FOODINNOVATION

Research Infrastructure

Service Catalogue

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1.INTRODUCTION

To put science at the heart of societal and economic development, we need to devise strategies to push the limits of science in order to promote innovation, tackle societal challenges and deliver big results. In Europe, one such strategy is the development of research infrastructures - organizations that enable the research community to use specific facilities, resources and services, thus fostering collaboration between scientists from different countries, economic sectors, research fields, and institutions.

FOOD INNOVATION RI is a distributed national research infrastructure of Greece that aims to support research, education and innovation of the agri-food sector by implementing breakthrough research and providing access to first class facilities, knowledge and advanced services to researchers and professionals from the academic, domestic and industrial sector.

Going through its preparatory phase, it combines the facilities, knowledge and experience of high-quality research groups from 7 Universities of Greece with a complementary scientific background including food chemistry, biochemistry, microbiology, genetics, nutrition and biotechnology.

FOOD INNOVATION RI was included in the National Roadmap for Research Infrastructures in Greece in November 2016 and, two years later, initiated its activities in the city of Patras. It consists of research groups and laboratories from the University of Patras, which stands as the Central Hub, and from 6 Research Organisations of Greece operating as interlinked regional nodes. These Organisations are the University of Ioannina, the Agricultural University of Athens, the Harokopio University of Athens, the Aristotle University of Thessaloniki, the Democritus University of Thrace and the Ionian University.

FOOD INNOVATION RI vision is to constitute one of the main pillars for the national, European and international research ecosystem fostering high quality research, education and innovation in the agri-food sector.

FOOD INNOVATION RI is going through a three-year preparation phase with main strategic objectives to strengthen the innovation capacity of the agri-food sector, to create a research network of excellence and to provide open access services to users.

FOOD INNOVATION RI mission is to provide the necessary resources to researchers and professionals from the academic, domestic and industrial sector to plan, develop, evolve and valorise food products and ingredients, production processes and novel technologies related to the agri-food sector that will benefit human health, reduce cost of production, improve the quality and sustainability of the final product and improve their environmental performance.

This catalogue of services constitutes the first published version and contains services that are currently offered by FOOD INNOVATION RI to users. To keep informed about changes in the service catalogue subscribe in our news-letter and be the first to know what is coming up.

Following global technological challenges and new trends in the agri-food sector, FOOD INNOVATION RI develops and provides services that will enhance the innovation capacity of companies, research centres and public bodies of the agri-food sector. Technology transfer, training and education, facility access and R&D services are constantly being developed, modernized and evolved to meet users' needs and expectations and foster innovation in the agri-food sector.

2.KNOWLEDGE TRANSFER SERVICES

In General

Novel technologies in food processing that benefit human health, reduce production cost, improve the quality and sustainability of products and processes, reduce food wastes and improve environmental impact are developed by FOOD INNOVATION RI to enhance the innovation capacity of the agri-food sector. These technologies are offered to SMEs, large companies, research centres or public bodies, also referred to as stakeholders, in order to further develop and exploit the technology into new products, processes or services of their interest.

FOOD INNOVATION RI will promote the technology transfer process by sharing data, methods, knowledge and skills during every step of development.

How to Gain Access

Technologies offered for transfer are designated as OPEN on FOOD INNOVATION RI website (www.foodinnovations.gr) and are provided either on a continuous basis or following a Call for Expression of Interest. In both cases the stakeholder shall submit on line a short project proposal to demonstrate how they can contribute to the development and exploitation of the technology. A group of experts from FOOD INNOVATION RI will evaluate the proposals with respect to the proposed plan of actions, the resources offered, the experience of the

stakeholder and the general criteria highlighted in our access policy which can be found at FOOD INNOVATION RI website. A cooperation agreement for the development and exploitation of the technology will be offered to the selected stakeholders.

Calls for Expression of Interest are launched to promote technologies that are offered for transfer by FOOD INNOVATION RI and are addressed to bodies or firms, whether public or private, which are interested in further developing and exploiting an offered technology.

Current List of Technologies

This catalogue contains the technologies that are, or have been, offered by FOOD INNOVATION RI for transfer. The status of each technology, OPEN or CLOSED, is designated on the website of the research infrastructure (www.foodinnovations.gr).

A short description of these technologies, together with a reference to the opportunity identified in the market, the solution that is offered, the principle of the technology, the main advantages and innovations and the stage of development, are provided herein. For each technology the partner of FOOD INNOVATION RI that offers it is specified along with a contact person available to give more information if needed.

Continuous milk coagulation using a novel bioreactor

A novel technology for low volume bioreactor development for the dairy industry

Code: 21-UP-01

The Opportunity

The use of biocatalysts such as rennin has been extensively used in cheese making. However, in an industrial setting the application of biocatalysts has many challenges such as complex processes, low yield due to enzyme instability, increased risk of contamination due to open tanks, as well as the overall need for high investment.

Our Offer

Based on enzyme immobilization technology on tubular cellulose/starch matrix, we have developed a closed, cost-effective, bioreactor system, that allows real time milk coagulation offering better control of the process and decreased risk of contamination.

Using our system, milk coagulation for cheese making process occurs in a continuous mode enhancing productivity while engaging limited working space compared to traditional systems.

The Technology

Our processed tubular cellulose is combined with starch gel, which due to the smaller pore size and reduced crystallinity, makes a perfect matrix for enzyme immobilization. Our novel matrix is then used to encapsulate rennin, ensuring enzyme stability. This novel biocatalyst is then used to process milk in a continuous flow in a closed bioreactor system.

We have ascertained that a continuous milk flow through a closed bioreactor system using encapsulated rennin in our novel matrix results in the production of higher quality cheese in a less expensive setting.

After a 60-day ripening period, the cheese produced develops unique aromas due to the formation of volatile compounds, different to the ones produced with free rennet.

Our continuous milk coagulation process produces a unique final product at a much higher production yield with a smaller production cost and less space requirements (a bioreactor of 1m³ can treat approx. 12,000L milk per day).

Advantages & Innovations

- Increase of milk coagulation productivity
- Acceleration of the cheese maturation process
- Environmentally friendly process
- Process based on a novel technology
- Reduction of industrial site size
- Reduction of investment cost
- Economically viable investment
- High-quality product
- Reusability of the biocatalyst

Stage of Development

This novel technology has been designed and tested in an industrial scale up setting. It has been shown that by using a continuous milk coagulation process based on encapsulated rennin in our novel matrix, issues such as coagulation inside the bioreactor and contamination can be eliminated.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to further develop this technology. The ideal Partner shall be a cheese manufacturer with a strong retail network or an equipment designer and manufacturer eager to further develop this system in a relevant and operational environment. Alternative options may also be considered.

Offered by

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Contact

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Food Chemistry and Biotechnology Group

Low-temperature beer fermentation: continuous & batch brewing

A novel technology for industrial high-quality beer making

Code: 21-UP-02

The Opportunity

The beer market is forecasted to reach USD 805 billion by 2024, registering a CAGR of 6.2% during the period 2019-2024.

Changing lifestyle, increasing consumption rate of alcoholic drinks, high disposable income, and popularity of beer among the young population are a few factors driving the global beer market.

However, the high cost of investment in equipment and the increased competition in the market are the main bottlenecks for new ventures in this sector.

Our Offer

We have developed a novel bioprocess enabling beer production at extremely low temperatures by adding processed cellulose and wort to a psychrophilic yeast strain S. cerevisiae AXAZ-1. This novel setup requires an investment cost of 1/10th of the traditional method.

This novel technique not only reduces production costs since less energy is used up, but also increases product quality. The final product is a bright, clean, clear, crisp lager with minimal phenolics, less ester production and a satisfying finish.

We understand that the preferred method of brewing, continuous or batch, depends on the brewer. Hence, we have further developed and adapted our novel technology, offering the choice of continuous or batch production to brewers while still being able to brew at extremely low temperatures.

The Technology

The principle of this technology is based on extremely low temperature fermentations of wort that are performed by immobilized cells of the strain AXAZ-1 in tubular cellulose (TC). The tubular cellulose is produced by the delignification of sawdust or straw and acts as promoter of alcoholic fermentation even at very low temperatures. This positive effect of TC is attributed to the reduction of the activation energy of the alcoholic fermentation. The reduction of activation energy increases the rate of fermentation at extremely low temperatures and therefore beer productivity, as compared to the method of free cells. As a result, fermentations in line with the required standards of the beer industry at 1-3 °C become feasible.

Advantages & Innovations

The novelty of brewing at low temperatures significantly reduces the time and cost of production as it requires no maturation, and hence increases the product yield turnover.

- Significantly less required space for brewing
- Substantially less liquid waste
- Environmentally friendly bioprocess
- Bright, clean, clear, crisp lager
- Minimal phenolics, less esters, improved taste
- Process based on a unique technology
- Adapted technology for both continuous and batch brewing
- Economically viable investment
- High quality product

Stage of Development

Our innovative processes, available for both continuous and batch brewing, have been validated in a lab environment. The next step requires validation and production at an industrial setting in order to ensure the effectiveness of the process in large-scale manufacturing. Alternative options may also be considered.

