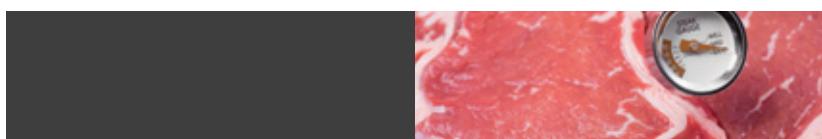




Foodbest catalogue of business opportunity areas

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Introduction

Within the context of a possible Food4Future KIC, Foodbest aims to turn global challenges within Food and Health, Food security and Sustainability into business opportunities that create economic growth and increase competitiveness in the European food sector.

During the past years, Foodbest has compiled the Business opportunity areas in close dialogue with relevant stakeholders from the food industry and the academic world. Industry requirements and academic competencies have been compared, and potential Business opportunity areas have been identified.

Across Europe, this adds up to a total of 30 Business opportunity areas (BOAs) which are described in this catalogue. Some of the areas are broad and some more narrow. The 30 BOAs should be seen as a start of the creation of innovation platforms that can populate a KIC. The BOAs, and therefore also the platforms, will overlap and connect to each other. This will always be the case when dealing with problems in a sector. However, it is impossible to work on innovation platforms covering all challenges, the food sector as a whole including the full value chain.

We, the content working group of Foodbest, hope that this can fill the aim of being a inspirational starting point for discussions on how to programme a KIC through thematic innovation platforms which are functional for the entire knowledge triangle – innovation – education and research.

Foodbest still needs valuable input from relevant and committed stakeholders to provide the organization with sufficient weight and arguments to be able to submit a proposal for a winning KIC bid. Give us your input on the BOAs through the participation in the Business stakeholder meeting. You and other companies will select the Business opportunity areas to be included in a possible Food4Future KIC.

The Content working group
Foodbest

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Innovative and sustainable approaches to improve plant raw materials

Objectives and goals

Improve the productivity and sustainability of the agro-food chain while enhancing the quality and healthiness of food products deriving from plant raw materials.

safeguarding environmental biodiversity and load, and protecting consumer and animal health, especially for raw materials used as feed. Common indicators for assessing the quality of raw materials should be developed and validated.

Challenges to be addressed

Challenges within “Food Security” will be addressed through the selection of target traits such as yield and resistance to diseases and pests. The “Sustainability” challenge is also pressing in view of the negative effects of climate change and the dwindling availability of natural resources required for intensive crop production, particularly water and soil. Also, challenges within “Food & Health” are addressed through the tailoring of strains and species suitable for novel and healthy products.

Long-term competitive advantages

Effective selection of novel plant strains coupled with advancements in production techniques (e.g. precision farming) will lower production costs of raw material and will accelerate the production of novel products specifically targeting consumers’ needs. This will provide the opportunity for patents that will play an increasingly pivotal role in the competitiveness of the agro-food chain.

Description

Improving the output of raw agricultural material will require a better understanding of the functions that underline plant productivity and how they adapt to a rapidly changing environment. Genomics offers a new paradigm to dissect the functional and mechanistic basis of crop production while offering unprecedented opportunities to improve the effectiveness of selection and harness the allelic richness of plant biodiversity. It also offers the chance to tailor new strains and species with novel features that can positively impact consumer health and wellbeing while reducing agriculture’s impact on the environment.

Novel techniques and tools have to be developed in order to decrease the environmental burden and resource consumption related to cultivation techniques, allowing rationalization and more efficient use of available resources. This will also include the possibility to address problems relating to guaranteeing plant health while

Value chain

Consumers will benefit from enhanced raw material production and improved food quality. A more efficient production of raw materials will decrease the ecologic footprint, including the impact of agriculture on environment (e.g. lower CO₂ release, lower resource consumption per unit of product). Selected crop cultivars that are more tolerant to pathogens and pests will reduce the use of chemicals and/or provide consumers with healthier products (e.g. lower mycotoxin content, enhanced vitamin or fibre content).

Competencies and knowledge requirements
The skills required to fully harness the potential of genomics and other advanced technologies requires understanding of the suite of molecular and bioinformatics tools required to identify and clone genes and characterize their functions. Additionally, a multidisciplinary approach is necessary to ensure that basic knowledge will impact the production of raw material and translate into products meeting farmer and consumer needs.

Examples

- Develop tailored strains and species suitable for novel and healthy products (e.g. manipulation of starch metabolism in cereals to prevent obesity).
- Identify and clone the genes regulating the key metabolic steps for production of specific molecules to enhance our capacity to produce novel products.
- Marker assisted selection (MAS) and genomic selection (GS) will accelerate the rate of gain from selection for target traits (e.g. resistance to diseases and pests).
- Breeding of plants adapted to environmental stress, e.g. drought, caused by climate change, resulting in higher quality and yield.



Improve gastrointestinal health

Objectives and goals

Develop foods that contribute to gut health throughout life from neonate to old age based on understanding the interaction between foods, gut microbiota and gut physiology and functions.

Challenges to be addressed

This business opportunity area targets global challenges within "Food & Health" by exploiting how diet can improve human health. Developing targeted foods that are capable of improving human gastrointestinal health can positively influence not only human health, but also wellbeing and quality of life.

Description

There is increased knowledge to support the hypothesis that interactions between foods, the gut microbiota and the intestinal and colonic mucosa play a major role in gut health issues, such as Inflammatory Bowel Disease (IBD), Pouchitis and even Irritable Bowel Syndrome (IBS) and other health related disorders such as food intolerance, coeliac disease or obesity.

This provides an opportunity to tailor food products targeting specific modifications of the gut microbiota for a wide range of consumer groups including healthy subjects or individuals with gastrointestinal disorders.

To produce substantiated tailored food, knowledge is required about human gut microbiota composition and diversity, how food impacts on these, and the relationships between food, gut microbiota and gut physiology and dysfunctions. Targets for foods acting on gastrointestinal health are gut microbiota, intestinal and colonic mucosa and the gut-associated Lymphoid System. Examples of active components include prebiotics and fibres, microorganisms (e.g. probiotics), and plant bioactive components.

Long-term competitive advantages

The current product market demonstrates that consumers are generally willing to pay more for food products with verified health benefits. This business area offers companies the opportunity to create ingredients and food products with substantiated health claims, with potential long-term competitive advantages both within and beyond the European market.

This provides an opportunity to tailor food products to target specific modifications of the gut microflora for a wide range of consumer groups.

Value chain

Companies involved in producing foods and food ingredients with the potential for demonstrating gut health improvement and related disorders will particularly benefit from developments in this business opportunity area. It is envisaged that this area will provide opportunities to develop new ingredients and food products as well as enhance the value and appeal of existing products.

The food industry will also benefit from collaborations with the academic world and regulatory bodies, where open dialogue and exchange of knowledge and expertise will provide mutual benefits for all stakeholders.

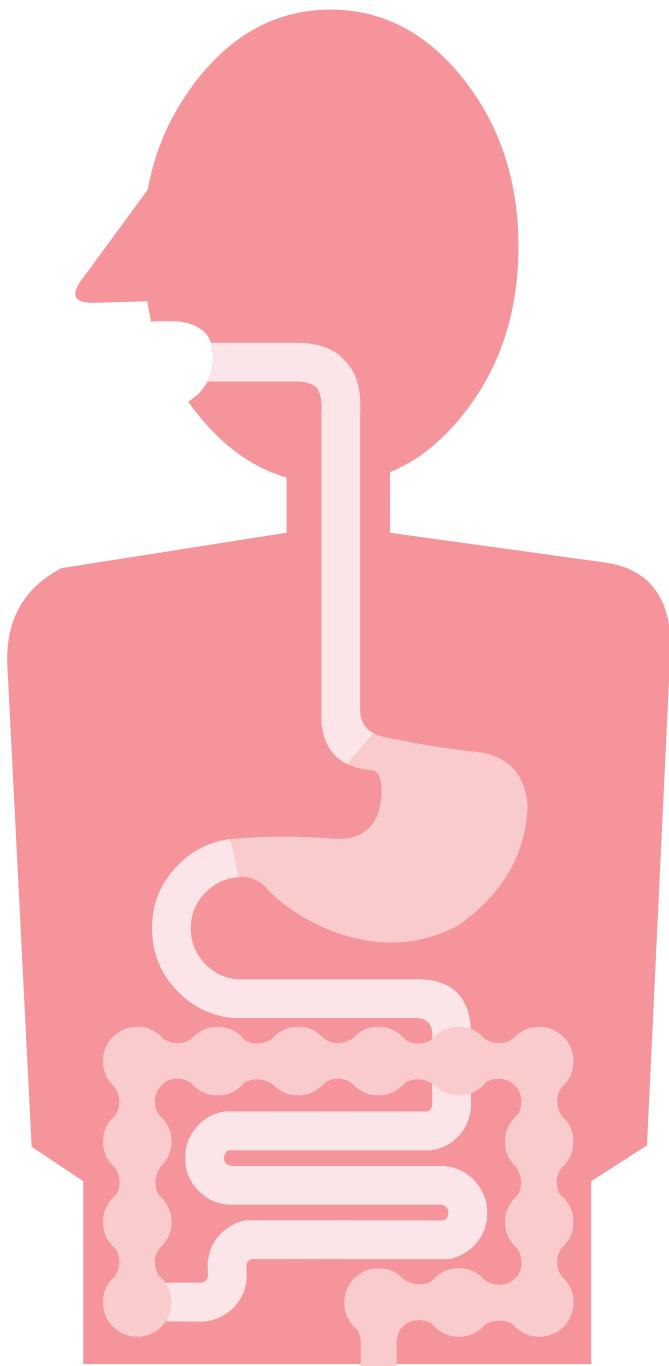
Consumers will also benefit from food products that are specifically produced to improve gut health and overall health. This applies to consumers who are already at risk, or suffering from gut health issues, as well as the wider population.

Competencies and knowledge requirements

In order to develop and produce substantiated foods for improving gut health, insight into gut microbiology, ecophysiology and the pathophysiology of gastrointestinal disorders is required (e.g. understanding the roles of genetic susceptibility, immune dysfunction and gut microbiota). Also, it is essential to know more about the dietary habits of consumers, as well as to have an understanding of the interaction between dietary habits and physical activity and their impact on gastrointestinal health.

Examples

- Functional foods and ingredients for improving gut health (e.g. pre- and probiotics, fibres).
- Formulation of new functional products based on identified microorganism and new bioactive compounds from vegetables, and their impact on immunological activity.
- The role of microbiota in the biotransformation of food components and its effect on mucosal homeostasis, GALT function and intestinal functions.



Improve taste and quality of foods by understanding consumer perceptions and preferences

Objectives and goals

Design healthy, high quality and excellent tasting food products based on the improved understanding of consumer perceptions and preferences.

Challenges to be addressed

In particular, this business opportunity area targets global challenges within "Food & Health" as consumer perceptions and preferences are crucial for ensuring that the right food products reach the right consumers. Also, the ability to improve food quality and increase health benefits in a sustainable manner will ensure that the global challenges within "Food Security" are positively influenced.

Description

This business opportunity area addresses consumer demands for tasty food products of specific nutritional value (e.g. low fat, low salt, high protein, slow release carbohydrate). Differences in sensory needs and demands of various target groups (e.g. the elderly, culture groups) for different products, occasions and places have to be identified and taken into account.

Hedonistic aspects of foods are closely related to sensory attributes such as texture and flavour. Research into the relationship between food composition, microstructure, physiological aspects of structural breakdown, flavour release and adhesion in the mouth during mastication, and dynamic sensory perception will provide knowledge of how to obtain foods satisfying specific sensory demands.

In addition, satiety-inducing food (e.g. taste-induced satiation) can be used to regulate food intake and so as tools for tackling the growing problem of obesity. Research into the causal relationships between

sensory properties, food texture, metabolic satiety and neurological reward mechanisms is necessary.

Research into the genetics and functionality of taste and smell receptors may provide knowledge of the physiological changes that occur during an individual's lifespan. This may foster the development of food products that match the changed perception of flavour of certain target groups (e.g. the elderly) and/or modulate food intake.

Food texture and flavour are largely affected by production processes (e.g. cooking, fermentation, drying, baking), the interaction between food constituents and storage conditions. Understanding the mechanisms involved will allow optimal texture and flavour characteristics to be maintained or promoted.

Long-term competitive advantages

The failure rate for new product introduction in the retail industry is very high, as much as 80%. Innovation in this business opportunity area will provide food producers with a unique opportunity to develop food products that are more likely to succeed and will support them to stay competitive in a changing market.

Value chain

Understanding consumer perceptions and preferences can be used to develop high quality products that satisfy growing consumers demand for tasty, healthy and nutritious products. Stakeholder involvement along the value chain may reach as far as producers of raw material.

