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Italiadomani  
PIANO NAZIONALE  
DI RIPRESA E RESILIENZA

SUS-MIRRI.IT

# TRAINING-COURSE

Isolation, cultivation, preservation  
and characterization of bacteria,  
fungi, viruses: microbial-based  
biotechnological solutions (MBBS)  
in agri-food, environmental, cultural  
heritage, energy and  
pharmaceutical fields

Annamaria Bevivino, Coordinator  
ENEA PNRR SUS-MIRRI.IT

November 27, 2023

Hybrid course

c/o ENEA CR Casaccia

Sala Blu, Via Anguillarese 301, Roma



## Programme overview

How can microorganisms and the microbiome be utilised for application in the agri-food, environmental, cultural heritage, energy and pharmaceutical fields?

- The microorganisms and microbiome
- Isolation, detection, characterization of bacteria, fungi, viruses
- Microbial-based solutions: how to apply microorganisms and microbial consortia in agri-food, environmental, cultural heritage, energy and pharmaceutical fields.



The course is organised in theoretical lessons, practical lectures and laboratory activities. The main aim of the training course is to provide updated concepts and methodologies on the microbial applications in different fields.



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## November 27 - Theoretical session

- 9:30-10:00 The new age of soil microbiome - A. Bevivino
- 10:00-10:30 Isolation, cultivation and preservation of microorganisms - S. Tabacchioni, A. Del Fiore
- 10:30-11:00 Biofilms and microscopic observations – L. Di Gregorio, E. Clagnan
- 11.00 - 11:30 Coffe break
- 11:30-12:00 DNA analysis, targeted and untargeted methods in metagenomics – M. Costanzo and A. Bevivino
- 12:00-12:30 Pipelines for NGS data (Illumina/Nanopore) – A. Visca
- 12:30-13:00 Bioaugmentation strategies to improve the energy valorization of organic waste –G. Massini, V. Mazzurco



## November 27 - Practical session

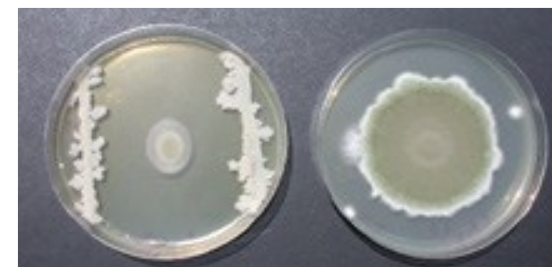
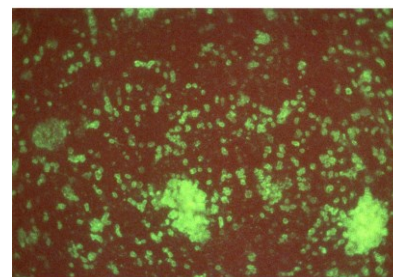
- 14:00-14:50 Microbial consortia set-up for sustainable agriculture and biotechnological applications
- 15:00-15:50 Assay of plant-growth promoting and biocontrol activity
- 16:00-16:50 Microbial biofilms: methods of detection



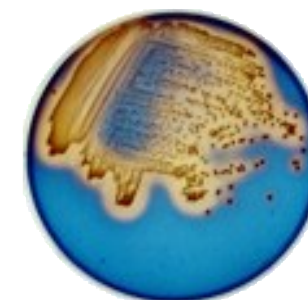
ASM MicrobeLibrary.org © Hedetniemi and Liao



N-fixing, P-solubilizing and PGPM



Biocontrol agents





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## November 28 - Theoretical session

- 9:00-9:30 The two-faced plant viruses: from plant pathogen to smart nanoparticles – C. Lico
- 9:30-10:00 Prebiotics and probiotics for biopackaging: a case study – L. Di Gregorio, M. Costanzo
- 10:00-10:30 Combination of membrane filtration and fermentation to produce poly-hydroxyalkanoates (PHA): the BIOCOSI' project – V. Miceli, D. Cuna
- 10:30-11.00 The flow cytometry and implication in food safety: V. Poscente
- 11.00 - 11:30 Coffe break
- 11:30-12:00 Antibiotics and antibiotic resistance genes in anaerobic digesters and agroecosystems – A. Visca
- 12:00-12:30 Use of microorganisms for the bioremediation of contaminated environments/cultural heritage – F. Tasso, C. Alisi
- 12:30-13.00 Training course wrap-up, discussion and conclusion – A. Bevivino