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Making beer at home

A novel technology for high-quality beer-making using a home-based kit
Code: 21-UP-03

The Opportunity

Home brewing has become more than a hobby – is it now a lifestyle obsession. Beer enthusiasts are always in the search for new and easy ways to brew beer at home, saving on time and cost, but without compromising the quality and taste, always indenting to produce a fine drink.

Our Offer

The conventional yeast starter or dry yeast methods used have limitations and often require expensive equipment, many steps and precision in controlling the process. Our novel beer brewing home kits use yeast immobilization as an alternative vehicle to increase product quality and reduce production costs, as there is less energy consumed.

Our method is currently the only one that can lead to high quality beer production using a domestic refrigerator, simply by adding a powder-based product to water.

In comparison to the commercially available beer brewing kits, our technology offers a beer brewing process that is much easier and less complicated. Additionally, the lower temperature fermentation results in less ester production and hence, offers a final high-quality product – a bright, clean, clear, crisp lager with minimal phenolics and a satisfying finish.

The Technology

A powder-based product has been developed enabling consumers to use a home brewing kit to produce high-quality beer in their refrigerator at home. While, the beer brewing kits available in the market use a yeast starter or dry yeast, our technology differs: Cellulose and wort are processed and added to a psychrophilic yeast culture (Saccharomyces cerevisiae AXAZ-1). The mixture is then fermented and freeze-dried. The lyophilized preparation is simply dissolved in water and after six weeks (fermentation) in the refrigerator, a clear, high quality, beer is ready to be consumed.

The principle of this technology is based on the immobilization of cells of Saccharomyces cerevisiae AXAZ-1 on a tubular cellulose carrier. The positive effect of tubular cellulose during low-temperature brewing is that the freeze-dried immobilized yeast cells reduce the fermentation rates in contrast to freeze-dried free cells. Immobilization also enhances yeast resistance at low-temperature fermentation, reducing the minimum brewing temperature value.

The tubular cellulose, a nano/ microporous cellulosic material obtained after delignification of sawdust, is a suitable material for use in food bioprocessing as

a cell immobilization carrier. It is an abundant, low-cost, food-grade material that can be easily prepared and handled. The immobilized cells are entrapped or attached to tubular cellulose and act as promoters of alcoholic fermentation even at very low temperatures.

Advantages & Innovations

The home scale application of the technology provides the opportunity for a consumer to produce good quality, home-made beer easily and at low cost in a domestic refrigerator. In addition, the immobilization of cells on a tubular cellulose matrix, an abundant and low-cost support, results in a clearer final product with improved aroma characteristics. The proposed technology is an interesting alternative to conventional home brewing methods and can provide potentially high-quality beer with possible commercialization potential.

- Easy beer making at home
- Cost effective process
- No need for expensive equipment and process control
- Bright, clean, clear, crisp lager
- Minimal phenolics, less esters, improved taste
- Environmentally friendly, as less energy is required
- Based on a unique disruptive technology
- Economically viable investment
- High quality product

Stage of Development

This novel technology is an innovative process validated in a lab environment. The next step requires industrial setting validation and production in order to ensure the effectiveness of the process in large-scale manufacturing.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be an equipment manufacturer or a beer ingredient producer with a strong retail network eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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A novel pasteurization process

A novel technology to ensure product safety, improved aromatic profile and reduced operation cost

Code: 21-UP-04

The Opportunity

Heat treatment, the most commonly used thermal process to ensure microbial stability and safety for liquid food, is a costly process and often leads into vitamin and volatile compounds reduction and into toxic chemical compound formation. On the other hand, chemical treatment of water or wine is an effective process routinely used but associated with the presence of toxic chemical residues in the final product.

Our Offer

A “cold pasteurization” technology, that results in removal of microorganisms at levels up to 90-100% when applied to liquid food such as juices, wine, water and milk, has been developed by our researchers offering the food industries a means to produce safe and stable liquid food at a lower cost and with an improved nutritional and aromatic profile.

The Technology

The principle of cold pasteurization is based on the use of innovative filters that contain tubular cellulose (TC) and are organized in a parallel layout to facilitate the continuous operation of the pasteurization system.

Microbes that are present in the source liquid are entrapped in the tubes of TC and so removed from the food liquid. The TC filters can be successfully regenerated by rinsing with hot water.

Microbial load removal reached values of up to:

- 90-100% when applied to apply apple juice
- 100% when applied to water
- 97% when applied to wine
- 100% when applied to orange juice

Advantages & Innovations

The technology is an innovative bioprocess that has been validated in lab environment, for liquid food such as water, fruit juices, wine, beer and milk.

- Low energy requirements
- Extension of the shelf-life of liquid foods for several days or weeks
- Products with improved nutritional value and aromatic profile
- Heat-sensitive ingredients are protected
- No use of antibacterial chemical compounds

- Low-cost investment - low operational cost
- Adaptable to existing infrastructures
- Opportunity to expand business: New products and New markets
- Higher quality products

Stage of Development

The technology is an innovative bioprocess that has been validated in a lab environment for treating water, fruit juices, wine, beer and milk. Validation in an industrial environment is the next step in our schedule to ensure the effectiveness of our process.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be a food equipment manufacturer or a liquid food producer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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Wine making in domestic refrigerator

A novel technology for high quality, sulfite-free wine using a home-based kit
Code: 21-UP-05

The Opportunity

Winemaking throughout the centuries has been a complex, time-consuming process, utilizing the natural fermentation process to produce fine wine products enjoyed by consumers around the globe. Wine enthusiasts are always in the search for new and easy ways to produce wine at home, saving on time and cost, but without compromising on quality and taste.

Our Offer

In industrial winemaking, lowering the temperature leads to a slower fermentation rate, which results in an enhanced wine flavor and aroma.

The conventional free yeast cell method has limitations and yeast immobilization can be used as an alternative in order to increase product quality and reduce production costs, as there is less energy needed. Our novel technology is based on this principle, following however a specific bioprocess: Processed cellulose is added to a psychrophilic yeast culture (Saccharomyces cerevisiae AXAZ-1). The mixture is then fermented and freeze-dried. The lyophilized cellulose-based product is an excellent immobilization material (biocatalyst) due to the low cost and the simplicity of achieving the process.

Two powder-based products have been developed enabling consumers to produce wine at home, all year round. Consumers would be able to obtain the

powder-based products from the supermarket, and regardless of the availability of grapes, would be able to produce high-quality wine using their home refrigerator according to one of the following options:

- Option 1. Powder-based product A: contents are dissolved in water and after six weeks in the refrigerator, a high-quality clear wine, without sulfur dioxide or chemical preservatives is ready to be consumed.
- Option 2. Powder-based product B: contents are dissolved in grapes/ grape juice and after six weeks in the refrigerator, a high-quality clear wine, without sulfur dioxide or chemical preservatives is ready to be consumed.

The wine produced has a fine aroma, magnificent taste and acceptable clarity without the need of any further processing for precipitation of suspended solids.

The Technology

The principle of this technology is based on extremely low temperature fermentations of grape must performed by immobilized cells of the strain Saccharomyces cerevisiae AXAZ-1 in tubular cellulose (TC) inert matrix. The tubular cellulose, a nano/microporous cellulosic material obtained after delignification of sawdust, is a suitable material for use in food bioprocessing as a microbial cell immobilization carrier. It is an abundant, low-cost, food-grade material that can be easily prepared and handled. The immobilized cells are entrapped or attached to tubular and act as promoters of alcoholic fermentation even at very low temperatures.

This positive effect of TC is attributed to the reduction of the activation energy of the alcoholic fermentation. The reduction of activation energy increases the rate of fermentation at extremely low temperatures and therefore wine productivity. As a consequence, fermentations in line with the required standards of the wine industry at 1-3ºC become feasible improving the quality characteristics of the wine. This technology was used to develop two commercial products for producing wine at home:

- Product type 1: contains a mixture of freeze-dried grape must and freeze-dried TC with immobilized cells of the psychrophilic strain S. cerevisiae AXAZ-1.
- Product type 2: contains freeze-dried TC with immobilized cells of the psychrophilic strain S. cerevisiae AXAZ-1.

Advantages & Innovations

- Clarifications processes are not necessary
- The wine has a fine aroma and taste
- This technology can be combined with a variety of cultivated grapes resulting in high-quality products
- This technology leads to safe production of wine with low alcohol content
- The wine is produced without addition of sulfites
- Superior quality product due to the low fermentation process
- Wine production all year round, even when there is a lack of grapes
- The nutritional value of the wine is improved, due to low concentrations of higher alcohols

Stage of Development

This novel technology is an innovative process for the production of two powder-based products that has been validated in the lab environment. The next goal requires an industrial large-scale validation and production in order to ensure the effectiveness of the process on a large-scale production environment.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be a chemical ingredient producer or a food equipment manufacturer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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Innovative dairy products based on cheese whey

An innovative technology for the formulation of products from cheese whey
Code: 21-AUT-01

The Opportunity

Cheese whey is the yellowish liquid that remains after the coagulation of the caseins during the production of different rennet cheeses. For a long time, cheese whey was considered a waste product and usually was disposed as untreated material. Whey is composed of various organic compounds and, thus, has very high BOD (biological oxygen demand) and COD (chemical oxygen demand) values, which present a great environmental hazard. The proteins inherent to whey have a very high nutritional value and are an excellent source of essential amino acids. Thus, removing whey proteins from the waste stream and incorporating them into the human diet will be beneficial for both, the environment and the human health.