Competencies and knowledge requirements

Suitable methodologies and technologies are required for defining sensory target parameters, and creating food products with superior organoleptic properties. To this end, competences and knowledge are needed on e.g. food sensory attributes, sensory technologies, flavour analysis (taste panels, advanced analytics), food processing, food (bio-)chemistry, human nutrition and physiology, obesity, and psychological and social aspects (incl. consumer studies).

Examples

- Design or optimize products and cooking techniques to maintain and promote optimal sensory quality.
- Design or optimize products with specific texture to ensure taste and palatability by new non-thermal technologies.
- Development of food product validation methodologies based on consumer perception.
- Development of innovative techniques (e.g. electronic nose and tongue) for the rapid screening/evaluation of sensory properties of raw materials and food products.



Improve quality of meals supplied in institutions and food services

Objectives and goals

Enable providers of meals in closed settings and of food services to offer healthy and nutritious meals, which match their customers' preferences and fulfil their physical, mental, and social needs.

Challenges to be addressed

This business opportunity area addresses challenges within "Food & Health" and food safety. Improving the quality of food services and meals supplied in various closed settings can ensure a better and healthier choice of food for customers and consumers. A better selection of quality meals targeted to align with consumer preferences and needs can increase health and wellbeing, and contribute to reducing the societal burden of nutrition-related diseases.

Outbreaks of food-borne toxin infection from food and catering services means a continuous approach is needed, focussing on the service environment, including raw material storage, manipulation, cooking, chilling, packaging, reheating and service.

Description

Food supplied in closed settings and by food services is frequently inadequate in serving customer needs in respect of meal quality, nutrient content, healthiness, and variety. Developing a greater variety of nutritious meals and meal components other than pre-prepared (ready) meals, provides customers with a greater choice based on their preferences and needs.

Information about the characteristics, preferences and physical, mental, and social needs of target groups is

essential for improving the quality of meals supplied in closed settings and by food services. Gender, age, health, and cultural background may all affect consumer choices.

Meal quality is determined by several factors. Food production and the correct use of meal preparation systems in the settings where food is provided are important for meal quality. Improvements in the use of cooking methods and hot holding practices enhance taste and nutrient content, and therefore meal quality.

The current lack of information available to the consumer on the nutrient content of meals supplied in closed settings and by food services needs addressing. Nutrient data are calculated on the basis of recipe ingredients, nutrient retention, yield factors and through analysis of prepared menus. The use of expanding food composition databases with more food components (e.g. lactose, uric acid, trans fatty acids) will enable food providers to tailor foods and meals to the more specific needs of target groups.

Long-term competitive advantages

Varied demographics in many European countries will provide the food industry and food service providers with enhanced business opportunities to develop and improve the quality of food services and meals supplied in closed settings. The number of elderly people is increasing, as is the demand for quality meals targeted towards the elderly in closed settings. The general increase in demand for convenience food presents further market opportunities for offering nutritious meals to health-conscious consumers.

Value chain

Several stakeholders from the food value chain play a role in this business opportunity area. Caterers, food services providers and kitchen technology providers in closed settings can all benefit from improving the quality of their products and services. Customers and consumers will obtain larger and healthier choices of food and meals matching their preferences and needs, so contributing to their health and wellbeing.

Competencies and knowledge requirements

Cross-disciplinary work combining competencies within natural and social sciences and within science and practice is needed. This includes knowledge on nutrition, consumer behaviour and preferences, recipes and ingredients, sensory quality of meals, industrial food processing, meal preparation and distribution systems.

Examples

- Develop quality meals targeted at specific groups and settings (e.g. halal meals, vegetarian meals, healthy convenience, school canteens, and hospitals).
- Provide consumer-friendly information about meals supplied in closed settings (e.g. nutritional, food processing, meal preparation, source of food).
- Enable meal providers to fulfil the needs of their customers via training and education.



Innovate in flavours, nutraceuticals, bioactives, additives and other ingredients

Objectives and goals

Develop high-quality, smart and innovative ingredients from known and alternative sources in order to optimize their functionality, taste and health-promoting effects.

to discover and develop new and functional ingredients. In addition, further development of methods, processing and fractioning techniques is essential in order to obtain high quality ingredients.

Challenges to be addressed

Human health challenges and a growing world population highlight the need for collaborative and innovative work on ingredients. This business opportunity area targets challenges within the areas of "Food & Health" and "Food Security" in particular. In some communities, the main aim is to make sufficient nutritious foods available to the consumer, whereas lifestyle-related diseases and general health will be targeted in others. In addition, consumers' growing demand for safe, high-quality food and drinks need to be considered while taking into account issues surrounding "Sustainability".

Long-term competitive advantages

Exploring, developing and producing high quality and innovative ingredients from known and alternative sources will give the European ingredient and food & drink industries a unique opportunity to increase economic growth, competitiveness and greater visibility globally. Global challenges can be targeted through new business opportunity areas, new and optimized ingredients, and new food and drink products in order to access new markets and customers worldwide.

Description

Ingredients are used in the food industry to improve consistency, taste, flavour and shelf life, as well as to optimise health properties, the use of raw materials and waste reduction. Ingredients can also be used to develop tailored foods and drinks that meet the requirements of target groups. For example, tailored food and drink may address areas such as general health promotion, specific disease prevention, and tailored nutritional composition of food.

Value chain

This business opportunity area will target most parts of the value chain from farm to fork. High-quality, smart and innovative ingredients will add value to food and drinks, attracting consumers who focus on safe quality products, who are challenged by lifestyle-related diseases, or who have a particular need for foods with a high nutritional value. Industry and academia will play essential roles in the development of ingredients. In collaboration, they will be able to explore and produce knowledge-based ingredients for food and drinks, increase knowledge and technology transfer, promote industry-driven research, and create spin-outs, patents and value-added products. In addition, plant, animal- and marine material producers will benefit from the opportunity to deliver raw material from both existing and new sources for innovative ingredients.

Ingredients comprise a highly differentiated group such as bacterial cultures, enzymes, emulgators, flavours, nutraceuticals and bioactive compounds. They originate from many sources, with plant-, animal-, marine- and bacterial-based ingredients as the most common. Alternative sources such as algae, fibre fractions and products from side streams should be used innovatively

Competencies and knowledge requirements

Interdisciplinary thinking and collaboration across universities and industries is required to make this business opportunity area a success. Research needs include further studies in the areas of ingredients, nutrition and new technologies.

Examples

- Identify food ingredients from alternative sources (e.g. algae).
- Develop tailored foods and drinks with specific flavours and high added value or healthier properties (e.g. addition of polyphenols).
- Develop delivery systems for optimal health benefits and integrated flavour solutions.



Increase productivity by 30%

Objectives and goals

30% increase in productivity by 2025.
Maintain 2014 input level (index 100).

Challenges to be addressed

This business opportunity area addresses challenges within both "Food Security" and "Sustainability" by increasing the output from a maintained input level (baseline).

Description

High productivity is critical for maintaining the competitive position of the European food production industry. This increase in productivity should be obtained by increasing the output while maintaining the input at the 2014 (index 100) input level. This will foster more efficient food production and, at the same time, will result in more sustainable production through improved utilization of raw materials and reduction of by-products, in addition to reducing the consumption of both energy and fresh water.

Food processes will be redesigned to obtain improved processability through easy maintenance, rescaling and cleaning procedures. In addition, novel and emerging technologies, including those that optimize the use of raw materials (including water) through wastage reduction and exploitation of endogenous organoleptic and nutritional potential, will help to achieve this.

Automation and process analytical technology (PAT) are considered the main keys in productivity improvement. Advanced sensor systems and 3rd generation robotics will be able to analyze raw materials and optimize their use in the subsequent processing steps. In-line quality evaluations of raw materials provide producers with an opportunity to actively control the end product quality by adjusting the process continuously. This will reduce product wastage as a result of production errors or default settings. Advanced analytical technology, including sensor systems, will allow high-throughput selection towards tailor-made raw materials with better

processing quality and yielding products of consistent and improved quality. Access to tailor-made raw materials will be facilitated through state-of-the-art breeding technologies.

By designing a "production and distribution package for the future", it will be possible to cluster together the primary food producers and the processing and distribution industry in a chain with mutual commitment and dependency.

Long-term competitive advantages

Improved processing efficiency will foster improved utilization of raw materials and reduction or valorisation of by-products with a concomitant reduction in energy and fresh water consumption. This results in a more sustainable and cost-effective production chain.

Value chain

This area enables a more efficient food supply chain that benefits individual consumers as well as a growing world population. Simultaneously, the improved utilization of raw materials will also meet the demands of consumers and producers for more sustainable food production across the whole value chain. Involvement of all parties in the value chain is crucial for successfully achieving the goals.

Competencies and knowledge requirements

Innovation within productivity requires a broad base of competences and should be in constant focus (e.g. breeding, food technology, food chemistry, electronics, nanotechnology, IT, mechanics/robotics, water and energy management). It is important to focus on the whole value chain. Therefore interdisciplinary competences should be obtained through a comprehensive dialogue between education and industry.

Examples

- Improve processability through development of easy maintenance, rescaling and cleaning procedures.
- Develop advanced sensor systems and 3rd generation robotics to select specific quality traits in primary production and analyze raw materials for better utilization in food production.



Tackling obesity and the metabolic syndrome

Objectives and goals

Develop novel food products and meal concepts that will provide consumers with a multitude of safe, nutritious, attractive and tasty food choices that will counteract development of obesity and metabolic syndrome. The associated cognitive impairment is also addressed.

Challenges to be addressed

The number of people who are overweight or obese has increased globally since 1980s and is the fifth most prevalent cause of death worldwide. Obesity and associated health problems are becoming endemic in a number of European countries, and changing to a healthier diet and a more active lifestyle is essential. This business opportunity area targets a serious global challenge within "Food & Health". Food quality has a major impact on overweight and obesity. Lifestyle diseases such as obesity and metabolic syndrome have a significant negative impact on quality of life and healthy ageing, and this business opportunity area addresses the potential for food products to support consumers in improving their approach to diet and health. The challenge related to obesity and the metabolic syndrome also includes the associated cognitive decline. Particular challenges relate to development of foods for adolescents and small children, and to offer foods and meal concepts that can be adopted at a family level.

Description

This business area focuses on the development of foods that form part of diet adapted for weight control and related health benefits. One of the approaches for tackling obesity is through the development of food and food formulations that address weight management and satiety. Specifically, substantiated food products will be developed, for example:

- Low-calorie, palatable and nutritionally complete foods with high satiety efficacy.
- Food materials resistant to digestion in order to reduce the available calories within foods.

- Functional foods and ingredients that enhance the satiety response, increase satiation and extend satiety such as peptides, prebiotics, fibres and textured products.
- Digestion-delaying formulations so that the consumer does not fully digest the food and hence gains fewer calories.
- Formulations triggering intestinal receptor systems to link the gut-brain interface (e.g. peptides that trigger receptors and gut taste receptors).
- Novel technologies for targeted delivery.
- Food concepts targeting sub-clinical inflammation, including aspects related to food processing conditions.
- Food concepts reducing risk of obesity, metabolic risk factors and cognitive impairment associated with metabolic syndrome.
- Meal concepts including timing of meal constituents.

Long-term competitive advantages

This business opportunity area targets challenges that are truly global, and can lead to increased competitiveness in the food industry. Obesity and resulting lifestyle challenges exist in both the developed and developing world. Consequently, the food industry has a great opportunity to develop and supply foods with credible health benefits to widely diverse populations. This opportunity will be further enhanced through validation of the health claims by the appropriate regulators worldwide.

Value chain

The food industry will benefit from this business opportunity area in cooperation with the academic world and regulatory bodies. This area is equally amenable to the development of products aimed at the wider consuming population (the "worried well") as well as to compromised populations under medical supervision (the clinically obese).

Competencies and knowledge requirements

Knowledge within a number of disciplines such as nutrition, endocrinology, weight management and satiety, metabolomics and genetics is necessary for this business opportunity area. Competence in characterisation of the gut microbiota are of particular interest, as are studies linking dietary choice to possible effects on. Developments in genetics and metabolomics of affected and non-affected populations need to be harnessed in order to relate genotype and phenotype to risk factors and diet. This will allow the targeting of groups that will actually respond to the food products developed in this business area. An important feature when addressing the challenge of obesity and its application in the food development process is the need to avoid nutritional imbalances in consumers when using weight-controlling foods that either delay digestion or reduce appetite. Additionally, the competence within the industry on functionality of different ingredients, food processes and unit operations, including extraction of potentially bioactive components is crucial.