## November 28 - Practical session

- 14:00-14:50 Metabolic fingerprinting: The BIOLOG system
- 15:00-15:50 The Flow Citometry: the VBNC state
- 16:00-16:50 Microbial application for cultural heritage







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## ABOUT ENEA

- **ENEA** is the **National Agency for New Technologies, Energy and Sustainable Economic Development**, a public body aimed at research, technological innovation and the provision of advanced services to enterprises, public administration and citizens in the sectors of energy, the environment and sustainable economic development (article 4, Law no. 22 of 28 December 2015).
- **ENEA** operates in the fields of energy, environment and new technologies to support the Country's competitiveness and sustainable development
- **ENEA's mission** is to contribute to Italy's competitiveness and sustainable development by conducting research and technology development activities in support of Public Administration, companies particularly SMEs- and citizens.
- **The institutional mandate** of the Agency is to disseminate and transfer knowledge, innovation and technology to industry, institutions and civil society at large



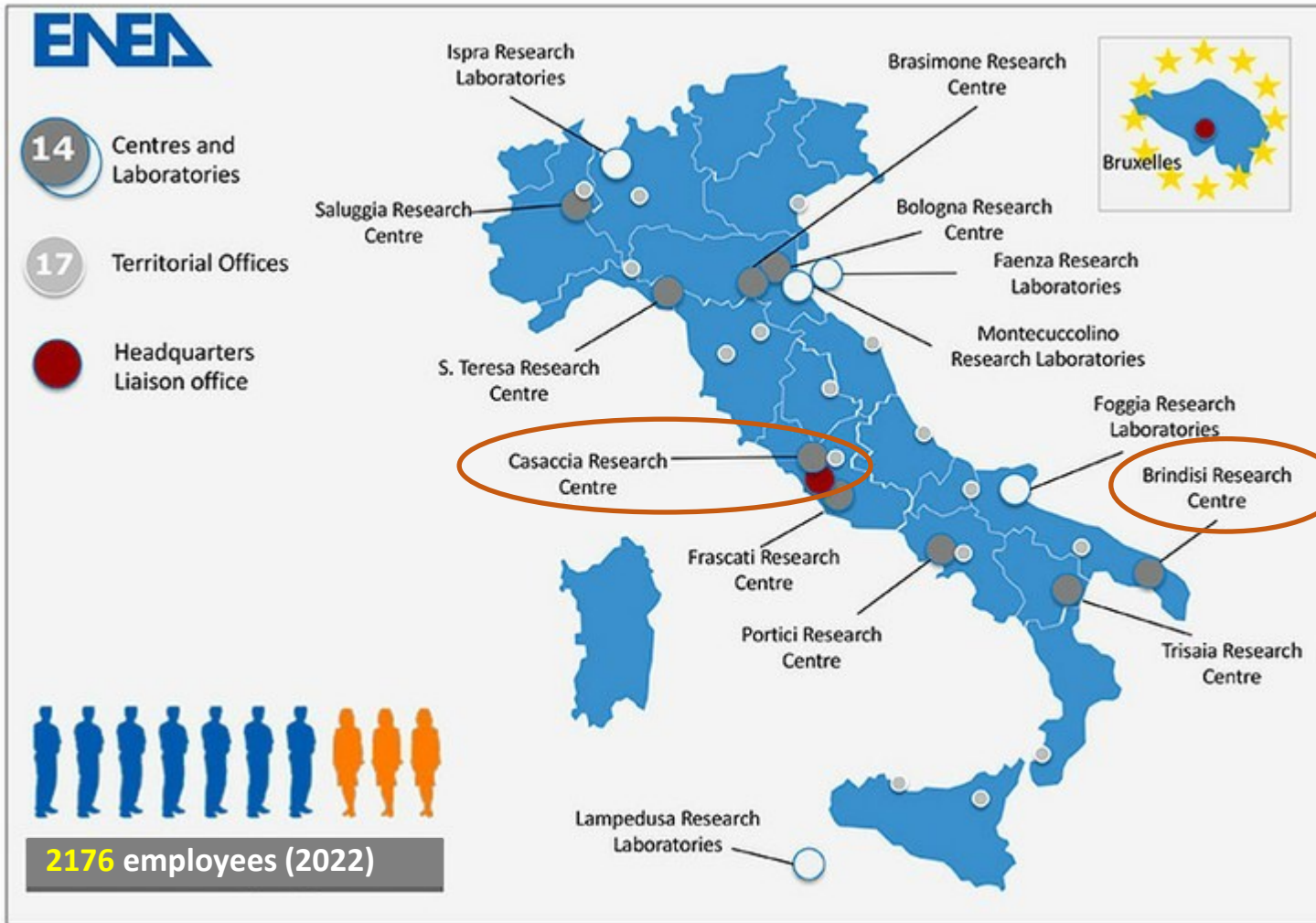
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**ENE A's** activities span many fronts ranging from basic to applied research and innovation:

**Research:** Basic, mission-oriented, applied and industrial research, also through the development of prototypes and product industrialization

**Technology Transfer:** Dissemination and transfer of research results to industry and public administrations, and exploitation for production purposes

**Advanced services:** Studies, measurements, tests and assessments tailored to both public and private bodies and enterprises

**Training and information:** Activities aimed at broadening sector expertise and public knowledge and awareness



- 75% of ENEA staff is employed in the **4** technical macrostructure called **Departments** working in the following areas:



Sustainability



Energy  
Technology



Energy Efficiency



Nuclear Fusion



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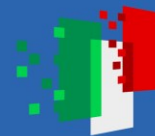




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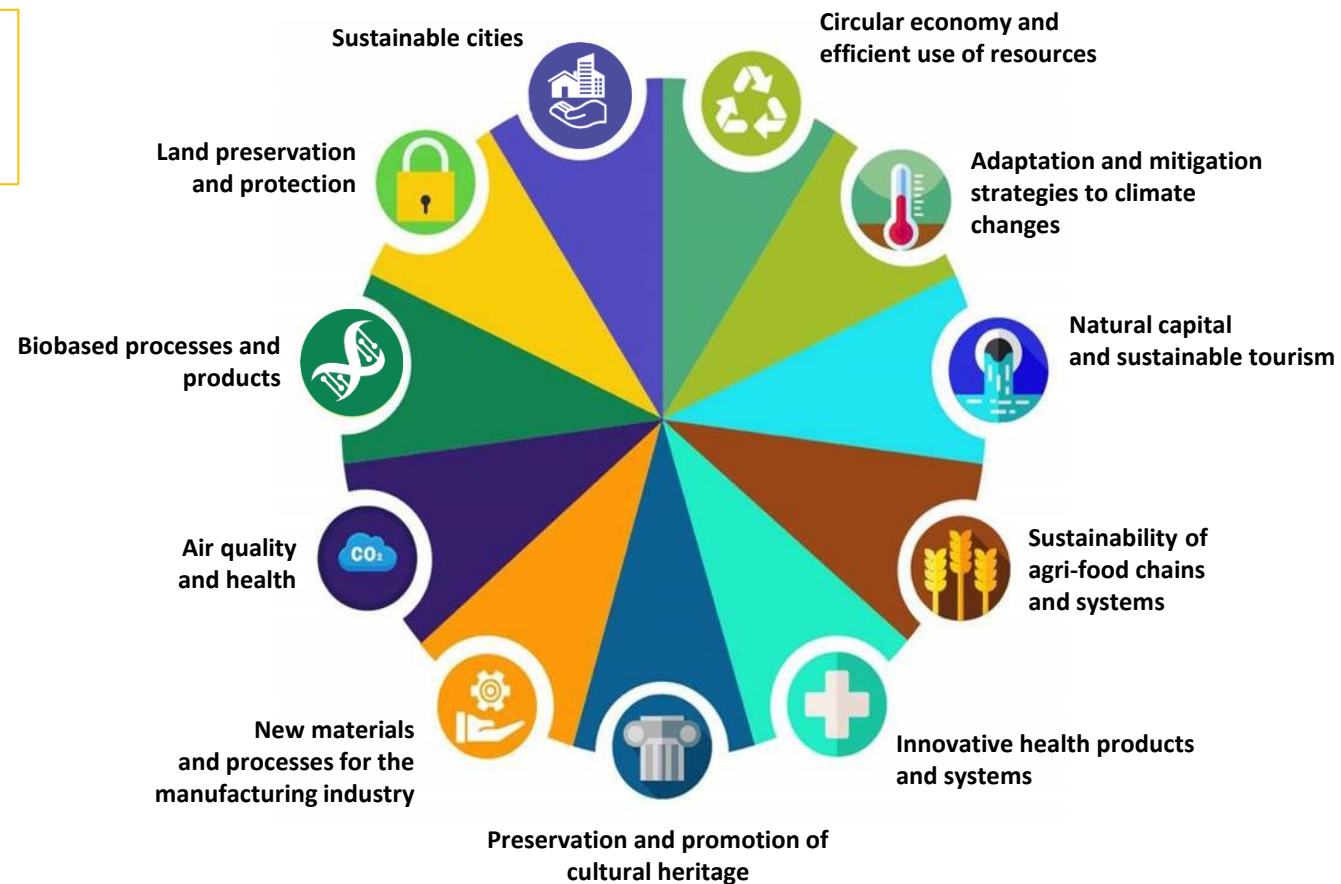
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## Department for Sustainability – strategic themes