Whey proteins not only have a very high nutritional value, but their functional properties can give rise to new dairy products, if appropriate heating protocols (usually around 90°C) are applied. The heat induced denaturation and subsequent gelation of the whey proteins can be enhanced by the addition of salts and/or organic acids. In this way, whey has been traditionally used in Greece to produce several whey cheeses, such as Manouri, Anthotyros and Mizithra, which are also exported to various developed western countries. More than 1.5 million kilograms of whey cheeses are being produced annually in Greece and the current trends show a production growth of 2% per year. Different types of whey cheeses are also produced worldwide, but on a small scale.

Our Offer

The typical steps of whey cheese production include heating, under constant stirring of the cheese whey up to 90°C. Traditionally, the next step would involve draining the coagulated dispersion to obtain the final product.

An innovative and promising technology of structuring whey proteins by forming complexes with edible biopolymers has been developed. This method is proposed as an alternative method to utilize cheese whey directly to form complex structures with innovative sensorial properties, in an attempt to produce an innovative whey-based product that resembles a conventional spreadable product (e.g. cream cheese), and, additionally, reducing the whey proteins and milk fat in the remaining waste stream. The final product attributes are a high protein content, resulting in increased product yield.

It is the right time for the dairy enterprises, small, medium or large, to CHEESE THEIR WHEY and WHEY UP THEIR CHEESE.

The Technology

The principle of this technology is based on the utilization of certain edible biopolymers to form complex structures with whey proteins and overall, transform the liquid whey into a product resembling cream cheese.

Advantages & Innovations

- The use of liquid whey to form innovative products with high nutritional value
- No need for purchasing new equipment
- Innovative products resembling cream cheese
- Removal of whey proteins and milk fat from the cheese waste stream
- The existing production technology for whey management-product development is not altered significantly

Stage of Development

This novel technology is an innovative process for the production of spreadable cheese products based on whey. The sensorial properties can be tuned according to the biopolymer addition. The next step requires a large-scale validation to ensure the effectiveness of the production process on industrial scale.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be cheese manufacturers with a strong retail network or a food ingredient producer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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Structured olive oil as animal fat substitute in meat products

A novel technology for the formulation of meat products with a healthier profile
Code: 21-AUT-02

The Opportunity

Meat products, such as sausages, salami etc., are very popular food products. Yet, they typically contain high amounts of saturated fat and cholesterol, originating mainly from the pork backfat often used for their formulation. The current nutritional recommendations focus on limiting the intake of these ingredients, and favoring the consumption of vegetable oils (such as olive oil) that have a healthier fatty acids profile. A novel technology that allows for the successful incorporation of vegetable oils, including olive oil, into meat products has been developed, that can help to improve the nutritional characteristics and marketability of such novel meat-based products.

Our Offer

Fat provides unique sensory properties (texture, mouthfeel, hardness) to meat products. Hence, the reduction or replacement of saturated animal fat from these foods may result in serious and undesirable changes in physical and sensorial characteristics of the final products.

A novel and promising technology of 'structuring' different vegetable oils (including olive oil) by forming oleogels has been developed. Oleogelation has been proposed as an alternative method to utilize liquid vegetable oils to mimic hardstock structures that resemble the properties of conventional fat, reducing saturated animal fat and improving the nutritional profile of final products.

Through the oleogelation process, an edible liquid vegetable oil, such as olive oil, is converted into a gel-like structure without modifying its chemical characteristics, by the addition of soluble lipophilic low-molecular-weight oleogelators. Vegetable oil-based oleogels can be formulated by different ways to have varying textural characteristics and can be incorporated into various meat products for the substitution of pork backfat (lard) that is typically used. The resulting novel meat products can be designed to have similar organoleptic characteristics with conventional products, but a significantly improved nutritional profile with decreased saturated fat and cholesterol contents.

The Technology

The principle of this technology is based on the utilization of certain low-molecular-weight compounds (oleogelators) to structure liquid vegetable oils into solid-like materials that can be used as animal fat substitutes. Various compounds have been used as oleogelators, including monoglycerides, fatty acids, alcohols, lecithins, mixtures of phytosterols and oryzanol, ethylcellulose,

ceramides or waxes. The oleogelators usually form thermoreversible oleogels that are typically based on supramolecular assemblies of the oleogelators via non-covalent interactions. The formation of oleogels is based on self-assembly and/or crystallization of the oleogelators that are capable of entrapping liquid vegetable oil. Thus, oleogels possess solid-like texture and desirable mechanical properties (plasticity and elasticity), while eliminating trans- and minimizing saturated fatty acids and cholesterol.

Advantages & Innovations

- The use of animal and saturated fat can be reduced or eliminated in meat products
- The nutritional profile of the meat products can be improved by the addition of olive oil
- The meat products maintain their desirable organoleptic characteristics
- The production technology is not altered significantly

Stage of Development

This novel technology is an innovative process of the production of oleogels. Oleogels from different vegetable oils have been produced, utilizing an array of different oleogelators. The next step requires an industrial large-scale validation and production in order to ensure the effectiveness of the process in large scale and manufacturing.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be meat product producer with a strong retail

network or a food ingredient producer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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Gluten free bakery products: alternative plant raw materials and traditional technologies in developing gluten-free bakery products

Innovative gluten free bakery products with an improved nutritional profile, sensory characteristics and shelf life, formulated by alternative plant raw materials and produced by traditional technologies
Code: 21-AUT-03

The Opportunity

Gluten-related disorders are all conditions that are related to consumption of gluten containing food items and can be managed merely by strict adherence at a gluten-free diet; these gluten-associated conditions include celiac disease, wheat allergies, dermatitis herpetiformis, gluten ataxia and nonceliac gluten sensitivity (NCGS), a recently accepted distinct clinical entity. Moreover, consumer data (food product preferences) reveal a notable increase of gluten-free target audience due to increased number of diagnoses of the above disorders, as well as growing awareness of these ailments among patients; these trends have stimulated a rather broad expansion of the gluten-free product market. However, most of the gluten-free baked goods (e.g., bread, muffins, biscuits) in the market have high prices, poor sensory properties, short shelf life and there is also a concern for their nutritional value because they are often characterized by high levels of sugars and fat and reduced concentration of dietary fibers, vitamins, minerals and antioxidants,

resulting in increased risk of chronic disease incidence such as diabetes type 2, cardiovascular diseases and obesity. Therefore, the development and formulation of gluten free bakery products with high nutritional value, acceptable sensory attributes and increased shelf life still is a challenge for the food industry.

Alternative plant raw materials, such as some cereal and pseudocereal grains, legume and oil seeds and nuts can be used for the formulation of gluten free bakery products that will allow enhancement of the nutritional profile of these products, while traditional technologies, such as incorporation of sourdough, roasting and sprouting of added grains and seeds will contribute to the improvement of sensory characteristics and the shelf life of the developed baked goods and thus, increase the consumer acceptance.

Our Offer

Gluten is the main structure-building protein in baked products, responsible for the elasticity and extensibility of the dough as well as for retaining of gas produced by yeast fermentation resulting in palatable products with high loaf volume, fine structure and enhanced flavor retention. On the other hand, absence of gluten leads to a liquid batter rather than an elastic dough, unable of retaining the produced carbon dioxide and end-products with poor flavor, hard and crumbly crumb, low volume, coarse crumb porosity and increased staling rate. Moreover, the typical main ingredients of gluten free bakery products are rice and corn flours, as well as corn, potato and cassava starches having a poor nutritional profile and largely contributing to increased glycemic responses upon consumption of such ingredients.

Alternative plant raw materials, such as cereal (oat, sorghum) and pseudocereal grains (quinoa, buckwheat), legumes (chickpea, lentils, yellow split pea) and oil seeds (flax, sesame) as well as nuts (acorn, chestnut) are proposed for partial substitution of rice flour and pure starches into gluten free bakery product formulations (e.g., bread, muffins, rusks, bagels, biscuits) due to their high levels of proteins with a better amino acid profile than cereals and high contents of dietary fibers, polyunsaturated fatty acids and phenolic compounds and therefore, their use can lead to baked goods with improved nutritional value, low glycemic index and nutrient-dense raw materials enriched with bioactive compounds. These alternative gluten free ingredients can be used in combination with traditional technologies based on bioprocessing methods or following appropriate thermal treatments, such as sourdough made from gluten free flours (e.g., chickpea , rice), and seed sprouting and/or roasting (e.g., chickpea, lentils, yellow split pea). These technologies can contribute to improvement of sensory attributes, that is high loaf volume, soft texture and enhanced flavor and taste and extended shelf-life through inhibition of crumb hardening, moisture loss and fungal growth.