Examples

- Role of the gastrointestinal tract in food uptake (e.g. gastrointestinal peptides and their receptors).
- Identification and/or development of functional foods or ingredients that target food intake control, appetite regulation and/or increase or prolong satiety (e.g. peptides, prebiotics, fibre, texturized products, microorganisms and bioactive compounds).
- Production of palatable food products with high satiety efficacy but low in calories.
- Genetic and metabolomic profiling for controlling body weight and onset of diseases.
- Clinical validation of new food products in relation to health claims about weight loss.
- Production of foods that beneficially affect key metabolic risk factors and reduce risk of contracting diabetes and cardiovascular disease
- Production of foods that counteract metabolic risk factors and associated cognitive decline by addressing the gut-brain axis.



Develop healthy food products for specific subgroups at risk

Objectives and goals

Develop multifunctional and palatable foods with beneficial health properties for specific target groups to prevent and/or treat diseases and other health conditions.

new food, drinks and formulations (e.g. tailor-made fortification of food products, reduction or replacement of nutrients, high-satiety products, nutraceuticals, etc.).

Challenges to be addressed

On a global scale, human health needs attention. Lifestyle diseases and other compromised health conditions are negatively affecting life quality and wellbeing. This business area provides an opportunity to address the “Food & Health” challenge by developing targeted food and drinks to prevent health outcomes for specific groups of people.

Long-term competitive advantages

Many consumers are willing to pay more for food products if health benefits are conveyed in a credible and clear way. The ability to produce proprietary ingredients or food products with substantiated health claims to address individual needs will ensure long-term competitive advantages for the European food and drink industry.

Description

Diet plays an important role in defining health conditions, making targeted foods highly relevant to maintaining health. The overall challenges are to avoid the need for medical interventions. This can be achieved by preventing or delaying onset of disease, or by further designing or administering specific targeted diets for their treatment.

Development of personalized nutrition for individual target groups requires knowledge of the mechanisms at the basis of the dietary health-modulation in each specific subgroup. Target groups could include pregnant women, children, bariatric patients, risk groups such as allergen sensitive, type I diabetics, and those affected by cardio-vascular diseases and metabolic disorders (e.g. ketonuria).

Research and identification of specific micronutrients and bioactive compounds is necessary in order to develop

Value chain

Consumers can be helped to achieve their specific health goals using food products with beneficial health properties.

Also, building trust among consumers is seen as a key issue. Targeted products promise specific benefits that are often health-related. Verifying these effects, legislation on health claims, novel food regulations and food safety issues are important. Building trust requires cooperation and transparency with all stakeholders, including the academic world, industry, regulatory authorities, the media and interest groups.

Ingredients and food producers are the primary beneficiaries, as they will have the opportunity of adding foods with health claims to their portfolio of products. Identification and processing of healthy food and drink products will foster development of new processing and production technologies.



Competencies and knowledge requirements

Successful development of health-promoting food products requires a combination of knowledge about biomarkers of human health, the efficacy and biological activity of ingredients, and an understanding of dietetic or nutrition requirements, as well as consumer culture and preferences, to mention a few.

Examples

- Development of new food formulations (targeted functional foods).
- Development of personalised nutrition for individual target group and group at risk.
- Development of non-allergenic foods.
- Production and clinical validation of cereal derivatives with low concentration of gluten.
- Identification of new microorganisms and bioactive compounds targeted to different types of allergies (skin, food, seasonal allergies) for the development of new functional foods.
- Development of rapid methods (biosensors/ICT-solution placed on processing lines) for the detection of allergens in fresh/ processed foods or raw materials (vegetables/ plants).

Healthy foods for healthy people

Objectives and goals

Deliver health benefits to consumers by developing new food products or optimizing existing food products based on a comprehension of human physiological mechanisms related to consumer lifestyle. Furthermore, to identify new concepts associated with different consumption opportunities (at home, outside, at work, formal and informal situations, during leisure time, etc.) to ensure a balanced diet.

Challenges to be addressed

In particular, this business opportunity area targets challenges within "Food & Health" and "Food Security". Inadequate human health and a growing world population call for easy and secure access to foods with substantiated health promoting properties.

Description

Worldwide public health authorities consider food reformulation as the easiest strategy to obtain public health benefits in the short term. Food reformulation is defined as developing new food products that are low in undesired nutrients and/or high in beneficial nutrients. In particular, the reformulation of foods to contain less salt, fat and sugar and/or increased amounts of ingredients positively impacting human health is important for the well-being of the general population. For example, the sodium intake should be reduced by approximately 50% for European citizens. Increasing the content of beneficial nutrients includes increasing the protein and fibre content without compromising taste or palatability of foods. Another important area is identifying and maximally exploiting bioactive compounds of plant and animal origin with health promoting qualities.

Physiological insights into, for example, organ function, gastrointestinal tract function, gut-brain axis, and long term versus short term physiological effects after food

intake all provide valuable knowledge that can be used in the development of new food products and/or optimizing existing products.

Palatability and consumer acceptance of reformulated foods is in focus, since food cultures differ across Europe and influence the purchasing decisions of consumers. Taste and rheological properties are essential to developing foods with adequate consumer preference and these properties can be modulated as a function of age, living area, traditional habits, etc. of the target group. These factors must be taken into account both in relation to product development, with a view to improving the quality of the food industry's product portfolio, and in respect of marketing activities to successfully introduce reformulated foods to the market.

Besides reformulation as discussed above, foods with superior nutritional properties (e.g. increased nutrient bio-availability) can be obtained through intelligent processing of raw materials.

Long-term competitive advantages

The European food industry can achieve higher competitiveness through reformulating foods and developing new food products with health promoting benefits for consumers. Doors for new markets will open, and by balancing nutritional benefits with consumer acceptance and desires, the food industry will gain valuable expertise about consumers' present and future needs.

Value chain

The end user of reformulated and new food products with added value and health benefits is the main beneficiary as the consumer gains access to better health. The European industry, comprising businesses such as Fast Moving Consumer Goods (FMCG) companies, ingredient solution providers,

bulk ingredient processors (e.g. fibre producing companies) and manufacturing companies will benefit through an enlarged product portfolio and increased competitiveness. One of the other benefits for the industry is that the risk of product market failure will be mitigated by involving many disciplines, pooling European resources and successful experiences, and by using industry associations.

Competencies and knowledge requirements

Competences are required to validate the health-promoting effects of reformulated and new foods. This includes competences within nutrition, physiology, bioactive compounds, product development and processing technologies. Also, competences on sensory

qualities, consumer acceptance and preferences, and marketing management are required to make this business opportunity area a success.

Examples

- Palatable food products with reduced salt, fat and/or sugar content.
- Tasteful food products with increased fibre content.
- Low salt bakery, cheese and meat products.
- Overcome technical hurdles in reformulation strategies, e.g. shelf life, stability, water binding capacity, flavour release, crispiness and microbial safety.
- Identifying bioactive compounds with effects on brain development and cognitive performance.
- Products with increased nutrient bio-availability.



Create new automation tools in food handling

Objectives and goals

Develop and implement new tools for automated food handling, including sensor technology, data collection, processing and transfer systems, statistical process control and robotics and grippers.

Challenges to be addressed

Automation in food handling addresses challenges within "Sustainability". Tailored automation is an area contributing to the sustainable growth of the food industry by allowing a better and more flexible adaptation to demographic changes and manpower availability in Europe. Automation in food handling can increase food safety and quality thereby benefiting consumers.

Description

At present, many food handling processes are manual due to complexity and variability in the form of, for example, food form, structure, composition, shape and size, and the requirement for integrated quality and safety inspection by staff during food handling.

Automated food handling systems have to be tailored to match the different requirements of production facilities and product portfolios (e.g. speed, flexibility, availability of raw materials and product quantity demands). The systems must guarantee high quality, safe food. New sensors and ICT systems have to be developed, using multiple sensor signals to enable automation of more sophisticated quality and safety controls of food items. Also, the ability to communicate with consumers via packaging and special tools (e.g. smartphones, social networking channels) is expected to become much more important in the future in respect of consumer trust and product integrity.

Food handling includes detecting the position and alignment of food pieces, and automated control of quality and grading into different quality classes (e.g. based on organoleptic and safety parameters). Due to the high variability of food characteristics, such exact quality classification is currently not fully automated. Systems capable of obtaining signals from several

sensors can provide more accurate information for food handling.

Consumers want to know more about the food they buy and will increasingly use modern ICT tools to obtain these data. Such data include traceability along the chain, origin of raw materials, and sustainability of the individual food products (carbon footprint and energy consumption). Also, data on the microbiological state of a packed and stored food product will contribute to higher consumer trust in processed food.

Tailored automation is an area that will enable a further sustainable growth of the food industry by allowing a better and more flexible adaptation to demographic changes and manpower availability in Europe.

Long-term competitive advantages

Automated food handling is a prerequisite for the global competitiveness of the European food manufacturing industry. This will be based on reducing manufacturing costs, implementing the use of continuous operating systems, increasing production flexibility related to intelligent control by robot-based automation systems, a high level of food safety and a longer shelf life. New export markets for products may open up.

Value chain

Direct benefits exist for food manufacturers using automated food handling systems, and producers of automated food processing equipment and systems (e.g. sensor and image technologies, ICT-tools, robotics). Opportunities exist for selling more advanced equipment to the food industry, and also to pharmaceutical companies and feed producers. Universities and application oriented R&D institutes will play a central role in establishing principles and developing innovative technologies.

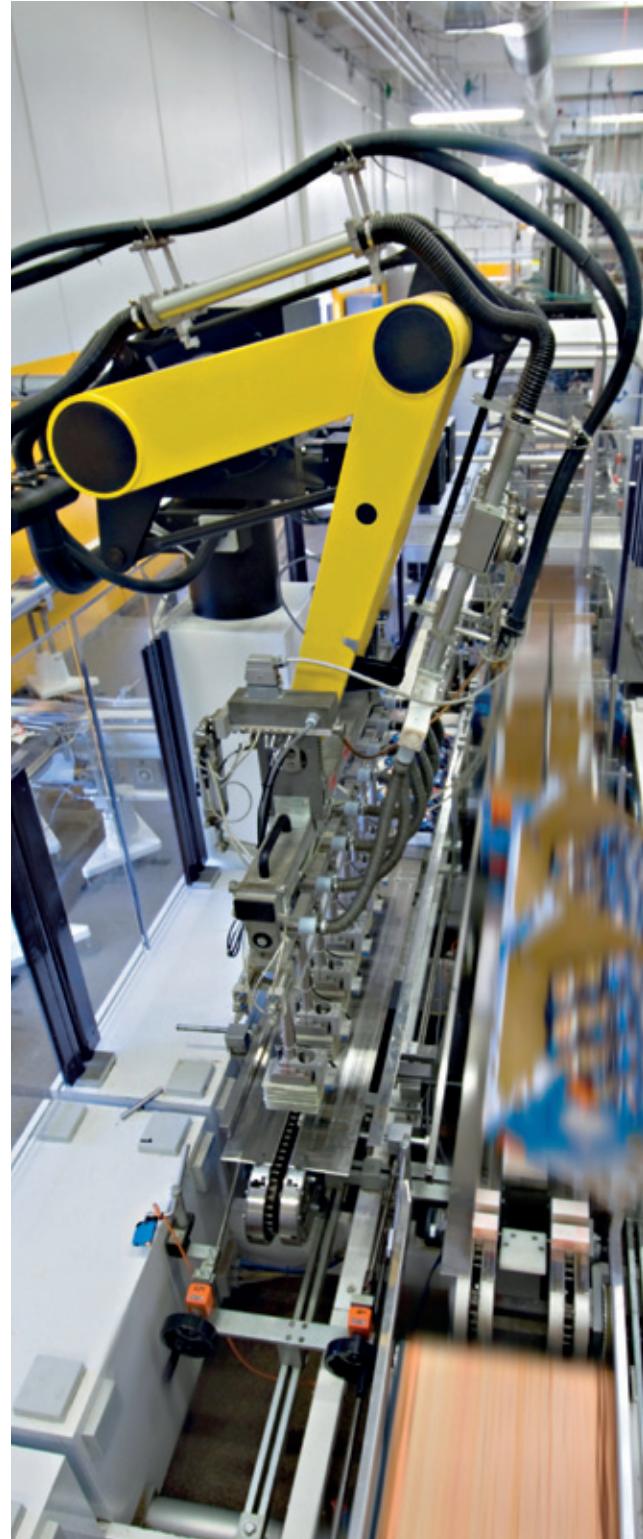
Competencies and knowledge requirements

Knowledge is required about (1) new sensor principles and processing of sensor signals in ICT, (2) food and

food engineering competencies for understanding and modelling the interactions between food matrices, food processing equipment, and sensors, (3) smart packaging with extended functionality and (4) advanced communication technologies (e.g. web-based tools, smartphone apps) for providing information about a food product and its qualities.

