected in the range of 12500-3600 cm^{-1} with the resolution of 16 cm^{-1} and with 32 scans co-added to obtain the averaged spectrum. The spectra were measured in triplicate for each sample and the average spectra were used for further analysis. The soluble solids content (SSC) of the juices was determined refractometrically and expressed in percentage units (%). Partial least squares (PLS) regression was used to develop the calibration model between the juices spectra (the X matrix) and the chemical parameter (the Y matrix).

The beverages under study were characterized by various soluble solids content ranging from 6.4% to 68.3%, with significantly higher concentration determined in syrups. The model with the highest predictive ability for determination of SSC using NIR spectra was characterized by R^2_P = 0.99, and RMSEP = 1.1. Results demonstrate good capacity of the NIR spectroscopy to predict basic quality parameter of red fruit juice.

Keywords: soluble solids, red fruit juice, NIR spectroscopy, partial least squares regression

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

TRADITIONAL BULGARIAN SMILYANSKI BOB (SMILYAN BEANS)

Sabka Pashova

Department of Commodity Science, Faculty of Economics,
University of Economics-Varna, Bulgarian,
spashova@ue-varna.bg

The development of food technology is the cause of a wide variety of food in modern times. Traditional Bulgarian Smilyan beans are available to consumers on the national market. They have specific composition and properties for the region in which they are cultivated and produced. The aim of the present study is to present types of traditional Smilyan beans, their properties and nutritional value and to analyse the influence of the external environment on the production of Smilyan beans.

Accordingly, the main objective in the paper is to identify the key elements determining the possibility of implementing sustainable production of Smilian beans in the upper areas of Arda river basin. As part of the research some elements that have the impact on the implementation possibilities of sustainable production were identified and the most important ones were presented. Taking into account the context defined by the PESTLE analysis, potential opportunities and threats associated with their implementation within beans production were also indicated. In general, we can summaried and report a relatively favorable impact of the external macro environment on the business climate in the country and in particular on the studied production. Based on the derived features, we provide a summary list of opportunities and threats, presented by the external macroenvironment. We outline these factors that are most important for the specific production, for the subject of our study, we use a matrix of threats and a matrix of opportunities.

Based on the made analyzes, it can be summarized that: The main risks associated with the sustainable production of Smilyan beans are lack of sufficient labor and opportunities to improve the technology of cultivation and production, as the area is mountainous and the places where the plants are grown are fragmented and decomposed along the Arda River.; Through the development and improvement of the production of the traditional for the country product - Smilyan beans, will increase the number of employees in the region and the quantities and the quality of produced beans.; Through the Smilyan Bean Festival the traditional product will be advertised outside the borders of Bulgaria, and this will favor the development of rural tourism in the region.

Keywords: traditional Bulgarian Smilyan beans, production, types of beans, properties, nutritional value

ANTIOXIDANT PROPERTIES OF STRAWBERRY JUICES

Katarzyna Pawlak-Lemańska, Martyna Kisała, Anna Gliszczyńska-Świgło

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, Poznań, 61-875, Poland,
katarzyna.pawlak-lemanska@ue.poznan.pl

Strawberries are characterized by attractive sensory attributes and high content of nutrient and non-nutrient components. They are readily consumed fresh, but due to the very short shelf-life and seasonality, a large part of the fruit is used as material for the processed products like jams, syrups and direct juices. Direct juice (*non-from-concentrate*,) is a natural juice, not subjected to pasteurization process, therefore, it can be considered as a minimally processed product, retaining most of the health-promoting properties of raw material. However, it is a product with a short shelf life, due to chemical changes of ingredients occurring because the activity of enzymes that are not inactivated as in the pasteurization process.

The aim of the study was to compare the antioxidant parameters of strawberry's juices directly squeezed in lab conditions from selected varieties of strawberry collected in two year's season from different arable fields in Poland. The TEAC (Trolox Equivalent Antioxidant Capacity), FRAP (Ferric Reducing Antioxidant Power), total polyphenol (TPC) and total flavonoid contents (TFC), served as antioxidant indicators.

Large differences in the antioxidant activity occur between the squeezed juices depending on the strawberry variety and year of harvest. The total concentration of phenolics and flavonoids varied from 666-1299 mgL^{-1} and 170-500 mgL^{-1}, respectively. The varieties richest in polyphenols were Honeyone, Florentina and Romina. The antioxidant activity expressed as the TEAC value varied from 6.9 to 16.0 mM and the FRAP reducing power was in the range of 6.1–17.9 mM.

Taking into account the variety of strawberry's material, the less popular varieties (Honeone, Florentina and Romina) appears to be a better source of beneficial health-effect polyphenol compounds than varieties most popular on the Polish market (Rumba and Azja) irrespective of the year of harvest.

Keywords: antioxidant activity, strawberries, juices, quality control, polyphenolic compounds.

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

THE INFLUENCE OF EFFECTIVE MICROORGANISMS ON THE CONTENT OF SELECTED NUTRIENTS IN VEGETABLES

Agnieszka Anna Pilarska

Department of Plant-Derived Food Technology, Faculty of Food Science and Nutrition, Poznań University of Life Sciences, Wojska Polskiego 28, 60-637 Poznań, Poland, pilarska@up.poznan.pl

Nowadays, it is possible to observe a growing trend towards ecological solutions in agriculture and a desire to increase the quality of raw materials. There is a close relationship between the nutrient content of vegetables and soil composition. The use of special microbiological preparations in the form of effective microorganisms (EM) can significantly improve soil properties. The application of EM is a way to enrich and regenerate soil. EM preparations contain a mixture of different, coexisting and safe microorganisms. The main families include lactic acid bacteria, photosynthetic bacteria and yeast. The high activity of lactic bacteria fosters the sterility of soil conditions. Photosynthetic bacteria produce organic compounds. Yeast generates active substances stimulating the activity of lactic acid bacteria and *Actinobacteria*, which produce antibiotics.

The aforementioned indications inspired the performance of an experiment, which involved the planting and allotment cultivation of selected types of vegetables using particular fertilisers. Vegetable samples (control, fertilised with mineral and EM preparations) were analysed with regard to their chemical composition, including vitamin A and C, micro- and macronutrients, as well as dietary fibre content. The biochemical and microbiological properties of soil samples from each of the three crops were examined as well. Furthermore, certified organic farm owners took part in an interview, which focused on topics related to soil conservation methods and crop quality.

As a result of the study, the beneficial effect of the application of effective microorganisms on soil parameters was observed. The use of EM preparation contributed to the occurrence of higher levels of enzymes, indicating the humification of soil organic matter. Moreover, an increased bacterial mass was obtained in the presented sample, which competitively fostered a decrease in the content of fungi. The results of the chemical composition analysis performed on vegetables indicated an increase in vitamin C and vitamin A content in vegetables cultivated on EM-enriched soil. An increasing trend in fibre content was also observed in the samples of presented vegetables. In turn, there was no increase in micro- and macronutrient content, which remained at comparable levels.

Keywords: effective microorganisms, fertilisation, chemical composition of vegetables, soil properties, ecology

ASSESSMENT OF THE QUALITY OF NON-CONVENTIONAL FLOUR BASED ON THE CHARACTERISTICS OF SELECTED PHYSICOCHEMICAL PARAMETERS

Millena Ruszkowska, Patrycja Długosz

Department of Commodity Science and Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, 81-225 Gdynia, Poland,
m.ruszkowska@wznj.umg.edu.pl

The request for gluten-free products makes it necessary to partially or completely eliminate the recipe composition of wheat flour and contribute to the search by producers of new raw materials, e.g. flour unconventional.

The aim of the study was to characterize the physicochemical parameters of selected non-conventional flours. The work also attempts to sensory evaluation of products made in 100% from the tested unconventional flours. The research material was hemp flour (I), tapioca (II), coconut flour (III) and flour obtained from domestic crickets (IV). The research methodology included the assessment of water content and activity, density assessment, determination of Hausner's coefficient and Carr's index, determination of the angle of discharge and embankment. The sensory evaluation included the characteristics of the manufactured products based on the following predictors: appearance, tenderness, smell, color taste and the degree of product acceptance. In order to statistically analyze the physicochemical parameters, the Fisher-Snedecor F test combined with the post-hoc analysis, in which the least significant difference (NIR) test was used. The statistical analysis of the sensory evaluation test was used Kruskal-Wallis test. On the basis of the conducted research, it was found that the tested flours differed statistically significantly in terms of water content and activity, and tapped density. In contrast, hemp flour (I) and domestic cricket flour (IV) were characterized by statistically significantly higher values of the Hausner's coefficient and Carr's index compared to other unconventional flours. On the basis of sensory evaluation, it was found that the appearance and color of products made from hemp flour (I) was rated highest. Products made of coconut flour (III) had the best smell, taste and a high degree of acceptance.

Keywords: unconventional flours, water content, water activity, flowability, sensory evaluation

SELECTED PROBLEMS OF ROAD TRANSPORT OF FRESH PRODUCTS

Magdalena Satora

Department of Packaging of Goods, College of Management Sciences and Quality
Cracow University of Economics, Rakowicka 27 St., 31-510 Cracow, Poland
magdalena.satora@uek.krakow.pl

The aim of the article is to present and analyze selected problems occurring in the road transport of fresh products industry on the example of a company dealing with international deliveries of fruit and vegetables.

Transport of fresh products must be carried out in accordance with applicable formal and legal acts, since the health and even life of consumers depends on the proper condition of the products. The most important documents regulating issues related to the transport of these goods include Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP). This document contains numerous standards and requirements that must be respected during the transport of perishable food products from the moment of loading to unloading in a designated place in order to ensure the high quality of goods, their healthiness and properties. One of the requirements is connected with the temperatures at which individual products should be carried. However, meeting certain requirements is not the only problem faced by companies operating in this industry. The seasonality of product supply is also an important issue. Seasonality is the occurrence of annual recurring regular fluctuations in the intensity of economic activity as a result of changes in the conditions of production and consumption caused by successive seasons.

In the article the legal requirements for the transport of fresh fruit and vegetables were presented and the analysis of selected problems occurring in this industry based on data on deliveries in two analogous periods from years 18-19 was performed. These data related to, i.a., the number of deliveries of individual fruit and vegetables and their countries of origin. Then factors affecting the occurrence of the problems were identified and measures were proposed to increase the effectiveness of the enterprise being the subject of the analysis.

Keywords: road transport, fresh products, seasonality, food safety

EVALUATION OF THE MICROBIOLOGICAL QUALITY OF INNOVATIVE FERMENTED MILK BEVERAGES ON THE TRI-CITY MARKET

Jadwiga Stankiewicz

Department of Commodity Science and Quality Management,
Faculty of Management and Quality Science,
Gdynia Maritime University, Gdynia 81-225, Poland,
j. stankiewicz@wznj.umg.edu.pl

Promotion of the positive effect on health is one of the reasons why consumers are interested in new assortments of fermented milk beverages. Also, higher nutritional awareness of buyers, the syntax of producers to search for product innovations in this sector of the dairy industry.

The aim of the research was to assess the microbiological quality of innovative fermented milk drinks available on the Tri-City market.

A total of 30 samples of these products, with different compositions, from 7 producers were tested. In the material tested, the total number of aerobic mesophilic bacteria, the number of lactic acid bacteria, the number of coagulase-positive staphylococci and the presence of *Salmonella* were determined. The analyzes were carried out using the traditional plate method with flooding inoculation, according to the applicable methodological standards, on the day of purchasing the products. The research material was transported to the laboratory while maintaining the cold chain. The main distinguishing feature of the microbiological quality of fermented milk beverages is the presence of a live and active number of characteristic microflora. Over 30% of the tested samples did not meet the criteria for the presence of the number of these microorganisms at the appropriate level (10^7 cfu / g). No *Salmonella* was found in any of the tested samples, while the presence of coagulase-positive staphylococci was noted in 10% of the tested material.

Keywords: microbiological quality, fermented milk beverages, innovative fermented milk drinks

ANTIOXIDANT ACTIVITY OF HOME-MADE ISOTONIC DRINKS PREPARED FROM FRUIT JUICES

Ewa Stasiuk

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia 81-225, Poland,
e.stasiuk@wznj.umg.edu.pl

Isotonic drinks belong to the group of functional drinks, which is an important category in domestic market. Ready-made isotonic drinks are sold in neighbourhood shops, hypermarkets, retail chain or petrol stations. The price of these beverages is affordable to most consumers.

The use of isotonic drinks is primarily to provide electrolytes and water for the body. The most frequent consumers of these drinks are sportsmen, as well as people taking care of their health and figure. Also, there have been websites that provide recipes for making yourself an isotonic drink at home. To prepare isotonic drink at home, fruit juices, compotes, tea infusions or honey are very often used.

In this work, isotonic drinks based on citrus fruit juices with NaCl and KCl were prepared and their antioxidant activity was determined. Freshly squeezed juices of lime, lemon, grapefruit, orange and tangerine were used in the study. Recipes have been made for isotonic drinks taking into account the amount of carbohydrates in the fruit juices. Two variants of beverages were made: the first with NaCl addition, the second with NaCl and KCl addition. Their osmolality ranged from 271 to 302 mOsm/kg. These beverages conformed to the isotonicity requirements (300 mOsm/kg±10%).