The Technology

These approaches to develop novel gluten free baked goods and overcome both technological and nutritional challenges that are usually involved in

production of gluten free bakery products are based on use of alternatives ingredients (cereal and pseudocereal grains, legume and oil seeds and nuts) with high nutritional value and content of bioactive compounds, combined with traditional bioprocessing methods (sourdough fermentation and sprouting) and/or thermal treatments (roasting) for improvement of nutritional value and bioavailability of nutrients as well as enhancement of product sensory attributes (roasting and sourdough). However, incorporation of these nutritionally advantageous raw materials into gluten free bakery products can be a challenge since it may negatively affect the physicochemical and sensorial attributes of the end-product, resulting in lower loaf volume, unfavorable flavor and taste (e.g., "beany" flavor from added legume flours) and high levels of anti-nutrients (e.g., legumes, acorn). Therefore, several technologies have been employed in our laboratory to overcome these hurdles. Bioprocessing methods, such as addition of sourdough made by lactic acid fermentation or fermented extracts from chickpea has been employed as alternative physical leavened agents; the latter sourdough is used in a Greek traditional bread called 'eftazymo'. Both type of the above sourdoughs can increase loaf volume and improve crumb texture attributed to enzymic activity and gas formation during fermentation by the microflora, acting as flavor enhancers, sources of bioactive compounds (e.g., dietary fibers, organic acids, antioxidants, prebiotics) and antifungal factors. As a result, there is improvement of sensory and nutritional properties of gluten-free products and extension of their self-life. Moreover, germination of the added grains and seeds that result in their sprouting can be applied before their incorporation into the gluten free bakery formulations. During germination, sugar content is increased, which leads to a more pleasant, sweet taste and at the same time the "beany" flavor of legumes is largely eliminated. In addition, the enzymic systems that are activated may work as natural dough improvers and increase the bioavailability of nutrients by reducing anti-nutrient factors. Regarding roasting, caramelization and Maillard browning reactions that take place during such treatments can further alleviate the off-flavors through the production of pleasant nutty flavor notes.

Advantages & Innovations

- The nutritional profile of the gluten free bakery products can be improved by the incorporation of alternative grains, seeds and nuts into their formulation

- The use of traditional technologies of sourdough and, seed sprouting and roasting can enhance the organoleptic characteristics and extend the shelf life of gluten free bakery products, and thereby improve consumer acceptability for the products.
- The proposed formulations and production technologies of gluten free bakery products, using optimized protocols, will significantly contribute to overcome the technological and nutritional challenges of these food products.

Stage of Development

The formulation of gluten free bakery products based on their enrichment with alternative grains, seeds and nuts and the use of traditional technologies commonly employed for cereal and nut-based products is an innovative holistic approach undertaken for the production of this category of baked goods. Gluten free bakery products (breads, muffins) with various grains, seeds and nuts by using sourdough, and sprouted and roasted seeds have been produced, utilizing an array of different formulations and processing of raw materials. Additionally, the resultant final products have been evaluated for their quality attributes and shelf life using both instrumental analytical methods and sensory analysis as well as for their glycemic response by employing in vivo methods (glycemic index estimation) and in vitro protocols simulating the human digestion process.

The next step requires an industrial large-scale validation and production of some of these products in order to ensure the effectiveness of the process at a large scale and actual manufacturing conditions.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop these products and applied commercially the proposed formulations and

technologies. The ideal Partner could be a gluten free bakery product producer with a strong retail network or a plant ingredient (grains, seeds, nuts) producer eager to further develop these technologies in a relevant and operational environment.

Offered by

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Contact

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Food Chemistry – Food Physics

Spent coffee grounds valorization to produce microbial oil-based oleogels rich in carotenoids

Code: 21-AUA-01

The Opportunity

Modified vegetable oils (mostly palm oil) are widely used for the production of spreads, confectionery, bakery, dairy and meat products. The common practice to transform vegetable liquid oils into solid-like fats include partial hydrogenation or interesterification with side-effects the creation of saturated and trans fatty acids, which have been associated with adverse effects on human health such as obesity, metabolic syndrome and cardiovascular diseases. Legislative limitations related to the use of trans and saturated fatty acids and health considerations regarding the increased use of palm fat in food lead research to reformulation of fat- containing food products. The US Food and Drug Administration partially characterized hydrogenated oils as no "GRAS" that has to be removed, or at least minimized, from food products. Oleogelation is a new technology that can reduce the trans and saturated fat content in processed foods leading also to higher content of unsaturated fatty acids.

Our Offer

FOOD INNOVATION RI researchers have employed bioprocessing based on circular economy aspects for the valorization of spent coffee grounds to produce high value-added oleogels that could lead to sustainability and a low environmental footprint. The novel oleogles could be applied as highly

promising alternative to replace trans and saturated fatty acids in food formulations i.e substitutes of butter and spreads, and shortening in the confectinery industry.

The Technology

Nutrient rich fermentation media were produced by applying enzymatic hydrolysis of spent coffee grounds (waste stream of the coffee industry). Fed batch bioreactor fermentations with Rhodosporidium toruloides were carried out to produce microbial oil rich in carotenoids.The innovative technology of oleogelation was applied to develop oleogels by employing plant-based oleogelators (carnauba and candelilla wax) and microbial oil rich in carotenoids. The strategy of employing low molecular weight molecules as oleogelators was evaluated. Oleogels were prepared by the entrapment of liquid microbial oil into a three-dimensional and thermo-reversible network by using low concentrations of carnauba and candelilla wax. Semi-solid structures were thus obtained. The concentration of both waxes was optimized, and the novel structures were evaluated in terms of their physicochemical properties, rheological behavior and stability.

Advantages & Innovations

- Desirable texture, firmness and spreading abilities were achieved
- The efficient gel formation of oleogles was confirmed by storage modulus (G′) >loss modulus (G")
- Microbial oil-based oleogels rich in carotenoids showed an enhanced gelation behaviour

The overall evaluation of oleogels properties demonstrated their potent application in confectionary products and spreads for the substitution of conventional fatty materials containing trans or saturated fatty acids.

Stage of Development

This novel technology is an innovative process for the production of low fat containing food formulations via oleogelation and it has been validated in lab scale. The next step requires an industrial large-scale validation and production to ensure the effectiveness of the process in large scale and manufacturing.

Partner Search

FOOD INNOVATION RI is seeking for Partners from the Food Industry with the capacities to develop this technology. The ideal Partner shall be a confectionery industry with a strong retail network or a food ingredient producer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

Offered by

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Contact

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Food Process Engineering

Development of edible and biodegradable films for active packaging applications

Code: 21-AUA-02

The Opportunity

Nanotechnology preferentially combined with bioprocessing could offer alternative and environmentally friendly routes for the development of renewable and sustainable end-products. Biodegradable and biocompatible nanocellulose-based materials could be produced to serve applications in highly demanding industrial sectors, i.e. catalysis, elastic conductors, pharmaceuticals, medicine, tissue engineering, drug delivery systems and the food and biopolymer industry in the form of aerogels, hydrogels, nanocomposites, emulsions, and membranes/films. Conventional formulations of some of the aforementioned applications lag behind in mechanical strength which can be controlled by adding nanocellulose in the form of nanofibers or nanocrystals.

Production of bacterial cellulose via microbial bioconversion of lignocellulosic residues and its subsequent transformation into nanostructures, could sustain the production of functional end-products at low environmental impact. Nanocellulose could be an ideal building block due to its unique structure which gives rise to properties such as high Young's modulus and enhanced mechanical strength. The production of bacterial cellulose nanocrystals via acid hydrolysis of bacterial cellulose under specific conditions is a novel and highly promising approach to obtain high performance nanomaterials, i.e. reinforcements in polymeric matrices and nanocomposites for active food packaging.

Our Offer

FOOD INNOVATION RI researchers have used industrial side streams as sustainable resources ensuring that they will be re-introduced into food value chains. They employed bioprocessing to produce bacterial nanocellulose via the valorization of renewable resources, i.e. crude glycerol derived from the biodiesel industry, spent coffee grounds, citrus waste and side-streams from the confectionery industry.

Our research team developed a novel formulation of biodegradable and glycerol-plasticized bacterial nanocellulose-based films. Sunflower protein isolates have been incorporated into the biopolymer matrix serving dually as a source of natural antioxidant compounds and as a vehicle of these antioxidants to prolong the life span of the applied food product.