Examples

- Intelligent processing of sensor data (e.g. fuzzy logic or self-learning programs) to improve quality and safety evaluation of highly variable food items (e.g. potatoes, meat).
- Development of ICT tools for automatically controlling food processes, and the recognition and identification of final products.
- Development and implementation of technologies for visualisation and analysis of food nano- and micro-structures.
- Development and implementation of technologies for non-destructive, high-throughput, on-line (internal) food quality and safety assessment (e.g. based on computer-aided tomography, NIR-based sensors, biophotonics, acoustics, biosensors).
- Development and implementation of novel sensor (e.g. based on Surface Plasmon Resonance - SPR, lab-on-chip) and imaging technologies (e.g. hyperspectral imaging, 3D-imaging based on tomography) with accompanying biostatistics and software tools for control.
- Development of intelligent packaging systems with intelligent tags with integrated sensors (e.g. based on nano-electronics).
- Development of integrated intelligent food quality and safety monitoring systems.
- Development of advanced diagnostic systems (e.g. lab-on-chip, electronic nose and tongue).
- Development and implementation of precision mechanics for food handling (e.g. for grippers).



Innovate the global food chain

Objectives and goals

Improve the global supply chain by introducing innovations at all process levels, such as raw material sourcing, industrial processing, product innovation and marketing.

Challenges to be addressed

This business opportunity area targets the global challenges within “Food Security” and “Sustainability”. An optimized and improved global supply chain will produce food products competitively with minimal impact on the environment, and give easier access to an adequate supply of food globally.

Description

Food production processes are constantly adapting due to continually changing consumer demands, agricultural output, environmental requirements and sectorial competition. Hence production should be flexible in terms of the availability and quality of raw materials, process technologies, and logistics. More sustainable processing technologies must be introduced based on minimal processing, water recirculation technologies and energy saving measures, whilst maintaining high quality food products with regards to safety, taste and nutritional properties. Products of “quality by design” are products that have a monitored and controlled quality, which is based on a thorough understanding of products and processes. The concept is built on the reverse engineering principle starting with product quality specifications and consumer preference/acceptance and ending with the appropriate raw materials.

Long-term competitive advantages

A flexible and adaptable global supply chain will provide an enormous competitive advantage to the food industry. A global food supply chain, which is more sensitive and responsive to changes in consumer demands, as well as energy costs, environmental impacts and limits in natural resources, will give the food industry a real economic advantage and, at the same time, improve its sustainability.

Value chain

The entire global food chain needs to be involved to tackle this business opportunity area. Although the food industry has a pivotal role in the value chain, all stakeholders from primary producers to consumers should be heavily involved.

Food production is a process in constant adaptation due to continually changing consumer demands, agricultural output, environmental requirements, and competition from other food producers

Competencies and knowledge requirements

An in-depth knowledge of the entire food supply chain is required to ensure resource efficiency and reduced environmental impact. In addition, competences covering knowledge-based processing and product design/optimization must be included.

Examples

- Cold chain optimization and development of alternative sustainable cooling technologies.
- Global distribution of cool chain products outside the cooling chain.
- Identification of appropriate raw materials from product quality specifications and consumer preference/acceptance by reverse engineering.
- Development of optimized logistics tools for monitoring the integrity of food packaging during distribution.



Create new value chains based on waste and by-products

Objectives and goals

Create new value chains through renewed use of side streams from the production of food and drinks

2. Using them for the production of compounds for the chemical and pharmaceutical industry
3. Applying them for renewable energy production
4. Using them, or fractions thereof, as substrates for biomass production

Challenges to be addressed

Global challenges such as "Food & Health", "Food Security" and/or "Sustainability" are addressed through solutions that reduce the amount of waste, and optimize the utilization of raw materials and of side streams from food production.

Fractions containing bio-actives obtained through biorefining of side streams can be used to make products with improved (health) properties.

Description

The amount of waste and by-products from the production of food and drink is huge. New value chains that benefit the modern European food and drink sector economically must be explored and established. Food waste, especially from fruit and vegetables, can constitute the basis for the recovery of an extraordinary amount of functional biomolecules with high added value that could be used in the development and formulation of new functional foods and as natural preservatives in food processing and manufacturing. Besides amendments to existing production chains leading to waste reduction and economic advantages, new/improved methodologies and technologies are required in order to optimize the utilization of side streams in a sustainable way, e.g. for:

1. Turning them into high-value products/ingredients that can re-enter the food production chain (including feed applications)

Long-term competitive advantages

Exploitation of new value chains in food and drink production is important to boost competitiveness and increase sustainability of the European food and drink industry. Indeed, for the same production input, innovation in this area will result in a significant increased usable output and, hence, in economic advantages. The innovative use of waste and side streams from food production presents the industry with a unique opportunity to enter new business areas, product segments and markets, which may result in growth and more jobs.

Value chain

This business opportunity area is aimed at the development and optimisation of new value chains starting from different side streams along today's supply chain. Consumers will benefit from this by gaining easier access to products, including some with higher nutritional value, produced under more sustainable conditions.

Competencies and knowledge requirements

Further development of an interdisciplinary and cross-sector knowledge-base for raw material and 'waste' management/reduction and the development and implementation of new value chains is required. To this end, new methodologies and technologies need to be established through tight collaboration between industry and academia.

Whenever necessary and appropriate, the legal framework should be assessed and changed as well.

Examples

- Development of efficient solutions for detoxification of agro-food wastes.
- Develop new anaerobic fermentation systems to improve yields and production of bio-energy and bio-based chemicals.
- Develop gentler processing procedures to ensure greater utilization of raw materials by conserving nutritional value of constituents.
- Applying novel separation processes to side streams (e.g. to assist in extraction of bioactive compounds).
- Extraction of bioactive compounds to act as functional ingredients and pharmaceuticals in value-added foods, drinks and non-foods, or even in edible and/or bio-degradable packaging materials.



Improve shelf life of food products

Objective and goals

Develop, optimize and implement novel and emerging processing technologies, including packaging technologies, for the production of consumer products of superior nutritional and organoleptic quality, and with improved microbial and quality stability during shelf life.

Challenges to be addressed

This business opportunity area addresses challenges within "Food Security" and "Sustainability". Longer shelf life reduces wastage of valuable biological resources and food products, contributes to a secure food supply, reduces the environmental impact whilst also maintaining nutritional value and microbial safety. Development of technologies such as those that allow longer storage outside the cold chain will significantly reduce the ecologic footprint of certain food products. The development of innovative packaging and packaging materials will contribute to addressing this challenge.

Description

It is of vital importance to maximally exploit current knowledge in order to innovatively design or redesign today's food production systems to obtain novel products with improved organoleptic and nutritional quality, increased safety, minimal processing, and extended product shelf life. This encompasses a thorough understanding of the relationships between food ingredient/constituent molecular properties, processing and preservation technologies used, processing parameters (including fermentation), end-product quality, quality deterioration kinetics, preservation technologies, packaging systems including active and MA packaging, safety aspects, microbial, biological and chemical risk assessment outcomes and microbial growth/inactivation kinetics.

Incorporation, replacement or reduction of certain ingredients/constituents in food products can be used

to reduce costs or improve health-related properties. This requires process redesign to assure quality, safety and acceptable shelf life. Development of validated rapid methods to evaluate/predict shelf life will facilitate innovation in this area.

The ultimate aim is to deliver tasty, nutritious and safe food that consumers can trust, and to reduce waste and environmental impact

To fit with busy lifestyles and less frequent food shopping, consumers not only demand food products that are affordable, safe and of high organoleptic and nutritional quality, but also products that remain safe and retain their quality for longer periods.

Long-term competitive advantages

The availability of state-of-the-art processing technologies will equip the food industry with the necessary means to produce food products of superior nutritional and organoleptic quality, deal with microbial, biological and chemical risks, build consumer trust and enforce a stronger market position. Extending the shelf life of high quality food products can increase their added value, reduce the amount of food waste and provide logistical advantages when accessing more distant markets.

Value Chain

This business opportunity area is an advantage to the processing industry, but it also targets upstream activities (e.g. raw material and ingredient production/supply) and downstream activities (e.g. packaging, logistics, storage,

retail/catering). Input from universities and research institutes is crucial, and transfer of technologies from non-food sectors may end up facilitating innovation. The ultimate aims are to deliver tasty, nutritious and safe food that consumers can trust, and to reduce waste and environmental impact. Even though the main target is industry, consumers are also relevant. The purchase decision of the end-users of food products is influenced by issues such as taste, quality, nutrition, safety, clean labelling, and environmental impact.

Competencies and knowledge requirements

A multidisciplinary approach is required, and disciplines like food technology, chemistry, biochemistry, microbiology, biophysics, rheology, physicochemistry, physics, mechanics, engineering and nanotechnology need to be combined with industrial knowledge about processing and packaging technologies. Consumer and trade marketing competences are required.

Examples

- Develop multiple strategies (“hurdle technologies” to design a series of hurdles to ensure microbial safety of processed foods), e.g. for minimally processed foods and clean label products.
- Develop novel/emerging processing technologies (e.g. high hydrostatic pressure, high pressure homogenization, pulsed electric field, cold plasma) and also use advanced mathematical models.
- Develop rapid methods and tools/equipment to evaluate/predict shelf life in, for example, frozen/stabilized products and fresh critical food types (e.g. fish).
- Develop nanomaterials and edible coatings that release compounds to control microbial quality and enzymatic browning.
- Novel ingredients (incl. enzymes) and/or process (re) design for clean label products.



Reduced water use in the whole food value chain

Objectives and goals

Reduce fresh water use in food production by development of water saving technologies validated in the whole food chain from primary production to consumer, and to develop possibilities for reuse of water for different applications in a safe, economical and sustainable way.

Challenges to be addressed

“Food Security” and “Sustainability” are addressed by focusing on the scarcity and optimal use of fresh water. This business challenge also addresses aspects of the “Food & Health” challenge especially in relation to recycling of waste water.

Description

Water is used throughout the whole food value chain, from agriculture, processing, cleaning and preparation of food. A decrease in water use is of great importance as water is one of the future limiting factors for both agriculture and food production. To reduce fresh water dependency, steps need to be taken at all stages in the value chain. Drought tolerant plants need to be bred, cultivation techniques with less water use need to be developed, processing technologies with reduced water use and less water dependent cleaning techniques and appliances need to be developed. Finally, the amount of fresh water in food production can be efficiently reduced if the recycling of water in different quality classes is made possible. This requires a global standard which should be based on the development of rapid diagnostics for evaluating and classifying water quality and the possibility to tailor the optimal water treatment for the desired water quality. Furthermore water reduction in food manufacturing can be achieved by introducing minimal processing technologies for the utilization of water and steam in heating treatment, e.g. processes based on non-thermal or ohmic thermal treatments.

The main focus is on water but it also addresses energy efficiency and reuse of valuable components in the water (e.g. plant nutrients). Hence, focusing on reduction of fresh water usage in food production will initiate identification of valuable side streams.

Long-term competitive advantages

Implementation of water saving technologies in the whole value chain will help secure our ability to feed the world. Reduced water dependency in the processing part of the chain will reduce the increasing cost for water, thereby stabilising product price. Implementation of a water classification system will result in increased competitiveness through reduced production costs, less waste and improved food production sustainability in response to societal and consumer demand.

Value chain

Water reducing technologies will have a significant impact on the whole value chain. Water prices will increase in the future and decreased water dependency will secure and stabilize the overall food production. Detection and proper management of water with different qualities offers the potential to improve food safety, as well as reduce production costs by minimizing fresh water costs and the disposal of waste water. Overall, this would result in much more sustainable production, benefitting consumers, producers, and society as a whole. Municipalities and communities that use water and generate waste water can also benefit from the new developments in water handling technologies.

Competencies and knowledge requirements

Industry driven research is necessary together with identification of state-of-the-art knowledge of water handling. This area calls for an integrated water management competence centre that arches over the full food value chain.

Examples

- Water fingerprinting.
- Development of water handling technologies.
- Development of water saving agricultural practices.
- Drought resistant cultivars.
- Introducing low water use or steam –based technologies in food processing.



Human cardiovascular health improvement

Objectives and goals

Provide food products which prevent adverse effects on the human cardiovascular system, and formulate new food products suitable for already compromised individuals, for example, those with atherosclerosis and / or suffering from high blood pressure.

emerging solutions underpinned by scientific research include functional food products that lower the levels of colon microbial metabolites that potentially increase cardiovascular risk (e.g. diets rich in red meat). Other novel food and drink products with bioactive compounds and ingredients could promote vascular endothelium protection, and lower hypertension and incidents of atherosclerosis.

