

Food sector related knowledge integration

Food sector global market
trend analysis report



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WHO WE ARE

Partners from seven central European countries join their forces to improve entrepreneurial competences and skills in remote areas through food innovation potentials, led by the Pomurje Technology Park (Slovenia).

Slovenia

- Pomurje Technology Park
- Chamber of Agricultural and Food Enterprises

Austria

- Business Upper Austria

Hungary

- Campden BRI Hungary Ltd
- South Transdanubian Regional Innovation Agency

Italy

- CNA National Confederation of Crafts and Small and Medium Sized businesses - Regional Association of Emilia Romagna
- Industry Association Service & Training of Treviso and Pordenone

Germany

- University of Hohenheim

Poland

- Polish Chamber of Food Industry and Packaging

Slovakia

- Slovak Chamber of Commerce and Industry

INTRODUCTION

Slovenia, Hungary, Poland and Slovakia are facing declining employment opportunities in traditional industries because of structural changes. Therefore, steps to simulate economic activity with employment generating potential need to be taken. Analysis show that the food sector together with other value-chain related sectors represent one of the most important, potential fields to leverage improvement of socio-economic situation in remote areas. To support those food-producing SMEs, the I-CON project started in June 2016 to establish a joint transnational food mentor scheme. The current report consists of an overview of the major developments and trends in the food sectors of meat, milk, fruits and vegetables, grain and alcoholic and non-alcoholic beverages.



Who funds us

Our project is funded by the Interreg CENTRAL EUROPE Programme that encourages cooperation on shared challenges in central Europe.

With 246 million Euro of funding from the European Regional Development Fund, the programme supports institutions to work together beyond borders to improve cities and regions in Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia.



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EUROPEAN MARKET TRENDS



European Market trends



The Following section gives an overview of the state-of-the-art and economic trends of the European Food and Drink industry. It is based on the report of Food Drink Europe “Data and Trends 2014-2015”. The EU food and drink industry is the largest manufacturing industry in the EU and therefore a major contributor to Europe’s economy. With 15% share of turnover, 12,8% share of value added and 15% share of employment, the European food and drink sector is generating the highest turnover, value added and employment in the EU manufacturing industry ahead of other manufacturing

sectors, such as the automotive industry. Small and medium sized enterprises (SMEs) play a key role in this sector. More than 280000 SMEs which are representing 99% of the food and drink companies are responsible for almost 50% of the EU food and drink turnover. The top four manufacturing sectors are bakery and farinaceous products, meat products, dairy products and drinks.

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WORLD MARKET TRENDS

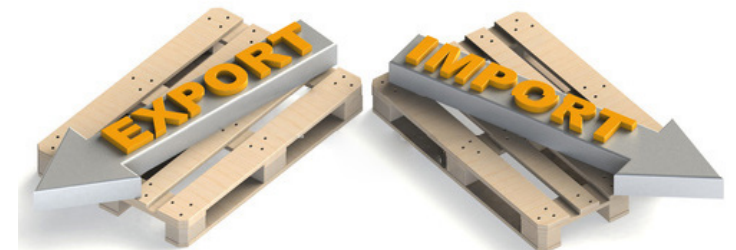


World Market trends



Since 2009 the European food and drink exports are at a growing rate causing an increased trade surplus. One quarter of these exports are sold to non-EU countries with a rising trend. The import market share of oils and fats, fish and seafood products, processed fruits and vegetables totalled 61%. In

global comparison, the EU is the leading exporter and second largest importer of food and drink products on the world market, ahead of China and Brazil. These numbers visualize the importance of the EU food and drink industry in terms of turnover and employment.