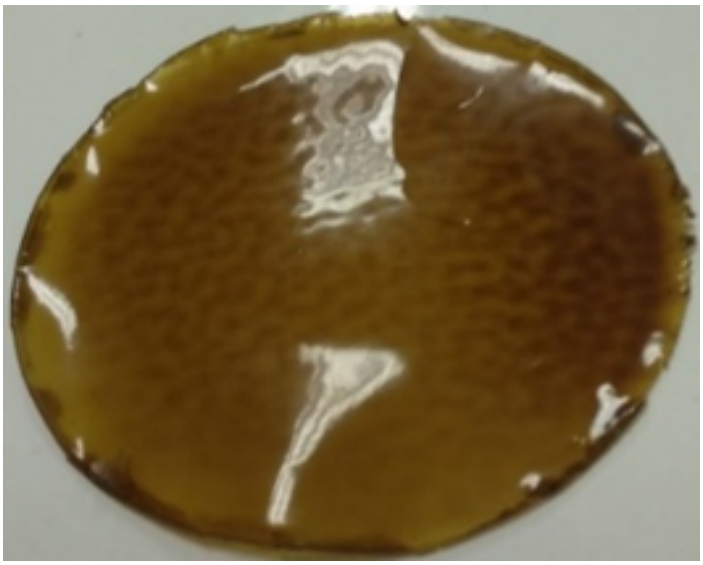
The Technology

Biodegradable films were produced using protein isolates, crude glycerol as plasticizer and bacterial nanocellulose as reinforcing filler. Optimal ratios of glycerol, protein isolates and bacterial nanocellulose were determined for good performance of films. Prior to their upgrade to isolates, crude proteins were treated for the recovery of antioxidant compounds using ultrasound-assistedethanol extraction. Antioxidants were incorporated at certain amounts into the biopolymeric matrix and the potential for preserving oxidation-sensitive products was evaluated via Rancimat analysis. Overall, the films were tested by contact angle measurements regarding their hydrophilicity/hydrophobicity, surface plasmon resonance (SPR) to evaluate the adsorbed amounts in thin films, FTIR to detect the separate components and their interactions and TGA to characterize their thermal properties.

Highly perishable products, i.e. strawberries, were stored in specific containers capped with the produced biofilms. Their sensory properties in terms of appearance, texture, aroma, and taste as well as firmness and color were evaluated throughout a 15-day period.

Advantages & Innovations

- Excellent barrier properties to oxygen
- Good mechanical properties
- Low permeability to water vapor
- Slow decay rates of highly perishable food products



The overall evaluation of novel biodegradable films properties demonstrated their potent application in active packaging applications.

Stage of Development

This novel technology is an innovative process for the production of edible and biodegradable films and it has been validated in lab scale. The next step requires an industrial large-scale validation and production to ensure the effectiveness of the process in pilot or industrial processes.

Partner Search

FOOD INNOVATION RI is seeking for Partners from the Food Industry to develop this technology. The industrial Partner shall further develop this technology in a relevant and operational environment. Alternative options may also be considered.

Offered by

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Contact

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Food Process Engineering

Food industry side stream valorisation into poly (3-hydroxybutyrate) production

Code: 21-AUA-03

The Opportunity

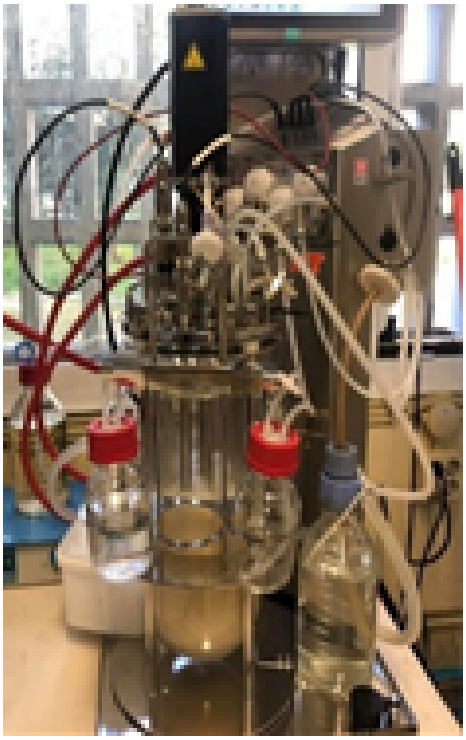
The increasing use of bioplastics is driven by the continuous demand for sustainable products by consumers and brands alike, due to a growing awareness of the environmental impact and the need to reduce the fossil resources dependency. New and innovative biopolymers such as polyhydroxyalkanoates (PHAs) show increasing commercial interest. In this context, the use of food supply chain side streams for PHAs production constitutes a sustainable approach. Poly(3-hydroxybutyrate) (P3HB) is an environmentally friendly bio-based polymer, member of the polyhydroxyalkanoates (PHAs) family. The versatile biodegradability properties in most environments exceed those of any other bioplastic. PHB features thermoplastic properties, physical and mechanical characteristics similar to widely used fossil-based materials, such as polypropylene (PP). Due to its numerous advantages, PHB could be used in biomedical, agricultural and packaging applications. However, the high production cost of PHB is one of the major barriers impeding industrial production. Thus, food supply chain side streams should be used in order to reduce the PHB production costs.

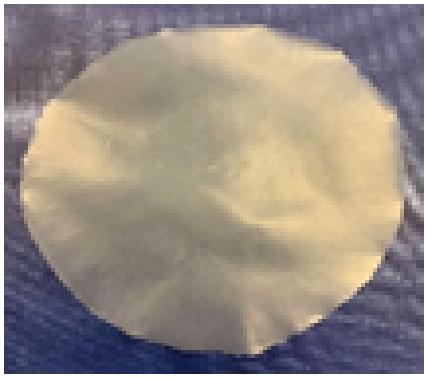
Our Offer

The development of an environmentally friendly and sunstainable biorefinery process for the production of PHB and other value-added products via valorisation of food industry side streams has been employed. Emphasis is

given on the utilization of side streams derived from fruit and vegetable juice production and flour milling industries (wheat bran) for PHB production for applications in food packaging. Therefore, in the context of the zero-waste circular economy, the simultaneous exploitation by fractionation of value added components (e.g. pectins, antioxidans) from the raw materials is performed.





The Technology

The free sugars from fruit and vegetable side streams were extracted and used as carbon source for PHB production. Phenolic compounds and pectin were extracted from the remaining solids by applying aqueous ethanol and citric acid based methods, respectively. Enzymatic hydrolysis of the remaining solids was performed and a carbon rich fermentation feedstock was produced. Considering the side stream of the flour milling industries, wheat bran was hydrolyzed into fermentation media using crude enzymes which were produced via solid state fermentation of Aspergillus awamori. Fed-batch fermentations with the bacterial strain Burkholderia sacchari were carried out using the aforementioned crude feedstocks (i.e. wheat bran hydrolysate, fruit hydrolysate and fruit sugars). A novel downstream separation and purification process for

the recovery and purification of the intracellular PHB was developed based on enzymatic cell disruption considering the minimum degradation of biopolymer molecular weight. Crude enzymes produced via solid state fermentation were used in this stage.

Advantages & Innovations

- Exploitation of value-added products from fruit and vegetable waste and industrial side streams
- High yields and productivities in the biotechnological production of PHB
- High recovery yield in downstream separation and purification process
- PHB production with high molecular weight and appropriate physical and mechanical properties for packaging application were achieved

The overall evaluation of PHB demonstrated the potential application in food packaging field as an alternative bio-based and biodegradable polymer for the substitution of fossil-based polymers.

Stage of Development

This novel biorefinery approach combining innovative technologies for valorisation of food industry side streams into sustainable production of PHB. The overall process has been validated in lab scale. The next step requires an industrial large-scale validation and production to ensure the effectiveness of the process in pilot or industrial scale.

Partner Search

FOOD INNOVATION RI is seeking for Partners from the Food Industry with the capacities to develop this technology. The Partner shall further develop this technology in a relevant and operational environment. Alternative options may also be considered.

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Contact

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Food Process Engineering

Developing functional snacks for modulation of gut microbiota in Type-1 diabetes

Development of novel short meals (snacks) for functional modulation of gut microbiota in Type-1 Diabetes

Code: 21-DUTH-01

The Opportunity

Due to the modern lifestyle needs, consumer demand for nutritional-enhanced and health-promoting short and quick meals (snacks) with an impact on functional modulation of gut microbiota in Type-1 Diabetes is steadily growing.

Our Offer

During the last decades, the incidence of Type 1 diabetes (T1D) has dramatically increased in developed countries, suggesting that beyond the genetic component, environmental factors, such as diet, intestinal microbiota, increased pharmaceutical use and chemical exposure contribute to the onset and the development of the disease. T1D is characterized by a series of events, resulting in autoimmune destruction of the insulin-secreting pancreatic β-cells and inability of the body to regulate and use blood glucose.

The gastrointestinal (GI) tract constitutes the most important site of interaction between the host immune system and microorganisms. Gut microbes exert both anti- and pro-inflammatory actions, since normal flora community includes

members that are capable to induce inflammatory responses. Thus, the intestinal microbiota is a major contributor towards the onset of T1D and/or is also modified as a result of T1D disease progression.

The restoration of normal composition of microbiota populations constitutes a new target for the prevention and treatment of the T1D. Diet is a major environmental factor contributing to gut microbiota diversity and functionality, as different dietary compositions have diverse effects on bacterial shifts. Hence, consumption of prebiotic fibers along with health-promoting microbial species (probiotics) has been associated with glucose intolerance, immune responses and intestinal microbiota regulation. Our technology includes fortification of prebiotic dietary fibers with functional microbial cultures that have been previously documented in modulating gut microbiota in Type-1 Diabetic patients.

