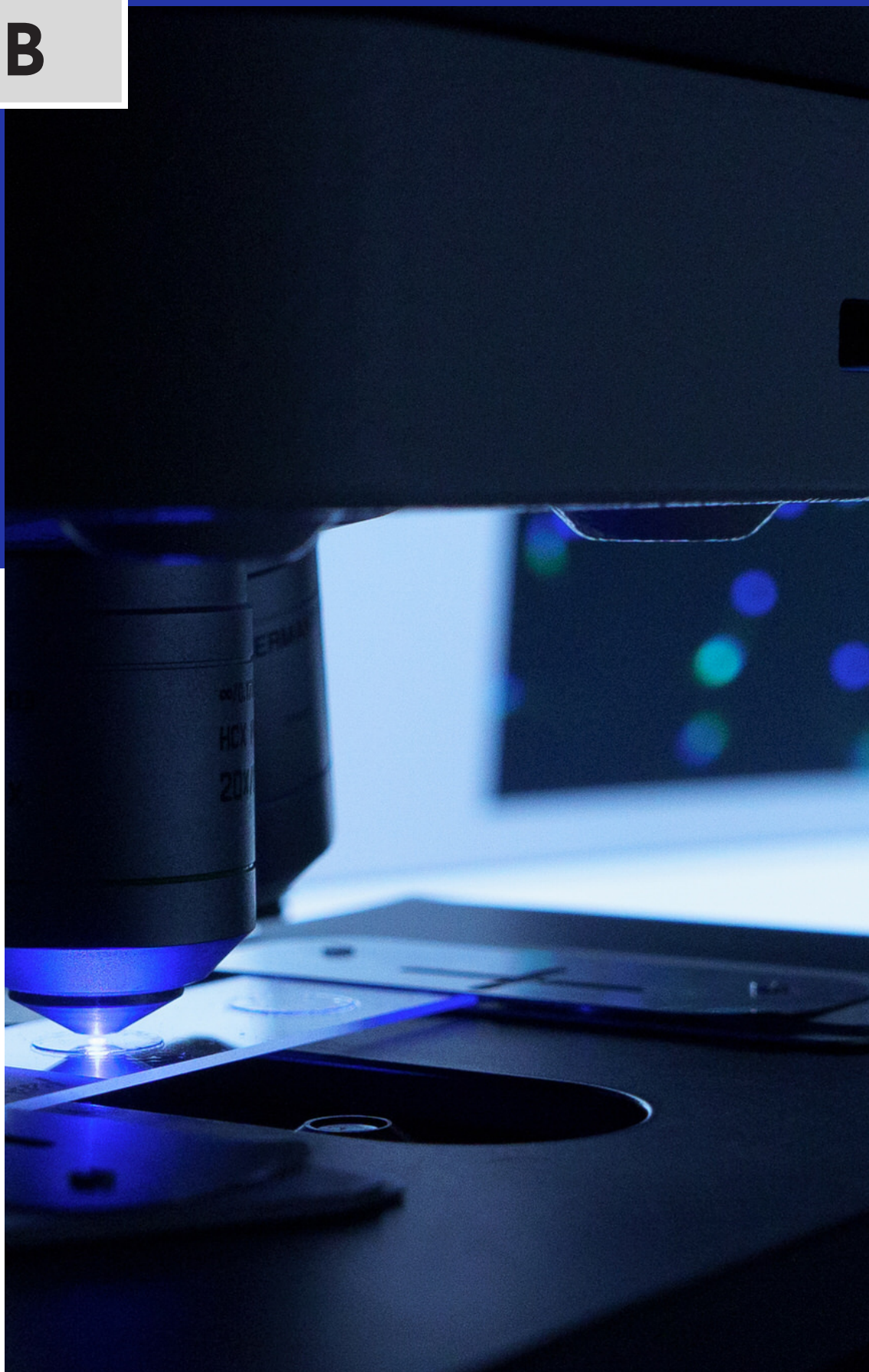


VERSION
2023-B

CATALOGUE OF SERVICES



FOODBIOMES
INNOVATIONS IN MICROBIOME APPLICATIONS

TABLE OF CONTENTS

03.

INTRODUCTION

29.

EDUCATION &
TRAINING

41.

HOW TO GAIN
ACCESS

05.

R&D SERVICES

35.

FACILITIES

42.

CONTACT US

INTRODUCTION

ABOUT FOODBIOMES

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.

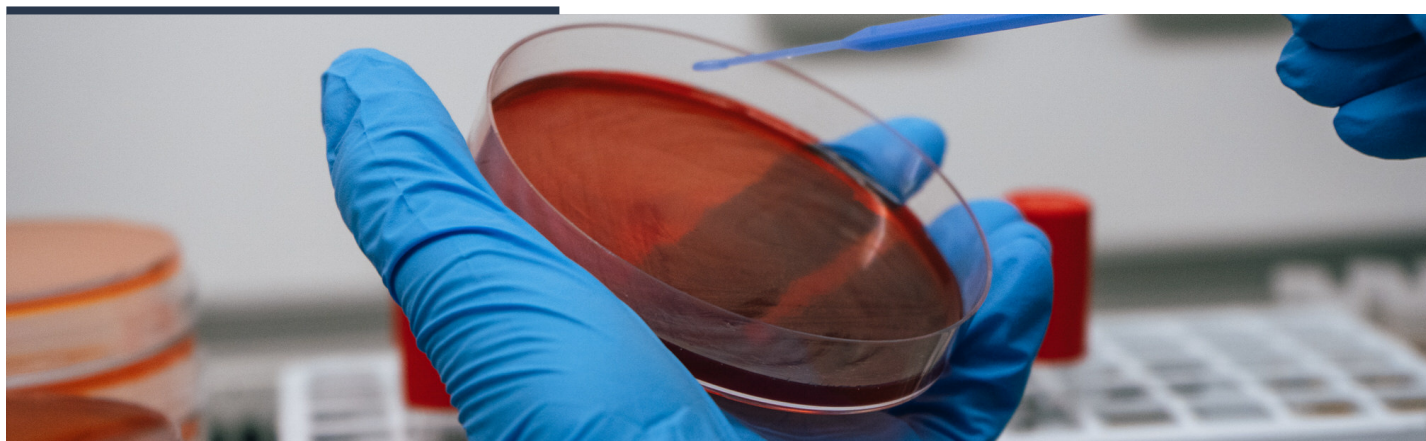
FOODBIOMES is an ambitious project funded by Greece and the EU that aims to establish in Greece a new research infrastructure that will offer world class research, education and innovation services exploring the impact of microbiome applications in food systems.

FOODBIOMES brings together the facilities, knowledge and experience of high-quality research groups from 4 Universities of Greece with a complementary scientific background; the Democritus University of Thrace, which stands as the Central Hub, and 3 regional nodes: the University of Aegean, the Ionian University and the University of Ioannina.

FOODBIOMES focuses on the study of the microbiome, and the identification, and effect of the microorganisms that compose the complex biocommunities on the various organs. The infrastructure also investigates the benefits and impacts of specific foods and food extracts to the human and animal microbiome. FOODBIOMES is an open science research network and welcomes knowledge sharing from research, industry and education.

Operating as a link between research, education and innovation, the FOODBIOMES business model is based on providing the necessary “resources” (knowledge, data, advanced services, technologies, facilities, methods) to researchers and professionals from the academic and industrial sector to further design, develop and produce products and services of their interest that will support the sustainability of the Agri-food sector.

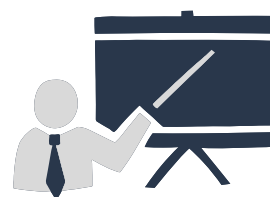
Following global technological challenges and new trends in the agri-food sector, FOODBIOMES develops and provides services that will enhance the innovation capacity of SMEs, research centres and public bodies of the agri-food sector. Education and training, facilities access and R&D services are constantly being developed, modernized and evolved to meet users’ needs and expectations and foster innovation in the agri-food sector.



This catalogue of services constitutes the first published version of FOODBIOMES and contains services that are currently offered to users. To stay informed about changes in the service catalogue, subscribe to our newsletter and be the first to know what is coming up.