ORGANIC FOOD AND DRINK INDUSTRY



Organic food and drink industry



Since 2011 the turnover of organic food and drink products in Germany has an annual growth rate of up to 11%. In total 38.259 producers, processors, importers and trading companies were employed in the organic sector in 2015. Overall, revenues of the European organic food and drink industry doubled in the last decade, recording a growth rate of 8% in 2014. Having a look at the global market share, the United States have spent € 27,1 billion for organic food and drink products, generating an organic market share of 5% of the total food market. In many European countries and the US, the domestic manufactures could not

meet the high demand for organic food products, with the result that these countries increasingly depend on imports. However, there is a large potential for an increase of production in Romania, Russia and Slovakia (BÖLN, 2011). The organic food sector is representing a market niche but it had high growing rates in the past and will continue to grow in the coming years. Furthermore, the organic food sector reflects market and diet trends. An important example is baby food. In this product category 60% of all consumed products are from organic production and processing (GfK, 2016).

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MEAT MARKET TRENDS



Meat market trends



Globally, meat production and per capita consumption of meat have more than doubled from 1961 to 2007 and is projected to grow; more rapidly in developing countries in comparison to developed countries. This trend is linked to several variables of increasing population and prosperity accompanied by urbanization, industrialization, increased trade and globalization of “Western” food culture (Kumar et al., 2014). On example for this trend is the growing halal meat market. It shows an unprecedented development across Europe, though the intensity varies from country to country. Looking at specific meats

over a time period of the last 50 years the poultry consumption has increased three-fold, and pig meat consumption has risen by 80%, whereas per capita beef consumption in Europe was 2008 much less than in 1961. The trend shows a replacing of beef with chicken meat. In spite of these global trends, European meat consumption has been relatively stable in the recent past, even though the consumption patterns vary between countries.



Sustainability and consumption of meat substitutes

It is well known that meat production is responsible for environmental, animal welfare and health issues (Vranken, 2014). The large scale of meat production uses a high amount of natural resources (e.g. land, oil, water, uniform agricultural animal species) and causes air, water and ground pollution. The increasing debate about meat and a raise in consumer awareness might reverse the tendency of increasing meat consumption. Despite studies showing a positive effect of lower meat consumption the number of vegetarians in Europe varies and ranges from around 1% to between 5-10%. The

market for meat substitutes is beginning to develop and at present accounts for 1-2 % of the total meat market. Currently, vegetable proteins are the main source for meat analogues in which soybean represents the bulk of production and the cheapest source of protein raw material. In the near future vegetable proteins probably get replaced by algae, yeast, mushroom or bacteria (Kumar et al., 2014). The consumption of insects has increased over the last few years. Insects are highly nutritious and contain much of high-quality protein. In addition, they

are environmental friendly. In general, meat substitute consumption is very low because of neophobia, especially the fear of negative sensory qualities. Furthermore, the consumer education on cultural, nutritional and ecological aspects could also play a major role.



FUNCTIONAL FOODS



Functional Foods



Profound changes in the lifestyles lead to changes in consumer behaviour, including more awareness for relation of diet and health. As a result of this changes new products have been developed. The market for functional food has been growing in the last years, depending on the countries there are different intensities and trends. Functional foods are often sold at higher prices than conventional foods, which makes this sector very attractive for supply chain stakeholders. Especially in the European Union, the functional foods market presents great expansion capabilities (Giannetti et al., 2009). Since 1 July 2007, the area of health

claims is regulated in Europe with the regulation on nutrition and health claims made on foods (Regulation (EC) No 1924/2006). It says that any claim made on a food's labelling, presentation or advertising in the European Union must be clear, accurate and based on scientific evidence and food bearing claims that could mislead consumers are prohibited on the EU market (European Commission, 2016). "A food can be regarded as 'functional' if it has satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to

either an improved state of health and well-being and/or reducing the risk of disease. The class of functional foods is very heterogenic since it includes all kind of products. In most cases functional food is made by adding ingredients (e.g. ingredients not present like prebiotics, antioxidants). Furthermore, manufacturing of functional food could also be the elimination of components (e.g. lactose, gluten and allergenic proteins), augmenting concentrations (e.g. micronutrients,

functional "no-nutrients") or substituting components (e.g. protein micro particles instead of fat). Dairy products seem to have the largest share in the market, followed by beverages, cereals, snack food and fats.