The antioxidant activity of isotonic drinks was defined by the DPPH method as the scavenging ability against free radicals (expressed as a percentage). Measurements were taken on the day the drinks were made, the day after, and two day after the drinks were made. Beverages prepared from tangerine juice had the lowest average scavenging activity against radicals (59,2% and 62,2%). The highest antioxidant activity had beverages prepared from orange juice (95,5% and 96,3%). The other beverages also showed high antioxidant activity (82,3% - 94,6%).

Studies have confirmed that home-made isotonic drinks based on citrus juices have strong antioxidant effects. It was also found that the high free radical scavenging capacity of the home-made isotonic drinks persisted for two days.

Keywords: DPPH, isotonic drinks, antioxidant activity

QUALITY DESIGN OF DRY TASTE YOUGHURT WITH THE ADDITION OF NATURAL BIOACTIVE INGREDIENTS

Hanna Śmigielska, Patrycja Trzęsowska

Department of Natural Science and Quality Assurance, Institute of Quality science, Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, h.smigielska@ue.poznan.pl

Functional food is of great interest to the consumer, because its use have an positive effect on health and is an excellent source of bioactive ingredients. Fermented milk drinks are considered healthy food because they have a particularly positive effect on the microbiota of the digestive system and support the immune system. The combination of bioactive ingredients with a fermented product gives the consumer a double health benefit. One of the bioactive ingredients proposed for production of innovative fermented products is spiruline - sea algae and Polish herb - wild garlic. Both of these ingredients show health-promoting properties, contain high content of essential amino acids, vitamins and minerals, and have antioxidant and anti-inflammatory properties.

The aim of the work was to design yoghurts with the addition of spiruline and wild garlic, as well as to produce and carry out their quality assessment. For the purpose of the study, a pilot evaluation was carried out on consumer acceptance of fermented milk products characterized by dry taste. The study included yoghurts with addition of algae and other flavour enhancing ingredients as well as yoghurts with addition of wild garlic only. The organoleptic tests, pH, syneresis measurements, and the content of lactic acid bacteria were carried out. Moreover, nutritional value of the yoghurts was calculated based on their composition.

Consumer pilot studies showed that only 13% of the respondents have ever eaten dry taste yoghurt, while about 63% are interested in buying this type of yoghurt. In organoleptic tests, a team of 30 people gave the highest marks to yoghurts with 2% addition of algae or 1% of wild garlic. The addition of lemon flavour and sugar or xylitol improved the sensory evaluation of yoghurts with algae. Both types of investigated yoghurts showed adequate acidity and the content of yoghurt bacteria cultures. Due to the addition of bioactive ingredients, the yoghurts had a liquid consistency and may require the use of thickeners for full consumer acceptance or to be offered as drinking yoghurts.

Keywords: functional food, fermented milk drinks, yoghurt, spiruline, wild garlic

FAST SORTING OF APPLE JUICE ACCORDING TO THE TOTAL ANTIOXIDANT CAPACITY USING SYNCHRONOUS FLUORESCENCE SPECTROSCOPY AND CHEMOMETRICS

Katarzyna Włodarska[1], Przemysław Nowak[2], Ewa Sikorska[1]

[1]Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland, katarzyna.wlodarska@ue.poznan.pl
[2]Department of Spectroscopy and Magnetism, Faculty of Chemistry, Adam Mickiewicz University in Poznań, 61-614 Poznań, Poland,

Apple juice is an important source of phenolic compounds that mainly determine its antioxidant activity. The antioxidant properties are related to the health beneficial effects, therefore the control of total antioxidant capacity (TAC) of apple juices may be of primary interest for manufacturers as well as consumers. The TAC of food products is determined using several assays, all these methods rely on conventional wet chemistry approach and are greatly tedious and time-consuming. The aim of the study was to applicate front-face synchronous fluorescence coupled with chemometrics for discrimination between the apple juices with low and high total antioxidant capacity.

Apple juices under study included commercially available juices reconstituted from concentrate (clear and cloudy) and direct (preserved by pasteurization). The juices originated from 16 different producers, and the samples from three different production batches were analysed. The TAC of juices was determined using Trolox equivalent antioxidant capacity (TEAC) assay. The synchronous fluorescence spectra (SFS) of juices were recorded for emission-excitation wavelength offsets ($\Delta\lambda$) from 10 to 160 nm, with 10 nm step. Partial least square discriminant analysis (PLS-DA) was used for development of multivariate models for sorting the juices into the respective categories.

The performance of PLS-DA models showed dependence on both $\Delta\lambda$ selected for synchronous fluorescence measurements and pre-processing applied to the spectra. The lowest misclassification errors rates of 0.0625 for cross-validation and external validation were obtained for the model based on unit vector normalized SFS measured at $\Delta\lambda$=120 nm.

The multivariate discriminant models based on the fast direct fluorescence measurements enabled sorting commercial apple juices according to their antioxidant properties. Such approach may be useful for quality control in food industry for rapid analysis of high number of samples. It reduces the consumption of reagents and laboratory waste and supports sustainable development.

Keywords: apple juice, antioxidant capacity, synchronous fluorescence, partial least squares discriminant analysis, variable selection

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

DESIGN, QUALITY AND SAFETY OF NON-FOOD PRODUCTS

BIO-BASED PACKAGING MATERIALS FROM AGRO-FOOD WASTE VALORISATION

Giulio Mario Cappelletti[1], Karolina Wiszumirska[2], Giuseppe Martino Nicoletti[1], Carlo Russo[1]

[1] Dipartimento di Economia, Management e Territorio, Università di Foggia, Via Caggese, 1, 71121 Foggia, Italy
[2] Department of Industrial Products and Packaging Quality, Institute of Quality Science Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, karolina.wiszumirska@ue.poznan.pl

The use of bio-polymers as packaging materials is growing worldwide. Many technical experimentations were carried out in order to validate the characteristics and properties of agro-food wastes with interesting implications in terms of active functions. Indeed, a lot of waste and by-products, coming from the processing of agricultural products, presents important elements (such as antioxidants) which could play a key role for the economic and environmental valorisation of the overall agro-food chain in a circular perspective. It is worth nothing that the sustainable aspects of the use of the agro-food by-products and wastes should be considered by taking into account not only the direct effects (waste reduction or not disposal, reduction of fossil resources) but also the indirect ones linked to the capability of the active bio-based material to prolong the shelf-life of product and reduce food waste. It is also true that the exploitation of these material is strictly linked to the availability in time and space as well as transports, impacts of processes, hidden costs along the chain and impact on local communities. For these reasons this paper aims to investigate the potential valorisation of the main agro-food by-products as bio-based packaging materials by comparing the Italian and Polish situation. In order to make the two scenarios comparable the analysis focuses on the same agro-food chain for both the Countries: cereals and vegetables. The purpose of this research is to evaluate the possible substitution of the traditional LDPE o PP packaging films with one produced by using 100% bio-polymers obtained from agro-food waste or by-product valorisation. The use of the bio-polymers as additive was also investigated. The results of this study represent the first step for future development and implementation of circular economy solutions for leading agro-food sector towards an ecological transition.

Keywords: Bio-polimers. Biobased Materials, Packaging materials, Life Cycle Assessment (LCA).

IS RECYCLING OF STRETCH FILM POSSIBLE AND ENVIRONMENTALLY BENEFICIAL? DATA PREPARATION FOR PRODUCT LIFE CYCLE ANALYSIS – A CASE STUDY

Giulio Mario Cappelletti[1], Karolina Wiszumirska[2], Patrycja Wojciechowska[2], Agnieszka Pawlicka[3], Hubert Klamecki[3], Giuseppe Nicoletti[1], Carlo Russo[1]

[1] Dipartimento di Economia, Management e Territorio, Università di Foggia, Via Caggese, 1, 71121 Foggia, Italy
[2] Department of Industrial Products and Packaging Quality, Institute of Quality Science Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, karolina.wiszumirska@ue.poznan.pl
[3] FOLGOS Sp. z o.o., Grabonóg 67C, 63-820 Piaski, Poland

In the agricultural industry, polymer materials are widely used, most often in the form of films, hoses, nets, plates and others. Among many of plastics linear low-density polyethylene (LLDPE) is used as stretch films for the production of silage. Unfortunately, inadequate management of the agricultural foil by the farmers, such as incineration, burying into the ground or landfilling has led to the concerning environmental issue. Although, the local system of collection, segregation and processing is still in infancy, there are attempts to develop a closed loop system.

The subject of the study is to analyze the technical possibilities, legitimacy and environmental benefits of mechanical recycling of stretch film used for the production of silage. The raw material is LLDPE in white or light green colour, offered without printing, however containing additives for the protection against undesirable effects of UV solar radiation. Some other optional additives, e.g. silage enhancers are also applied. It must be underlined that post-consumer waste (PCW) stretch film for silage bales is characterized by a significant degree of contamination with both organic and inorganic residues, which has been so far the main obstacle to its recycling.

The aim of this work was to analyze the data obtained from FOLGOS - recycling company and silage film producer, specializing in the processing of stretch film (PCW) in a closed loop system, in order to prepare an input data sheet, system boundaries and scenarios of production and processing. The profitability and legitimacy of the recycler's actions in terms of their impact on the environment using the Life Cycle Assessment tools was determined.

The analysis allowed to identify critical areas influencing the environmental burden such as transport, process or energy efficiency, as well as the benefits of using secondary raw materials with a known source of origin compared to the production using virgin materials.

The results of the study allow in the future to collect high-quality, representative process data in order to conduct Product Environmental Footprint and Carbon Footprint analysis.

Keywords: LCA, recycling, stretch, film, LLDPE, agriculture

THE PERCEPTION OF ACTIVE AND INTELLIGENT PACKAGING BY THE CUSTOMERS, INDUSTRY AND SCIENCE

Ryszard Cierpiszewski

Department of Industrial Product and Packaging Quality, Institute of Quality Science, Poznań University of Economics and Business, Poznań, 64-600, Poland,
r.cierpiszewski@ue.poznan.pl

In recent years, a rapid development of the packaging industry has been observed, and one of the directions of development is active and intelligent packaging. It is believed that the demand for such solutions is related to, inter alia, with new consumer preferences, social changes and attempts to reduce food losses.

The definitions used in the literature regarding active and intelligent packaging, as well as legal acts enabling their introduction to the market has been discussed. On this basis, active and intelligent packaging has been characterized. The publication and patenting activity related to these solutions were also analysed.

Growing interest in active and intelligent packaging manifested by the increasing number of scientific publications devoted to this subject. A search conducted in the Elsevier database in the period from 1980 to 2020 indicates that the interest in active packaging is much greater compared to smart packaging.

The results of research on the knowledge of active and intelligent packaging among consumers and their tendency to purchase food products in such packaging are also presented. Acceptance studies of active and intelligent packaging carried out in many countries indicate that consumers' knowledge on this subject is low. However, after learning about this technology, they believe that its use can bring benefits.

Another significant factor is the interest of companies in active and intelligent packaging. The results of a survey of senior executives show that intelligent packaging will be the subject of a significant investment. Their application is predicted primarily in three areas: inventory management, protection of product integrity and its perception by the consumers.

Based on the analysis of the scientific literature, it was found that active and intelligent packaging show significant potential for further development, but its future is difficult to predict.

Keywords: active and intelligent packaging, patents

INCREASE THE EFFICIENCY AND LIFE OF PORTABLE ELECTRICAL STORAGE DEVICES

Jacek Czerniak, Anna Gacek

Department of Metrology and Instrumental Analysis, College of Management and Quality Sciences, Cracow University of Economics, Cracow 31510, Poland
czerniaj@uek.krakow.pl

The concept of sustainable use of energy banks seems understandable, but the precise definition and interpretation of what sustainable use is requires both a technical and a practical explanation. The appropriate and sustainable use of portable energy storage, commonly known as power banks, is a compromise between the amount of energy accumulated during the charging cycle and the life of this type of product. The capacity declared on the power bank packaging differs significantly from the actual (usable) capacity. These data are provided by some manufacturers in the attached technical specifications, but not by all. The differences mainly result from the discrepancy of the voltages of the component cells of the entire device compared to the voltages compliant with the standard of the USB port which is the charging socket for devices connected to the power bank. At the same time, they determine the quality of a given device from the consumer's perspective. Manufacturers of most power banks provide them with LED indicators that inform about the power bank's charge status expressed by the number of LEDs.

According to the literature data and the results of our research, a battery can be considered fully charged if the current stabilizes at a certain level and its and cannot go down further. The research was based on this understanding of capacity, and the capacity of the power bank was defined in two charging scenarios. One of them was the observation of optical indicators placed on the device and the end of the charging process when the last marker was activated. In the second case, a device monitoring the power consumption was connected to the power bank and its indications determined the moment of ending the charging process. The results of power bank capacity tests in both charging scenarios showed differences. Accordingly, the method of charging determines the service life of the battery and its maximum capacity. The option of maximum use of the device's capacity, which allows the maximum use of the stored energy, also shortens the life of the power bank.

Keywords: power bank, sustainable use, quality

QUERCETIN AND SYRINGIC ACID AS ACTIVE INGREDIENTS IN WHEY PROTEIN ISOLATE FILMS FOR FOOD PACKAGING

Sabina Galus[1], Laure-Marie Sansguilhem[2]

[1]Department of Food Engineering and Process Management, Institute of Food Science Warsaw University of Life Sciences, Warsaw 02-776, Poland
[2]Université de Bourgogne Franche-Comté, AgroSup Dijon, F-21000 Dijon, France
sabina_galus@sggw.edu.pl

Active compounds introduced in edible films or coatings and their impact on structure and physicochemical properties are of great interest due to the potential in applications as intelligent food packaging. Quercetin and syringic acid were used as active ingredients in whey protein isolate films obtained by casting method. Aqueous film-forming solutions were prepared from whey protein isolate powder and glycerol as plasticizer, then quercetin and syringic acid were added. The effects of two active compounds on morphological behaviour, thermal stability, wettability, optical, mechanical, barrier and antioxidant properties of whey protein isolate films were investigated.