**Research &
Development**



**Education &
Training**



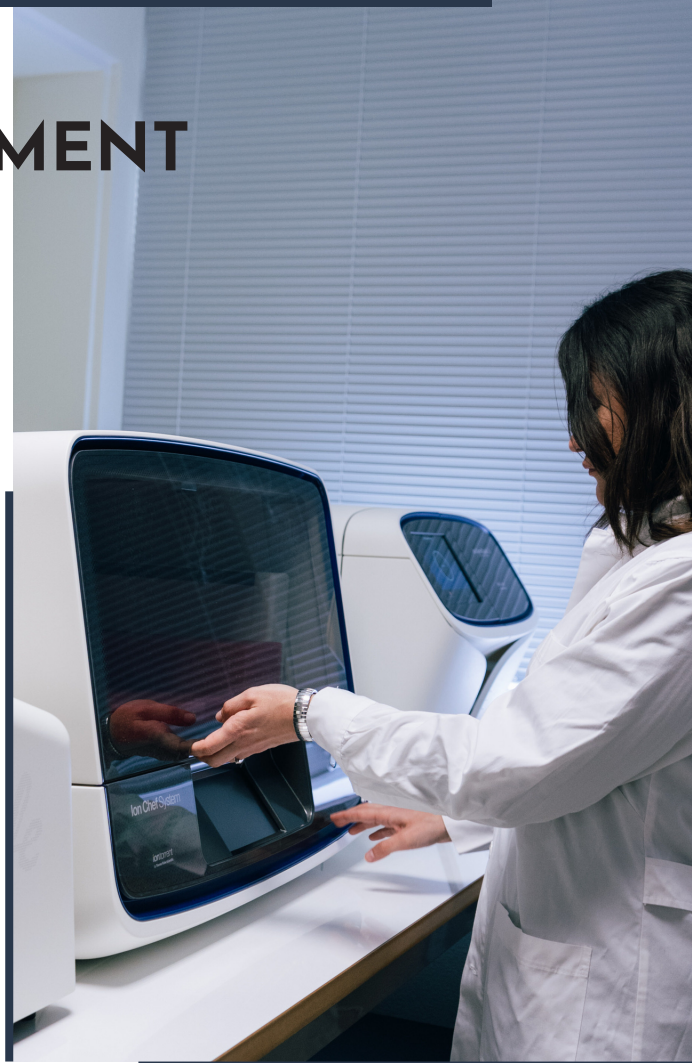
Facilities

RESEARCH & DEVELOPMENT SERVICES

FOODBIOMES offers advanced R&D services valorising the knowledge gained from research conducted on the food, human and animal microbiome as well as on the beneficial properties of food microorganisms for humans, animals, the environment, the economy and society in general. The aim of the services is to enhance the innovation capacity of the Agri-food sector for the production of healthy, safe and sustainable food systems.

Services that have been developed and offered at FOODBIOMES are included in the following list:

- Whole genome sequencing of microorganisms
- Evaluation of the probiotic potential *in silico*
- Evaluation of the adhesion of probiotic microorganisms on eukaryotic cells
- Analysis of the structure of food microbiome
- Analysis of the structure of gut microbiome
- Isolation of functional strains for food production
- Isolation of yeasts and malolactic bacteria to improve the quality and highlight the local characteristic of the wines
- Design and development of functional food ingredients
- Microbial metabolites profile analysis of starter and functional cultures used in food production
- Nutritional interventions-clinical studies to study the functionality of new food ingredients
- *In vitro* study of the bioactivity and bioavailability of functional food ingredients
- Development of innovative bio-economy food products and food properties analysis
- Development of edible and biodegradable materials





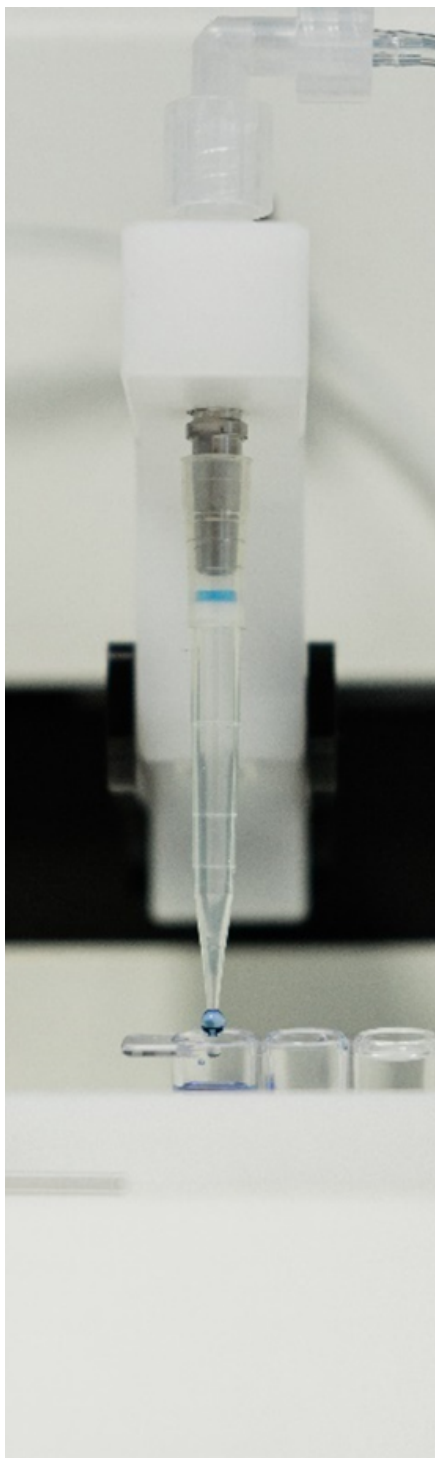
FOODBIOMES may also undertake or design for third parties research and development projects aiming at:

- Enhancing the functional activity of traditional foods and at new products with superior quality and functional characteristics
- Documenting the authenticity of food
- Improving traditional production and processing techniques
- Generating new knowledge on the effects of new innovative ingredients on the human microbiome and health.

The services are offered to researchers and professionals from the academic and/or business sector who can submit their requests or proposals by contacting FOODBIOMES at info@foodbiomes.eu.



WHOLE GENOME SEQUENCING (WGS) OF MICROORGANISMS



In the past 10 years, the efforts to produce using sustainable processes, new functional foods and other products that improve the quality of life have been intensified. However, the success is largely dependent on the availability of suitable microorganisms.

Thus, intensive and systematic approaches are undertaken worldwide to isolate from various sources, such as fermented foods, extreme environments or agro-industrial waste, novel strains which can be used for the development of foods or other products and services that are beneficial for the human or animal health, for waste treatment and production of useful molecules, such as microbial oils or microbial proteins, etc. Identification of novel strains is usually based on either morphological criteria or limited genomic information (e.g. sequence of part of the 16S gene or ITS). However, these approaches neither answer the question of whether an isolated strain is new nor provide data about its functions.

Users of our microorganism WGS service are researchers in Universities, Research Centers or professionals in companies that, as part of their activities, isolate new strains of microorganisms in order to study and/or patent for the development or improvement of innovative products and services. The service includes DNA isolation from the strain, sequencing using Next Generation Sequencing on our ION TORRENT S5 Gene Studio system and assembly, followed by genomic analysis to determine whether the strain is novel and therefore, worthy of study and/or patenting by comparing the genome of the new strain with those of other sequenced strains of the same species functional information.



Service

Whole genome sequencing of microorganisms

Equipment

- ION CHEF System
- ION TORRENT S5 Gene Studio
- Freezers
- Incubators
- Qubit/ Nanodrop
- Digital qPCR Quant studio 3D
- Centrifuges
- Other molecular biology laboratory equipment
- Servers & PCs & software

Target Group ☺

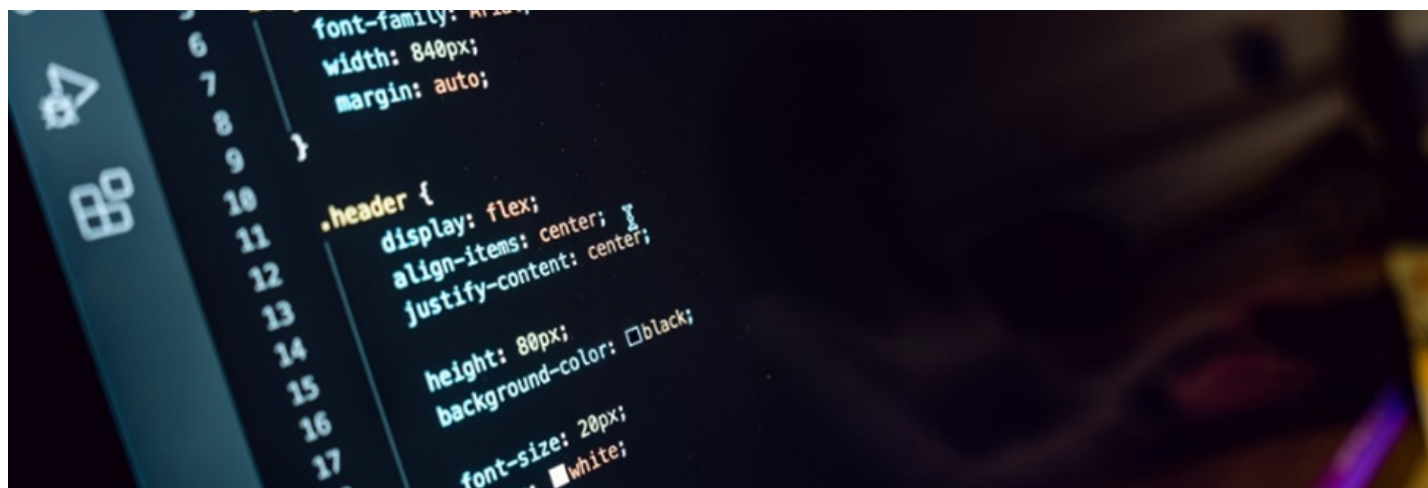
Researchers in Universities, Research Institutes, Companies