Head Dr. Roberto Morabito

A work methodology  
based on integrated  
approaches





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## Presence throughout the country

**494**

employees (SSPT staff at  
2022/12/31)

**80%** of which

researchers/technicians

Research grants, thesis  
students, doctorates,  
fellows





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## Biotechnologies and Agro-industry (SSPT – BIOAG)

Head Dr. Massimo Iannetta



This Division carries out research and innovation activities for the agricultural and food system, fostering the system's competitiveness and sustainability of production from a circular bioeconomy viewpoint, to boost performance in terms of quality, quantity, safety and traceability of products, thereby contributing to public health and wellbeing.

- Systems for sustainability, quality and safety of Agroindustrial productions
- Innovative biotechnology products, processes and systems

87 employees (2022) - R.C. BO, BRI, CAS, TRI, POR

<https://bioagro.sostenibilita.enea.it/en>



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# SUSTAINABILITY, QUALITY AND SAFETY AGRIFOOD PRODUCTIONS LABORATORY

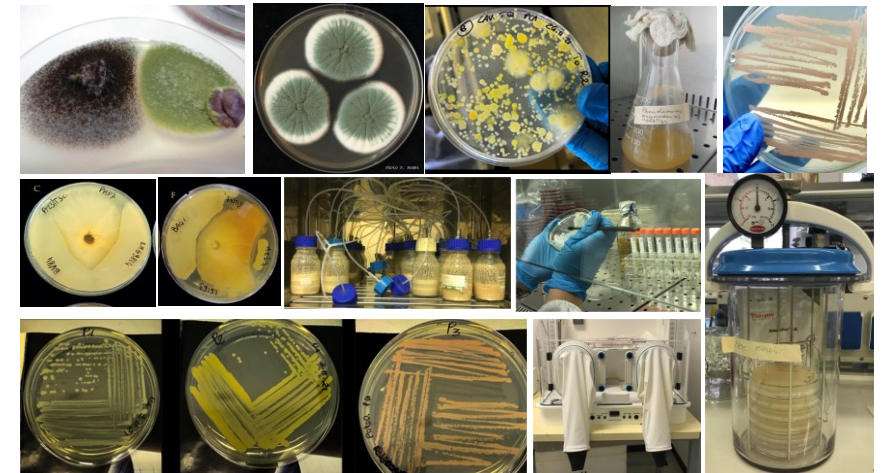
## ACTIVITIES

- **SOQUAS** Laboratory carries out RTD & D activities to support the competitiveness and innovation of agri-food and agroforestry production systems, in terms of improving sustainability, quality and safety, both for the aspects of supply (food security) and healthiness (food safety).
- It pursues eco-innovation objectives in order to optimize and / or reduce the use of resources in all phases of the production chains, closing the cycles through the recovery and enhancement of by-products and waste.

The activities are carried out by making use of innovative infrastructures, equipment, facilities, technologies and service platforms.

## FACILITIES

- ✓ Laboratory of microbiology
- ✓ Laboratory of metagenomics for soil/food microbiome
- ✓ Laboratory quality chemical and biological measurements
- ✓ Molecular biology laboratory for the quality and early detection of toxins in foods
- ✓ Laboratory of biomaterials





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## Protection and enhancement of the territory and natural capital (SSPT – PROTER)



65 employees (2022) - R.C. CAS, POR, SAL, STE

<https://ambiente.sostenibilita.enea.it/en>

### Head Dr. Giovanna Armiento

The Division acquires data and develops methodologies and technologies for environmental characterization, protection, management and remediation and for the understanding climate system and its variability, collaborating with the corporate sector for the development of innovative prototypes and tools for environmental protection.

It designs and manages integrated observatories and studies for the enhancement and protection of ecosystems and natural resources.