The results showed transparent and smooth control films, bright yellow films containing quercetin and heterogeneous, shiny films containing syringic acid. Film with active ingredients showed slightly lower thermal stability, which was better observed at the second stage of thermogravimetric analysis when degradation occurred at lower temperatures. It was observed that the presence of quercetin and syringic acid resulted in lower water wettability observed by decreased contact angle values and lower amounts of absorbed water vapour in the sorption kinetics. All films were characterized by relatively low mechanical resistance and high lightness, however, the total colour difference was significantly high for films with quercetin. Incorporation of active ingredients resulted in slightly higher water vapour transmission rate and significantly increased oxygen permeability values. Both, quercetin and syringic acid showed high antioxidant capacity, which gives the possibility of using them as active films or coatings for food packaging.

Keywords: edible films, active packaging, whey protein, quercetin, syringic acid

OCCURRENCE OF ACNE IN ADULTS AND ITS INFLUENCE ON THE QUALITY OF LIFE

Natalia Grzyb[1], Emilia Klimaszewska[1], Leszek Markuszewski[2]

[1]Department of Cosmetology, Faculty of Medical Sciences and Health Sciences
[2] Department of Medicine, Faculty of Medical Sciences and Health Science
University of Technology and Humanities in Radom, 26-600 Radom, Chrobrego 27, Poland
e.klimaszewska@uthrad.pl

The purpose of this study was to analyze the prevalence of acne lesions in adults based on a survey. The study was conducted among 130 randomly selected women aged 18-35 years who have or are suffering from acne. A questionnaire was used for the study, which consisted of 31 questions regarding demographic data, type of acne lesions, course and duration of the disease, treatment and care methods.

More than half of the respondents (58%) noticed the first changes during adolescence. The duration of persistence depended on many factors, i.e. the type of lesions, their location, lifestyle, diet, etc. In most cases of "late" acne, lesions appear after the age of 25 and a typical feature of this disease is resistance to treatment. The lesions are most often located on the face (100%), back (60%) and on the cleavage (50%), and may have varying degrees of severity. About 60% of the respondents described their clinical condition as moderate, about 25% as mildly affected, and about 19% described their condition as severe.

Exacerbating factors may include the use of certain foods in the daily diet, such as chocolate, carbohydrates, milk, spicy and hot foods, and fast food and alcohol. No person indicated fruits, vegetables, and healthy foods as exacerbating factors for acne. Other factors that cause or exacerbate acne include stress, frequent exercise, and hormonal disorders. More than half of those surveyed said that acne negatively affects their lives. Acne symptoms cause psychological problems, may hinder contacts with other people, cause depression and bad mood. Therefore, it is very important to alleviate existing symptoms, prevent the appearance of new lesions and prevent the formation of scars and scarring. A large number of respondents (80%) chose to seek specialist help. Treatment methods include topical treatment, general treatment, and supportive treatment, i.e. the use of cosmetic preparations designed for acne skin, as well as a number of different cosmetic procedures. The choice of treatment method depends on: the form of acne, the severity of the changes, the tendency to scarring, the place of occurrence, the type of skin, other diseases, lifestyle, age and sex of the patient.

Keywords: acne in adults, treatment methods, cosmetics, quality of live

COMPETING BY DESIGN

Ľubica Knošková, Renáta Ševčíková

Department of Marketing, Faculty of Commerce,
The University of Economics, 852 35 Bratislava, Slovakia,
lubica.knoskova@euba.sk, renata.sevcikova@euba.sk

Design is increasingly taking on a new role, becoming a competitive advantage and a differentiating factor. As part of the innovation process, it has the potential to significantly contribute to improving the brand image, increasing sales and the company's profitability. An increasing number of companies are integrating product design into the process of developing their products in order to gain a competitive advantage in the market. It is important to increase the level of public awareness of design and its added value for products and services. Design awards are one of the design promotion activities that give companies a reputation and publicity. The National Design Award is a prestigious award organized by the Slovak Design Center since 1993. The awarding of the National Design Award is the highest form of award in this area of creative activity in the Slovak Republic. The aim of the paper is to examine the impact of the awards in the category of product design on the reputation of the company, improving the image of its brand, increasing sales and profitability of the company. It is also beneficial to find out the impact of the award on the work of the awarded designer and its further application. Through a qualitative survey, we found that the cooperation between the producer and the professional designer is mutually beneficial. Producers of award-winning products improve the company's reputation, increase sales of award-winning products and gain a better competitive position. Award-winning designers find it easier to obtain offers for further cooperation and are better suited to the international design environment.

Keywords: product design, The National Design Award, competitive advantage

ASSESSMENT OF READABILITY OF LABELING NATURAL COSMETIC PRODUCTS

Natalia Kozik

Department of Packaging Science, Institute of Quality and Product Management Sciences, The Cracow University of Economics, 31-510 Kraków, Poland
natalia.kozik@uek.krakow.pl

Cosmetic products are among the basic necessities. Therefore, the cosmetics industry is one of the largest and fastest growing. Currently, one of the leading and shaping trends in the industry are natural cosmetics, which are distinguished not only by their composition and properties, but also by the appearance of their packaging. Manufacturers use packaging to effectively convince the buyer to believe that these products are unique. By means of graphic design, i.e. colours, symbols, inscriptions, shapes and other optional signs, they create the quality of cosmetics in the eyes of consumers. These procedures affect the legibility of the message conveyed, and according to Regulation (EC) No 1223/2009 a cosmetic product placed on the market should have indelible, easy to read and visible marking.

The purpose of this study was to investigate the readability of packaging labelling of natural cosmetic products. An assessment was carried out of 10 packaging of shower gels available in domesics market – 5 produced in Poland and 5 imported. The research was conducted using the TVScore (Typography Variable Score) method, which evaluates 15 typographic parameters of the text placed on the packaging: style of print, print size, leading, use of boldface or italic print, case, line length, justification, organization, contrast, reverse print, shiny/light reflecting, reproduction, read through, hyphenation and abbreviation. The obligatory information on each packaging were assessed. It was found that every packaging obtained total scores above 8 points TVScore, which allows according to method guidelines to conclude that they are characterized by low readability. This article recommends that all tested packages should be redesigned due to low informativeness and making it difficult for consumers to perceive the information placed on them.

Keywords: labelling, natural cosmetics, packaging, legibility, TVScore.

CLAIMS ON THE PACKAGING OF NATURAL COSMETIC PRODUCTS

Natalia Kozik

Department of Packaging Science, Institute of Quality and Product Management Sciences, The Cracow University of Economics, 31-510 Kraków, Poland,
natalia.kozik@uek.krakow.pl

Packaging is one of the most important tools of marketing communication between the consumer and the producer. By placing various signs and information on labels, manufacturers try to evoke positive associations with a given product. For this purpose, they often use product claims, which are the basic way to differentiate products, including natural cosmetic products.

According to Commission Regulation (EU) No 655/2013 laying down common criteria for the justification of claims used in relation to cosmetic products, product claims are signs presented in both textual and iconic form that serve to inform the consumer about the properties and characteristics of products. However, despite the requirements and guidelines developed for all cosmetic products, the lack of a precise definition of a natural cosmetic and the detailed regulations in the legislation, or the lack of knowledge or non-compliance with the criteria for substantiation of claims foster unfair practices on the part of manufacturers.

This article reviews the legal acts regulating the placement of claims on the packaging of natural cosmetic products in the European Union. It also presents the evaluation of product claims in terms of their frequency of occurrence and compliance with legal requirements. The research material consisted of packaging of 10 natural shower gels available on the domestic market – 5 produced in Poland and 5 imported. Special attention was paid to information confirming natural character of the product (including certificates granted by specialized entities) and its functions, as well as properties of particular ingredients and presence or absence of given ingredients. Irregularities were found in the claims made on the packaging of natural cosmetics.

Keywords: labelling, natural cosmetics, packaging, claims.

APPLICATION OF INNOVATIVE ACTIVE INGREDIENTS IN TOPICAL ANTI-SCARRING AND SCARS REDUCING PRODUCTS AVAILABLE ON POLISH PHARMACEUTICAL MARKET

Paulina Malinowska

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland
paulina.malinowska@ue.poznan.pl

In this work the analysis of Polish pharmaceutical market offer of topical anti-scarring and scar reducing products (cosmetics, medical devices and drugs) was conducted. The aim of work was to analyse of marketing communication used by producers and to estimate the kinds of physicochemical forms and active ingredients used in products.

The analysis showed that the biggest group of topical anti-scarring products are medical devices, occurring mainly in form of gels and plasters, and cosmetics, occurring in form of gels and creams. Gels are the biggest physicochemical forms of ani-scarring and scars reducing products.

A detailed analysis of the chemical composition identified 64 active ingredients. The content of active ingredients in the analysed products ranges from one to several. The most popular active ingredients turned out to be polysiloxanes especially in medical devices, and plant derivates in cosmetics and medicines. Silicone-based products are widely and readily available, relatively inexpensive and have long been used for hypertrophic scar prophylaxis treatment. Plant extracts, such as onion extract, chamomile, calendula, Asian pennywort, sea buckthorn, aloe, tamarind, red clover and paper mulberry also turned out to be very popular ingredients in anti-scarring cosmetics and medicines. Another commonly used actives are vitamin E, heparin, plant oils, essential oils, nacre and snail secretion filtrate.

The analysis of marketing communication of cosmetic properties of topical anti-scaring and scar reducing products showed that the key cosmetic claims used by producers differ depending on the legal status of products. A cosmetic is used for e.g. cleansing the skin, changing its appearance and keeping it in good condition. In turn, medical devices and medicines can restore, correct or modify physiological functions of the skin. With reference to claims and active ingredients, cosmetics manufacturers are required to meet the expected regulatory conditions. The analysis confirmed that the claims concerning properties of cosmetics do not go beyond the definition of a cosmetic. In turn the claims concerning properties of medical devices and medicines in accordance with legal requirements say about preventing, treating or alleviating the scars.

Keywords: topical anti-scarring and scar reducing products, active ingredients, marketing communication, pharmaceutical market

THE ANALYSIS OF MARKET OFFER OF CLEANSING WET WIPES FOR BABY SKIN CARE AVAILABLE ON THE POLISH MARKET

Paulina Malinowska

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland
paulina.malinowska@ue.poznan.pl

In this work the analysis of market offer of cleansing wet wipes for baby skin care was conducted. 135 products from 33 brands available in drugstores, discount stores, hyper- and supermarkets on the Polish market were analyzed in the fourth quarter of 2020. The aim of work was to analyse the pricing strategy and marketing communication used by wet wipes producers and to estimate the kinds of active ingredients used in wipes formulations.

The analysis of pricing strategies showed that the most expensive comfort baby wet wipes were from brands: Isana Kids, Dove Baby and Nivea Toddies, the cheapest ones were Linteo Baby, Gaga and Fred&Flo. The most expensive sensitive baby wet wipes turned out to be Jelp and Dove Baby, the cheapest ones were Fred&Flo and Life Baby. The most expensive baby water wipes were Dada Aqua and Water Wipes, the cheapest ones were Kindii Pure and Huggies Pure. The most expensive biodegradable baby wet wipes turned out to be Tami Kids and Tami Bio, the cheapest ones were Dada Naturals, Nello and Lupilu Natural Care. The brands use mostly penetration pricing strategy, price leadership strategy and psychological pricing strategy.

The analysis of marketing communication of cosmetic properties of baby wet wipes showed that the key cosmetic claims used by producers concern naturalness, protection of baby skin, prevention against the irritations, conducted tests, safety and recommendations. With reference to claims and active ingredients, cosmetics manufacturers are required to meet the expected regulatory conditions. The analysis confirmed that the claims concerning properties of analysed wet wipes do not go beyond the definition of a cosmetic.

A detailed analysis of the chemical composition of baby wet wipes identified 30 active ingredients. The most popular active ones turned out to be glycerin, allantoin, aloe juice, panthenol, camomile extract, vitamin E and olus oil. These all active ingredients soothe irritation, moisturize and calm the baby skin.

Keywords: baby cleansing wet wipes, active ingredients, pricing strategy, marketing communication, cosmetics market

THE ROLE OF THE JAPANESE PEARL FLOWER EXTRACT IN THE QUALITY CONTROL OF EMULSION'S USAGE PROPERTIES

Anna Małysa, Anna Trojanowska

Department of Industrial Chemistry, Faculty of Chemical Engineering and Commodity Science
Kazimierz Pulaski University of Technology and Humanities in Radom,
Radom, Chrobrego 27, 26-600, Poland,
a.malysa@uthrad.pl

The paper presents results of assessment of cosmetic emulsions containing japanese pearl flower extract. From the analysis of the market we can conclude that the pearl flower extract, although it has been used in Chinese medicine for years, is not popular on the European market and is rarely found as an ingredient of creams. However, Japanese pearl flower extract in cosmetics is a new trend, due to the fact that previously it was mainly used as an infusion or an oral preparation, so in time there may be more cosmetics with this preparation.