Challenges to be addressed

Background: cardiovascular diseases, mainly heart disease and stroke, are the leading causes of death globally. In 2008, an estimated 17.3 million deaths were the result of cardiovascular diseases (30% of deaths globally). The number of consumers adversely affected by cardiovascular diseases places a significant strain on national health systems. It has long been recognized that particular diets can help consumers avoid and manage such conditions, thus supporting a healthy lifestyle and healthy ageing.

The challenges to be addressed include developing ways and means for improving human cardiovascular health using nutrition as the principal driver.

Cardiovascular diseases, mainly heart disease and stroke, are the global leading cause of death. In 2008 alone, an estimated 17.3 million people died from cardiovascular diseases, i.e. 30% of all global deaths.

Target area

This business opportunity area addresses challenges within "Food & Health".

Long-term competitive advantages

The main focus of this business opportunity area will be on populations in developed countries where inappropriate diets and lifestyles have resulted in compromised human cardiovascular systems (e.g. hypertension, atherosclerosis). As the incidence of lifestyle-related cardiovascular diseases is not expected to decrease in the foreseeable future, companies producing existing or novel food products with verified health or nutrition claims will benefit from the widespread opportunities offered in this area.

Envisioned outcomes

Food-based solutions that will result in a significant global reduction in:

1. incidences of cardiovascular diseases, and
2. the demands these disease place on national healthcare systems, especially in developed countries.

Value chain

This business opportunity area will target consumers that are:

- Already at risk of developing cardiovascular diseases; and
- Generally conscious of maintaining good health.

Given the increasing awareness among consumers of the interaction between diet and health, this food category is a good example of where enhanced sales of

Description

It is recognized that diet can either be used to maintain or improve cardiovascular health. Novel intervention food products based on developing existing and

value-added foods can be expected. It is anticipated that major players in this business opportunity area will be:

- The food industry, which will be developing and marketing substantiated health food products
- The academic world
- Relevant regulatory authorities.

The latter two will provide research, knowledge, and an understanding of regulatory requirements.

Competencies and knowledge requirements

Extensive knowledge in the broad scope of cardiovascular health needs to be acquired, and includes an understanding of:

- The role that colon microbial metabolism plays in cardiovascular health (gut protein fermentation and microbial metabolites)
- The involvement of key genetic switches in the health of the cardiovascular system

- The interaction between plant metabolites and the human metabolome verifying the activity of biological compounds in promoting health effects when these compounds are ingested as food.

In addition to the above, all health claims need to be verified by clinical studies.

Examples

- Ingredients that can be used to develop functional foods that can lower the levels of colon microbial metabolites which potentially increase the risk of developing cardiovascular disease.
- New, effective bioactive compounds for incorporation in food matrices (e.g. to reduce hypertension, atherosclerosis, and promote vascular endothelium protection).
- Food products with reduced fat and salt contents.



Optimize food processing

Objectives and goals

The objective is to (re)design and introduce new processing concepts and to develop technologies allowing mild, more efficient processing and production of food products of superior quality (e.g. related to nutritional, sensory and stability parameters).

centralised operations toward more local processing of raw materials, where processing moves upstream. An example of processing moving downstream could be working in collaboration with the kitchen appliances industry to facilitate further food processing nearer to consumption (during meal preparation) in household or institutional environments and for food services. Both will require smarter but flexible processing equipment.

Challenges to be addressed

This business opportunity area addresses the challenges within "Sustainability" by reducing the need for extensive processing, thereby increasing processing efficiency and improving utilization of raw materials. It will also address challenges within "Food & Health" by factoring in health benefits into the development of new technologies in order to tailor foods with targeted functions, including safety, nutritional and sensory quality.

Description

Technological innovations towards improved unit operations such as cleaning, decontamination, cutting, classification, conveying, milling, (dry) fractionation, extraction, drying, blanching, pasteurisation, sterilisation, cooking, optimisation of heat, moisture, gas and mass transport during processing and development and optimisation of processing aids (e.g. enzymes) are within the scope of this business opportunity area.

Innovative control of current equipment will be included, to maximise asset utilisation.

Emerging technologies such as high hydrostatic pressure processing, pulsed electric field technologies, cold plasma, light pulses and ultrasound can be used to develop sustainable and 'mild' food processing concepts. Combinations of traditional processing methodologies (e.g. thermal processing) with emerging processes will be essential to produce safe foods with tailored superior nutritional and sensory quality.

Healthier foods will require optimisation of existing processes when presented with novel formulations.

There is a huge potential in examining the position of processing in new supply chains such as the development of distributed manufacture away from

Long-term competitive advantages

Food chains now exist on a worldwide basis. To ensure continuing competitiveness of food manufacture within Europe we will need to be at the forefront of technical development, both in processing equipment design and manufacturing operations.

Optimising the efficiency in energy, water and raw material use, will ensure that food processing operations remain competitive and sustainable.

Innovation in food processing toward milder processing will result in higher consumer acceptance, and simultaneously provide the consumer with palatable food products in which micronutrient levels are secured.

Processing foods reformulated to deliver healthier macronutrient composition will allow manufacturers to provide sensorially acceptable foods with lower calorie and salt content.

Distributed processing and manufacture will shorten supply chains (easing traceability) and personalise products in line with consumer needs.

Europe should aim to lead these innovations for industrial development worldwide.

Value chain

Optimal food processing can be used to satisfy the growing demand by consumers for safe, palatable food products that are beneficial to their health and produced in a sustainable manner. Therefore, optimized processing is an effective way of influencing the preferences, acceptance and needs of consumers.

The European food industry will benefit from an improved product portfolio and increased competitiveness.

Development of new processing and production technologies will promote growth for equipment providers.

Academic and training organisations will play an essential role by collaborating in industry-driven research, supplying knowledge, developing new technologies, and training the next generation of managers and technologists capable of leading more sophisticated and "smarter" food processing businesses.

Competencies and knowledge requirements

Highly interdisciplinary approaches are required. These will include:

- Integration of innovative processing schemes in existing processing lines, (Engineering for Manufacture)
- The development of radical processing innovations. (Process Engineering)
- Research within process-structure-function relationships, (Chemistry, Physics, Biology and Materials Science)

- Modelling for improved and sustainable food processing and product quality, (Mathematics and Computing)
- Packaging innovations, (Materials Science and Mechanical Engineering)
- In addition, new business models for new innovation need to be fostered (e.g. open innovations for SMEs)

Examples

- Develop combination processes (e.g. moderate heat combined with emerging technologies) for milder processes.
- Develop minimal energy, water use and nutrient loss processes.
- Develop surface decontamination processes (e.g. cold plasma, light pulses) to reduce cleaning downtime and chemical use.
- Design and produce food structures for optimum nutrient content and delivery.
- Develop rapid techniques to monitor food quality and safety.
- Exploit packaging innovations for minimal wastage of product and pack.



Healthy food in a lifespan perspective

Objectives and goals

Increase the health and perceived quality of life of elderly citizens by optimizing individual lifestyles. The goal is to provide health-promoting food products and services for elderly people living at home, in institutions and hospitals.

Challenges to be addressed

This business opportunity area targets the global challenges within "Food & Health". Healthy ageing is important both for the individual consumer and, in terms of the cost, for society. By optimizing nutrition during the human lifespan, it is possible to improve the prerequisites for healthy ageing and to increase health status during all the stages of the human life. Furthermore, ensuring adequate food and developing nutritionally valuable food products are of interest to this business opportunity area.

Description

The focus of this business opportunity area is to improve health in the ageing population by providing health promoting food-related products and services for elderly people, who represent an increasing share of the EU population. Improvements are required in relation to overall food intake, nutritional and sensory quality of foods and meals, with a specific focus on protein, fibre and vitamin intake.

It is important to understand the nutritional and sensory needs of elderly people, how they buy and cook meals, and to translate these insights into food products, meals and logistic services, which could postpone the onset of age-related diseases (e.g. in relation to neurocognitive function, bone loss, muscle loss, intestinal functionality, etc.) or alleviate symptoms of these conditions.

Long-term competitive advantages

The European food industry can stimulate its growth, competitiveness and entrepreneurship by targeting Europe's consumer needs along the entire lifespan, in terms of product development and marketing. Notably, the number of elderly consumers is increasing in Europe, and to a large extent they are affluent, interested in their health, and to date largely ignored by supermarkets and food-related service providers outside the health care and pharmaceutical sectors. The current situation, due to a limited knowledge about this heterogeneous population group, results in the need for market segmentation and implemented product differentiation.

Value chain

The entire value chain is highly involved in and influenced by this business opportunity area. Elderly consumers are rewarded with access to tasty and healthy food products and services. Knowledge institutions and universities benefit from increased research activities and collaboration with the European food industry, and companies benefit through an increased product portfolio and improved marketing opportunities that result in increased competitiveness. Company examples are Fast Moving Consumer Goods (FMCG) companies, food-related service providers, care providers (hospitals, nursing homes, etc.) and technology providers (kitchen equipment, technical aids, etc.).

Competencies and knowledge requirements

A combination of nutritional sciences, behavioural and consumer sciences, gerontology, supply chain management and product development is needed.

Examples

- Development of novel elderly-tailored food products (identification of specific micronutrients and ingredients, development of new formulations)
- Development of foods to postpone the onset of age-related disorders (e.g., bone loss, muscle loss, cognitive impairment)
- Development of transmural nutritional concepts: assisting elderly patients with their food intake before, during and after hospitalisation, to improve their nutritional status.



Optimize logistics systems

Objectives and goals

Reduce logistics costs.

Challenges to be addressed

This Business Opportunity Area (BOA) targets global challenges within “Food Security” and “Sustainability”. The ability of producers to meet food safety and food security requirements will be increased, whilst simultaneously improving production sustainability by reducing energy consumption and waste (including storage losses).

Description

Greater sustainability in logistics will lead to a direct and immediate read-across including reducing carbon emissions and cost efficiency. Logistics providers, manufacturers, and retailers are collaborating more because of, inter alia, environmental and cost-based reasons, and adapting to FMCG (fast moving consumer goods) sector consolidation.

Logistics in the agro-food industry includes: transportation, inventory, handling and storage of materials, packaging and traceability. As well as to lower costs and environmental impacts, logistic systems and chains need improvement to minimize food contamination, spoilage, and wastage and reduce stock inventory needed to assure continuity in production or supply to consumers, for example JIT (just-in-time) delivery systems balancing demand and supply. This must also satisfy consumer needs and expectations (e.g. e-commerce, service, high-speed delivery).

Identifying and analyzing critical control points in logistics systems and chains will enable logistics providers, manufacturers and retailers to undertake targeted actions related to:

- Intelligent planning (e.g. order, transport, and JIT delivery of goods).
- Overcoming physical or material shortcomings resulting in bottlenecks in delivery pipelines (e.g. stacking, dead space, cooling).
- Handling, packaging, and storage of goods, and establishing intelligent monitoring systems (e.g. sensor systems for monitoring cold chain integrity)

to minimize spoilage, contamination and, eventually, product recall.

- Handling of waste/side stream products for recycling or disposal.
- Inventory (in-process/out-of-process).
- Developing optimal company internal structures and procedures.
- Developing and implementing intelligent electronic data collection and exchange systems: allowing efficient connection between actors, and traceability in logistic chains (e.g. ICT-tools, modern information and multimedia technologies).
- Monitoring, controlling, and managing the flow and safety of raw materials and finished goods.
- Optimizing services to the client/consumer.

Lifecycle assessment studies including an evaluation of the environmental and social impact of a product or process from a ‘cradle-to-grave’ perspective may generate new concepts for optimizing logistic systems and chains.

Long-term competitive advantages

Optimization of production logistics will reduce logistics costs, ensure more sustainable and secure food production and delivery, reduce waste and improve food safety aspects and authenticity. This may offer several competitive advantages.

Value chain

This area spans the entire value chain. In addition to cost reduction and sustainability, optimal logistics can contribute to satisfying the growing demands from consumers regarding product history and traceability.

Purchasing decisions are increasingly based on individual needs and values, e.g. allergen content, authenticity, sustainable production, and fair trade. Furthermore, a traceability system may ensure cold chain integrity supporting the delivery of fresh products, and reducing product contamination and spoilage. Logistics providers, manufacturers and retailers will benefit from improvements in shelf-life management and consumer services.

Successful logistics is important to producers as it is of key importance in efficient production management, and for increasing productivity.