1924
2006
Regulation on nutrition and health claims made on foods

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CLEAN LABELLING



Clean Labelling



Clean labelling is a general trend in the food industry with growing demand. There is no agreed definition on the term “clean label” (Saltmarsh, 2015; Varela & Fizman, 2013). Saltmarsh, 2015 reported a shift away from the use of E-numbers to the use of the names for additives. There is also a change in the use of food colours. This trends reflects the tendency to avoid the use of anything the consumer might consider an additive, especially linked with colours and preservatives. But also other additives are influenced by this trend and the development forces the food industry to replace artificial ingredients with natural ones. The tendency for clean label food has

promoted the research for the use of native starches (Saltmarsh, 2015). Another trend in food labelling and especially in clean labelling is the use of the terms “organic”, “non-GMO” and “no hormones or antibiotics”. There is also an increasing demand for “free-from” foods by consumers. Reasons could be on the one hand that consumers become more concerned with their health and well-being and on the other hand that there are intolerances to those ingredients. The most important “free-from” labels apply to lactose, sugar, salt and gluten. In Europe, up to 17% of people are lactose intolerant. (Van den Berg, 2016).

REGIONAL AND SEASONAL FOOD, TRADITIONAL FOOD



Regional and seasonal food, traditional food



In general, traditional food may be understood as food that communities can access locally with an inherent deep knowledge about their natural environments, including farming and wild harvesting (Kuhnlein et al., 2009). Nowadays, traditional and regional food can play the important role to feed around 925 million people who suffer from hunger and malnutrition in the world, even when sometimes this food has been undervalued and judged as “forgotten food”. “According to FAO, globalization has reduced the number of plant species used for food and other purposes from roughly 100,000 to about 30. “Even

when consumed in small quantities, traditional foods contribute large amounts of essential nutrients to the diet so that individuals have significantly higher micro-nutrient intakes on days when traditional foods are consumed than days where traditional foods are not part of the diet” (Schuster et al., 2014).

GENERAL TRENDS AND INNOVATIONS IN THE FOOD INDUSTRY



General overview of Food safety and labelling at European level



Recent food safety crises have created a high degree of concern among consumers and consumer perception has evolved to a high level of awareness and a much reduced certainty, which has led to a generalized lack of confidence. Accordingly, the industry needs to ensure that the consumer is provided with safe products and products possessing the required sensory characteristics, at maximum convenience, and at an affordable price. Food safety is a major public health and economic issue for Europe both for foods consumed within the EU and those that are exported. Therefore the food sector has a very

clear interest and responsibility in addressing food safety challenges.

- Predicting and monitoring the behaviour and fate of relevant known and emerging biological hazards.
- Predicting and monitoring the behaviour and fate of relevant known and emerging chemical hazards including toxins of biological origin.
- Appropriate risk benefit assessments and communication to the various stakeholders of the food chain.
- Understanding and addressing consumer concerns with food safety issues

The advances in “omics” technologies and Systems Biology provide new tools and possibilities to target the above mentioned challenges. Microbial activities may be deciphered for specific microorganisms at a molecular level leading to a novel and improved predictability of production of toxins, virulence factors, and spoilage capacity. At a second level it will be possible to understand and predict interactions within ecosystem (foods, human hosts and the environment). Recent scientific advances allow the stakeholder to set the appropriate, robust and consistent standards with the help of Robust and cost-effective Risk Analysis (RA) concepts as well as Real-time and rapid detection tools to ensure safety and security of the food chain, including food defence. It is important to manage safety hazards and risks in processing, distribution and sale. Therefore, a management of food-borne hazards and threats -from availability of definitive information on specified hazards (e.g. known and emerging pathogens, allergens, known

and emerging chemical species, foreign bodies) through continued cultivation of a food safety culture to the practical implementation of systems such as HACCP, TACCP, risk management and due diligence testing is necessary. One way to enhance and maintain the quality of food could be effective process technology. Also important are systems for assuring and independently validated methods for rapidly and cost-effectively assessing the safety and spoilage of food and drink products - especially new and emerging products (e.g. intermediate moisture, low temperature cooking). It is important to maintain the product quality throughout shelf life. This could be done by clear definitions of product quality - including sensory, physical, chemical, nutritional and microbiological attributes / criteria - and the way in which it is measured and perceived.