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

EVALUATION OF THE PROBIOTIC POTENTIAL *IN SILICO*



Probiotic organisms are microorganisms usually of the genera *Lactobacillus* and *Bifidobacterium* that are found primarily in fermented foods such as yogurt or sour milk, and, when administered in the appropriate dosage, have beneficial effects on the health of their host. In the recent years, as consumers and businesses are increasingly looking for products that are beneficial to the human or animal health, systematic and intensive efforts are being made to isolate new probiotic strains, that, if they have probiotic properties, they can be used for the design and development of innovative products such as juices or even chewing gum.

To evaluate the probiotic properties of a novel strain, a series of tests are carried out, some of which (for instance adhesion to eukaryotic cells, cholesterol binding assays, etc.) are expensive and time-consuming. This service provides an evaluation of the probiotic potential of a novel strain based on the comparative genomic analysis. Therefore, the sequence of the whole genome is a prerequisite.

The pipeline of our *in silico* approach includes the analysis of the main characteristics of the genome (genes, coding regions, etc.) and comparative genomic analysis focusing in genes associated with probiotic properties (adhesion to eukaryotic cells, resistance to low pH, antibiotic resistance genes). It has been designed to help the selection of the most promising, in terms of probiotic potential strains, for further study and characterization with selected *in vitro* tests. Researchers from research institutions or companies, that in the context of their activities have isolated new strains and have their entire genome sequenced, are potential users.



Service

Evaluation of the probiotic potential *in silico*

Target Group

- Researchers
- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

EVALUATION OF THE ADHESION OF PROBIOTIC MICROORGANISMS ON EUKARYOTIC CELLS

Probiotic organisms are microorganisms usually of the genera *Lactobacillus* and *Bifidobacterium* that are found primarily in fermented foods such as yogurt or sour milk, and, when administered in the appropriate dosage, have beneficial effects on the health of their host.

In the recent years, as consumers and businesses are increasingly seeking products that are beneficial to the human or animal health, systematic and intensive efforts are being made to isolate new strains, that, if they have probiotic properties, they can be used for the design and development of innovative products such as juices or even chewing gum.



The ability of probiotic microorganisms to adhere to eukaryotic cells of the intestinal epithelium is of paramount importance, as strains with low adhesion are difficult to exert their beneficial effects, even if administered in very high numbers daily. Therefore, this service can decisively assist users in selecting a strain for further studies.

For the evaluation of the adhesion ability of candidate probiotic strains *in vitro* the prokaryotic cells are incubated with cells that possess the characteristics of the intestinal epithelium, and following incubation the percentage of attached cells is estimated. Researchers from research institutions or companies that, in the context of their activities, have isolated new strains and have their entire genome sequenced are potential users.



Service

Evaluation of the adhesion of probiotic microorganisms on eukaryotic cells

Main equipment

- Cell culture facility
- Class II biosafety cabinets
- CO₂ incubators
- Incubators
- Inverted & Upright Leica DM 6000 and DM 4000 fluorescence microscope with image analysis software
- EVOS7000 high-performance fluorescence microscope with automatic image analysis software

Target Group ©

- Researchers
- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

ANALYSIS OF THE STRUCTURE OF FOOD MICROBIOME

In the recent years, microbiome studies in the field of Agri-Food are rapidly growing. Applications based on the analysis of the microbiome have been developed and are used to monitor processes such as fermentations, to optimize crop production, to monitor and manage waste, to detect and monitor environmental problems, and in general to develop new products and services that exploit microbial biodiversity.

Notably microbiome studies are expected to contribute substantially to the solutions of major social challenges of the 21st century, for instance providing safe and nutritious food to a growing population reducing at the same time the environmental footprint.

This service provides microbiome analysis of samples from various sources, such as foods, crops, soil etc.



Service

Analysis of the structure of food microbiome

Main equipment

- IONCHEF System
- ION TORRENT S5 Gene Studio
- Incubators Qubit/ Nanodrop
- Digital qPCR Quant studio 3D

Target Group ☺

- Researchers
- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

ANALYSIS OF THE STRUCTURE OF GUT MICROBIOME



In the past years the number of studies focusing on the effects of foods, or functional ingredients, complex nutritional interventions on the gut microbiome of healthy people, animals or patients suffering from various diseases (such as obesity, irritable bowel syndrome, etc.) or animal models of diseases, has been rapidly increasing.

Moreover, companies involved in the production of foods have realized that the effect of a product on the gut microbiome is an important issue, as the addition of specific ingredients may have a positive effect on the health of an individual. Thus, in an increasing number of preclinical and/or clinical trials of food ingredients or other products or complex nutritional interventions, the results of microbiome analysis are also taken in account for the selection of the most appropriate product or nutritional intervention.

This service provides microbiome analysis of samples from human or animal feces or gut. Metagenomic DNA isolation is followed by next-generation sequencing - amplicon or shotgun - and analysis of the data using in house pipelines. Moreover, statistical analysis and comparative analysis of microbial communities of different samples is available.



Service

Analysis of the structure of gut microbiome

Main equipment

- IONCHEF System
- ION TORRENT S5 Gene Studio
- InQubit/ Nanodrop
- Digital qPCR Quant studio 3D

Target Group ©

- Researchers
- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

ISOLATION OF FUNCTIONAL STRAINS FOR FOOD PRODUCTION

An increased interest for new functional foods containing beneficial (probiotic) microorganisms is observed lately. Probiotics are defined as living microorganisms which, when administered in sufficient quantities, provide a beneficial benefit to the health of the host. Most probiotic microorganisms belong to the *Lactobacillus* and *Bifidobacterium* genus and are mainly used for the production of fermented milk products.



Traditionally, products containing probiotic cultures are fermented foods such as yogurt, sour milk, kefir, sauerkraut and fermented vegetables. Recently, various products have been developed, such as probiotic juices (GoodBelly, Danone), chewing gum (Nebraska cultures), etc, indicating the intense efforts for the development and production of new probiotic products.

An important factor for commercial success is the microbial strain. Although, today, consumers are turning to health-promoting foods, the commercially available options for products related to clinical trial results are limited. Despite all the industry efforts, no food product has been linked to an official health claim by the European Union so far.

The specific service concerns the isolation of functional cultures from suitable sources (e.g. traditional foods for the production of which no commercially available starter cultures are used) and their evaluation for beneficial properties *in vitro* to be used as starter and/or adjunct cultures for the production of new foods with potential health benefits.