Competencies and knowledge requirements

An interdisciplinary network of competence centres is necessary contributing know-how, facilities and infrastructure within food, food production, and logistics. Competences will be required in areas such as biotechnology, robotics and automation, workplace ergonomics, data collection and management (ICT) and consumer behaviour..

Examples

- Improvement/development of (new) post-harvest storage technologies and regimes, optimized for specific horticultural products (e.g. fruit and vegetables).
- Development of new technologies for refrigerated foods to ensure cold chain integrity, less environmental impact and improved energy efficiency. Passive refrigeration and early "in field" refrigeration.
- Development of smart-tags (e.g. with integrated sensors) to monitor, control, and manage the quality and safety of goods along the supply chain.



Utilize and exploit risk assessment

Objectives and goals

Analyse, evolve and develop the already available information of quantitative risk assessment of chemical and microbiological contaminants to support food manufacturing companies, food export and import businesses, and to improve food safety by enhancing traceability and the development of HACCP plans.

Challenges to be addressed

This business opportunity area addresses challenges within “Food & Health” and food safety through the development and implementation of risk assessment strategies that will increase the safety of food supply at national and international levels. In addition, ensuring a safe food supply will enhance successful trade and reduce the amount of waste products due to less spoiled food, and hence the opportunity area also addresses challenges within “Sustainability”.

Description

Food safety will be improved by enhancing traceability and the development of food safety management strategies like HACCP plans. In addition, companies involved in food manufacture, food export and food import require support in respect of quantitative risk assessment.

Internationally recognized standards for risk assessment form the basis of international trade. These risk assessments can be used to inform food manufacturers of limitations and vulnerabilities in the international food chain and in their own production facilities. Risk assessments can be used to enhance efficiency and are the basis on which HACCP plans are described. Accordingly, the further development and implementation of risk assessments can only improve industrial efficiency and safety.

Long-term competitive advantages

Quantitative risk assessments, e.g. for microbiological risks, are one of the accepted criteria adopted by the Codex Alimentarius for international trade. By providing new and updated information to improve risk assessments, the food industry will increase the level of food safety and thereby obtain a long term economic gain. Risk assessments can also improve traceability, which is beneficial to the industry in times of crisis management in relation to product recalls or specific product contamination. In addition, the consumer is safeguarded and protected from products at risk.

Value chain

The entire value chain must to be addressed when developing and improving risk assessment. All links in the food value chain, from primary production to purchase by the consumer, will have to be thoroughly assessed and evaluated in order to further develop risk assessment tools and standards.

Competencies and knowledge requirements

A multidisciplinary approach is required to cover the enormous task of developing and improving risk management systems. Amongst others, there is a need for improved detection techniques and computing resources for handling the relevant risk assessment data sets (e.g. molecular epidemiology, and the associated mathematics involved in the combination of probabilities). Furthermore openness, trust and extensive collaboration between food producing companies, the academic world and regulatory authorities is vital in order to successfully incorporate risk management systems into food production.

Ensuring a safe food supply will enhance successful trade and reduce the amount of waste.

Examples

- Improve information inputted into risk assessments.
- Develop objective indicators for risk assessment.
- Predict and address emerging chemical and microbiological risks (by including stress resistance, biofilms etc. into risk assessments).
- Develop efficient risk communication for optimizing information sharing to facilitate risk assessments and HACCP plans in food.
- Systematically evaluate the risk level for consumers eating specific categories of food products in relation to specific pathogens.
- Develop processing / handling models able to minimise the occurrence of chemical / physical / biological risks



Reduce energy consumption in food production

Objectives and goals

The objective is to contribute to the EU 2020 targets by reducing greenhouse gas emissions by 20 %, increasing to 20 % the share of energy from renewables and increasing energy efficiency by 20 %. (30%, if the conditions are right).

Challenges to be addressed

This business opportunity area targets challenges within "Sustainability" by reducing energy requirements along the entire food value chain.

Description

A large quantity of energy is consumed during, for example (thermal) processing, drying, food preparation, storage (e.g. cooling), packaging and (cooled) transport. The development and implementation of more energy saving technologies, systems and practices, and approaches for energy recuperation and production from renewables (e.g. food waste streams) will deliver a huge economic advantage by reducing costs.

More flexible use of production equipment across the whole value chain and optimization of logistics (incl. planning, shelf life and food quality management during transport in combination with better data utilization to balance supply and demand) will add to reduction of energy consumption. Furthermore, a focus on energy efficiency improvement will foster more rapid development of energy reducing technologies. Energy consumption assessment, monitoring and control [e.g. by use of data collection systems, sensors and software for data handling] along the value chain for different product categories to identify and tackle prime targets

for improvement will further help this development. A prime target could be the elimination of the cold chain as much as possible by getting as many products as possible into an ambient stable state. This will save energy in cool transport, storage, retail and for the consumer. Another target could be to use less water before drying or transport. Packaging issues need to be considered in this frame, regarding the assessment of the ratio between energy saving in prolonging SL and environmental impact evaluated in term of LCA. Reduction of energy consumption will, by default, decrease greenhouse gas emissions and will reduce pressure on the environment and climate.

Long term competitive advantages

Reduction of energy and logistic costs will increase the competitiveness of our food industry. As consumers are becoming increasingly aware of the impact of our daily life on environment and climate, sustainability as a trademark is becoming more important.

Value chain

The entire food value chain is relevant when reduction of energy consumption is addressed.

Competencies and knowledge requirements

It is important to boost competences within food technology, logistics, energy management, data collection and analysis, sensor technology and food quality and safety management.

Examples

- New heating/cooling techniques for food preparation, pressure-based techniques.



Enabling consumers to make informed food choices

Objectives and goals

Develop foods and systems, as well as communication and marketing strategies that educate and enable consumers to make informed food choices that are healthy, sustainable and acceptable long term.

order to:

- Develop and market foods that will be liked and wanted by the consumer and as a result repeatedly purchased and
- Develop strategies that allow the consumer to choose foods and diets that align closely with their preferences and needs.

Challenges to be addressed

Challenges to be addressed include ways in which to:

- Enable the consumer to make choices about food that are both healthy and informed
- Improve the health status of the European population as a whole
- Better equip consumers to make sound choices in respect of: (a) their own health, and (b) sustainability issues.

Consumer preference and choice are broad and complex subjects. Themes that directly involve the consumer as an individual include aspects such as consumer tastes, previous experience, expectation, profiles in consumer health, disease, and nutrition, psychological issues (e.g. related to eating disorders), diet types, and culture. Other themes relate either directly or indirectly to foods, and include functional properties, convenience issues, usefulness, economic factors, food security, and sustainability. In addition to taking this complexity in food development and production into account, it will also be necessary to develop communication and marketing strategies that are targeted towards the differentiated criteria on which consumers base their choice about foods.

This business opportunity area will integrate the biological and cognitive dimensions of consumer behaviour, food preferences and needs, the influence of cultural and socio-economic factors on consumer choices, the role of food security and sustainability on consumer choices, how to innovatively educate and enable the consumer to make healthy and sustainable choices, and the need to take differentiated approaches into account to target consumers' different physiological needs.

Envisioned outcomes

The key to changing dietary habits to a healthier and more sustainable future is in the hands of consumers. Opportunities for improving the overall health status of the European population will be broadened with a corresponding reduction in societal costs associated with the treatment of lifestyle diseases and conditions. Consumers will also be better equipped to make sound choices in respect of their own health, and sustainability issues.

Target areas

This business opportunity area targets global challenges within the areas of "Food & Health", and "Sustainability".

Description

Consumer choices are determined by complex processes that are related to both internal and external factors. It is crucial to understand these processes in

Long-term competitive advantages

The European food industry will benefit from an increased understanding of consumer behaviour, and improved opportunities to develop and market food products that consumers will actually choose. This improves market success of new products. Equipping

consumers with skills to make proper choices (e.g. in respect of health and/or the environment) increases the marketing potential and growth opportunities for the food industry.

Value chain

Outcomes from empowering and educating consumers to make healthy and informed choices about food will be an improvement in the overall health status of European consumers, and will give rise to increased growth and competitiveness of the food industry. In order for this to take place, cooperation between stakeholders in the food value chain is necessary, especially between academia, industry, regulatory authorities, and the media.

Competencies and knowledge requirements

For this business opportunity area to be successful, competencies and knowledge are required within and between different disciplines such as consumer behaviour and preferences, neuroscience, psychology, sociology, communication, economics, education, and information technology. Knowledge about the determinants of consumer choices has to be included to enable the food industry to adjust its food production and distribution, communication, and marketing to consumer realities.

Examples

- Develop an understanding of the complexity of consumer food choices in real life environments such as supermarkets and out of home situations.
- Develop efficient methods to access consumer behaviour and preferences.
- Understand neural pathways that control food choices, food intake, and eating habits.
- Develop education systems for children and families enabling them to make healthier food choices.
- Use intelligent labelling for products of sustainable food production, and clean label products.

Innovative food marketing

Objectives and goals

Develop innovative consumer-oriented business models and methodologies to promote consumer choices towards healthy and safe nutrition as well as sustainable food production.

Challenges to be addressed

This business opportunity area addresses the global challenges within “Food & Health”, “Food Security” and “Sustainability”.

Description

Given that new technologies, including web- and mobile-based applications, are having a dramatic impact on consumer behaviour, the innovative development and implementation of new methods to promote a healthy and sustainable lifestyle is crucial in targeting the needs of individuals. In particular, developing information management systems customized to individual habits, nutritional needs and preferences will be important in order to get easy and immediate access to information about specific food products on the shelves. Furthermore, these systems and methods will allow growers, producers, distributors and retailers to optimize the process and distribution and to acquire knowledge about consumer behaviour and preferences. In addition integration of e-commerce applications with logistics/ transportation management software will make it possible to improve the efficiency of traditional business methods used by European retailers, as well as the creation of new chain concepts and innovative marketing concepts.

Long-term competitive advantages

Knowledge gained about consumer behaviour and preferences will provide the European food and drink industry with a huge advantage and will also

considerably increase their competitiveness and profit. At the same time, consumers will have access to food products specifically produced and processed to meet their nutritional needs, quality and safety demands as well as sustainability requirements.

Value chain

Consumers will benefit from easy accessible and informative knowledge that specifically targets their needs at particular points in time. In addition, companies as well as governmental organisations and public agencies will benefit from the knowledge obtained about consumer behaviour and preferences. Optimized communication channels and information flow between growers, food producers and consumers will also improve the automation and logistics across the entire food chain, thereby enhancing its traceability and providing the opportunity to create innovative solutions.

Competencies and knowledge requirements

Extensive interdisciplinary knowledge about consumer behaviour (including, for example, psychology, sociology, and economics), industrial economics, logistics and management is required. This knowledge should be linked to IT technology and informatics as well as to communication systems. Synergies between industrial partners, universities and research centres, healthy authorities and policy makers will optimize the development of innovative methodologies and their dissemination, including those developed and commonly utilized in other industrial sectors such as ICT and engineering.

Examples

- Development of software for sharing customized information about individual habits, nutritional needs, taste preferences, mapped by mobile apps, and

- managed through a CRM database linked to a customer identification system.
- Development of software to help consumers to evaluate the nutritional and safety information about the food they have purchased.
 - Development of IT technologies to optimize daily/ weekly purchasing, by creating automatic detection software for managing the level of inventories for fast moving consumer goods (FMCG).
 - Development of logistics and automation solutions throughout the market chain as well as innovative selling models.
 - Predictive models for distributors/retailers based on information stored in ticket sales.

Innovative development and implementation of new methods to promote a healthy lifestyle is crucial in targeting the needs of individuals



Combat food pathogens and prevent contamination

Objectives and goals

Improve the microbiological safety of food products by controlling and preventing the entry of foodborne pathogenic bacteria at any point in the food chain. This will be achieved by improved formulation of foods, application of novel and existing processing, and exploitation of novel sensor technologies for prevention and detection and implementing risk assessment at an industrial level.

Challenges to be addressed

Food related disease is a serious concern for otherwise healthy consumers and can be life threatening to an already at risk population. In addition, interactions with inherited conditions can result in chronic illness which imposes significant burdens on healthcare systems.

Target areas

This business opportunity area mainly addresses the challenges within "Food & Health." It also addresses "Food Security" due to the consequences of food spoilage and subsequent food losses.

Envisioned outcomes

Opportunities for improving the overall health status by means of a significant reduction of food related diseases from pathogenic microorganisms.

Description

The presence of pathogenic bacteria in food products continues to challenge the food industry and contributes to unacceptably high incidences of food related diseases in most world populations. It is well recognized that food related diseases have a considerable impact on the consumer and on society, and carry a considerable risk for companies, in terms of product recall, loss of market and loss of consumer trust.