quality of food
process technology



General overview of Food design and Packaging at European level



Though Food and Drink companies clearly identify packaging performances as important and integral part of their products, their general attitude leans toward keeping packaging cost as low as possible. So packaging is mainly intended as support to carry regulatory information and mandatory performance only as well as provide anti-tampering. Other purposes are to let customers better perceive messages induced at the very moment of choice. A problem are disposable single-use packages which cause a waste problem. It appears that the adoption of advanced technology is very limited

in Food and Drink packaging solutions. They are reserved to specific and very demanding niches. However, companies are looking with a lot of interest to the recently introduced paper-like finished packaging materials as it appears to be a satisfying solution to offer customers the feeling of the food/drink genuineness they demand for.

TRENDS AND INNOVATIONS IN MEAT PROCESSING SECTOR



Trends and innovations in meat processing sector



According to Gfk, 2012 report in which the whole EU meat market was analysed on Theory of Planned Behaviour model (covering ability, motivation, opportunity, satisfaction), the following main conclusions can be drawn. In terms of opportunity the consumers were asked to identify their main sources of information when purchasing meat. The most frequent answers are labels on the packaging (68%) and labels on the shelf/counter (59%), followed by staff at the retailer (56%). Consumers use 4 information sources on average. Three aspects drive satisfaction levels for both satisfied and dissatisfied consumers

and are the key elements of consumer satisfaction: taste, freshness and the availability of meat produced in the consumer's country. Besides the solutions of the general challenges on food safety (allergen management on processed meat, prevention of the pathogens, Listeria, TACCP, etc.) and labelling (labelling of the first freezing time on meat product) the following solutions also contribute for future success of the sector:

A challenge is the prevention of light-induced discoloration of cooked meat products whilst on display in retail stores which is leading to

a lot of waste product. As customers are shying away from buying the affected packs, to better understand the cause and identify potential remedies a project was started. In particular this is the assessment of the effect of potential changes of in store lighting from fluorescent tubes to LEDs.

There is an ever-increasing need to transfer measurement and sensing technology from the laboratory / research area into food manufacturing facilities (at- or on-line). A

major driver is the need for rapid, sensitive measurements to enable quick reaction to changes in product quality or process conditions. This need is best met by detection and sensing solutions which can be integrated for automated control of manufacturing processes, which can also provide quality assurance data and remote monitoring of product quality and process performance.

UV light treatment is a non-thermal, non-chemical technology to inactivate

microorganisms, which has been used to disinfect water/air systems and for surface decontamination (packaging/work surface) for many years. UV light is part of the electromagnetic spectrum, and lies in the range between 100 - 400 nm. It can be subdivided into three categories: UV-A from 315 to 400 nm, UV-B from 280 to 315 nm and UV-C from 100 to 280 nm. Treatment with ultraviolet energy offers several advantages to food processors as it does not leave a residue, and does not require extensive safety equipment to

utilize. It is easy to use and characterised by favourable costs of equipment, energy and maintenance.

Intelligent linking of processes and the increased use of modern information and control technology are increasingly the focus of the meat-processing industry. An important innovation for even more efficient processing lines is the precision-proportioning and fixed-weight packaging. The fully automatic portioning and loading of meat and sausage products of any kind into the packaging requires high-tech solutions. Most systems consist of measuring systems such as laser and X-ray scanners with integrated scales, supply units for the cutting device and also the cutting device itself. Further conveyor belts transport the products to appropriate belt sorting systems with sophisticated shuttle systems or to highly complex robot systems. Further logistics can lead to various autonomous systems or conveyor belts. Robot-based automation in slaughter and cutting

operations remains one of the greatest technical challenges. What a specialist is mastering with his or her senses and many years of experience in cutting, provides robots with major problems. Animals have great differences in weight and size.