The influence of this extract concentration on physical-chemical and functional properties was discussed. Emulsions compositions based on literature data and own experience. The viscosity values were within the range of error. All formulations tested demonstrated the ability to moisture the skin compared to the control point and maintained high levels of moisturization even after 2 hours. In a tranepidermal water loss study, it was found that the emulsion containing the highest concentration of the extract 1% wt. protected the skin from excessive water loss. After sensory analysis, it was found that the base sample received the worst ratings, and the higher the extract concentration, the better the overall ratings.

It was showed that japanese pearl flower extract used in 1 and 2 % concentration allowed to receive viscosity, skin moisture and sensory profiles comparable or even better to market product and basic formulation. The obtained results of the study may be a premise for the use of this extract in other facial cosmetics.

Keywords: emulsions, quality, japanese pearl flower extract

ECOLOGICAL IMPACT OF VARNISHES AND PAINTS USED IN THE FUNERAL INDUSTRY

Przemysław Mirek

Department of Metrology and Instrumental Analysis, Faculty of Commodity Science and Product Management, The University of Economics, st. Rakowicka 31 31-510 Krakow, Poland,
przemyslaw.mirek@phd.uek.krakow.pl

One of today's world's biggest issues is the impact that various industries have on the environment. In the face of a constantly growing demand for different products, every industry should be concerned about its effect on the natural ecosystem. One of many industry branches facing this dilemma that could benefit from more eco-conscious solutions, is the funeral industry. This is all the more important as the practice of burying the dead has been an inevitable part of human societies since the very beginning.

Usually the funeral industry is using coffins, caskets or urns made of various types of materials, for example: different types of wood (beech, ash, pine, oak), metal (ordinary steel, stainless steel or even chrome steel), composite materials in variety of types (resin mass, ordinary polyethylene, polypropylene, nacre or mixed types of plastic elements). In terms of coffins, caskets and urns current manufacturing methods use different types of varnishes, paints and stains – usually water or solvent based. These types of coatings can contain chemical compounds damaging to the environment that could have a huge negative impact on natural groundwater, soil and other parts of the ecosystem, as well as a harmful effect on human and animal health and lives as a result. In these circumstances, the manufacturers and business owners should do everything they can, and look for every possible way to neutralize the harmful influence of this industry on our planet's natural environment.

This article presents the magnitude of the impact that chemical substances used in the funeral industry have on the natural ecosystem, focusing mainly on soil and groundwater pollution. The second part of the article explores different ways of how the manufacturing process could be improved, so that the industry that takes care of such elementary and crucial parts of human culture as funeral ceremonies and burial could be more sustainable and less harmful to the environment.

Keywords: paints, varnishes, stains, funeral, casket, coffin, urn, chemical impact on nature, ecology,

PRICE-AFFECTING QUALITIES OF OXYGEN ABSORBERS. EMPIRICAL STUDY

Joanna Olszewska[1], Dawid Szutowski[2]

[1]Institute of Quality Sciences, Department of Quality of Industrial Products and Packaging
[2]Institute of Accounting and Financial Management, Department of Controlling, Financial Analysis and Valuation,
Poznań University of Economics and Business, 61-875 Poznań, Poland
olszewska.joanna@poczta.onet.pl
dawid.szutowski@ue.poznan.pl

Oxygen absorbers are one of the most popular solutions of the active technology in the food industry. They are chemical compounds or mixtures of substances, which involve in a chemical or enzymatic reaction with the oxygen. The result of this reaction is the removal of oxygen from a package. However, despite their indispensability for the food industry and the large-scale industrial application, the knowledge gap concerning the determinants of their market price remains.

In this regard, the purpose of this investigation was to identify the characteristics of oxygen absorbers critical in shaping their market prices, and consequently rightfully assess the competitiveness of ZEVIFOS prototype oxygen absorber patented at the Poznań University of Economics and Business.

In order to achieve the established objective, a focused empirical research was conducted. It involved gathering a set of data for the most popular oxygen absorbers, covering their crucial appropriable qualities such as: ability to oxygen sorption, amount of ferrum in sorbent packet, oxygen sorption efficiency, absorbent dimensions and, of course, the market price. Once the data was gathered, regression was employed to analyze the relationships of interest. Based on the scrupulous analysis of data, a group of principal determinants of oxygen absorbers' market prices were identified. Considering the characteristics and the proposed market price of ZEVIFOS, its market potential was evaluated as high. The conclusions provided contribute to both theory and practice, as according the best authors' knowledge no similar study was performed previously.

Keywords: oxygen absorber, oxygen scavenger, food safety, quality, packaged product, oxidation, price, market price

BACTERIAL CELLULOSE IMPREGNATED WITH ESSENTIAL OILS AS A BIOMATERIAL USED IN GROWTH INHIBITION OF *BACILLUS CEREUS* ATCC 14579 AND SELECTED CRONOBACTER STRAINS

Justyna Płoska[1], Anna Bętkowska[2], Lidia Stasiak-Różańska[1]

[1]Division of Milk Technology, Department of Food Technology and Assessment, Institute of Food Sciences, Warsaw University of Life Sciences, Warsaw, Poland
[2]Faculty of Horticulture and Biotechnology. Warsaw University of Life Sciences, Warsaw, Poland
justyna_ploska@sggw.edu.pl

Bacterial cellulose (BC) is a biopolymer produced by some acetic acid bacterial species. Due to the ability to absorb various compounds and its permeability to liquids and gases, BC is mainly used in medicine as a wound dressing and drug carrier. In recent years, there has been an increased interest in BC as a material for food packaging enriched with bioactive substances. Essential oils are aromatic substances of plant origin, accumulated in the secretory tissues of plants as a final product of metabolism. The aim of this study was to investigate the effect of bacterial cellulose produced by *Gluconacetobacter hansenii* ATCC 23769, soaked in essential oils (thyme, lemongrass, rosemary, lemon, anise) on the growth of *Bacillus cereus* ATCC 14579 strain and selected *Cronobacter* sp. bacteria: *C. muytjensii, C. sakazakii, C. condimenti, C. turicensis and C. malonaticus*. The antimicrobial activity of BCs soaked in the active ingredient was investigated by the disk-diffusion method. The water activity of dry bacterial cellulose and the absorption capacity of essential oils by this biopolymer were also investigated. Bacterial cellulose with thyme oil showed antimicrobial activity against all bacterial strains tested. The highest zone of growth inhibition was observed for the strain *C. sakazakii.* Bacterial cellulose with the addition of lemongrass and rosemary oil inhibited the growth of Gram-positive bacteria to a greater extent. The bacterial cellulose with the addition of aniseed and lemon oils did not show any growth inhibitory effect on the tested bacterial strains. These results show that bacterial cellulose enriched with bioactive compounds can be a material that limits the growth of microorganisms. Bacterial cellulose showed the ability to absorb the tested essential oils, which may indicate its potential use as a biomaterial for the production of active packaging to inhibit bacterial growth in food.

Key words: biocellulose, antimicrobial activity, essentiail oils, *Bacillus, Cronobacter*

THE ROLE OF PRODUCT DESIGN IN THE GLASS INDUSTRY

Renáta Ševčíková, Ľubica Knošková

Department of Marketing, Faculty of Commerce,
The University of Economics, 852 35 Bratislava, Slovakia,
lubica.knoskova@euba.sk, renata.sevcikova@euba.sk

The glass industry is one of the oldest industries, a capital-intensive sector which needs to respond to challenges related to its competitiveness, such as globalization, increased environmental regulation and rising energy costs. The success of innovative design-driven practices that drive sustainable long-term growth in business revenues and company performance has been demonstrated in many studies. Design, as an important strategic marketing tool, is playing a growing role in the search for a company's sustainable competitive advantage. The glass industry in Slovakia has a long tradition, whether in the form of the production of utility glass or technical glass. The aim of the paper is to investigate the best practices using product design for innovation in glass industry to get better understanding of how design supports firm competitiveness. We have chosen Rona, the leading utility glass producer with long tradition in Slovakia. The firm thanks to technological know-how and cooperation with designers, competes with world glass producers. The paper was elaborated using a case study method, which resulted in several recommendations for the use of product design to achieve a sustainable competitive advantage. The analysed firm has been paying great attention to the design of its products since the first half of the 20th century. The strong position of the company's internal designer positively impacts the quality and perception of products. Internal designers are in daily contact with the company, they are perfectly acquainted with its technology and thus have been able to harmonize commercial requirements with individuality and design. The important role of design is underlined by organizing international glass symposia and cooperation with external designers and students. An open-minded approach and following new trends, can lead to the excellent position in the international glass industry.

Keywords: product design, glass industry, competitive advantage

AGENT-BASED SIMULATIONS OF ECO-INNOVATIONS

Jakub Wienskowski [1, 2]

[1] Poznań University of Economics and Business, Institute of Quality Science, Department of Non-Food Product Quality and Packaging Development, 61-875 Poznań, Poland
[2] Centre for Advanced Technologies of Adam Mickiewicz University in Poznań, 61-614 Poznań, Poland
jakub.wienskowski@gmail.com

Eco-innovations possess features making them a distinctive type of innovations. Various aspects of eco-innovations have been approached from many different research perspectives. Due to the obvious limitations of the empirical approach, theoretical (mathematical) modelling is widely applied. The review focuses on a subset of mathematical models known as agent-based models (ABMs). These models implemented as computer simulations are gaining popularity in many different fields of social science. They offer modelling flexibility allowing to describe the phenomena much more realistically than what is possible with standard models. The number of published papers applying ABMs is growing fast also in the field of eco-innovation research. The work in this literature review is twofold. First, the aim is to clarifying the core features of the ABMs applied in the eco-innovation context. Identification and classification various model of assumptions give a comprehensive perspective on the broad modelling opportunities offered by ABMs. The strengths and weaknesses of agent-based modelling are examined as well as outline the best practices and recommendations. Second, the aim is to presenting the key results in eco-innovation research reached so far with ABMs. This review could be helpful for researchers to identify opportunities for further work.

The review is aimed to help two groups of researchers. One of them are scientists active in the field of eco-innovation research looking for a new method to address their research questions. The other group consists of agent-based modellers willing to apply their approach to new research areas. Moreover, as a result the review could be of interest to practitioners (policy-makers) as ABMs are well-suited to analyze consequences of different policy proposals. They can be useful in assessments such as the impact analysis of REACH policy on innovative activities or how environmental policies influence the direction of innovation.

Keywords: agent-based model (ABM), computer simulation, eco-innovations, environmental policies

BOTOX AND "BOTOX-LIKE" PREPARATIONS IN ANTI-WRINKLE THERAPY

Katarzyna Wybieralska, Izabela Chłodzińska

Department of of *Technology and Instrumental Analysis, Faculty of of Commodity Science, Poznań University of Economics and Business, Poland,*
k.wybieralska@ue.poznan.pl

Ever-present advertising, film productions, and new technologies reassure consumers, especially women, in the belief that only beautiful and young people have a chance for a good quality of life. Cosmetic treatments and the possibility of using a wide range of aesthetic medicine treatments are gaining more and more popularity. In purpose to have of firm, smooth skin, even younger consumers are eagerly reaching for anti-wrinkle creams. This is due to the market offer offering “eternal” youth, suitable lifestyle (medicine of stress, air pollution), but also from greater consumer awareness about their body, skin, tissues and the way antioxidants work. Injection methods of fighting wrinkles, such as the use of tissue fillers or botulinum toxin, are also gaining more and more popularity. Unfortunately, such treatments can have side effects and are associated with a painful process of introducing the substance. Cosmetic companies develop technologies that allow the non-invasive use of active compounds, which cause an effect similar to the effect of botox.

The aim of the study was to evaluate the effects of preparations that guarantee results similar to aesthetic medicine treatments with the use of botox. Cosmetics with botox-like substances (argireline, herbal botox, DMAE, bee venom, snake venom, conotoxin, stoichiol) regularly used are an alternative for consumers who do not like invasive care methods. The properties of these compounds and their diversity should encourage customers to try them out and use them regularly. The effects of botox-like substances were discussed by comparing the feelings of people taking part in the study and by studying the information gathered about specific preparations. The analysis of consumers' preferences regarding the use of botox treatments and the application of preparations rich in compounds which, according to the producers, guarantee strong anti-wrinkle effects was also performed.

Keywords: Botox, botox-like preparations, aesthetic medicine treatments, consumer feedback

ON CORRELATION BETWEEN AQUATIC TOXICITY AND DETOUR MATRIX OF ALKYLBENZENE SULFONATES

Ryszard Zieliński

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics, Poznan 61-875, Poland,
r.zielinski@ue.poznan.pl

In this work we study the effect of the chemical structure of various isomeric anionic surfactants belonging to sodium salts of alkylbenzene sulfonates on the partition coefficient between n-octanol and water. We try to correlate the values of log $K_{O/W}$ available in literature for 23 surfactants with the number of carbon atoms in the side alkyl chain of surfactant, characteristic volume (V_X) and the topological index known as Wiener's number (WN) as well as detour number (DD) of the surfactant molecule.

We have found a good correlation between 23 experimental and computed values of the logarithm of n-octanol-water partition coefficient (log $K_{O/W}$) for a series of anionic surfactants belonging to sodium salts of alkylbenzene sulfonates having various structures of the alkyl part of the surfactant molecules. The resulting correlation equation using the Wiener's number (WN) is as follows:

$$\log K_{O/W} = -0.21706 \cdot B + 0.039096 \cdot V_X + 0.001002 \cdot WN + 0.9992$$

while the correlation equation obtained using the detour number (DD) is:

$$\log K_{O/W} = -0.16210 \cdot B + 0.026947 \cdot V_X + 0.000783 \cdot DD - 6.1793$$

where B is the number of carbon atoms in the side alkyl chain, V_X is the McGowan's characteristic volume of the surfactant molecule.