Service

Isolation of potential functional (probiotic) cultures, identification and characterization of their functional properties

Main equipment

- Laminar flow hoods
- Incubation chambers
- ION TORRENT

Target Group ©

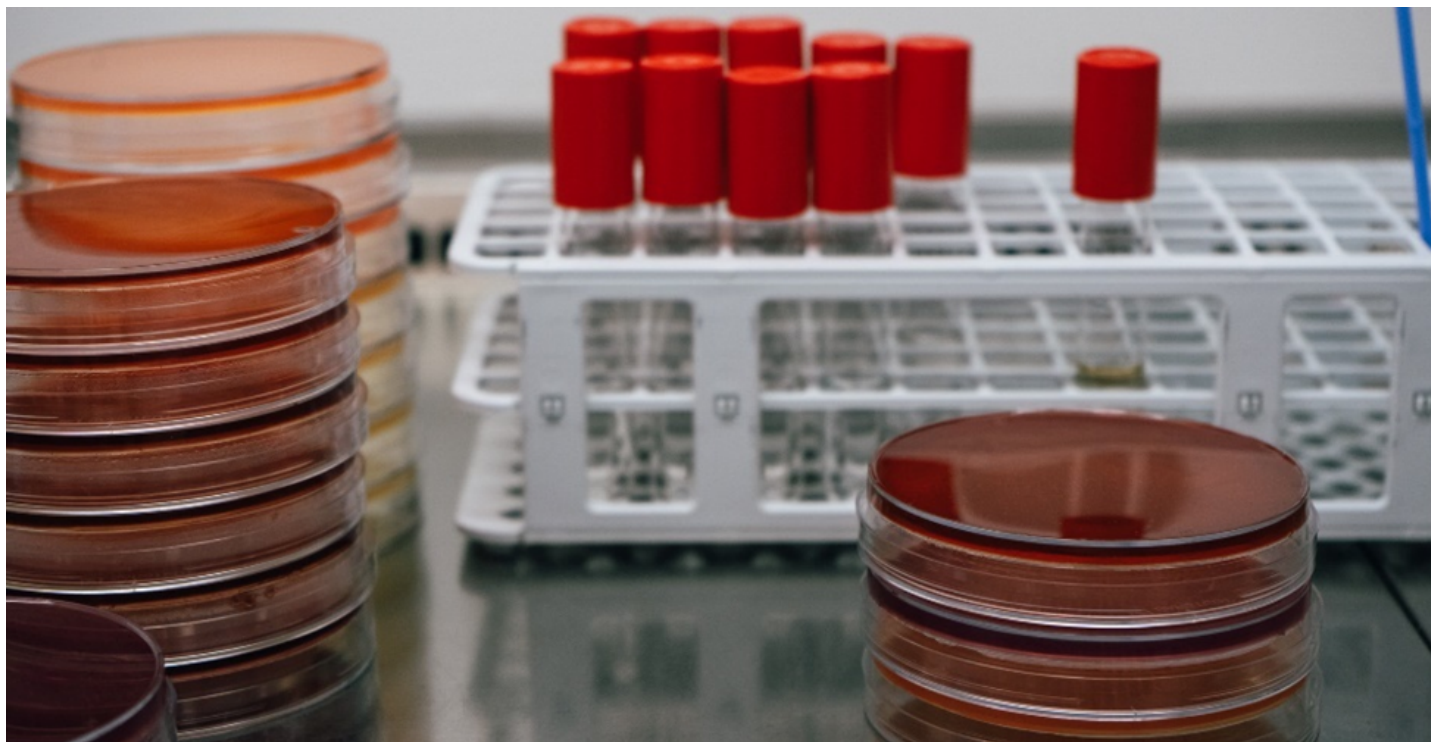
- Researchers
- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

ISOLATION OF YEASTS AND MALOLACTIC BACTERIA TO IMPROVE THE QUALITY AND HIGHLIGHT THE LOCAL CHARACTERISTICS OF THE WINES



The production of high-quality wines, apart from the raw material (grape variety), depends on the initial microbial cultures (yeasts and malolactic bacteria) and their metabolic products, which determine the quality characteristics of the final product. Today, however, industrial winemaking relies, almost entirely, on commercially available cultures, resulting in wines lacking the distinctive character of each region and variety that the local microbial flora could impart.

Nowadays, there is a strong interest in the microbial ecology associated with grape varieties and regions of oenological interest, due to their association with the "microbial terroir". The term "microbial terroir" includes the indigenous microbial populations with distinct phenotypes mainly related to vineyard location, climate and variety, and can also be used as a means of identifying the origin of wines. Therefore, the "microbial terroir" determines the uniqueness of local, but also domestic wines, leading to an increase in their value.

Despite there being a strong interest in the utilization of the microbial terroir in important wine-producing countries, such as Italy, Spain, France and Portugal, in Greece, there is a gap in the identification and utilization of indigenous yeasts and malolactic bacteria in the wine-producing regions and especially in the Region of Eastern Macedonia and Thrace, which is mainly due to the lack of systematic effort.

In this vein, the aim of the provided service is to exploit the microbial wealth of an area, through the isolation and characterization of "wild" indigenous microbial flora from different vineyards and winemaking grape varieties, with the aim of composing starter cultures for the wine industry to produce wines with special characteristics.



Service

Isolation of indigenous yeasts and malolactic bacteria from different vineyards and winemaking grape varieties, with the aim of composing starter cultures for the wine industry to produce wines with special characteristics.

Main equipment

- Laminar flow hoods
- Incubation chambers
- ION TORRENT

Target Group ☉

Companies



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

DESIGN AND DEVELOPMENT OF FUNCTIONAL FOOD INGREDIENTS

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 been largely 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 service focuses on developing nutritious food ingredients by enriching prebiotic dietary fibers with beneficial microorganisms tailored to maintenance of human health.

Service



- The principle of this service is the development of structured delivery assemblies to protect the functional cultures against various harsh degradative conditions during food production, storage and digestion.
- The proposed technology aims at marketable "ready-to-eat" functional food ingredients consisting of prebiotic dietary fibers fortified with health-promoting microbes and is expected to provide superior-quality and nutritious alternatives with a high commercialization potential.

Main equipment

- Laminar flow hoods
- Incubation chambers
- Autoclaves
- Centrifuges

Target Group ©

Companies



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

MICROBIAL METABOLITES PROFILE ANALYSIS OF STARTER AND FUNCTIONAL CULTURES USED IN FOOD PRODUCTION



The beneficial activity of microbial cultures, as well as the quality characteristics of fermented foods and drinks are determined by their metabolic products.

However, no systematic effort has been documented towards characterization and commercial exploitation of fermentation metabolites, while the -almost exclusive- use of market available microbial cultures, mainly results in product diversity limitations and loss of distinct identity.

Nevertheless, in recent years, the consumers' intense interest for products with health-promoting effects and distinctive quality characteristics has caused a constantly increasing interest for the use of "wild-type" microorganisms in the food and beverage industry. Thus, the aim of this service is the determination of microbial metabolites profile in fermented products (microbial cultures supernatants, foods, beverages, etc).

Application of HPLC, GC/FID & GC/MS methodologies is expected to certify the products' high quality, and verify their complexity and unique characteristics. The characterization of the profile of the microbial metabolites of fermented products (culture supernatants, food, beverages, etc.) through liquid and gas chromatographic techniques (HPLC, GC/FID & GC/MS) is expected to contribute to the assessment of the beneficial effects and to certify the complexity and special features of the new products.

By this way, the food and beverage industry will be able to cope with the challenges for new products with potential beneficial actions and distinctive organoleptic character, thus increasing their added value and their competitiveness in the domestic, but also in the international market.

Service



- The principle of the present service is the determination of microbial metabolites profiles in fermented products (microbial cultures supernatants, foods, beverages, etc).
- The proposed technology aims at the assessment of the health-promoting effects of starter and functional cultures, product quality assurance, verification of the repeatability and compliance with the production process and enables novel product development with a high commercialization potential.

Main equipment

- HPLC system (Shimadzu Corp., Germany) equipped with:
 - DGU-20A5R degassing unit
 - LC-20AD pump
 - CTO-20AC oven
 - RID-10A refractive index (RI) detector
 - SPD-M40 diode array (DAD) detector
 - Nucleogel ION 300 OA (300 x 7.8 mm) column (Macherey-Nagel, Germany)
 - Shim-pack GIST C18 (300 x 4.6 mm) column (Shimadzu, Germany)
- MASTER GC system (DANI Instruments S.p.a., Italy) equipped with:
 - MASTER AS autosampler
 - FID detector
 - CP-Wax 57 CB (50 m x 0.32 mm i.d., 0.20 µm film thickness) column (Agilent Technologies, USA)
 - Supelcowax 10 (30 m x 0.25 mm i.d., 0.25 µm film thickness) column (Supelco, USA)
- GC/MS system (6890N GC, 5973NetworkedMS MSD, Agilent Technologies, USA) equipped with:
 - Autosampler (7683, Agilent Technologies, USA)
 - HP-5MS (30 m x 0.25 mm i.d., 0.25 µm film thickness) column (Agilent Technologies, USA)
 - SPME fiber 2cm in length coated with 50/30 mm divinylbenzene/carboxen/poly-dimethylsiloxane (Supelco, USA)

Target Group ©

- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

DESIGN, DEVELOPMENT AND OPTIMIZATION OF MICROBIAL GROWTH PROCESS ON A PILOT SCALE



Microbial biomass production holds a pivotal role across diverse domains in the food industry. The present service opens new horizons in the field of food and beverage microbiology and biotechnology. Thus, researchers from academia and the industry will have the chance to design and develop novel microbial cultivation processes, as well as to optimize microbial cell growth on a pilot scale, contributing to the improvement of competitiveness and the development of new bioprocesses.