The Technology

The principle of this technology is based on the development of structured delivery assemblies to protect the functional cultures against various harsh degradative conditions during food production, storage and digestion.
A properly designed strategy for incorporation of functional cultures into foods (formulation strategies, processing, stability and organoleptic quality issues) is a key factor in the development of functional products. Although encapsulation technologies have largely been exploited in the pharmaceutical (e.g. drug and vaccine delivery) and agricultural/agro-industrial industry (e.g. fertilizers), the food industry has only recently become aware of the immense benefits that these technologies can offer. Incorporating functional microbes (probiotics) into a food matrix presents a fully new challenge, not only because of their interactions with other constituents, but also because of the severe conditions often employed during food processing and storage, as well as during the GI transit until they reach the desired site in the body. These severe conditions might lead to important losses in viability, as probiotics are thermally labile (on heating and/or freezing), sensitive to acidity, oxygen or to other food constituents (e.g. salts). To overcome this deficiency, cell immobilization has been proposed to maintain the probiotics in their active and functional form, ensuring thus that they reach the desired site of the GI without modifications but intactly. Therefore, the challenge for food manufacturers is to develop effective

protective delivery systems for probiotics without adversely affecting the sensorial quality and/or the shelf-life of the fortified products.

Our idea was to develop a commercial healthy and nutritional snack product by enriching prebiotic dietary fibers with beneficial microorganisms tailored to functional modulation of gut microbiota in T1D.

Advantages & Innovations

The proposed technology aims at marketable "ready-to-eat" snack products consisting of prebiotic dietary fibers fortified with health-promoting microbes and is expected to provide superior-quality and nutritious short meal alternatives with a high commercialization potential.

- No need for extensive equipment and precision
- High customer market
- Economically viable investment
- High nutritional product
- Short meal alternative

Stage of Development

This novel technology is an innovative process validated in a lab environment. The next step requires an industrial setting validation and production in order to ensure the effectiveness of the process in large-scale manufacturing.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be a food manufacturing company with a strong retail network or a food ingredient producer eager to further develop this technology in a relevant and operational environment. Alternative options may also be considered.

Offered by

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Contact

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Microbiology

Lipase catalyzed synthesis of food flavors: natural-labeled food flavor esters

Production of natural, low cost and environmental friendly food flavors

Code: 21-UOI-01

The Opportunity

The increasing demand for natural ingredients in food products is a market's driving factor. Today, there is a decreased availability in the market of food additives with positive nutritional and environmental sign. Therefore, we have developed a low-cost green technology for the production of food flavor esters from low-added value agro-industrial wastes, which could be labeled as natural. An economically viable process for the synthesis of flavor esters is now available; these products can be formulated in easily handled encapsulated forms and launched into the market with domestic use perspectives.

Our Offer

The synthesis of food-flavors is a promising approach conformed to the increasingly markets' demands for safe, pure, low-cost and easy-handled products labeled as natural, according to the Legislations in EU and the USA. Long self-time preservation and controlled release during food processing, are prerequisites for their successful marketing. Therefore, we scheduled the development of two different commercial products synthesized catalytically by microbial lipases.

Product A: Depending on the end use and processing conditions of these esters, we selected water-soluble, lipid-stable and edible soft gelatin capsules, each containing about 5 mg of the pure finished product, which will be commercially available for use in vials of 25 easily handled capsules.

Product B: Commercially available food flavors in liquid form in small dropper vials containing ester's quantities varying from 2 to 5 ml.

Both of these high-quality products can be used in the food industry (e.g. desserts, confectionery, instant soft drinks, etc.), in many forms of home cooking and baking and in cosmetics, to add a desired fragrance and ameliorate their organoleptic properties.

The Technology

This integrated cost-effective and advanced technology for food flavors production is based on the lipase catalyzed esterification of short chain fatty acids, from acidogenesis of liquid agro-industrial waste biomass, with selected alcohols. We applied "smart" strategies in order to enhance the quality and yield of the products.

Additionally, in order to maintain the integrity and stability of these particularly expensive compounds and for commercial use, encapsulation techniques have been employed. The encapsulation follows the dissolution of ester in vegetable oils (30%), in order to avoid its loss through volatility. These innovative technologies enable the two distinct forms of food flavor esters (product A & B) to satisfy all relevant market demands and consumer's inclination towards "natural" products.

Advantages & Innovations

- A low-cost green technology for production of food flavor esters has been developed
- The applied technology releases pure compounds free of contaminations from other chemicals
- The described products are safe and effective for use in foodies
- The produced esters could be labeled as natural
- Encapsulation enables long storage and shelf life and easy product handling for domestic use
- Our aim is orientated to decrease the cost of the commercially available proposed products by means of continual study and experimentation

Stage of Development

The proposed sustainable bioprocess for the production of food flavor esters has already been validated in Laboratory scale. There are many prospects for the industrial scale-up expansion of this technology in order to evaluate the effectiveness, quality and the economic viability of the products.

Partner Search

FOOD INNOVATION RI is seeking for Partners capable to develop the proposed technologies. Potential Partners should be food industries and/or flavor manufacturers interested in driving the further development of this proposed technology in a relevant and operational environment.

Offered by

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Contact

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Clarification of wines using plant proteases

Controlled effect of plant proteases, for the clarification of white wines, targeting to preserve their traditional organoleptic properties
Development of an efficient low cost process for haze prevention in winemaking
Code: 21-UOI-02

The Opportunity

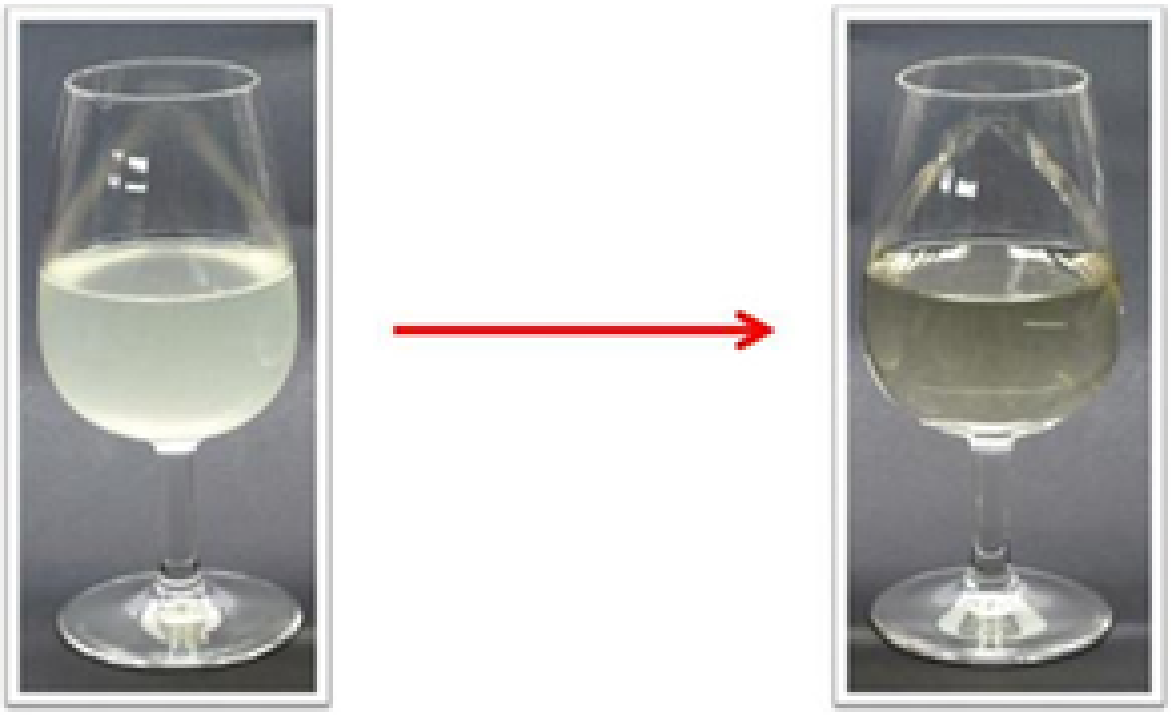
By living in a wine-producing region (Epirus-Greece), we realized the increased needs and demands of the market for the availability of high-quality wines, which in turn should keep as much as possible their traditional organoleptic properties, and to be free of synthetic chemicals.

Protein haze formation is an aesthetic problem in white wines, which caused by grape proteins that have survived the winemaking process. The current practice for wine clarification is the use of Bentonite which results in quality degradation and wine loss. We suggest a viable option for wine clarification using proteolytic enzymes which are routinely used in the beverage industry, in an efficient immobilized form.

Our Offer

Nowadays, the use of enzymes at different stages of large-scale production of wine, even in small wineries, is not an uncommon practice.

We have developed an innovative product based on immobilized plant proteases for clarification of wines and prevention of protein haze formation during wine making. This is a low-cost alternative versus Bentonite, as well as to other fine chemical products, which ultimately will benefit wine makers and wine industry.



Clarification Product: Commercially available 15 g/L biocatalyst (mixture of proteases immobilized in specified matrix), ready to use either in grape juice or in fermented wine prior to bottling.

The produced wine has lower production cost, negligible loss in value, high quality and an acceptable clarity for the consumers.

The Technology

This integrated cost-effective and advanced technology for clarification of wines and prevention of protein haze formation is based on using immobilized plant proteases as alternatives to Bentonite, as well as to other fining agents. Prior to their use the plant proteases were purified up to homogeneity and immobilized on safe matrices consistent with good manufacturing practice for food preparations. These easily-handled enzyme preparation packages might be added either to grape juices (musts) or to fermented product, and removed later from the end product. Wine profiling is performed during all stages using specified analytical techniques versus proper blank samples. The above-

mentioned process minimizes wine volume loss and quality degradation (flavor and aroma compounds) during winemaking.