It was found that the application of this developed correlation equation based on the detour number to sodium salts of alkylbenzene sulfonates allows for prediction log $K_{O/W}$ with the maximum error of 0.18 units.

In another part of the work we correlate the detour numbers computed for 20 sodium salts of alkylbenzene sulfonates and corresponding experimental aquatic toxicity data for those surfactants published in literature. We have found that the detour number can be applied for prediction of aquatic toxicity data (pEC_{50} based on molar concentration) against goldfish and the corresponding relationship for pure isomers of various sodium salts of alkylbenzene sulfonates can be given by the following empirical equation:

$$pEC_{50} = 0.001979 \cdot DD + 1.133$$

It was found that the detour number (DD) of tested anionic surfactants allows for prediction their aquatic toxicity against goldfish species with the maximum error of 0.13 pEC_{50} unit.

Keywords: surfactant safety, toxicity prediction, topological indices, detour matrix, partition coefficient

QUALITY IN INDUSTRY 4.0 ERA

RISK FACTORS OF PRODUCTION PROCESS AUTOMATION. CASE STUDY ANALYSIS IN THE CONTEXT OF INDUSTRY 4.0

Jarosław Maćków, Krzysztof Nowosielski, Ewa Walaszczyk

Department of Process Management, Faculty of Management,
Wroclaw University of Economics and Business, Wroclaw 53-345, Poland,
ewa.walaszczyk@ue.wroc.pl

In the last few years, the fourth industrial revolution (Industry 4.0; I4.0) has been taking place. In general, this term means increasing the use of information and automation technologies in the manufacturing environment, increasing digitalisation and automation of manufacturing, and creating a digital value chain to enable and improve the communication between products, environment, and business partners.

The manufacturing of medical products is subject to rigorous quality standards. The requirements for the production environment in the medical industry are precisely defined in legal regulations and standards. They should be monitored throughout the whole life cycle of a product. The main determinants of the quality standards of the manufacturing environment are standards for the production of medical products (e.g. ISO 13485) and standards for clean zone rooms where production processes are carried out (e.g. ISO 14644). Additional guidelines that must be followed are GMP (Good Manufacturing Practice) and industry standards.

The aim of the study was to identify risk factors of production process automation. The research approach was based on a single case study, and it was mostly quantitative in nature. The broad spectrum of potential risk factors, both economical and technological in nature, was taken into consideration during the research process. The main findings are that the risk issue of automation of production processes is multifactorial. The automation process can be traced back to the feasibility study phase in order to be analysed. It also covers many issues different in nature, for instance: employees involvement, machine efficiency and project management methods and tools. All these issues must be taken into consideration when the decision of process automation is made.

Keywords: Industry 4.0, automation, air quality, risk factors

CLASSIFICATION OF STRAWBERRY JUICE ACCORDING TO PROCESSING USING ABSORBANCE-TRANSMISSION AND FLUORESCENCE EXCITATION-EMISSION MATRIX TECHNIQUE

Ewa Sikorska, Katarzyna Włodarska, Katarzyna Pawlak-Lemańska

Department of Technology and Instrumental Analysis, Institute of Quality Science, Poznań University of Economics and Business, 61-875 Poznań, Poland, ewa.sikorska@ue.poznan.pl

The objectives of this study were characterization of spectral properties and discrimination between direct fresh juice and commercial pasteurized beverages obtained from strawberries, using an absorbance-transmission and fluorescence excitation-emission matrix (A-TEEM) technique coupled with chemometrics.

Strawberries are popular fruits with attractive sensory attributes and high content of nutrient, and bioactive non-nutrient components. Due to their very short shelf-life and seasonality, they are processed into various products, including beverages. A growing number of studies demonstrate that molecular absorption and fluorescence spectroscopy coupled with multivariate analysis has been successfully used as fingerprinting techniques in quality evaluation of various food products, including fruit juice.

The subject of this study were freshly squeezed juices and commercial beverages obtained from strawberries. Commercial beverages covered various categories of products available on the market, including juice, syrup and nectar. Fresh juices were obtained from fruits of three varieties.

The total fluorescence spectra (excitation-emission matrices, EEM) and absorbance spectra were simultaneously recorded for each diluted juice using an A-TEEM technique.

The exploratory analysis of absorption spectra and unfolded EEM using principal component analysis (PCA) revealed differences between freshly squeezed juice and commercial products. Parallel factor analysis (PARAFAC) of EEM enables characterization of four fluorescent components present in strawberries products, which were related to various groups of polyphenols and non-enzymatic browning products, that arise during the processing and storage of commercial beverages.

The partial least squares – discriminant analysis (PLS-DA) was used to test usability of absorbance spectra and EEM for classification of strawberry products. The similar low misclassification errors were obtained for the models based on absorption spectra and EEM.

The presented results demonstrate that an A-TEEM technique may be useful tool for authenticity testing and processing control in beverage industry, enabling rapid analysis of high number of samples.

Keywords: strawberry juice, fluorescence, partial least squares discriminant analysis, parallel factor analysis

Grant 2016/23/B/NZ9/03591 from the National Science Centre, Poland, is gratefully acknowledged.

BIG DATA IN FOOD SECTOR

Krzysztof Wójcicki

Department of Technology and Instrumental Analysis, Institute of Quality Science
Poznań University of Economics and Business, Poznań 61-875, Poland,
krzysztof.wojcicki@ue.poznan.pl

A huge volume of data is being produced worldwide in nearly all sectors of the society including manufacturing, business, government, health care, and research disciplines such as: natural sciences, social sciences, life sciences, engineering and humanities. As more and more of this big data become available, it can be used to enable new insights, improve decision-making, and enhance the quality of products and services

The term Big Data is used in various ways but always refers to large volumes of different types of data- both structured and unstructured. The concept of big data gained momentum in the early 2000s when industry analyst Doug Laney articulated the now-mainstream definition which suggest that Big Data possess a suite of key traits: volume, velocity and variety (the 3Vs).

Today, industrial manufacturers are leveraging big data to transform their processes, their organizations and, in some cases, entire industries. The food industry is one of the largest and most important industries in the world. It covers everything from manufacturers and shipping companies to grocery stores and restaurants. Therefore, more and more often the food industry uses the same big data services as financial companies and marketing departments in order to better understand consumers, increase efficiency and even create new products. Big Data applications, although to varying extents, can be found in all steps of the food supply chain from farm to fork to optimize production while maintaining safety and quality standards.

This study conducted an overview of the recent developments in Big Data applications in food sector.

Keywords: Big data, food, food safety, quality,

MANAGEMENT FOR SUSTAINABILITY

INTELLIGENT PACKAGING AS A TOOL IN SUPPLY CHAIN TRACEABILITY IN THE FOOD SECTOR

Marta Biegańska

Department of Industrial Product Quality and Packaging Development,
Institute of Quality Science, Poznań University of Economics and Business,
Poznań 61-875, Poland,
marta.bieganska@ue.poznan.pl

As a result of globalization, consumers have easier access to products from all over the world. It also influences the extension of supply chains. Today, consumers, especially in developed countries, are more aware of food quality and safety. What's more, the observed trends of a healthy lifestyle, eating on the go, or increased attention to the country of origin of products and / or the method of obtaining raw materials for their production, translate into growing requirements for food producers. Ensuring food safety and quality throughout the entire supply chain is a real challenge for producers, especially in the case of perishable products. Despite the implementation of various types of quality assurance systems, food safety systems (e.g. GMP, HACCP, GlobalGAP), the use of better means of transport, innovative packaging materials or packaging systems, incidents related to food contamination or its adulteration are still not avoided.

In order to increase consumer confidence, traceability systems have been introduced to enable food chain monitoring 'from farm to fork'. Food producers can use traceability systems to identify sources of food contamination and withdraw a product from the market or a raw material / intermediate from the production process at the right moment. On the other hand, consumers see traceability as a tool that provides information about the safety and quality of food and its ingredients. Moreover, more stringent legal requirements in terms of food safety, quality and traceability are introduced in developed markets with a high standard of living, such as the USA, Europe and Japan.

In traceability systems, the flow of information along the supply chain is crucial. Usually, the collection of data regarding e.g. the place of cultivation, the plant species, the method of harvesting in the first stages of obtaining raw materials for food production takes place on specific forms agreed with contractors. To improve the flow of information, the number of which increases with each stage of food production or an element of the logistics chain, intelligent packaging (e.g. barcodes, RFID tags) are suitable. Recently blockchain technology has been implemented for transparency and traceability in the food and beverage segment.

Keywords: intelligent packaging, traceability, blockchain, RFID, supply chain management

THE ROLE OF INTERNAL ASSESSMENT IN HIGHER EDUCATION QUALITY IMPROVEMENT

Andrzej Chochół, Olga Hnatyszak

Department of Management and Quality Sciences, Faculty of Quality Sciences and Product Management, Cracow University of Economics, Cracow, Poland,
chochola@uek.krakow.pl

The aim of the article is to present an internal assessment of education quality in higher education institutions as one of the key elements in the process of improving education quality. The paper discusses issues related to the concept of the quality of higher education, its evaluation, as well as the process of internal assessment of education quality within a university. It has been presented that despite the unusual importance of the internal assessment of education quality, there are no specific recommendations or regulations in this area. The analysis of documentation of internal education quality assurance systems for selected Polish universities has shown that very often these systems are developed as a minimum required in relation to the guidelines of the Polish Accreditation Commission.

Internal evaluation of the quality of education is an inseparable element of the process of improving the quality of education in a higher education institution and should constitute one of the key elements of a formalized internal education quality management system. The Authors also present proposals for actions aimed at conducting internal assessment of education quality in a higher education institution. This assessment should be carried out on the basis of indicators related to the expectations of different groups of stakeholders of a given university as well as it should take into account its specific operating environment. For successful implementation it is important the presented vision to be consistent with the mission and strategy of the university.

Keywords: higher education, higher education quality, internal quality assessment, quality improvement.

MOTIVATORS AND BARRIERS OF SUPPLY CHAIN SUSTAINABILITY IN FOOD COMPANIES

Łukasz Małys

Department of International Marketing, Institute of International Business and Economics, Poznań University of Economics and Business, 61-875 Poznań, Poland, lukasz.malys@ue.poznan.pl

The idea of sustainable development has been gaining more and more popularity in recent years. It is often emphasised that its implementation in business practice requires cooperation and agreements of various companies. In this context, cooperation within the supply chain is most often mentioned, which has led to the development of the concept of supply chain sustainability. When implementing activities in the field of sustainable development as part of cooperation in the supply chain, companies are guided by various motivators, but also face various barriers to their implementation. Identifying these types of motivators and barriers may, among others, contribute to a better planning of incentive and support systems for companies deciding to implement the idea of supply chain sustainability.

The aim of the paper is to verify whether there are differences in the motivators and barriers in the implementation of the supply chain sustainability of food companies compared to all the companies. Identification of such differences would indicate the need to adapt activities supporting the implementation of supply chain sustainability specifically to food companies. The article will present the results of a survey conducted on a sample of 500 companies located in Poland. Out of 500 surveyed companies, 38 belong to the food industry. As part of the analysis, declarations regarding the motivators and barriers to the implementation of supply chain sustainability of food industry companies and all the companies will be compared.

Keywords: supply chain sustainability, motivators, barriers, food industry

S-LCA FOR EVALUATING AN AGRO-ECOLOGICAL MODEL OF ORGANIC CULTIVATION

Giuseppe Martino Nicoletti, Giulio Mario Cappelletti, Carlo Russo, Alfredo Ernesto Di Noia

Department of Economics Management Territory, University of Foggia, Foggia 71100, Italy
alfredo.dinoia@unifg.it

The Italian organic food market, although growing steadily, has in recent years shown increasing criticalities in the supply side.

On the one hand, there is the inability of the supply to meet the evolving needs of the demand, which has shown increasing interest in issues of environmental and social sustainability, in addition to the usual "economic" one. On the other hand, there are critical points in the biological system that generate a potential limitation of productivity, with critical implications along the chain.

In order to face this issue, a two-year project, named “Organic farming Innovations to improve sustainability of Apulia farms for cereal and industrial crops”, has been developed and implemented (in progress) in Southern Italy to define a new agro-ecological model, characterized by the use of solutions/innovations, based on the crop rotation of the main apulian herbaceous crops, such as industrial tomatoes, durum wheat and legumes. This model is being tested in some “pilot farms” to measure the increase in productivity and its “sustainability”. This is so that the model can be subsequently transferred to farms in the area.

As regards the measurement of social sustainability, a methodology based on life cycle assessment can be adopted: Social Life Cycle Assessment (S-LCA). However, the S-LCA approach is still evolving, since the first guidelines were published in 2009, successively complemented in 2013 (Methodological Sheets), and the latter in 2020. Furthermore, above all, still has few implementations of S-LCA have been carried out related to food issues.

The paper presents the Social Life Cycle Assessment (S-LCA) methodology focused on the production of the organic food used in the crop rotation model that was tested. In particular, this research focuses on the issues regarding the system boundaries of the agro-ecological model and the individuation of the processes for the life cycle assessment as well.

Results aim to highlight hotspots, principal stakeholders, impact categories, and indicators that were adopted in the questionnaires that will be submitted to pilot farms.