In the meantime, however, there are also economic and above all high-performance solutions. The highly developed 3D scanner for determining the topology of the animals makes this possible.



TRENDS AND INNOVATIONS IN MILK PROCESSING SECTOR



Trends and innovations in milk processing sector



Throughout history, milk and milk products have been staples of the diets of young and old around the world. In fact, milk contains nine essential nutrients, making it one of the most nutritious beverages one can enjoy. However, the carbohydrate in milk, lactose, cannot be physically tolerated by millions worldwide, resulting in stomach cramps, bloating and other gastrointestinal symptoms. Therefore strict adherence to prescribed procedures based on comprehensive risk analysis is critical. Critical points are: Pasteurization of Milk, Pathogen Control, Allergen Control, Lactose Intolerance, and Supplier

Control. In summary, dairy product manufacturers have many food safety issues and opportunities that are unique within the food industry. Strict regulations, the potential for bacterial and allergenic issues, ingredient concerns and the need for heightened surveillance of suppliers provide constant challenges. The following solutions contribute for future success of the sector:

Inhibition of pathogens (*Listeria monocytogenes* and *Staphylococcus aureus*) by different consortia has been studied for a large range of traditional European cheeses, such

as Livarot, Tolminc, Gravieria and Saint Nectaire. For each case, significant results have been obtained with the selection/definition or more or less complex consortia involving different levels of pathogens inhibition. The most significant result corresponded to a simplified consortium (called AB) isolated from raw milk, and composed of a limited number of Lactobacillus, leuconostoc and Gram+ catalase + bacteria. By analysing the transcriptome upon contact of Listeria with an antilisterial consortium, it was shown that virulence genes were repressed and bacteriocin sensitivity increased. After acid stress the virulence genes were induced. As a general rule, the inhibitory properties of the different consortia may be rather attributed to suitable

balance between different microbial populations with an important role of lactic acid bacteria rather than one population.

A general mathematical package based on artificial neural networks (multilayer perceptron, radial basis function) was developed to describe the effect of food structure and composition on microbial growth of L. monocytogenes. The average deviation of predicted from observed values for the growth of the pathogen ranged within acceptable limits compared to literature data. The impact of food texture on L. monocytogenes growth was studied on model gels mimicking dairy products. Gelling agent concentration

and temperature had a great influence on L. monocytogenes growth rate, and high gel concentrations (carrageenan based) could inhibit growth.

The versatile and cost-effective applications combining Spectral Fluorescence Signature (SFS) analysis with chemometrics techniques offer an efficient and effective method for the determination of contaminants and impurities in our food supply. NarTest has developed a wide spectrum of customized screening applications for the portable spectrofluorometer NTX2000, that allow quick and easy safety and quality analysis of variety of foods incl. milk and dairy products, meat, vegetable oil, spices, fruits, alcoholic beverages.

TRENDS AND INNOVATIONS IN FRUITS AND VEGETABLES' PROCESSING SECTOR





Trends and innovations in fruits and vegetables' processing sector



FRUITS AND
VEGETABLES

Specific challenges are the introduction of new for Europe pathogenic bacteria and virus strains, but also parasites and nonetheless contamination of known vegetable products with closely related, but harmful vegetable species (cases of consumers' intoxication by consumption of star anise tea contaminated with Japanese star anise) or unexpected reactions producing toxic substances during food processing, like synthesis of benzene from benzoate, used as preservative, and vitamin C. Unexpected food safety risks are also resulting from criminal activities like food frauds and counterfeits.