Service



- Design, development and optimization of a microbial growth process on a pilot scale

Main equipment

- Bioreactor Model xCubio, in-situ 50, bbi BIOTECH, Germany
- Freeze Dryer Zirbus, Model VaCo 10, Zirbus, Germany
- High-throughput bioprocessing and blood bank centrifuge, Hunan Kaida Scientific Instrument Co, China
- Biological Safety Cabinet (AC2) ESCO GLOBAL, Model Airstream-AC2-4E8
- Ultra-low Temperature Freezer ESCO, Model UUS-363A-1-SS

Target Group ©

- Companies
- Research organizations



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

PRODUCTION OF PLANT EXTRACTS WITH GREEN EXTRACTION TECHNIQUES (SUPERCRITICAL FLUID CO₂)

Economic viability and safety are increasingly being considered together, and safer, less hazardous solvents that are simple to remove or recover are becoming more and more popular. With the use of the technology known as supercritical fluid extraction (SFE), a large range of unique chemicals can be extracted from various plant matrices. SFE is a reliable cleantech method for obtaining natural substances with unquestionable environmental friendliness. This is because the fluids utilized, like CO₂, are non-toxic. There are many benefits over traditional liquid solvent extractions, such as speed, selectivity, cleanliness, minimal solvent volumes required, and the ability to change the extract's chemical composition by the selective precipitation of different classes of molecules. SFE can be applied on a larger scale to either remove undesirable components from a product (such as caffeine) or collect a desired product, or as a sample preparation step for analytical purposes (e.g. essential oils). The most common supercritical fluid is carbon dioxide (CO₂), which is occasionally mixed with co-solvents like ethanol or water.

Advantages

- Selectivity

The supercritical fluid's characteristics can be optimized by adjusting the pressure and temperature, enabling selective extraction. For instance, low pressures (100 bar) can be used to extract volatile oils from plants, whilst liquid extraction would also remove lipids.

- Speed

Diffusion-based processes like extraction require the solvent to permeate into the matrix and the extracted substance to migrate into the solvent. Since diffusivities in supercritical fluids are substantially higher than in liquids, extraction can happen more quickly. Additionally, the solvent can go deeper into the matrix than liquids can since they have minimal viscosities and no surface tension. Whereas supercritical fluid extraction can be accomplished in 10 to 60 minutes, organic liquid extraction may require several hours

ince it offers an alternative to established procedures like organic solvent extraction and steam distillation, the extraction of essential oil constituents using SFE has attracted a lot of attention, particularly in the food, pharmaceutical, and cosmetic industries. The market for natural products around the world is consistently and significantly dominated by flavors and perfumes. Most plants used in the food, fragrance, and medicinal industries are known for their essential oils.

Researchers, individuals, private companies, or R&D departments can utilize this plant extract production technology to:

- add value to food and cosmetic/pharmaceutical products,
- fulfill their R&D requirements
- follow regulatory requirements
- enhance academic results but also entrepreneurship
- meet consumer needs

SFE has added a new dimension to pharmaceutical and nutraceutical research, and formulation development and its potential can be exploited technologically and economically to provide new sustainable and reliable natural resources contributing to the human and environmental quality of life.

Service



- Production of rich plant extracts using a non-toxic and environmentally friendly supercritical fluid extraction with CO₂.

Main equipment

- Supercritical Fluid Extractor semi-industrial system
- Rotary Evaporators
- Lyophilizers
- Analytical Balances
- Freezer at -80°C

Target Group

- Companies
- Research organizations



Location

Laboratory of Organic Chemistry and Biochemistry, Department of Chemistry, University of Ioannina, Ioannina

PHYTOCHEMICAL CHARACTERIZATION OF PLANT EXTRACTS

"Natural products" have become an integral part of everyday life, as they are used in a wide variety of consumer products, with a noticeable increase in their use. However, little is known about composition, and diversity within the same species or between different species. "Natural products" have become an integral part of everyday life, as they are used in a wide variety of consumer products, with a noticeable increase in their use. However, little is known about composition, and diversity within the same species or between different species.

The need for quantitative and qualitative determination of the main components, and detailed characterization of plant extracts is clear. A serious issue that poses a risk to public health is inadequate quality control. Especially in phytotherapeutics and nutritional supplements, the composition (chemical or even botanical) may differ from that declared (if declared), and there may also be impurities within them. Compared to other single-ingredient products, e.g. drugs, their analysis is a great challenge as the extracts are mixtures of a huge number of components, which in some cases may not even have been characterized.

Our Infrastructure has expertise and experience in the development of analytical methods, their validation, and their application to plant extracts. In addition, unidentified components can be characterized through a series of isolation procedures and spectrometric analysis.

Our expertise in extraction and composition determination allows us to:

- assess various aromatic and medicinal plants (wild populations and cultivated), of different varieties, and record their characteristic chemotype, which can help verify the authenticity and traceability of the final products.
- guide the creation of new herbal-based products.
- study of their stability.

Researchers, individuals, private companies, or R&D departments can utilize the plant extract phytochemical profile to:

- add value to food and cosmetic/pharmaceutical products,
- fulfill their R&D requirements
- follow regulatory requirements
- enhance academic results but also entrepreneurship
- meet consumer needs

Service



- Phytochemical characterization of plant extracts

Main equipment

- High-Resolution Mass Spectrometer in tandem with Liquid and Gas Chromatographer
- Analytical HPLC in tandem with Fluorometric, Refractive Index, and UV/Vis Detectors
- NMR Spectrometer (Department facilities)
- Rotary Evaporators and Lyophilizers

Target Group

- Companies
- Research organizations



Location

ULaboratory of Organic Chemistry and Biochemistry, Department of Chemistry,
University of Ioannina, Ioannina

NUTRITIONAL INTERVENTIONS-CLINICAL STUDIES

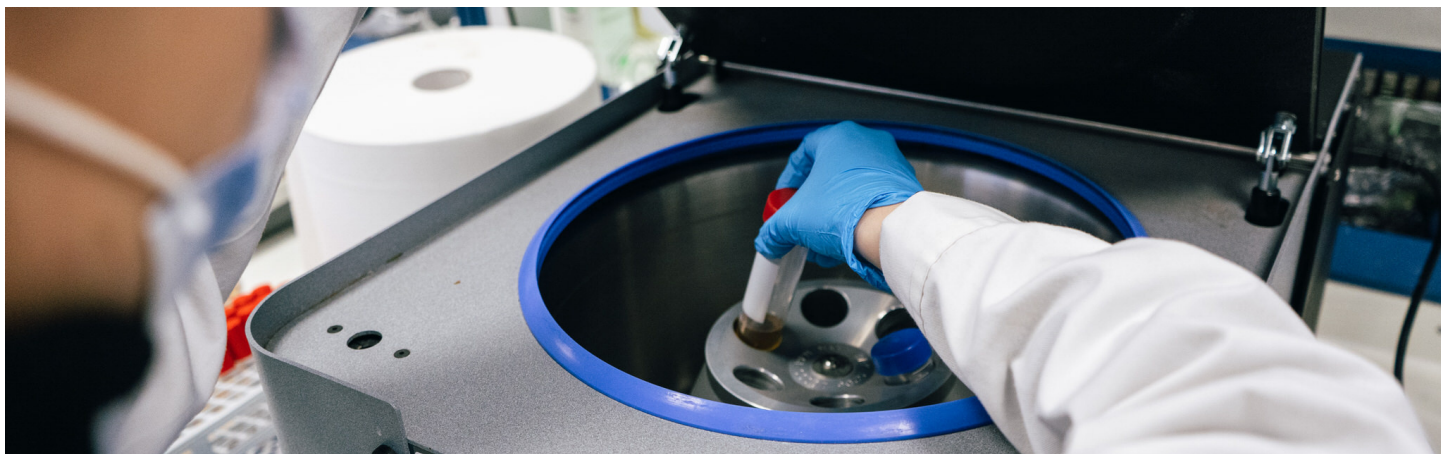
INVESTIGATING FUNCTIONAL FOOD INGREDIENTS

The role of nutrition as a factor in promoting and maintaining health is particularly decisive. Nowadays, there is a shift in consumers' preferences for foods of high nutritional value. The consumers want functional foods that provide health benefits, such as better bowel function, antioxidant activity, decreased levels of blood sugars and lipids, factors that have been associated with a lower risk of chronic diseases. Therefore, the functional food market is growing rapidly.