The main focus of this business opportunity area is therefore the development of safe food formulations and food processing systems for the prevention and control of foodborne pathogens along the entire food chain. Some of the ways this can be achieved include:

- The design of hygienic production equipment,
- The use of mathematical modelling for microorganisms to improve food formulations,
- Implementing Microbiological Risk Assessment at an industrial level,
- The application of existing and emerging food processing technologies,
- The integration of smart raw material testing and early risk assessment, to lower risks before production.

In addition, this business opportunity area offers the potential for inter-sector adoption of state-of-the-art sensor and detection technologies from non-food applications, including: (1) the development of methods for fast recognition and early and rapid alerts systems indicating the presence of biological (pathogenic) contamination; and (2) in situ control and monitoring to efficiently evaluate bacterial contamination (e.g. using wireless biosensors).

Long term competitive advantages

Food free from pathogens is to everyone's advantage. Accordingly, strategies developed in this business opportunity area will find applications that benefit food producers as well as consumers across all food sectors and all food types. The food industry will enhance their market position and competitiveness by virtue of being able to produce and market safe food products.

Value chain

Microbiological food safety is an absolute priority for the food industry. Therefore mitigation technologies and testing methods, developed within this business opportunity area, as well as predictive stochastic models to predict the contamination level at different stages of the processing chain, can be applied across all

categories of the food sector. Also, other stakeholders in the food value chain are of primary interest, i.e. research institutions and universities supplying research for development into technologies, and the consumer who is the end-user of the safe food products.

Competencies and knowledge requirements

Continuous knowledge gathering on pathogens and their behaviour as well as the detection of possible virulence changes are crucial in order to prevent and control their presence in food products and along the food production chain. Capacity to work closely together with manufacturers of production equipment that minimizes the risk of proliferation of microorganisms and recontamination.

Examples

- Methods for fast recognition and early and rapid alert systems indicating the presence of biological (pathogenic) contamination.
- In situ devices to control and to monitor bacterial contamination (e.g. using wireless biosensors).
- A realistic model for microbial inactivation and growth kinetic models. Technologies to selectively reduce and remove mycotoxins.
- Preservation technologies and ingredients with antimicrobial effect without compromising the organoleptic characteristics of food, including bioactive compounds.
- Use of agricultural by-products as a source of antimicrobial substances, reducing environmental contamination.



Connect global food systems

Objectives and goals

The goal is to increase the connection of global food systems in order to secure the global food supply by 2020.

Challenges to be addressed

One of the main global societal challenges facing agriculture and the agri-food industry is securing the global food supplies as the world's population is expected to rise from the current 7 billion to 9 billion in 2050. This business opportunity area targets challenges within "Food Security" in particular.

Description

The current uneven distribution of food availability across the world needs to be addressed at the global level. In a world of increasing international trade, Europe shares the responsibility for helping to find solutions to secure the global food supply through improved food systems. In addition, there is the challenge of accessibility and affordability of food in developing countries, as demonstrated by the world food crisis in 2007-2008.

Encouraging and facilitating local food production is viewed as one of the main keys for food availability and affordability. However, this will prove difficult to achieve, as 40% of the world population presently lives in cities of more than 1 million inhabitants. It is therefore crucial to develop a strategy for organizing the food system in order to feed the growing number of people living in large cities.

This issue is made even more challenging by the scarcity of natural resources, e.g. raw materials, water, and fossil

energy, coupled with the competitive use of raw materials in non-food agricultural products. The impact of climate change and need for to protect the environmental further exaggerates the scarcity of natural resources.

Long-term competitive advantages

Connection of global food systems will open up new markets, and will foster development of innovative products, technologies and services adapted to local contexts. This will also create competence requirements, demanding innovative training programmes in different countries.

Value chain

By definition, connecting global food systems addresses the entire value chain and all stakeholders, including consumers, who bear a responsibility on the basis of their food choices and consumption patterns.

There is a crucial need for sustainable solutions to address the issue of food security, in terms of production, processing and consumption of food. This in turn can open up new perspectives for food chain stakeholders. These may include increased productivity with maintained input, improved logistics and shelf life, and the development of functional ingredients and nutraceuticals to improve health and food safety.

Competencies and knowledge requirements

Competencies are needed to identify critical points in food systems. This requires interdisciplinary expertise in technology, economics, social issues, and new assessment methods based on multi-criteria analyses.

Examples

- Invest in rural entrepreneurship in developing countries.
- Invest in chain approach in developing countries.
- Set up local agri-food R&D institutions in developing countries.
- Resynchronize the food chain and agriculture in developing countries.



Innovative and sustainable raw material exploitation from marine and aquaculture sources

Objective and goals

The objectives of this business opportunity involve deriving innovative food products and ingredients from wasted biomass, as well as using underutilised biomass to develop new food products/ingredients. A further objective addresses currently exploited biomass and redesigning the value chains to ensure models of sustainable exploitation.

Considering the increasing demand for healthy aquatic foods and ingredients (fish/seafood/omega-3 etc.) full utilisation of the catch and optimisation of production systems for lowering waste are necessary. The production chain is very fragmented leading to huge losses in quality during operations. This can result in loss of valuable ingredients and products. Redesigning the process operation by assessing all steps of the value chain is needed.

Challenges to be addressed

This business opportunity area targets to “Food Security” and “Sustainability”.

Description

The biodiversity of the aquatic biomass is recognised, but currently less than 1% is exploited. This represents a huge gap and open up possibilities for harvesting for new resources, new products and new revenues. Harvesting and farming of currently exploited biomass concentrate on a limited number of species, with the rich aquatic biosphere representing a large variety of untapped resources. This includes not only new species but also novel bioactive compounds (enzymes, antibiotic, ingredients etc.), new sources of energy (proteins & lipids), as well as novel food. However, sustainable utilisation of these aquatic resources requires an enhanced understanding of the aquatic ecosystems.

The perishability of aquatic resources make them a delicate raw material to produce and process and to limit the waste the value chain needs to be addressed to minimise losses and to exploit resources in B-streams. At the same time the current exploitation of the aquatic biomass is unsustainable. Up to 50% of the aquatic resources end up as by-products, waste or low added value products and there is the potential to convert these residual resources into higher added value products.

Long-term competitive advantages

Identification of available biomass and B-streams from aquatic food production as well as their sustainable utilisation will lead to competitive advantage on a growing market. This will address the provision of enough sustainably-produced food for the growing population. Identification of gaps and opportunities for delivering food products, bioactive ingredients and for obtaining more value for money from our aquatic resources will be addressed. At the same time this will guarantee not only growth but also sustainability and the renewal of our aquatic resources which will lead to long-term competitive advantage.

Value chain

The Business opportunity targets the entire value chain from resource exploitation to the final product. It is essential that all the links in the value chain are evaluated in order to optimise the utilisation of exploited, underexploited or overexploited aquatic resources. This means addressing discovery, research & development, and the identification of equipment, suitability, production, optimisation and design of process and distribution systems.

Competencies & knowledge requirements

Extensive interdisciplinary knowledge about biology, chemist/biochemist, nutritionist, pharmacologists, and food/feed /ingredients producers, together with process management, and environment/ecology.

Examples

- New bioactive compounds (antibiotics, antimicrobials, antioxidants, enzymes etc.).
- Methods to address sustainability issues for the aquatic environments in a food production context.
- Exploitation of new resources for food production e.g. algae, bivalves and planktons.
- Capture value from waste streams or by-product.
- Development of rapid methods to assess freshness of aquatic food resources and their shelf life in relation to storage conditions.
- Development of methods to extend shelf life of marine or aquatic products.



Regionality as base for new foods

Objectives and goals

Develop innovative foods characterized by regionality and exploit beneficial characteristics of traditional foods as well as exploit regional/traditional best practices in food production, transformation and distribution.

Challenges to be addressed

This business opportunity area primarily targets the “Food & Health” priority. Exploring the health benefits of regional foods and combining this knowledge with culinary and cultural aspects gives a unique opportunity to tailor healthy products for different regions and thus enable more informed food choices and improve the health status of the population. Development of new regional food production and transformation methodologies may also address challenges within “Sustainability” and “Food & Health” simultaneously. In fact, facilitating regional food production and processing may promote the optimization of the supply chain management, reducing the gap from production to consumption.

Description

Europe is a multicultural continent with unique regional and traditional foods. Development of regionally inspired cuisines, as seen in the Mediterranean Diet and New Nordic Food, is an opportunity to create good and innovative foods from locally/regionally produced ingredients combined with inspiration and best practices in food preparation from other regions. Combining the demand for good taste with modern knowledge of health and well-being along with inspiration from “grand chefs” gives a unique possibility to improve population health and develop sustainable production methods. Development of regional cuisines should encompass gourmet restaurants, school canteens as well as private

kitchens and include cooperation with representatives throughout the entire food chain from primary producers to consumers. Also, development of new regional cuisines may be the most appropriate tool for facilitating the global promotion of regional food products, as well as their inclusion into the everyday eating habits. Notably, regional and traditional foods have uniqueness in terms of biological, sensory and chemical properties, as well as culinary aspects. This results from intrinsic food properties, food production methodologies and cooking procedures. Research is needed to better determine health properties of regional/traditional foods and to optimize/valorise/functionalize the current regional products, and to determine the optimal production and cooking methodologies for maintaining and valorising health benefits of these foods.

Long-term competitive advantages

Focus on regional cuisines will foster a competitive advantage of regional produce and simultaneously open doors for food tourism and export of innovative food products and methodologies. European consumers can profit from the results of this business opportunity, having easier access to healthy regional/traditional eating options, thus enforcing the role of the regional food producers and distributors along the supply chain. Finally, the development of regional foods and food practices will result in more sustainable production due to reduced production costs, shorter supply chain and reduced waste levels from primary production to food processing.

Value chain

Exploitation of new regional cuisines will present opportunities for the regional agro-food chain, animal and food production industries and the academic world. Research will be exploited to innovate and

optimize regional/traditional foods, and knowledge will be gained to better understand how different intrinsic food properties and production methodologies impact specific health benefits of the food products. European consumers are, however, the ultimate beneficiaries of the outcomes of this business opportunity area, having easier access to high-quality and healthy regional/traditional foods.

Competencies and knowledge requirements

In order to successfully develop and distribute innovative foods based on regionality and local traditions, a combination of knowledge within food chemistry and technology, sensory sciences, human nutrition, consumer sciences, cooking methodologies, and logistics is needed.

Examples

- Develop or redefine regional cuisines to fit consumers demand for great taste and high nutritional quality.
- Exploit existing regional cuisines to extract and commercialise knowledge and experiences on best practices on cooking methodologies, taste preservation together with other quality properties.
- Develop innovative food products based on health properties from regional foods, e.g. low-fat and high-protein/high-omega-3 fish products, wholegrain-based bakery and pasta, high-polyunsaturated fat and low-cholesterol extra virgin olive oil.
- Develop innovative “ready meals” based on regional foods and traditions, e.g. Nordic fish-based foods and Mediterranean pasta-based foods.



Develop new, beneficial microbial strains

Objectives and goals

Identify and develop new microbial strains for use in fermentative processes to improve the nutritional value, safety and sensory properties of food products.

Challenges to be addressed

Through fermentation the nutritional value of food products may be increased and product safety may be enhanced. Hence the present business opportunity area addresses challenges within "Food & Health" by focussing on new products that are capable of supporting health and wellbeing. The area also addresses challenges within "Food Security", since the fermentation can be applied to increase shelf life.

Description

Microorganisms play a major role in the production of fermented foods, including dairy, dough/batter, vegetable and meat matrices. They are also responsible for several industrially-relevant biotransformation processes, resulting in the production of microbial metabolites/compounds (enzymes, antioxidants, vitamins, antimicrobials, polysaccharides, etc.) that are necessary to provide specific sensorial, textural, nutritional and safety features to final products.

The selection and development of new microbial strains in order to discover new functional properties and to optimize technological and process characteristics of microbial strains is of great interest to the food industry. Novel microbial strains will provide the food industry with additional tools to improve existing fermentation processes or develop new ones. Specific objectives may include reducing the concentration of preservatives, improving digestibility, extending shelf life, optimizing product ripening, reducing food intolerance in dairy and lactose-based products, improving the nutritional (bioactive) profile, and improving organoleptic features. Apart from these aspects, benefits may be increased yields and reduction of by-products and waste.

Long-term competitive advantages

An economic advantage and access to new markets for the food industry is evident when newly developed products can: (1) promote health and wellbeing; (2) increase food safety by means of natural, microbial metabolites; (3) enhance the palatability and the sensorial properties of traditional and innovative foods; and (4) increase the sustainability of food production processes.