The following solutions contribute for future success of the sector:

Temperature monitoring and last-mile disposition system with a smart system. Tsenso is a wireless sensor to monitor the cargo temperature, which is a complete monitoring solution with smart predictions and early warnings, suited for all kinds of transportation in the range of -25°C to 70°C. The sensor is continuously transmitting temperature values to the cloud via a mobile App. The intelligent algorithm is then calculating the probable evolution of the cargo temperature and predicting the

remaining time for the cargo to reach its limit temperature.

HACCP system has proven to be effective against accidental contamination. However, companies have to think about deliberate contamination or fraud as well. TACCP (Threat Assessment Critical Control Point) is a risk management methodology which aligns with HACCP, but it is focuses

on to improve the resilience of the supply chain against fraud or other form of attacks. One of the digital identification solution is available on <http://www.cssgplc.com/biometrics/>.



temperature
monitoring

HACCP system

TRENDS AND INNOVATIONS IN GRAIN PROCESSING SECTOR



Trends and innovations in grain processing sector



GRAIN

The gluten-free products are important for people who suffer from coeliac disease (CD), an immune mediated enteropathy causing inflammation in the small intestine. It is triggered by the ingestion of prolamins from wheat, rye and barley (“gluten”) in genetically susceptible individuals. The following solutions contribute for future success of the sector:

The European Commission is intending to propose maximum levels for ergot alkaloids in unprocessed grain from 2017. Ergot is the name given to the sclerotia of the fungus *Claviceps purpurea*,

which is widespread and infects many cereals, including wheat, rye, barley and oats. A sensitive mass spectrometry-based method was developed by Campden BRI UK to detect the six major ergot alkaloids as defined by EFSA (ergometrine, ergotamine, ergosine, ergocristine, ergocryptine and ergocornine) and their corresponding epimers at levels as low as 1µg/kg. The validated method has been accredited by UKAS to ISO17025.

The determination of gluten is quite expensive and time consuming. The quick and qualitative dip stick for gluten analyses (RIDA, QUICK) Gliadin, for raw and processed materials were tested and in both cases gave very good performance, so it can be used well for process verification at company level.



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TRENDS AND INNOVATIONS OF ALCOHOLIC AND NON- ALCOHOLIC BEVERAGES



EFSA
ergot alkaloids
Gluten free



Trends and innovations of alcoholic and non-alcoholic beverages



ALCOHOLIC
AND NON-
ALCOHOLIC

During the past ten years major changes have occurred in the global beverage market. Functional beverages and bottled waters constitute the fastest growing sectors. Energy drinks and non-alcoholic malt beverages are also gaining popularity. Many modern beverages have higher level of nutrients for microbial growth, lower acidity and / or milder carbonation level compared to traditional soft drinks. Thermal and chemical preservation have also been reduced. The following solutions contribute for future success of the sector.

Beer with different fruit flavours- pasteurization to keep microbiological stability and satisfied quality. Contamination of beer by spoilage micro-organisms remains a considerable challenge for the brewing industry. A lab-based method was developed to accurately model the rate of microbial death during pasteurization. The approach allows to see how increasing the level of pasteurisation impacts the survival of even thermo-tolerant microorganisms so that an optimal pasteurization regime for a specific product can be advised.

Many foods and food contact surfaces are washed or cleaned by either spray or deluge of water. Further research in Japan, using nano-scale bubbles in water, has also shown potential for practical improvements in cleaning. There is great potential for the use of this technology. Modifying the properties of the water by introducing air into the liquid provides the additional cleaning forces.

Global Beverage Market



Interreg
CENTRAL EUROPE



I-CON

European Union
European Regional
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About the authors

The I-CON project partnership was made upon knowledge and experiences from past and current initiatives dealing with innovation and cross-sector topics, with emphasis on food sector. Special thanks to the staff members of the partner organizations.



Pomurje
TECHNOLOGY PARK

Gospodarska
zbornica
Slovenije

Zbornica kmetijskih
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