Innovative food products including foods with probiotic and prebiotic activity, foods high in fibers and antioxidants, are being studied and developed aiming to offer substantiated benefits to human health. However, to get a proof of principle is important to take the leap from *in vitro* studies to human trials. Nutritional interventions will allow investigating the effect of the consumption of the studied foods on long-term and short-term biomarkers related to the bioavailability and potential bioactivity of their components, thus understanding their role in health promotion.

Food clinical trials can study the effects of new or existing ingredients in volunteers. Our main advantages are the experience and flexibility to respond to specific objectives and time frames. Researchers, private companies, or R&D departments can utilize the outcomes of clinical studies as customized end-to-end solution to:

- add value to food products
- match the scope and specificity of research projects
- fulfill their R&D requirements
- follow regulatory requirements
- enhance academic results, but also entrepreneurship
- meet consumer needs



Service



- Organization and implementation of food nutritional interventions- clinical trials
- Implementation of short-term nutritional interventions / clinical studies
- Implementation of long-term nutritional interventions / clinical studies
- Study of the effects of traditional or processed functional foods on postprandial oxidative stress, postprandial glycemia and lipemia and other biomarkers, in the short term.
- Study of the effects of traditional or processed functional foods on markers of hemostasis, inflammation, lipid levels, hormones and other biomarkers in the long term.

Main equipment

- Biochemical Analyzer
- Immunological Analyzer
- Oxidative Stress Calculator
- Basic Metabolism Calculator
- Body Composition Calculators

Target Group ©

- Companies
- Research organizations



Location

Unit of Nutrition, Department of Food Science and Nutrition, University of Aegean, Lemnos, Myrina

IN VITRO STUDY OF THE BIOACTIVITY AND BIOAVAILABILITY OF FUNCTIONAL FOOD INGREDIENTS

The last decades, the evident health benefits associated with the consumption of functional foods, have become more popular among consumers. In Mediterranean diet, many food products can be characterized as natural functional foods. These include specific fruits, vegetables, legumes, wild greens, herbs, nuts, olives, and olive oil. These foods are rich in bioactive compounds such as antioxidants and polyphenols, have been associated with the prevention of chronic diseases and overall health promotion. Therefore, it remains important to study the bioavailability of these compounds.

In vitro studies have been widely used to estimate bioavailability of several bioactive compounds and nutrients. These model systems are relatively cheap and simple to procure, enabling reliable and efficient study results. The method of *in vitro* digestion of *in vitro* bioavailability provides integrated approach for the prediction of bioavailability of functional food ingredients before moving on to *in vivo* studies.

At FOODBIOMES the *in vitro* studies implemented, can examine the bioactivity of newly developed food products and functional food ingredients. Our main advantages are the experience and flexibility to respond to specific objectives and time frames. Researchers, private companies, or R&D departments can utilize study outcomes as customized end-to-end solutions to:

- add value to food products,
- match the scope and specificity of research projects
- fulfill their R&D requirements
- enhance academic results but also entrepreneurship
- meet consumer needs
- design clinical studies

Service



- Organization and implementation *in vitro* studies
- Study the bioactivity of functional food ingredients including antioxidant activity, total phenolic content
- Study the estimated bioavailability of functional food ingredients including antioxidant, polyphenols, proteins, carbohydrates using *in vitro* digestion model.

Main equipment

- Photometer
- Fluorimeter
- pH meter
- Freeze dryer

Target Group ©

- Companies
- Research organizations



Location

Unit of Nutrition, Department of Food Science and Nutrition, University of Aegean, Lemnos, Myrina

DEVELOPMENT OF INNOVATIVE BIO-ECONOMY FOOD PRODUCTS & FOOD PROPERTIES ANALYSIS

New strategies of E.U. encourages the transition to a more sustainable society and the development of sustainable food systems. In this context, the food sector faces the challenge to develop new and innovative foods with a minimal environmental footprint during their production. At the same time these new food products must meet consumers' demands, thus the characterization of food properties must be also evaluated.

At FOODBIOMES we provide services that will contribute to the easier transition to Circular Economy era, such as:

1. Research services for the development of new and innovative food products within the pillars of Bio-economy and the strategy "European Green Deal" through the valorization of food by-products
2. Analyses of food properties such as texture, rheological properties, chemical composition, identification of fatty acids, identification of phenolic compounds, but also microbial stability of food products during storage.
3. Access to stakeholders to the laboratory equipment in order to be trained in specialized equipment and food analysis protocols.



Service



- Research and development in designing bio-economy food products based on the needs of stakeholders
- Characterization of chemical /physical properties and microbiological stability of foods
- Training services in specialized equipment and food analysis protocols

Target Group ©

- Companies
- Research organizations



Location

Department of Food Science and Technology,
Ionian University, 28100, Argostoli, Kefalonia

DEVELOPMENT OF EDIBLE AND BIODEGRADABLE MATERIALS

The service targets to the development of edible and biodegradable materials having double role; i) to act as packaging materials in food products, replacing partially the conventional ones (e.g. plastic) and ii) as carrier to encapsulate functional compounds (e.g. antioxidants, plant extracts) or microorganisms with health benefits.

Taking into account the European strategies (Green Deal, Plastic Strategy etc.) and the global efforts towards a sustainable society, these materials are made from proteins that are preferably deriving from agro-industrial by-products. In this context, the by-products will be re-circulated as raw material for the production of novel packaging or encapsulating materials.

At FOODBIOMES we provide services related to the production of edible and biodegradable materials using protein raw materials and their further application in food products as active/edible/biodegradable packaging for food products or as carriers of bioactive components and microorganisms with health benefits.



Service



- Research in the development of protein-based biopolymers
- Develop films or coatings as packaging materials
- Develop protocol to encapsulate functional compounds or microorganisms
- Study of packaging films or coatings/carriers in food applications

Target Group ©

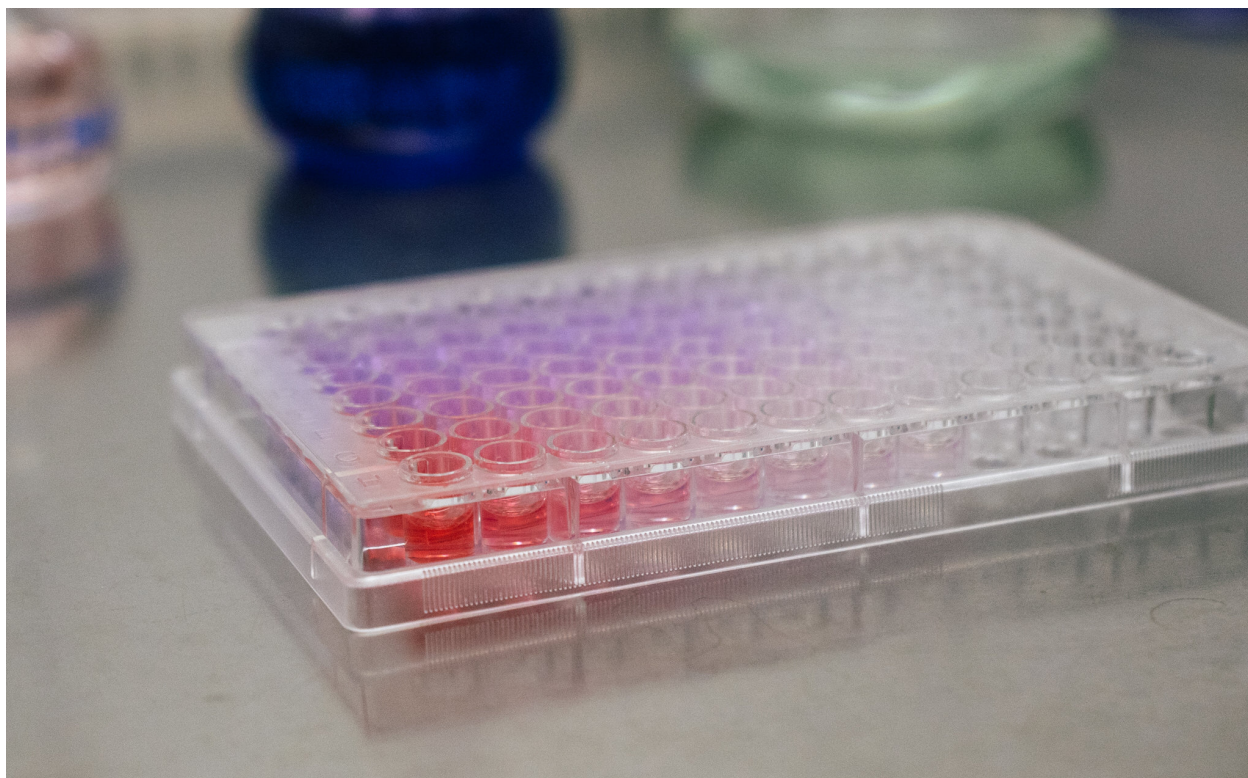
- Companies
- Research organizations



Location

Department of Food Science and Technology, Ionian University, 28100, Argostoli, Kefalonia

EDUCATION & TRAINING



FOODBIOMES aspires to constitute a model research, education and innovation infrastructure that will link local entities with scientific centres at an international level and play an important role in educating and upgrading human resources and local businesses.