Advantages & Innovations

- This advaned technology, is an alternative to Bentonite for wine clarrification
- This low-cost process minimizes wine volume loss, aroma stripping and quality degradation
- The employed plant proteases are effective and safe for use in food preparations
- The immobilization matrices and the consequent enzyme preparations are consistent with good manufacturing practice
- The proposed product would be added to grape juice or ferment with easy-handling removal
- The elimination of protein haze releases high quality wines preserving their traditional organoleptic properties

Stage of Development

The proposed products have already been validated in Laboratory scale. In a next step we will proceed to a scale-up expansion of this technology in order to evaluate the effectiveness, quality and the economic viability of the products.

Partner Search

FOOD INNOVATION RI is seeking for Partners capable to develop the proposed technologies. Potential Partners should be a winery with a strong retail network or a food ingredient producer interested to further develop the proposed technology in a relevant and operational environment.

Offered by

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Contact

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High-quality oenological yeast formula

Must fermentations using mixed yeast inocula and production of wines with improved organoleptic characteristics
Code: 21-UOI-03

The Opportunity

Wines are usually produced by employing a single oenological yeast strain (a Saccharomyces cerevisiae strain). The wine industries use a limited number of such strains as starters. This practice guarantees the standardization of the production process, but the final product has always the same characteristics. On the other hand, consumers demand new wine products with novel taste and aroma. This, we consider as a great opportunity, to produce wines with novel characteristics.

Our Offer

The use of mixed oenological, indigenous yeast inocula as starters provides new products with novel and improved organoleptic characteristics and especially with novel aromatic bouquets. Our approach aims to meet exactly the above stated need. We can provide lyophilized mixes of indigenous, oenological yeast strains, which we have isolated, biochemically and molecularly characterized and tested in laboratory micro-fermentations. These mixes have proven to produce (white or red) wines with novel aromas and generally improved organoleptic characteristics.

The Technology

The isolated yeasts originated from domestic grape varieties, are totally/ extra pure and completely characterized. The mixtures offered were obtained after many trials of different combinations which were exposed to microvinification and led to wine production with improved organoleptic characteristics. The use of different yeast combinations during must fermentation leads to the production of additional volatile compounds, which critically improve the flavor characteristics of the produced wine.

Advantages & Innovations

- Combination of new indigenous yeasts
- Production of wine:
  - with improved aromatic bouquet
  - with high quality organoleptic characteristics
  - with lower alcohol content
- Simple purchase and storage of product (house refrigerator)

Stage of Development

The yeast mixtures have been tested at lab scale including microvinifications. This approach will be developed by scaling up fermentations in appropriate bioreactors to verify the improved quality and the aroma content in the final product.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be a winery with a strong retail network or a food ingredient producer eager to further develop this technology in a relevant and operational environment.

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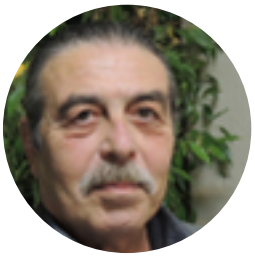

Assoc. Prof. Efstathios HATZILOUKAS
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Edible and non-edible biomass from wood-decay basidiomycetes

Formula of biomass of cellulolytic and ligninolytic, edible or non-edible bacidiomycetes, serving as food sources and/or bioremediation agents
Code: 21-UOI-04

The Opportunity

Wood industries accumulate byproducts that remain usually unexploited and are considered as putative pollutants. The opportunity resides in the prospect to convert the waste material in high additive value products and concomitantly to biologically remediate the pollutants.

Our Offer

We will manipulate the accumulated wood waste by testing indigenous bacidiomycetes for their potential to degrade wood industry byproducts by exploiting their cellulolytic and ligninolytic properties. Growth of bacidiomycetes on such waste will result in either the production of edible biomass, or the use of the biomass to produce valuable prebiotics (e.g. inulin). A formula of edible and non-edible fungal biomass will be provided.

The Technology

The wood-decaying bacidiomycetes are isolated from local forest habitats and characterized at the molecular level. The above isolates are grown on various

wood substrates, while the establishment of pure cultures is about to be completed at the present stage. The determination of enzymatic activity following molecular verification is still in progress. The collection of fungal biomass and the extraction of prebiotics (inulin and other non-digestible galacto-oligosaccharides) will be the final stage of this project.

Commercial bacidiomycetes are used as controls during each procedure.

Advantages & Innovations

- Creation of a domestic wood-decaying fungi collection from local forest habitats
- Biological degradation of wood industry byproducts by exploiting the cellulolytic and ligninolytic properties of the above basidiomycetes
- Conversion of a useless and hazardous industrial waste in valuable products
- Production of basidiomycetes edible and non-edible fungal biomass from a substrate of no cost

Stage of Development

Indigenous and commercial wood-decay bacidiomycetes are characterized at the molecular level and grown successfully on wood substrates.

Partner Search

FOOD INNOVATION RI is seeking for Partners with the capacities to develop this technology. The ideal Partner shall be a wood industry and a food ingredient producer eager to further develop this technology in a relevant and operational environment.

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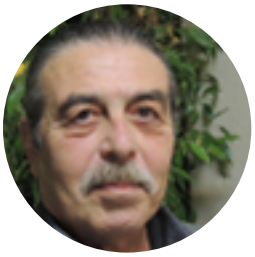

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3. R&D SERVICES

In General

More than 13 research groups from 7 Universities of Greece specializing in food biotechnology, catalysis, microbiology, molecular biology, genetics, enzyme engineering, process engineering, food chemistry and analysis are available to support users with scientific or commercial interests in the agri-food sector to perform their research projects or tasks, and develop new products and services. Transformation of ideas into competitive proposals or business opportunities to gain national or EU research funding or to hit the market are also offered.

Key research and technical approaches that can be offered include:

- Food product development including product and process design, production development, performance assessment, scaling-up and estimation of shelf-life
- Sensory evaluation of food products including a full descriptive profile, discrimination tests, consumer acceptance and consumer preferences analyses
- Microbial and physicochemical analysis of food products, ingredients and wastes
- Isolation and characterization of food related microorganisms
- Biorefinery design and technical feasibility evaluation enabling sustainable conversion of biomass into marketable products such as food and feed, materials, chemicals, fuels and energy
- Techno-economic analysis and evaluation of investments in new products and fermentation technologies with a focus on process simulation, process dynamics and optimization, process development and scaling-up, process operation and control, process safety and life cycle assessment

How to Gain Access

R&D Services are offered to SMEs, large companies, research centers and public bodies, also referred to as stakeholders. The stakeholder shall apply for access by sending an email to info@foodinnovations.gr or completing a form at FOOD INNOVATIONS RI website (if provided) describing the exact subject of interest and the service that they require. A group of experts from FOOD INNOVATION RI will evaluate the application with respect to the resources that are available, the relevance of the requested service to the FOOD INNOVATION RI scope, the science and complexity of the subject and the general criteria highlighted in our access policy which can be found on line (www.foodinnovations.gr). An expert from FOOD INNOVATION RI may contact the stakeholder for more information if needed and subsequently respond by offering a quotation or by sending a rejection letter if the request cannot be processed.

Details on R&D Services Offered by FOOD INNOVATION RI

In the following section R&D Services that are currently offered by FOOD INNOVATION RI are described in more detail giving information both on the sites offering the service and the equipment that is available.

Development of novel food products

Description

Following the new trends of food consumption, food companies need to redesign their product portfolio to meet consumer demands and health-related expectations. The road from products with no or low sugar to fortified products and personalized nutrition presages major shifts in the food sector in the near future. Consumers are more aware of the impact that food can have on their health and life. Scientific data from clinical trials and technology offer the means to develop new products with specific functional properties. The incorporation of micro- and macro- nutrients into foods to achieve a specific nutritional and functional profile is our expertise. An interdisciplinary team of higher-educated researchers will work with your marketers to design and develop novel products that meet your needs. Recent advances in technology, environment, legislation, as well as the social, economic and political macroenvironment of the new product will also be taken into consideration to increase the potential of success of the new venture.

Let us know what are you up to and let's discuss how we can make it happen.

Services

- Novel product recipe
- Novel production process
- Performance assessment

- Technical support for scaling up
- Advisory support for launching the product
- Shelf-life estimation

Main Equipment

- Freeze dryers, spray dryers, homogenizers
- Nanodrop, PCR, Real Time- PCR, HPLC, FPLC, GC, UV-Vis, FTIR, DSC, CLSM, TEM, EDXRF, WDXRF, RAMAN spectrometer, SEM-EDX-WDX, XRD, FAAS
- Micro-incubators, incubation cabinets, safety cabinets, fermenters and autoclaves
- Pilot plant facilities for alcoholic beverages, bakery, meat and dairy products

Location

- Department of Chemistry, University of Patras, University Campus 26504 Rio Achaia, Greece
- Department of Food Science and Technology, School of Agriculture, Aristotle University of Thessaloniki, Thermi-Thessaloniki, 57001, Greece

Microbial analysis of food

Description

Microbial analysis in food production constitutes one of the main tools to manage and effectively control microbial hazards and quality characteristics in food chain. Microbial analysis is routinely used by food traders, food production companies and authorities to manage processes and ensure safety of final products and conformity with standard quality characteristics and with management strategies according to HACCP studies.