Keywords: Social Sustainability, S-LCA, Innovation, Organic farming, Life Cycle Assessment

THE COSTS OF APPLICATION OF SHRIMP WASTE TO SYNTHESIS OF DEGRADABLE CHITOSAN BASED POLYURETHANE FOAMS

Agnieszka Piotrowska-Kirschling[1], Katarzyna Szelągowska-Rudzka[2], Mateusz Wilk[3], Joanna Brzeska[1]

[1]Department of Industrial Product Quality and Chemistry, Faculty of Management and Quality Science, Gdynia Maritime University, 81-25 Gdynia, Poland,
a.piotrowska-kirschling@sd.umg.edu.pl
j.brzeska@wznj.umg.edu.pl
[2]Department of Management and Economics, Faculty of Management and Quality Science, Gdynia Maritime University, 81-25 Gdynia, Poland,
k.szelagowska-rudzka@wznj.umg.edu.pl
[3]PPH SAS Przetwórstwo krewetek i owoców morza, 73-200 Choszczno, Poland,
pph.sas@o2.pl

Sustainable industry includes an economic policy based on a circular economy. The circular economy is concerned with the principle of closing the loop in the product life cycle. Maximum use of the potential of a product should ensure its (or its waste) reuse at the end of its life cycle in the same or another new cycle.

Shrimp shells are one of the seafood productions wastes in the food industry. The northern prawn is fished in the wild off the coast of Greenland in the North Sea. About 50 tons of shrimp waste (shells, head, etc.) is generated per month from 70 tons of raw material (northern shrimp). In shrimp and seafood processing plants, shrimp waste can be considered as a by-product. The amount of this waste causes many problems with its storage, e. g., without bothersome odour. Therefore, it is transferred to the meal production plant as component of the fish meal which is added to feed. The range of price of this waste is from 50 to 300 PLN per ton of delivered, non-dried raw material.

However, the shrimp waste can be also a source of chitin. From chitin, by chemical deacetylation, can be obtained chitosan (Ch) with unique physico-chemical and biological properties. Ch is a material which is the second most abundant polysaccharide in the world after cellulose. Furthermore, Ch is biocompatible, biodegradable, antibacterial, and non-toxic, so it can be used in variety branches of industry and medicine. We used Ch to synthesize degradable chitosan based polyurethane foams (PUR+Ch) with sorption properties.

The purpose of the work was to calculate the costs of using shrimp waste to obtain Ch and the costs of using the thus obtained Ch for the synthesis of PUR+Ch. To achieve this aim, the Ishikawa diagram was used to identify factors influencing the process of obtaining Ch and the synthesis of materials, which allowed for the identification of individual costs.

The results of the research allowed to estimate of the costs of application shrimp waste to the production of Ch and the costs of its use for the synthesis of PUR+Ch on a laboratory scale. The performed calculations are an introduction to further in-depth research on the possibility of using shrimp waste on a larger (industrial) scale for tested materials. These materials could be used, for example, in seaports to clean port water from petroleum and metal ions contamination.

Keywords (3-5 words): shrimp waste, fish meal, costs, chitosan, chitosan based polyurethane foams

NUTRITIONAL BEHAVIOUR AND ATTITUDES TOWARDS HEALTH VALUES OF FOOD BY WOMEN AGED 60+

Anna Platta, Karolina Śmigaj

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, 81-87 Morska St., 81-225 Gdynia, Poland, a.platta@wznj.umg.edu.pl

Attitudes towards food are good predictors of behaviors. If thoroughly explored, they play an important role in dietary education for different groups of the population, especially those at high risk of deficiencies in nutrients. Consumers increasingly experience problems with keeping in good health, regardless of their age. The production of food of higher quality, nutritional value and pro-health properties is a specific imperative for producers.

The objective of the study was to assess of nutritional behaviour and attitudes towards health value of food and functional food exhibited by a group of women past the age of 60.

The study was carried out in 2020 among 102 women, living in Gdańsk, while taking into account three variability factors: age, level of education and self-assessment of health. Empirical study was carried out by means of direct interview. In it were used such research tools as: the questionnaire for the analysis of the habitual menu according to Starzyńska, BSQFVF (Block Screening Questionnaire for Fruit / Vegetable / Fiber Intake), scales for examining attitudes towards health and health values of food (GHI - General Health Interest).

The level of acceptance of the introduced innovations in food products depended on the socio-demographic characteristics of consumers (women ≥ 60 years of age) such as age and level of education. The health condition of female respondents aged 60+ did not significantly affect the positive attitudes towards consuming food with health-promoting properties. People with both "good" and "neither good nor bad" health status showed ambivalent attitudes towards food with pro-health properties. The examined group of elderly women, when choosing food, considered its taste to be most important. It was established that the menus of the women are lacking in dietary fiber. Moreover, health value of foods only insignificantly influenced older people's choice and food with health-promoting properties consumption.

Keywords: nutritional behavior, health values of food, consumer, elderly women

A HOLISTIC APPROACH OF COMPANIES FROM FOOD INDUSTRY TO THE MANAGEMENT OF MARKETING COMMUNICATION IN THE AREAS OF PRODUCTION AND TRADE

Sylwia Sady, Bogdan Pachołek, Olgierd Głodkowski

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznan 61-875, Poland
sylwia.sady@ue.poznan.pl
Department of Product Marketing, Institute of Marketing, Poznań University of Economics and Business, Poznan 61-875, Poland
bogdan.pacholek@ue.poznan.pl

The food law strictly regulates the information that must be included in the labeling of foodstuffs. On the other hand, promotional and marketing information that is voluntarily placed on labels is rarely subject to specific legal conditions. Most often, in this respect, only a general prohibition of misleading consumers is in force, and producers and other entities involved in the process of developing communication often have a big problem in assessing when a given marketing slogan or other voluntary information about a product can be considered misleading, and when not. Food producers are not only obliged to provide consumers with relevant information but also to present it in an appropriate manner. From the technical point of view the challenge is often to ensure adequate legibility or distribution of information in food labeling in accordance with the legal requirements, as well as the division of mandatory information between the individual elements of the unitary and packaged product. Holistic communication management for food business managers is a difficult area of strategic management of a company. Financial losses, e.g. related to the withdrawal of products from the market, are the smallest consequence for the majority of food producers. Exposing consumers to a threat, loss of their trust, loss of image, undermining the reputation among business partners are problems for the food producers' environment.

The aim of the work is to review and analyse the current state of knowledge on a holistic approach to food communication strategies. To achieve the aim of the work, the method of analysis and synthesis was used, carried out on the basis of the data from the RASFF portal as well as legal requirements and guidelines of quality and food safety management standards. The RASFF system was presented as an element of the food safety communication strategy. Alert notifications to the RASFF system in 2020 concerning incorrectly labeled products were analyzed and good practices of information management in food production were presented.

Keywords: marketing communication, product management, consumer safety, food quality management

FOOD SAFETY MANAGEMENT SYSTEM AS A TOOL AIMED AT THE REDUCTION OF THE RISK RELATED TO THE ACTIVITIES OF ORGANIZATIONS IN THE FOOD CHAIN

Agata Szkiel

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia 81-225, Poland,
a.szkiel@wznj.umg.edu.pl

An integral element of food safety management systems that are implemented in organizations that are a part of the food chain, based on the requirements of the ISO 22000:2018 standard, is risk management, which may have an impact on the effectiveness of the system and the results achieved in the area of ensuring food safety. Effective risk management enables organizations to meet food safety objectives in an effective and efficient way, achieve the set goals by the food safety management system, and ultimately achieve lasting success in a complex, demanding and constantly changing environment.

In the article the author discusses the requirements for risk management included in the ISO 22000:2018 standard and presents the food safety management system as a tool enabling organizations in the food chain to take actions to eliminate or reduce the impact of uncertainty on the achievement of the set goals related to food safety.

As a result of the research that was carried out, it was found that the food safety management system is a tool that enables an organization to manage risk on two levels:

- operational, including risk management of the occurrence of food safety hazards at individual stages of the processes, which could have a potentially negative impact on the health and life of consumers,
- business, including risk management that may have an impact (positive or negative) on the ability of the food safety management system to achieve the set goals and the ability of an organization to achieve the objectives related to food safety.

Keywords: food safety, risk management, ISO 22000, food safety management system

NEUROSCIENCE IN BRAND MANAGEMENT

Henryk Szymusiak

Institute of Quality Science, Department of Technology and Instrumental Analysis, Poznań University of Economics and Business, Poznań, Poland,
h.szymusiak@ue.poznan.pl

A brand is a concept, idea, perception, expectation and belief that arises in the minds of consumers (existing or potential customers) or any individual who can influence an organization's business competence. Creating, or creating and successfully developing a brand that can be equally involved with the world's leading brands in the fight for consumers, both in the domestic market and in other markets, becomes a major factor and key to the success of modern business and contemporary organizations of the world of work. The ideas and impressions that the company assumes that customers are nurturing about its product brands are in the throes of competing ideas, which are also struggling for their own better market opportunity. In the work we are set to review recent papers on neuro-management that investigated the neural features of customer/consumer behavior. Many reports describe the brand management in terms of brand preferences, brand extension, personalized preference, perception and framing of price, and hazard perception (in term of financial decision making). For example: The preference for a certain brand as is a sign of customer loyalty was examined by recording ERPs to analyze brain activity during brand information processing when subjects/customers experienced victor or defeat. In ERP analysis, three components N2, P300 and N400 were identified during the brand extension assessment. Two ERP components, P200 and the late positive potential (LPP), were high in response to the best-preferred product designs vs. the least-preferred designs, when subjects saw the product designs without making a decision what shed light on the reasons why consumers like customized products. In few studies it was examined whether emotion arousal would influence consumers' price perceptions and their willingness to purchase. Both behavioral and ERP results indicated that subjects' price perception was deeply impacted by emotions induced from continuous win/lose experiences. One study has evaluated the case when the evidence and information are in a sequence and has found that order effect and biases have an impact in various areas. The behavioral outcomes, which are an investment decision, were consistent with the idea that individuals will invest more/retire less when receiving the information in a negative-positive order.

Keywords: brand management, branding, neuroscience

ENTREPRENEUR ON THE MARKET OF TRADITIONAL AND REGIONAL PRODUCTS

Magda Śniegocka-Dworak, Aleksandra Wilczyńska

Department of Quality Management*,*
Gdynia Maritime University, Gdynia, Poland,
m.sniegocka-dworak@wznj.umg.edu.pl , *a.wilczynska@wznj.umg.edu.pl*

Traditional and regional food are products that are made from special ingredients using traditional production methods. These products are characterized by naturalness, low degree of processing, no additives or other chemicals. Indicated features make traditional food more and more popular. It is undoubtedly more and more desirable by the consumer alternative for industrially manufactured products. As a result, there is an visible increase in demand for traditional food in the form of processed and unprocessed products from a proven source. The interest in traditional and regional products is growing continuously. This trend is observed not only on the domestic market, but also abroad, where traditional food is playing an increasingly important role.

In view of the above, it can be observed directly that food producers are interested in the production of products using the traditional method. Manufacturers are ready to apply for labelling and certification of their products.

The aim of the research was to analyze the factors influencing the decision of entrepreneurs to subject their products to certification and to issue labels, as well as to analyze the methods of distribution of these products.

The surveyed group of producers readily provided their products for certification and gave them labels. The main motive for this actions was the desire to preserve the tradition and regional identity.

Keywords: food quality, traditional and regional food, certification

THE ROLE OF PACKAGING IN MODERN SUPPLY CHAINS

Mariusz Tichoniuk

Department of Non-Food Products Quality and Packaging Development,
Institute of Quality Science, Poznań University of Economics and Business, Poznań, Poland,
mariusz.tichoniuk@ue.poznan.pl

Packaging is one of the fundamental elements in the supply chain. It makes products safer and easier to handle. Packaging protects them against adverse factors during storage, transport, and delivery. On the other hand, the environment is protected against the undesirable release of the products. A complement to these essential functions of packaging in the supply chain is the provision of information about the packaged product – the basic data allowing for the identification and tracking of the product in the supply chain, as well as additional information encouraging the members of the chain to decide on a given product and/or informing on how to proceed with it.

Modern supply chains place greater demands on packaging in terms of improving its efficiency, competitiveness, and sustainability. In particular, freight forwarding and e-commerce place great emphasis on the optimal use of packaging through the correct selection of its shapes, dimensions, and weight. Proper matching of packaging materials and construction forms to logistic processes facilitates their automation and increasing efficiency. An increasingly important criterion when choosing a package is the reduction of environmental impact and the introduction of sustainable technologies in modern supply chains. Recycled materials and bio-based packaging are gaining more and more interest, which is driven by general care for the environment but also by the social perception of the activities of the members of the supply chain. Therefore, the use of reusable packaging and the maintenance of the reverse logistics model is also considered. Modern supply chains incorporate often smart packaging technologies which improve the information transfer, product traceability, and efficiency of logistic processes such as Radio-Frequency Identification (RFID), Internet of Things (IoT) technologies, or e-printing techniques. All the above-mentioned solutions have been presented in the article, which confirms the important role of packaging in modern supply chains.