FOODBIOMES organises specialised education and training programs for researchers and professionals from the academic, public and business sector who are particularly interested in the microbiome and in its relation to nutrition.

The subject areas include applications of molecular biology, genomics, bioinformatics, microbiology, biotechnology and circular economy in the Agri-food sector and are covered by speakers from the academic and business sector.

HANDS-ON WORKSHOP ON MICROBIOME ANALYSIS

Microbial communities are complex and dynamic systems that have a central role in many biological processes of their host - plant or animal - and/or of the ecosystem. The rapid development of next-generation sequencing technology in the past decade has enabled rapid analysis of the microbial composition from different environments, such as food, fruit, soil, human/animal gut and feces, etc; these data are used for the development of innovative applications, services and products.

Researchers from research institutes or companies or scientists working in the public or private sector that, in the context of their activities, are interested in introducing microbiome analysis in the institution or company or wish to be able to evaluate microbiome analysis data are the target audience of these workshops. Need-based workshops can be organized for groups of users from an entity (e.g. company or a public body).

The workshops include lectures that provide the theoretical background on next-generation sequencing and how it is used to study the microbiome, as well as presentations and detailed analysis of all steps of the amplicon sequencing protocol. Participants are trained hands-on in both the laboratory part of the method (library construction, quantification, emulsion PCR and sequencing) as well as in data analysis and evaluation of results. Participants are welcome to bring 1-2 samples for analysis. Upon completion of the seminar, participants will have all the knowledge, skills and abilities required for this methodology, which is used in various ways, enhancing both the research and innovation capacity through the exploitation of data for the design and production of new applications, products and/or services.





Service

Hands-on workshop on microbiome analysis using amplicon sequencing

Main equipment

- ION CHEF System
- ION TORRENT S5 Gene Studio
- Qubit/ Nanodrop
- Digital qPCR Quant studio 3D

Target Group ©

- Researchers
- Research organizations
- Companies



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

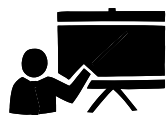
THEORETICAL AND PRACTICAL TRAINING SEMINARS IN FOOD QUALITY CONTROL WITH CHROMATOGRAPHIC ANALYTICAL METHODS



The theoretical and practical (hands-on) training seminars in Chromatographic Methods of Analysis are addressed to workers in private and public institutions, researchers and business executives who are interested in introducing the methodology of instrumental analysis of food and beverages in their laboratories or evaluating results of chromatographic analysis. Upon completion of the seminar, users will have acquired both the theoretical and practical background required for the specific methodologies and techniques.

The seminars include presentation of the theoretical background, training and development of skills in Food and Beverage Quality Control. The training covers both theoretical and practical (laboratory training) High Performance Liquid Chromatography (HPLC), Solid Phase Microextraction and Gas Chromatography and Mass Spectroscopy (SPME GC/MS) methodologies and techniques.

In addition, sampling methods, sample processing and preparation techniques, qualitative and quantitative determination methods, method evaluation and validation (detection limit determination, repeatability, etc.), as well as statistical analysis and presentation of the results are included. In the case of a group of users (e.g. industry or public body), it is possible to design the specific service based on the body's needs. Upon completion of the seminars, the users will have acquired both the theoretical and practical background required for the specific methodologies and techniques.



Service

Theoretical and practical (hands-on) training seminars in food quality control with chromatographic analytical methods

Main equipment

- HPLC chromatography system (Shimadzu Corp., Germany) equipped with:
 - DGU-20A5R degassing unit
 - LC-20AD pump
 - CTO-20AC oven
 - RID-10A refractive index (RI) detector
 - SPD-M40 diode array (DAD) detector
 - Nucleogel ION 300 OA (300 x 7.8 mm) column (Macherey-Nagel, Germany)
 - Shim-pack GIST C18 (300 x 4.6 mm) column (Shimadzu, Germany)
- MASTER GC Fast Gas Chromatography system (DANI Instruments S.p.a., Italy) equipped with:
 - MASTER AS autosampler
 - FID detector
 - CP-Wax 57 CB (50 m x 0.32 mm i.d., 0.20 µm film thickness) column (Agilent Technologies, USA)
 - Supelco wax 10 (30 m x 0.25 mm i.d., 0.25 µm film thickness) column (Supelco, USA)
- GC/MS (6890N GC, 5973 Networked MS MSD, Agilent Technologies, USA) equipped with:
 - Autosampler (7683, Agilent Technologies, USA)
 - HP-5MS(30 m x 0.25 mm i.d., 0.25 µm film thickness) column (Agilent Technologies, USA)
 - SPME fiber 2cm in length coated with 50/30 mm divinylbenzene/carboxen/poly-dimethylsiloxane (Supelco, USA)
- Mass spectra libraries
- Teaching classrooms

Target Group ©

- Researchers
- Research organizations
- Companies



Location

Democritus University of Thrace, Department of Molecular Biology & Genetics, 68100 Alexandroupolis, Greece

TRAINING PROGRAMS ON CIRCULAR ECONOMY STRATEGIES

The Department of Food Science and Technology at the Ionian University offers a range of training programs (seminars, webinars, workshops, e-learning programmes), which are delivered to researchers and professionals related to the food sector. Thematic areas that will be covered include Circular Economy guidelines, biorefinery development, processing and valorization of agro-industrial waste and food by-products, production of high added-value products and their re-utilization in the food supply chain.

Visit our website (www.foodbiomes.eu) and get informed about our next training program that suits your needs.

A special training program, that meet your needs, can be organised upon request by e-mailing us at info@foodbiomes.eu.



Service

- E-learning courses, webinars
- On-line seminars
- Specific programmes upon request

Main equipment

- Servers & PCs
- For on line seminars and webinars, appropriate device (computer, mobile phone or tablet) is required.

Target Group ©

- Researchers
- Research organizations
- Companies



Location

Department of Food Science and Technology, Ionian University, 28100, Argostoli, Kefalonia



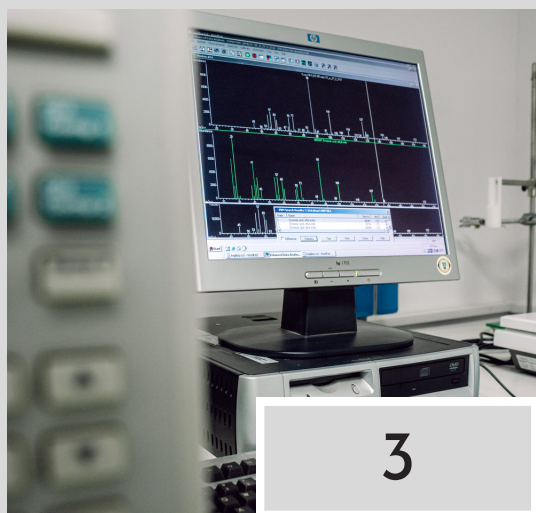
1

Hands-on
workshop on
microbiome
analysis



2

Theoretical and practical
training seminars in food
quality control with
chromatographic analytical
methods



3

Training programs on
circular economy
strategies



...

More education and
training opportunities
coming soon!

FACILITIES

FOODBIOMES consists of a continues developing network of more than 8 laboratories located in 4 Universities in Greece specializing in organic chemistry, food biotechnology, microbiology, molecular biology and genetics, food and plant analysis and clinical interventions.

In line with its mission to support academia and industry in designing, developing and producing innovative products that will benefit human and animal welfare, FOODBIOMES offers access to a set of high-tech equipment and state of the art labs that can help researchers and professional to implement the research activities of their interest.

These facilities are located at the Democritus University of Thrace, the Ionian University and the University of Aegean and are offered in an open access model as indicated herein.