The selection and development of new microbial strains in order to discover new functional properties and to optimize technological and process characteristics of microbial strains is of great interest to the food industry

Value chain

Producers of microorganisms and producers of (fermented) food products are the primary beneficiaries as they will have the opportunity to add foods with improved quality and safety aspects, and/or specific health claims to their product portfolios. Innovation in this area will foster the development of new processing and production technologies.

The consumer will also benefit from new products as a result of improved organoleptic quality, safety, shelf life and health-related properties. It is important to consider legal and regulatory issues related to, for example, safety, health claims and novel foods. Building trust requires cooperation and transparency with all stakeholders, including academia, industry, regulatory authorities, the media and relevant interest groups (e.g. consumers).

Competencies and knowledge requirements

Scientific interdisciplinary competencies from both industry and academia are required. These competencies will include different disciplines within biotechnology, microbiology, (molecular) genetics, fermentation chemistry, nutrition and nutritional biochemistry, food and sensorial sciences.

Examples

- Production of highly digestible, extended shelf-life, functional fermented milks enriched with calcium, dietary oils and omega 3.

- Development of optimized fermentative and ripening processes for meat-based products with reduced sodium content, fat and preservatives, and high nutritional value (antioxidants and vitamins).
- Identification of novel microbial starters for the development of conventional or acid fermentation processes in order to decrease the negative sensorial impact using beta-glucans and other prebiotics.
- Innovative strains and technologies for biopreservation of a variety of products: dairy, meat, seafood.
- Development of micro-organisms with tailored flavour properties.



Innovative packaging and packaging materials

Objectives and goals

Develop innovative and safe packaging systems in order to increase product quality and shelf life.

Challenges to be addressed

“Food Security” and “Sustainability” are addressed by novel packaging systems including the use of new materials. Furthermore, new technologies will extend product quality and reduce energy consumption and waste during storage and distribution.

Description

A key priority for the food industry and regulatory authorities is to ensure safe products for consumers. Effective packaging systems are crucial for protecting and preserving food throughout the supply chain. Packaging is also the main tool to convey information to users/consumers in modern distribution systems.

The development of active and intelligent functions in packaging systems will help ensure high quality product and extend shelf life. The focus on sustainable (recyclable, bio-based and biodegradable) packaging materials may lead to new innovative solutions including single-use packaging, reduced thickness of packaging, wrappings and secondary containers, and even edible coatings and packaging systems for storage of perishable foods outside the cooling chain. The use of these new innovative solutions will also generate less waste, thereby reducing the impact on the environment.

Active packaging materials are designed to include specific components, potentially including nanoparticles, which release or absorb substances into, or from, the packaged food or the surrounding atmosphere (“modified atmosphere packaging”). These include materials with improved and highly-specific barrier functions, integrated oxygen absorbers, antimicrobial compounds, antioxidants, ripening or anti-ripening agents.

The inclusion of intelligent packaging materials for a product can provide a rapid, low cost quality determination from the time of production to the time of consumption. The combination of sophisticated ICT systems with packaging may affect the way in which traceability and control is implemented. Likewise, it is important to consider the convenience of packaging materials as specific properties are often required (e.g. heat resistant packaging for ready meals).

Long-term competitive advantages

Extended product shelf life provides opportunities to access emerging markets worldwide and to ensure a better balance between demand and supply, thereby reducing overproduction.

Value chain

Consumers, distributors and food producers will benefit from the development of innovative and safe packaging systems. Access to safe and fresh products with increased shelf life will meet consumer demands for convenience and will also satisfy the wishes of both consumers and producers for low environmental impact.

These packaging systems will have to conform to European food safety policies, functional and marketing requirements, as well as consumer demand.

Competencies and knowledge requirements

There is a need for flexible exchange and mobility between scientists in academia and specialists in the industry. This should likewise be reflected in education programs, with an entrepreneurial culture becoming an integrated part of study courses.

Examples

- Develop new active packaging solutions with selective permeability to extend shelf life of fresh-cut food.
- Develop active packaging with antimicrobial antioxidant, ripening or anti-ripening effect to reduce pathogen contamination and/or modulate biochemistry or food metabolism e.g., respiration rate of fruit and vegetables.
- Develop intelligent packaging solutions that allow continuous determination of vital quality markers during storage.



Innovative and sustainable approaches to improve the animal raw materials

Objectives and goals

To improve farming methodologies and technologies, animal management logistics, dairy and meat production and slaughter and processing procedures to obtain high quality and safe raw materials for milk and meat-based food products.

Challenges to be addressed

Improving the quality and nutritional profile of milk and meat-based food products addresses the area of "Food & Health". Controlling animal diseases, and in particular zoonoses, at farm level will also improve food safety and food security throughout the food chain and will ensure high quality raw material for industrial processing. Sustainability issues will be tackled through improving management, feed efficiency as well as precision breeding program design and management.

Description

Animal feeding, rearing techniques, and management qualitatively affect the complex properties of foods of animal origin. An evolving knowledge of genomics is fundamental for innovation in breeding to understand animal quality traits and improve livestock quality.

Increasing concern over the use of genetically modified organisms, antibiotics and anthelmintics in animal production has a major social and economic impact, requiring effective procedures to evaluate and control the impact on human health. Consequently, procedures for effective control of animal diseases will likewise be improved.

For sustainable global dairy production animal health and welfare are of major importance, especially in relation to development of efficient automatic animal management systems in large dairy herds. Genomics, breeding and feeding technologies for efficient animal production systems with maintained high quality end products has to be developed further. Health-promoting components

in milk-based products are of particular interest for the consumers.

Specific indicators of pre-slaughter handling of commercially farmed animals will contribute to the development of technologies and strategies for improving animal welfare and the quality of meat-based products. In addition, utilization of new feed additives, including the use of pro-/prebiotics, is of particular interest for low-input livestock production systems.

Improved knowledge on the effects of feeding and technological approaches to animal genetic response and genetic improvement, as well as on the nutritional and nutraceutical characteristics of meat and milk-based products, contributes to providing valuable, healthier and nutritionally fortified food products for the benefit of the consumer.

Long-term competitive advantages

In response to consumer demands, innovative nutritional strategies along with advanced farming technologies represent a fundamental approach to improve animal welfare and produce high-quality, fortified meat and milk-based food products. In the long term, this will contribute to enhancing consumer trust and to strengthening the European food industries' economic competitiveness.

Value Chain

New technologies can help to secure optimal conditions during rearing, management, transportation of animals and slaughter. Finally, new technologies in handling of the milk will benefit the animals and the food production industries by lowering production costs and improving product quality. This will also meet consumer and producer demands for a more sustainable and high quality food production chain.

Consumers will also benefit from this business opportunity area through access to valuable, healthy and nutritionally fortified food products that take animal

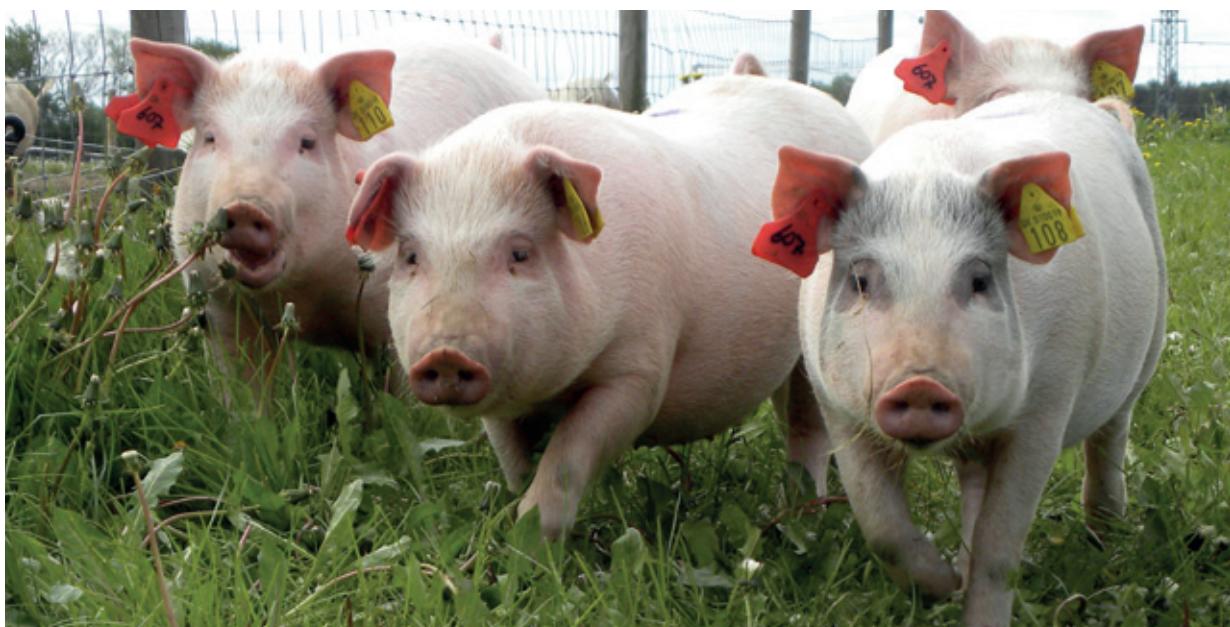
welfare strongly into account during farming and pre-slaughter handling.

Competencies and knowledge requirements

Collaborative approaches between research institutions and the animal and food industries are necessary to improve the quality of both livestock and food products. This area combines research and knowledge in quantitative genetics/genomics, breeding, physiology, systems biology, nutrigenomics, animal welfare, farming, food hygiene, toxicology, and raw food quality.

Examples

- New commercial diagnostic tests based on genomic markers of animal health quality.
- Tests for animal diseases, and in particular zoonoses.
- Analytical strategies for residue analysis of growth promoting agents in food-producing animals.
- Genomic tracers to ensure traceability of production systems, as well as to determine sensory or nutritional quality of livestock products.
- New technologies and equipment for the control of animal welfare during farming and transportation.
- Development of cost effective production systems that assures a high animal welfare and a good raw animal product quality.
- Develop new technologies and equipment for the control of raw milk quality at farm level and for the possibility at farm level to separate milk for different processes at the dairy.
- Development of sensor techniques for the supervision to maintain good raw milk quality and also to improve the raw milk quality for specific end products at the dairy.



Improve use of food raw materials

Objectives and goals

Maximize the exploitation of food raw materials through more efficient and intelligent processing, while maintaining or improving product nutritional and sensory properties and safety..

Challenges to be addressed

Both "Food Security" and "Sustainability" are addressed by minimizing the amount of 'waste' produced and reducing fresh water input. This business challenge also addresses aspects related to "Food & Health", especially by higher exploitation of the health potential of raw materials through processing and by increased use of fractions from by-products containing nutritionally valuable components. Innovations in this area contribute to a higher nutritional security.

Description

Reduction of the amount of 'waste' or by-products during food production and their valorisation, maximal exploitation of the organoleptic and nutritional potential of raw materials through intelligent processing, the use of tailor-made raw materials (e.g. by sorting and breeding), substitution of certain materials (e.g. from animal origin) by less expensive and/or more sustainable ones (e.g. from plant origin or algae), and material and water recycling will ensure more efficient raw material utilization and will increase productivity. In addition, cost-effective replacement of raw materials based on their seasonal availability will help to ensure more sustainable imports and higher quality of raw materials.

About 30% of the food and feed produced is lost during storage before processing or usage by the consumer. Requirements for storage differ widely among raw materials and intelligent monitoring systems will help to minimize storage losses. The systems may include advanced sensor systems coupled with intelligent programs, models and control systems that can predict spoilage, give warnings and adjust when necessary.

Long term competitive advantages

Reduction of losses during raw material storage, implementation of intelligent processing, flexible and optimised raw material (including water) use, reduction of 'waste' or by-product volumes and their valorisation will result in increased competitiveness through reduced production costs. Improved processing efficiency along the production chain will increase food production sustainability.

Value chain

This area enables a more efficient food supply chain that benefits both food producers and consumers, individually as well as the growing world population. The improved utilization of raw materials will meet the demand by consumers and producers for a more sustainable food production across the whole value chain. Involvement of all parties in the value chain is crucial for successfully achieving the goals. Focus on maximum resource utilization will also foster the development of new value chains and value-added by-products.

Competencies and knowledge requirements

Industry-driven research is required to improve the management and efficient utilization of raw materials, for which a broad range of competences is needed (e.g. breeding, food technology, food chemistry, water management, nanotechnology, sensor technology, IT, mechanics/robotics). It is important to focus on the whole value chain using an interdisciplinary approach taking into account consumer attitudes.

Examples

- Develop a global standard for water fingerprinting.
- Develop intelligent processing methodologies for improved use of raw materials.



Notes



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