Keywords: packaging, supply chain, active packaging, intelligent / smart packaging

AN ATTEMPT TO CLASSIFY THE QUALITY FACTORS OF AIRPORT SERVICES

Ewa Walaszczyk, Łukasz Gajewicz, Krzysztof Nowosielski, Michał Nadolny

Department of Process Management, Faculty of Management,
Wroclaw University of Economics and Business, Wroclaw 53-345, Poland,
ewa.walaszczyk@ue.wroc.pl

Air transport is one of the most dynamically developing types of transportation. This development influences the expansion of terrestrial infrastructure for passengers. Airports are essential for the air transport network, and the demand for airport services is growing. Efficiency and service quality are key performance indicators for airport operation, and airport service quality is crucial to airport management. Airports are multiservice companies and should be managed as such.

The aim of the study was to identify and classify the quality factors of regional airport services in the assessment of its passengers. The research approach was a single case study. The research object was a regional international airport in Europe. A diagnostic survey was used in the study, and the data were collected through a questionnaire of 40 questions. The study covered 260 people who have used the services of the examined airport. The research was quantitative in nature, and the collected data were statistically analysed. Based on the analysis, quality factors of airport services were identified and classified.

The main findings are that the passengers distinguish groups of factors influencing their satisfaction with airport services. The are three main groups in which the quality factors were gathered: 1) services associated with the mandatory for the air travel activities as check-in and boarding, both time of the services as well as the behaviour of the staff; 2) services connected with information, security and service for the disabled; 3) paid additional services like parking and shopping.

The results of the research indicate the main areas of passengers dissatisfaction with airport service quality. Further research should focus on identifying the causes of low-quality services in order to improve them and eliminate or at least reduce passenger dissatisfaction.

Keywords: service quality, airport services, quality management

THE IMPORTANCE OF COMMUNICATION AS A TOOL FOR IMPROVING THE OSH MANAGEMENT SYSTEM

Joanna Wierzowiecka

Department of Quality Management, Faculty of Management and Quality Science, Gdynia Maritime University, Gdynia 81-225, Poland,
j.wierzowiecka@wznj.umg.edu.pl

One of the key factors determining the effectiveness of an occupational safety and health (OSH) management system and the ability to achieve the results intended by an organization is ensuring effective communication. An organization shall establish, implement and maintain the processes necessary for internal and external communication that are relevant to the occupational safety and health management system. A particularly important element in the OSH management system is ensuring participation and consultation with employees, which implies two-way internal communication including a dialogue and an exchange of information.

The aim of the paper is to present the importance of communication in improving the effectiveness of the OSH management system, as well as to present the possibility of using the guidelines of ISO 14063 standard to build an effective communication process within this system. In the first part of the paper the author discusses the requirements of the PN-ISO 45001:2018 standard related to communication and the interested parties of an organization participating in the communication process. Then, the methods used in organizations to communicate in the field of the occupational safety and health management system are presented, as well as the possibilities of using the guidelines of ISO 14063 standard to establish the communication process.

Keywords: OSH management system, communication, improvement

QUALITY, SAFETY AND COMPATIBILITY OF PLASTIC PACKAGING IN THE LIGHT OF LEGAL REQUIREMENTS AND COSMETICS INDUSTRY STANDARDS

Karolina Wiszumirska[1], Katarzyna Michocka[2]

[1] Department of Industrial Products and Packaging Quality, Institute of Quality Science Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, karolina.wiszumirska@ue.poznan.pl
[2] Department of Technology and Instrumental Analysis, Institute of Quality Science Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, katarzyna.michocka@ue.poznan.pl

The assessment of the quality and safety of cosmetic packaging is one of the elements of the cosmetic safety report, which results from the requirements of the Regulation of the European Parliament and of the Council (EC) No. 1223/2009 of 30 November 2009 on cosmetic products. The cosmetic safety assessment relates to the normal and reasonably foreseeable use of the product, however, possible product-packaging interactions require a special testing program that should reveal potential incompatibility or confirm safety of use before the product enters the market. Research related to the quality and safety of packaging may be a certain difficulty, especially because there are no detailed guidelines, which does not exempt from the obligation to assess important properties of the packaging material, in particular its purity and stability, and the level of presence of trace amounts of prohibited substances. Such analysis is carried out by assessing the documentation of packaging or raw materials for their production and physicochemical tests. The requirements of good manufacturing practice (GMP) and the Regulation of the European Parliament and the Council of the European Union (EC) No. 1935/2004, concerning materials and products intended to come into contact with food, provides support in meeting the safety requirements of cosmetic packaging.

The selection of the cosmetic packaging in direct contact with the product should be based on verified data. The materials from which the container is made cannot affect the safety of the final product, therefore this article focuses on the description of exemplary interactions between the product and the packaging material, the phenomenon of substance migration, barrier properties and leakproofness of packaging. The results of own research with the use of several cosmetic formulations are also presented.

Particular attention was paid to the safety of the use of recycled materials in the packaging industry and materials from renewable sources, the recyclability of packaging from post-consumer collection and a new approach to the sustainable design of cosmetic packaging.

Keywords: packaging, plastic, requirements, cosmetic industry

INNOVATIONS IN BEEKEEPING AS PART OF PRODUCT MANAGEMENT

Natalia Żak

Department of Commodity Science and Quality Management,
Faculty of Management and Quality Science,
The Maritime University of Gdynia, Gdynia, Poland,
n.zak@wznj.umg.edu.pl

Food product innovation is part of product and brand management. For all enterprises on the market, they constitute an element of their operational efficiency. In the case of an enterprise with a specific form of activity, such as a beekeeping farm, the form of such product management is a challenge. The definition of natural honey and apiculture products states that no raw material modifications are possible. Therefore, it has become important to identify the possibility of increasing the range of products on the beekeeping market with the use of product management elements.

The aim of the study was to determine the possibilities and nature of innovation as an element of product management in a beekeeping farm. The scope of the research included a direct interview with beekeepers from all over Poland.

As a result of the research, it was found that the term innovation is only an element of beekeeping marketing. In addition, beekeepers indicated that they treat it more as an option to increase the range of their products on the market than innovation. The term innovation in the case of bee products is very difficult to define due to the traditional approach of consumers to the nature of apitherapy and the legal definition of the scope of the definition of natural honey and bee products. Beekeepers can be divided into two groups: I - traditionalists who do not care about marketing, II - willing to try changes and novelties in product and beekeeping management.

Keywords: honey, apitherapy, product management, innovations

CIRCULAR ECONOMY

EVALUATION OF THE REMOVAL EFFECTIVENESS OF PALLADIUM(II), PLATINUM(IV) AND GOLD(III) IONS FROM AQUEOUS SOLUTIONS WITH N,N-BIS(TETRADECYL)PIPERIDINIUM BROMIDE

Anna Cieszyńska

Department of Technology and Instrumental Analysis, Faculty of Commodity Science, Poznań University of Economics and Business, al. Niepodleglosci 10, 61-875 Poznań, Poland, anna.cieszynska@ue.poznan.pl

The global consumption of palladium, platinum and gold is still high due to their many applications e.g. in automotive, chemical, electrical, petroleum, jewelry, medical and biomedical industries. In 2020, demand for palladium was 307.7 tons, platinum 215.2 tons and gold 3,759.6 tons, and their prices were 2,178.96 $/oz, 893.39 $/oz and 1,773.73 $/oz, respectively. The effective recycling of spent materials containing these precious metals is required, as the natural resources of these metals are limited. Recycling of waste materials is perfectly legitimate, not only due to the impact that the ill-managed waste may have on the environment, but also because of its profitability in view of the possibility of recovery of valuable components, including precious metals.

The aim of work was to remove and separate of palladium(II), platinum(IV) and gold(III) ions from chloride media in the extraction-stripping process. N,N-bis(tetradecyl)piperidinium bromide ([PIP14-14]Br) has been synthesized and examined as a extractant for recovery of selected precious metals from hydrochloric acid solutions. The effectiveness extraction of palladium(II) and platinum(IV) with [PIP14-14]Br in toluene strongly depends on HCl concentration and decreases with increase of HCl concentration. Extraction of gold(III) is effective (near 100%) in the whole range of HCl concentration (1-5 M). The extraction ability towards examined noble metal ions with [PIP14-14]Br is in the following order: gold(III) > palladium(II) > platinum(IV). Also separation of metals from their model mixtures of composition based on real solutions obtained after leaching electronic wastes (e.g. mobile phones) was investigated. A procedure of effective separation of palladium(II), platinum(IV) and gold(III) from their mixture based on extraction-stripping process has been worked out.

Keywords: palladium(II), gold(III), platinum(IV), solvent extraction

FRUIT AND VEGETABLE WASTE MANAGEMENT - WELL-KNOWN METHODS AND CURRENT TRENDS IN SOLVING THE PROBLEM

Katarzyna Czerniewicz, Katarzyna Marchwińska, Daniela Gwiazdowska

Department of Natural Science and Quality Assurance, Institute of Quality Science, Poznań University of Economics and Business, Poznań 61-875, Poland, katarzyna.marchwinska@ue.poznan.pl

Sustainable fruit and vegetable waste (FVW) management is a challenge for the global economy. Waste is an undesirable effect resulting from the sum of product specifications, management practices, consumer trends and environmental factors. Non-utilization or under-utilization of FVW not only leads to loss of potential of components presented in residues, but also influences on human and animal health due to potentially pathogenic nature or microbial contamination.

Waste valorisation by reusing or recycling can increase the whole food supply chain efficiency by lowering a level of associated costs, security and accessibility of products. Waste generated from fruits and vegetables has the potential to be used in various industries as food, cosmetic, pharmaceutical and others. Primarily a problematic material deposited in the landfills that contributes to environmental concerns such as the greenhouse gasses emission, can be treated as a source of natural, bioactive ingredients. The richness of the bioactive substances e.g. proteins, carbohydrates, polyphenols or carotenoids, contained in the residues make it worth using on the industrial scale. Undoubtedly, the most beneficial characteristic of the residues is the diversity of compounds, but also presentence of health-promoting properties, which enables their numerous applications. In this study well-known methods and current trends in fruit and vegetable waste management have been shown and classified by methods of reusing and recycling. Reusing includes products for soil amendment and animal feed, while recycling is divided into whole waste mass recycle strategies (composting or flour processing) and specific ingredient extraction (food additives, pigments, enzymes or biofuels).

Sustainable development of FVW requires overall support of the industry, scientific and legislator areas. Despite the complexity of the issue of FVW management, it is worth developing these solutions not only from the economic perspective, but also from the social and, above all, the ecological one.

Keywords: bioactive compounds, fruit and vegetable waste, recycling, reusing, waste management

ORGANISATION OF LOGISTICS AT A MUNICIPAL WASTE TREATMENT PLANT

Artur Jachimowski

Department of Technology and Ecology of Products, Institute of Quality and Product Management Sciences, Cracow University of Economics, 31-510 Cracow, Poland, artur.jachimowski@uek.krakow.pl

An element that plays an essential role in circular economy is the waste management chain. It comprises all activities related to organising and improving waste disposal chains, and thus deals with planning, organising, implementing and controlling the flow of waste and related information from the point of generation, through storage, to a waste disposal or recovery facility. Waste logistics emphasises recycling of waste, and deals with flow streams wherein it may be possible to recover value from discarded products. The waste is therefore disposed of or processed so that it can find its way to the market again. This process must be comprehensive, and the individual components should be ordered and work with one another, which is why logistic systems are created to facilitate rational waste management.

The aim of this paper is to present the existing logistic solutions based on the activity of a selected municipal waste treatment company in Krakow. In compliance with the integrated permit, the plant under analysis operates systems intended for mechanical and biological treatment of mixed municipal waste, production of combustible waste, and for bio-drying of biodegradable waste other than hazardous or municipal waste.

The present study takes account of such issues as the functioning of a logistically integrated municipal waste management system, the procedure for receiving and keeping records of municipal waste at the waste treatment plant, and storage and transport of waste, as well as methods of collecting, transporting and managing waste generated at the plant in accordance with the principles of sustainable economic development and environmental protection. The choice of the research problem determined the choice of the research methods, such as literature review, analysis of internal materials and environmental documentations at the selected plant.

Keywords: municipal waste, waste logistics, waste storage, waste transport, logistic system

WASTE SEGREGATION IN POLISH HOUSEHOLDS

Klaudia Młoda-Brylewska, Krzysztof Melski

Department of Natural Science and Quality Assurance, Institute of Quality Science
The University of Economics, Poland,
klaudia.mloda-brylewska@ue.poznan.pl

Waste management covers a wide range of activities, from it generation to final utilization or landfill. According to EU regulations, in Poland there are the law regulations considering waste segregation among residents, as the main method of waste management and to reduce the amount of municipal waste landfill. Poland is obligated to achieve obligatory levels of recovery selected materials from waste. However, to make segregation process economic and environmental efficient, it must be easy and understandable to "waste producers" - consumer. Mix of many spheres of activity: making segregation easy, education, law regulations, economic profits etc. have influence on efficiency this first stage of waste management.

The purpose of the article is to present and analyze the results of research on the segregation of packaging waste by Polish consumers and to indicate the possibilities of more rational waste management at level of households including an environmental education of citizens. The research tool was a questionnaire survey and an in-depth questionnaire survey, which aimed to identify potential possibilities for improving the waste segregation system. The results of the survey show that over 84% of respondents declare waste segregation but more than half them do not avoid mistakes during assigning waste to the appropriate container. The greatest number of errors concerning the segregation of packaging waste is due to identify the main material of packaging waste. Placing easy to read information in the form of a symbol or inscription would greatly reduce this problem.