The development and application of methods for the identification of specific microbial strains in foods combining traditional microbial and chemical methods with modern molecular techniques is offered by FOOD INNOVATION RI exploiting the knowledge and expertise of research scientists in chemical, microbial and molecular analysis.

Services

- Identification and characterization of the microbial strain of interest
- Design of a strategy for the successful detection of the microbes
- Development and validation of an effective protocol
- Apply the method in an operational (industrial) environment
- Detection of food microbes
- Determination of food biodiversity
- Gene expression analysis in food systems

Main Equipment

- Nanodrop, PCR, Real Time- PCR, DGGE, HPLC, FPLC, GC, UV-Vis, TEM, EDXRF, WDXRF, RAMAN spectrometer, SEM-EDX-WDX, XRD, FAAS
- Micro-incubators, incubation cabinets, safety cabinets, fermenters and autoclaves

Location

Department of Chemistry, University of Patras, University Campus 26504 Rio Achaia, Greece

Sensory evaluation of food

Description

Sensory evaluation of food is a scientific technique that uses the human senses to evaluate the organoleptic properties of foods (e.g. taste, odor and texture). An array of techniques are used to assess the quality of food products, their shelf life and in trouble-shooting problems during new food product development. FOOD INNOVATION RI has state-of-the-art sensory facilities and a team of highly trained food panelists, who can evaluate the flavour, odour and textural attributes of food products, such as dairy, bakery, meat, and wine products. Moreover, the use of advanced statistical analysis allows the evaluation of similarities and differences between food products and help to examine whether the developed products meet the desired requirements-specifications. The results from the sensory evaluation are compared, associated, and related to the chemical, physico-chemical and microbial analyses of the food products.

Services

- Full descriptive sensory profiling
- Discrimination tests
- Consumer acceptance tests
- Consumer preference tests

Main Facilities

- Food sensory analysis laboratories
- Pilot plant facilities for alcoholic beverages, bakery, meat and dairy products
- Chemical, physicochemical and microbial analysis laboratories

Location

- Department of Food Science and Technology, School of Agriculture, Aristotle University of Thessaloniki, Thermi-Thessaloniki, 57001, Greece
- Department of Dietetics and Nutrition, Harokopio University, El. Venizelou 70, 17671, Athens, Greece

Isolation and characterization of probiotic microorganisms

Description

In recent years, consumers are turning to foods that not only meet their daily nutritional needs, but also protect and/or improve their health. A good example of such foods are those that contain probiotic microorganisms and/or dietary fibers with prebiotic properties. Probiotics are defined as living microorganisms which, when administered in sufficient quantities, provide a beneficial benefit to the health of the host, while prebiotics are indigestible food components that act beneficially on the body, selectively activating the growth and / or activity of the desirable gut microorganisms. Pre- and probiotics can be used to liken the intestinal microbial flora with beneficial effects in certain diseases. Over the last two decades the isolation and characterization of probiotic isolates has attracted the interest of both the research community and the food industrial sector. Traditionally, the main source of probiotics were fermented foods such as yoghurts, kefir, sauerkraut, kimchi and pickles. However, the isolation and characterization of probiotic cultures and their subsequent production gave birth to food supplements and fortified products such as chocolates, cereal bars, ice-creams and fruit juices. Scientists from FOOD INNOVATION RI may support your efforts in isolating and characterizing novel probiotic cultures or study the viability of commercial strains in your products.

Services

- Isolation and identification of potential probiotic bacterial strains
- In vitro characterization of probiotic properties
- Culture optimization of probiotic strains at lab and pilot scale
- Viability studies of probiotic strains in food products during processing and shelf life

Main Facilities

- Fully equipped micro-lab
- Bioreactors for cultures development

Location

Department of Agricultural Development, Democritus University of Thrace, 193 Pandazidou Str, 68200 Orestiada, Greece

Estimation of total polar phenol content

Description

Polar phenolic compounds are plant secondary metabolites, their consumption being largely associated with several beneficial effects on human health and wellbeing. They are potent free radical scavengers, while they also exert antimicrobial, anti-inflammatory, anticarcinogenic properties. Evidence from epidemiological data and clinical interventions is emerging with respect to their protective effects against degenerative diseases, including cancer and cardiovascular diseases. The potential role of food polar phenols on public health together with the fact that consumers' awareness on food polar phenolic content is becoming increasingly popular, makes polar phenolic content estimation an interesting parameter on food research project and/or new product development.

Services

Spectrophotometric estimation of food total polar phenol content after extraction using Folin Ciocalteu assay

Main Equipment

Sonicator bath, stirring apparatus, centrifuges, solvent evaporators, spectrophotometer, elisa reader

Location

Department of Dietetics and Nutrition, Harokopio University, El. Venizelou 70, 17671, Athens, Greece

Design of biorefinery

Description

FOOD INNNOVATION RI researchers have acquired first-hand knowledge and gained valuable expertise in development of innovative biorefineries. In FOOD INNOVATION RI we can simulate the technical feasibility and performance of process designs, using engineering rules and laboratory data enabling sustainable biomass conversion to its ingredients and marketable products such as food and feed, materials, chemicals and fuels and energy.

Learn how to design an effective biorefinery to obtain valuable components from various biobased feedstocks.

Services

- Biorefinery process design
- Performance analysis of process designs
- Technical feasibility evaluation

Main Equipment

- Bioreactor (1-30 L)
- HPLC/GC
- Spray dryer
- Evaporator

Location

Department of Food Science and Human Nutrition, Agricultural University of Athens, Iera Odos 75, Athens, Greece

Techno-economic analysis and evaluation of investments

Description

FOOD INNOVATION RI researchers have significant experience and know-how in the fields of design and evaluation of technologies for the valorisation of waste and by-product streams and in simulation and integration of industrial processes by understanding the parameters necessary to construct and analyze a technology. Researchers of FOOD INNOVATION RI can combine the actual lab or pilot plant data to carry out simulation, to perform techno-economic analysis, life cycle inventory analysis (LCI) and life cycle assessment for a new product or process. The group also has significant know-how in the systematic optimization of industrial systems, from the level of the strategic planning to the level of optimization of the mechanical design and nominal operation and in the development of novel bioprocesses for the production of chemicals and/or energy.

Services

- Process design and simulation
- Process development and scale-up
- Process operation and control
- Life cycle inventory analysis and life cycle assessment
- Techno-economic analysis

Main Tools

- UNISIM
- GAMS
- SUPERPRO
- GABI
- MATLAB

Location

- Department of Chemical Engineering, University of Patras, University Campus 26504 Rio Achaia, Greece
- Department of Food Science and Human Nutrition, Agricultural University of Athens, Iera Odos 75, Athens, Greece

4. EDUCATION AND TRAINING

In General

Education and training constitute a fundamental part of the FOOD INNOVATION RI programme aiming to play a critical role in the knowledge triangle (research, education and innovation) of the agri-food sector by bringing together researchers and professionals from the academic, domestic and industrial sector, enhancing their capacities and fostering their interactions.

FOOD INNOVATION RI delivers training courses (workshops, seminars, pilot plant demonstrations) that are open to researchers and professionals. Each course is organized at a different infrastructure node and focuses on a thematic area of the agri-food sector that is in line with the priorities of its region.

The thematic areas that are covered include food biotechnology, food chemistry, food microbiology, fermentation technology, food biotechnology, biorefinery development, food metrology, dairy science, meat science, baked goods, beverages and soft drinks, processing and valorisation of agro-industrial waste, food by-products, nutrition and use of scientific equipment, innovation management and business development.

Type of Courses Available

- On line courses
- Webinars
- Hands-on workshops

- Distance learning courses
- Demonstration events
- Special courses upon request

Location

- Department of Chemistry, University of Patras, University Campus 26504 Rio Achaia, Greece
- University of Ioannina, University Campus, 45110 Ioannina, Greece
- Department of Dietetics and Nutrition, Harokopio University, El. Venizelou 70, 17671, Athens, Greece
- Department of Food Science and Human Nutrition, Agricultural University of Athens, Iera Odos 75, Athens, Greece
- Department of Food Science and Technology, School of Agriculture, Aristotle University, Thermi-Thessaloniki, 57001, Greece
- Department of Food Science and Technology, Ionian University, 28100, Argostoli, Kefalonia
- Department of Agricultural Development, Democritus University of Thrace, 193 Pandazidou Str, 68200 Orestiada, Greece

How to gain access

Training courses are pre-announced on FOOD INNOVATION RI website and communicated to its subscribers by newsletters. All information needed to apply for attendance is described in the call announcement.

Visit our website (www.foodinnovations.gr) or register to receive our newsletters and find out when the next course that suits your needs is coming up. If you have a request for a special course, contact us at info@foodinnovations.gr.

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