Dependent on availability the equipment that are offered include:

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
Bioreactor Model xCubio, in - Situ 50, bbi BIOTECH, Germany	<ul style="list-style-type: none">• Working volume 35 liters• Cleaning in place• Sterilization in place	Suitable for aerobic and anaerobic cultures
Freeze Dryer Zirbus, Model VaCo 10, Zirbus, Germany	<ul style="list-style-type: none">• Condenser capacity 16 L• Temperature < -50°C• In line with the EU F-gas regulation No 517/2014	A complete system for freeze-drying applications (cultures, food etc.)
Freeze Dryer SP Scientific, USA	<ul style="list-style-type: none">• Condenser capacity 8 L• Temperature < -101°C	A lab scale system for freeze-drying applications (cultures, food etc.)
Refrigerated centrifuge Centurion Scientific Ltd., UK	<ul style="list-style-type: none">• Capacity < 1 L• Up to 10.000 g• Min working temperature 0°C	Molecular biology and micro applications

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
High throughput bioprocessing and blood banking centrifuge, Hunan Kaida Scientific Instrument Co, China	<ul style="list-style-type: none"> • Capacity <14.4 L • Up to 12,500g • Min working temperature -20°C 	Culture, food and molecular biology applications
Photometer ELISA, Model SPECTRAmax ABS, Molecular Devices, USA	<ul style="list-style-type: none"> • 96 well plates • Wave length range 340-850 nm with 1nm intervals • Software in place for processing and analysis of data 	Immunoassays
LC & GC Evo G2-XS QToF/ToF, Waters Corporation	<ul style="list-style-type: none"> • Dual-mode capability (QToF and ToF) • Accurate mass measurement with <5 ppm mass accuracy • High resolution mass spectrometry (up to 40,000 at m/z 200) • Up to 500 spectra per second acquisition rate • Dynamic range of more than 5 orders of magnitude 	Quantitation and quantification of a broad range of organic molecules. The instrument's combination of high-resolution mass spectrometry and liquid and gas chromatography capabilities allows the analysis of a wide range of sample types and the identification and quantitation of complex mixtures of compounds.

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
Gas chromatography system GC/FID MASTER GC, DANI Instruments S.p.a., Milan, Italy	<ul style="list-style-type: none"> • Temperature up to 450°C, 1°C resolution • Linear dynamic range >10⁷ • Minimum detectable level <1.8 pg Carbon / sec • Columns: CP-Wax 57 CB (50 m x 0.32 mm i.d., 0.20 µm film thickness) column (Agilent Technologies, USA), Supelcowax 10 (30 m x 0.25 mm i.d., 0.25 µm film thickness) column (Supelco, USA) 	Quantification of volatile compounds and fatty acids in biological samples
Gas chromatography system GC/MS 6890N GC, Agilent Technologies, USA	<ul style="list-style-type: none"> • Mass Range: 1.6-800 amu, Dynamic Range: 10⁷, Scan Range: 104 amu/s • El scan sensitivity: 60:1 s/n for 1pg octafluoronaphthalene (scanning 50-300 amu at nominal m/z 272 ion) • HP-5MS column (30 m x 0.25 mm i.d., 0.25 µm film thickness) (Agilent Technologies, USA) • SPME fiber 2cm in length coated with 50/30 mm divinylbenzene/carboxen/polydimethyl-siloxane (Supelco, USA) 	Chemical composition of biological compounds (natural extracts / essential oils / fatty acids / volatile compounds)

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
High performance liquid chromatography system HPLC - DAD/RI, Shimadzu Corp., Germany	<ul style="list-style-type: none"> • RID-10A detector: Range 0.01-500 x 10⁻⁶ RIU, Noise level < 2.5 x 10⁻⁹ RIU, Response 0.05 sec • SPD - M40 detector: Contains both a deuterium (D2) and tungsten (W) lamp, Wavelength range of 190 - 800 nm, Wavelength accuracy ± 1 nm, Noise level of 4.5 x 10⁻⁶ AU • Columns: Nucleogel ION 300 OA (300 x 7.8 mm) column (Macherey-Nagel, Germany), Shim-pack GIST C18 (300 x 4.6 mm) column (Shimadzu, Germany) 	Quantification of sugars, alcohols, organic acids and polyphenols in biological samples
Elemental Analyser EuroEA, EuroVector S.r.l. Italy	<ul style="list-style-type: none"> • High-sensitivity detection of light elements (C, H, N, O) and trace elements • Analysis of solid, liquid, and gaseous samples • Lowest absolute detection limit 0.2 µg • Precision and accuracy in the low parts per billion (ppb) range 	Determination of C, H, N, S and O in biological samples

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
Next Generation Sequencing Unit	<ul style="list-style-type: none"> • S5 ION Torrent Sequencer • ION Chef robotic System • ION Chef Touch 2/ES system • Qubit & Nanodrop 	<p>Microbiome analysis of various sample types (feces, food, soil water, etc)</p> <p>Amplicon Sequencing</p> <p>Whole genome sequencing of microbial strains</p> <p>Testing to determine species present in food, feed or environmental samples for safety or to detect Fraud/Adultery</p> <p>Bioinformatic analysis</p>
Genomics Unit	<ul style="list-style-type: none"> • qPCR systems ABI, • Digital PCR system Quant Studio 3 	<p>Rapid detection of common pathogens</p> <p>Quantitative expression analysis</p> <p>Species/Strain identification</p>
Cell based assays	<ul style="list-style-type: none"> • Tecan Microplate reader Infinity Pro • Tecan Sunrise Elisa reader 	<p>Reporter assay technologies based on luminescence, fluorescence and absorbance</p>

EQUIPMENT/LABS	FEATURES/SPECS	USAGE
Cell culture Unit	<ul style="list-style-type: none"> • Biosafety Cabinets HeraSafe II, • HERA Cell 2i, CO2 incubators, • Inverted fluorescent microscope EVOS 7000 • Inverted fluorescent microscope Leica DM4000 • Upright fluorescent microscope Leica DM6000 	<p>In vitro evaluation of the antiproliferative properties of natural products/substances</p> <p>In vitro evaluation of the antioxidant properties of natural products/substances</p> <p>In vitro evaluation of the neuroprotective properties of natural products/substances</p> <p>Evaluation of probiotic cell adhesion in vitro</p>
Microbiology laboratory	<ul style="list-style-type: none"> • Class II micro lab equipped with all the necessary instruments (incubators, autoclaves, dryers, safety cabinets, PCR, etc) for the cultivation and analysis of foodborne microorganisms using traditional microbiology methods and modern molecular techniques 	<p>Detection and quantification of Coliforms, Enterobacteriaceae, Salmonella, Listeria, E. coli, Bacillus spp., Lactobacilli, Clostridium spp., fungi, yeasts etc.</p>

HOW TO GAIN ACCESS

R&D SERVICES

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@foodbiomes.eu or completing a form at FOODBIOMES website (when provided) describing the exact subject of interest and the service that is required. A group of experts from FOODBIOMES will evaluate the application with respect to the resources that are available, the relevance of the requested service to FOODBIOMES scope, the science and complexity of the subject and the general criteria highlighted in our access policy which can be found on line (www.foodbiomes.eu). An expert from FOODBIOMES 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.

EDUCATION & TRAINING PROGRAMMES

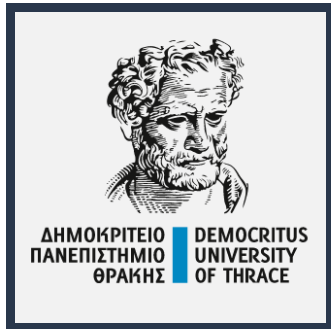
Education and training programmes are pre-announced on FOODBIOMES website and communicated to its subscribers by newsletters or via FOODBIOMES social media pages. All information needed to apply for attendance is described in the call announcement. Register to receive our newsletters (www.foodbiomes.eu) or follow us on linkedin / facebook 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@foodbiomes.eu.

FACILITIES

Facilities offered for usage are listed in FACILITIES ACCESS section and are provided following a Call for Expression of Interest for a specific period of time highlighting the terms of access. In any case, the stakeholder shall submit online a short description of his/her project demonstrating how the usage of the equipment or lab space will benefit his/her project, what is his/her experience in using such facilities, how he/she meets the terms of access regarding any fees applicable and when and for how long is he/she asking for access.

A group of experts from FOODBIOMES will evaluate the proposal with respect to the availability of resources offered, the relevance of the project to FOODBIOMES scientific scope and the experience of the stakeholder and the general criteria highlighted in our access policy which can be found at FOODBIOMES website. No longer than two weeks after the initial request FOODBIOMES will respond to the stakeholder by email highlighting the terms of access.

PARTNERS



CONTACT US



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