Keywords: waste segregation, circular economy, GOZ

FACING CIRCULARITY AND SUSTAINABILITY CHALLENGE IN AGRICULTURAL SECTOR – LCA APPROACH TOWARDS ASSESSMENT OF ITS CONSEQUENCES

Tomasz Nitkiewicz

Department of Business Informatics and Ecosystems, Faculty of Management, Częstochowa University of Technology, 42-201 Częstochowa, Poland,
tomasz.nitkiewicz@pcz.pl

The process of transition to circular economy through the delivery of sustainable products has already started while its environmental consequences are not fully investigated yet. Agricultural sector, as not many other sectors, has a natural potential for contributing to circularity and sustainability of its products. The problem is with measuring the consequences of striving for circularity goals with regard to its environmental, economic or social consequences. The objective of the paper is to present the opportunities with LCA use on selected agricultural products to design its life cycles with the circularity and sustainability constrains. The study is based on presenting the approach within LCA to cope with circularity and sustainability of agricultural products. Also, extensions of LCA, like life cycle sustainability assessment (LCSA), social life cycle assessment (S-LCA) and life cycle costing are considered as methodological support to deal with circularity assessment.

Keywords: LCA, circular economy, agricultural sector, life cycle management

CARBON FOOTPRINT ANALYSIS OF FROZEN BROCCOLI PRODUCTION

Magdalena Wróbel-Jędrzejewska, Joanna Markowska, Elżbieta Polak

Prof. Wacław Dąbrowski Institute of Agricultural and Food Biotechnology - State Research Institute, Frozen Food Technology and Refrigeration Department, Pilsudskiego 84, 92-202 Lodz, Poland
magdalena.jedrzejewska@ibprs.pl

The agri-food industry has a significant share in greenhouse gas emissions, assessed by the carbon footprint (CF). Restoring ecological balance requires immediate action to reduce pollutants generation. The aim of work was to determine frozen broccoli production CF in Polish plant Unifreeze.

Investigation results presented in this paper are a part of results obtained in the BIOSTRATEG3/343817/17/NCBR/2018 The development of an innovative carbon footprint calculation method for the basic basket of food products.

The CF analysis method was developed in accordance with ISO/TS 14067:2013 standard. The analysis included raw material transport from growers to plant, technological processes and finished product transport to distributors. Based on production scheme and prepared mass balances, the following emissions were determined: fuel combustion direct emissions from trucks in internal transport, and electricity consumption indirect emissions. Using developed and executed system for measuring technological lines, energy consumption measurement in time, in conditions of actual production, with size and production cycles number registration was carried out. 24 cycles of frozen broccoli production was carried out and CF was evaluated.

The calculated frozen broccoli production CF was low, approx. 0.14 kg CO_2/kg of product. In entire frozen product manufacturing process, the production stage had the largest share in CO_2 emissions, about 88%. However, in the production, freezing process (tunnel) had the largest share, about 95%. The shares of raw material transport to the plant and internal transport are 10% and 0.04%, respectively, while their absolute CF is 0.014kg CO_2/kg of product. The storage process was analyzed by comparing CF only for frozen broccoli production, determined at different time intervals. This made possible to calculate CO_2 emissions related to 6 weeks of freezing storage. The emission equaled 4,350 kg, constituted 75% CF of production. It was found that freezing in tunnel and storage are main factors of CO_2 emissions in production.

The developed methodology for frozen vegetables CF calculation will be used in environmentally friendly technologies development for the new multi-vegetable products production with reduced CF, by utilization of vegetable outgrades into valuable products.

Keywords: carbon footprint, frozen food production, outgrades

GENERAL SCHEDULE of the CONFERENCE

SEPTEMBER 13th, MONDAY

9.00 – 9.15	**OPENING CEREMONY** Maciej Żukowski, Rector of Poznań University of Economics and Business, Poland Ewa Sikorska, Director of Institute of Quality Science, Poznań University of Economics and Business, Poland
9.15 – 10.00	**OPENING LECTURE** **Paulo Sampaio**, University of Minho, Portugal *Quality 4.0: state-of-the-art, definition and developments* *Chair: Sabka Pashova, University of Economics-Varna, Bulgaria*
10.00 – 10.45	**KEYNOTE LECTURE** **Esther Sendra,** Miguel Hernandez University of Elche, Spain *Consumer sensory studies for food companies: challenges and trends* *Chair: Barbara Borusiak, Poznań University of Economics and Business, Poland*
	SESSION 1. CONSUMER DRIVEN PRODUCT DEVELOPMENT **Chair:** *Esther Sendra, Miguel Hernandez University of Elche, Spain*
10.45 – 11.00	**Andrzej Szymkowiak,** Poznań University of Economics and Business, Poland *Household food waste: the meaning of product's attributes and food-related lifestyle*
11.00 – 11.15	**Ľubica Knošková,** University of Economics in Bratislava, Slovakia *Consumer attitudes and importance of product design during shopping for selected non-food products. Consumer styles by design*
11.15 – 11.30	**Małgorzata Koszewska**, Lodz University of Technology, Poland *Consumers' openness to circular business models in fashion industry*
11.30 – 11.45	**Maria Sielicka-Różyńska,** Poznań University of Economics and Business, Poland *Consumers' perception of labelling in gluten-free product design*
11.45 – 12.15	Q&A
12.15 – 12.30	**BREAK**
12.30 – 13.15	**KEYNOTE LECTURE** **António Marques**, Portuguese Institute for the Sea and Atmosphere (IPMA), Portugal *Validated eco-innovative sustainable solutions for the seafood production and processing* *Chair: Pasquale Giungato, University of Bari Aldo Moro, Italy*
13.15 – 14.15	**POSTER SESSION**
14.15 – 14.30	**BREAK**
	SPECIAL SESSION DEDICATED TO PROFESSOR ZENON FOLTYNOWICZ **Chair:** *Ryszard Cierpiszewski, Poznań University of Economics and Business, Poland*
	14.30 – 16.40

SEPTEMBER 14th, TUESDAY

9.00 – 9.05	**OPENING** Katarzyna Marchwińska, Poznań University of Economics and Business, Poland
9.05 – 9.50	**KEYNOTE LECTURE** **Raquel Sendón**, University of Santiago de Compostela, Spain *Food packaging: main concerns regarding its safety* *Chair: Romdhane Karoui, University of Artois, France*
	SESSION 2. DESIGN, QUALITY AND SAFETY OF NON-FOOD PRODUCTS **Chair:** *Raquel Sendón, University of Santiago de Compostela, Spain*
9.50 – 10.05	**Wojciech Kozak**, Poznań University of Economics and Business, Poland *Determination of oxygen transmission rate of packaging materials using dynamic accumulation method*
10.05 – 10.20	**Małgorzata A. Jarossová,** University of Economics in Bratislava, Slovakia *The growing importance of sustainable packaging design*
10.20 – 10.35	**Michal Puchalski**, Lodz University of Technology, Poland *Distributions of random variable in quality assessment of modern nonwoven products on the example of thickness measurement of fibers*
10.35 – 10.50	**Pasquale Giungato,** University of Bari Aldo Moro, Italy *Sustainable consumption of filtering facepiece respirators during COVID-19 outbreak*
10.50 – 11.20	Q&A
11.20 – 11.35	**BREAK**
11.35 – 12.20	**KEYNOTE LECTURE** **Harshadrai Rawel**, University of Potsdam, Germany *Rape seed proteins: Potentials and perspectives in their bio- and technofunctional properties* *Chair: Alfred Błaszczyk, Poznań University of Economics and Business, Poland*
	SESSION 3. DESIGN, QUALITY AND SAFETY OF FOOD PRODUCTS **Chair:** *Harshadrai Rawel, University of Potsdam, Germany*
12.20 – 12.35	**Joanna K. Banach**, University of Warmia and Mazury in Olsztyn, Poland *Evaluation of starch, protein and lipid contents in domestic durum wheat grain from integrated cultivation system by its electrical parameters*
12.35 – 12.50	**Małgorzata Krzywonos,** Wroclaw University of Economics and Business, Poland *Bioeconomic aspects of the production, distribution and use of bio-based products from bio-waste and agrobiomass*
12.50 – 13.05	**Jacek Lewandowicz**, Poznań University of Technology, Poland *The effect of fat content on quality of natural yoghurt*
13.05 – 13.20	**Małgorzata Muzolf-Panek**, Poznań University of Life Sciences, Poland *Optimization protocol for the extraction of antioxidants from Nigella sativa using single- and multi-response surface methodology*

13.20 – 13.50	Q&A
13.50 – 14.00	**BREAK**
SESSION 4. YOUNG SCIENTISTS **Chair:** *Iga Rybicka, Poznań University of Economics and Business, Poland* *Giacomo Squeo, University of Bari, Italy*	
14.00 – 14.10	**Adam Miratyński,** Cracow University of Economics, Poland *Research on consumer preferences related to footwear used by people practicing skateboarding. Statistical analysis and selected qualitative aspects*
14.10 – 14.20	**Dominik Sikorski,** Technical University of Lodz, Poland *Chemical modification of chitosan*
14.20 – 14.30	**Monika Engler-Jastrzębska**, Gdynia Maritime University, Poland *Natural sunscreen preparations - a new quality on the cosmetics market*
14.30 – 14.40	**Bożena Filas**, University of Economics in Katowice, Poland *Art in management*
14.40 – 15.00	Q&A
15.00 – 15.10	**Michał Świtalski**, Gdynia Maritime University, Poland *Selected microbiological hazards of unpasteurised and unfiltered craft beers. Product quality and safety management*
15.10 – 15.20	**Natalia Kłopotek,** Gdynia Maritime University, Poland *Directions of using the Kano model to improve the quality of products and services*
15.20 – 15.30	**Maciej Świtalski**, Gdynia Maritime University, Poland *Comparison of the quality parameters of selected types of organic crispbread*
15.30 – 15.40	**Marcin Antoniak**, Poznań University of Economics and Business, Poland *Perception of nutrition claims and the origin of food products*
15.40 – 16.00	Q&A

SEPTEMBER 15th, WEDNESDAY

9.00 – 9.05	**OPENING** Katarzyna Marchwińska, Poznań University of Economics and Business, Poland
9.05 – 9.50	**KEYNOTE LECTURE** **Daniel Cozzolino**, University of Queensland, Australia *Sensing technologies and big data – their role in sustainable food chain* *Chair: Diego Luis García González, Instituto de la Grasa (CSIC), Spain*
SESSION 5. QUALITY CONTROL IN INDUSTRY 4.0 ERA **Chair:** *Daniel Cozzolino, University of Queensland, Australia*	
9.50 – 10.05	**Diego Luis García González,** Instituto de la Grasa (CSIC), Spain *Mesh cell FTIR spectroscopy to assess virgin olive oil stability under real marketing conditions*

10.05 – 10.20	**Giacomo Squeo**, University of Bari, Italy *Application of near infrared hyperspectral imaging for analysis of texturized vegetable proteins*
10.20 – 10.35	**Katarzyna Włodarska,** Poznań University of Economics and Business, Poland *Spectral fingerprinting and chemometrics in food quality assessment: A case study of fruit juices*
10.35 – 10.50	**Adam Gilmore***,* HORIBA Instruments Incorporated, USA *Automating authentication with absorbance-transmittance excitation-emission matrix (A-TEEM) spectroscopy*
10.50 – 11.20	Q&A
11.20 – 11.30	**BREAK**
11.30 – 12.30	**POSTER SESSION**
12.30 – 13.15	**KEYNOTE LECTURE** **Ulf Gustavsson,** European Organization for Quality EOQ, Belgium, *European Organization for Quality (EOQ) – transforming into the digital era* *Chair: Paulo Sampaio, University of Minho, Portugal*
	SESSION 6. MANAGEMENT FOR SUSTAINABILITY **Chair:** *Ulf Gustavsson, European Organization for Quality EOQ, Belgium*
13.15 – 13.30	**Piotr Kafel,** Cracow University of Economics, Poland *Quality and food safety management systems in official statements of selected food sector organizations operating on the Polish stock market*
13.30 – 13.45	**Przemysław Seruga***,* Wroclaw University of Economics and Business, Poland *Municipal solid waste anaerobic digestion as a component of the circular economy*
13.45 – 14.00	**Paweł Nowicki**, Cracow University of Economics, Poland *Recycler's audit within circular economy approach*
14.00 – 14.15	**Patrycja Wojciechowska**, Poznań University of Economics and Business, Poland *Recycling of plastics – challenges in closing the loop of a circular economy*
14.15 – 14.45	Q&A
14.45 – 15.00	**BREAK**
15.00 – 15.45	**KEYNOTE LECTURE** **Zenon Foltynowicz,** Poznań University of Economics and Business, Poland *Will conferences remain an essential part of every scientist's life?* *Chair: Stanisław Popek, Cracow University of Economics, Poland*
15.45 – 16.00	**CLOSING CEREMONY** Ewa Sikorska, Poznań University of Economics and Business, Poland

COOPERATION

Honorary patronage

Poznań University of Economics and Business

POZnań
Honorary Patronage of the Mayor of Poznań

eoq
European Organization for Quality

Media patronage

Przemysł Spożywczy
Food Industry • Lebensmittelindustrie

foodfakty
Food Safety Culture Initiative

Scientific patronage

PAN
Oddział Polskiej Akademii Nauk w Poznaniu

Polish Academy of Sciences
Poznań Branch

Polskie Towarzystwo Towaroznawcze

Polish Society of Commodity Science

Polskie Forum ISO 9000

Polish Forum ISO 9000

Sponsors

HORTIMEX

COMEF

HORIBA

Logos
Izabela Chrostowska-Siwek