**It develops biotechnologies for cultural heritage and for the bioremediation of contaminated sites.**





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## ENERGY TECHNOLOGIES AND RENEWABLE SOURCES DEPT Head Ing. Giulia Monteleone

ENEA Energy Technologies and Renewable Sources Department TERIN is focussed in conducting research and innovation activities, and provides public administration, enterprises and citizens with its advanced services in almost the main Energy technologies: Concentrated Solar Thermal Energy; Photovoltaics; Biomass and Biofuels; Solar Thermal Energy at low and medium temperatures; Hydrogen, Fuel Cells, Smart Network Energy management and Storage Systems, Advanced ICT service.





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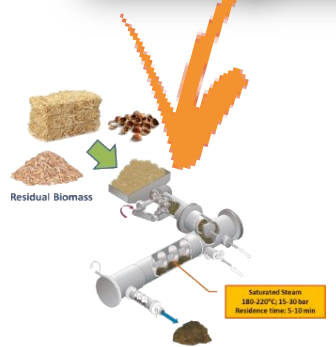


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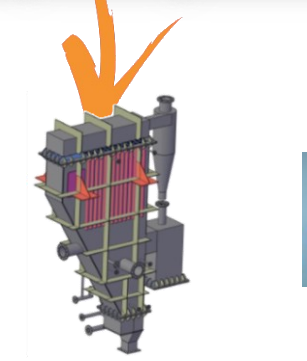


# DIVISION BIOENERGY BIOREFINERY AND GREEN CHEMISTRY Head Dr. Giacobbe Braccio

*Processes development for Biomass exploitation for **BIO-Energy** and **GREEN Chemicals** productions*



**Biomass Pretreatment via Steam Explosion, advanced biofuel, green building block**



**Gasification, Pyrolysis, Torrefaction**



**Anaerobic Digestion, BioHydrogen, BioMethane**

Advanced fermentation processes for BioMethane / BioHydrogen / Biofuels production



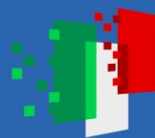
Biomass to energy pathways  
Energy, Biorefinery and Green Chemistry, Thermochemical processes, 2<sup>nd</sup> generation biofuels, Green Hydrogen



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# Laboratory of Biotechnological Processes for Energy and Industry

ENERGY

## BIOPROCESSES

Dark Fermentation (BioHydrogen), Biological Power2Gas (BioMethane), Advanced Anaerobic Digestion (Biogas), Bioelectrochemical Systems (BES)

Process development and implementation

Functional role of microbial components

Chemical-physical characterization

## BIOMASSES

(agricultural, industrial and urban wastes, by-products, biomass crops, etc.)



Biotechnological processes for biomass treatments

Molecular characterization and valorization of plant and microbial biomasses

Molecular engineering of plant and microbes

## BIOCATALYSIS

(hydrogen synthesis and/ or conversion, lignin transformation, etc.)



Identification and functional characterization of enzymatic and microbial biocatalysts

Metagenomic approaches for identification of microbial activities

Characterization of ligninolytic fungi

Phyto- and Myco-remediation

## ENERGY AND BIOPRODUCTS

(biohydrogen, biogas, natural rubber, specialized metabolites, building blocks, biochar, etc.)



Identification and characterization of bioproducts

Improvement of bioproducts production and quality

Study of bioproduct properties and applications

BIOTECHNOLOGY

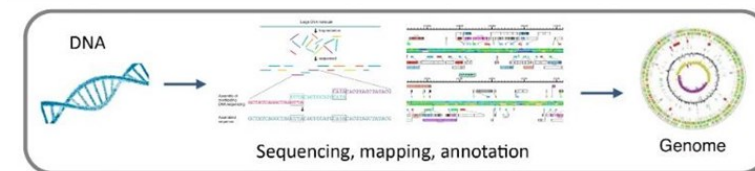
MICROBIOLOGY

OMICS SCIENCES (GENOMICS/METAGENOMICS, TRANSCRIPTOMICS)

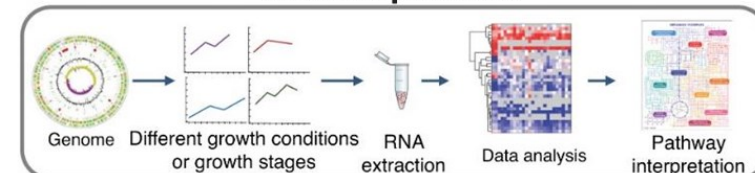
TECHNOLOGICAL DEVELOPMENT

GREEN CHEMISTRY

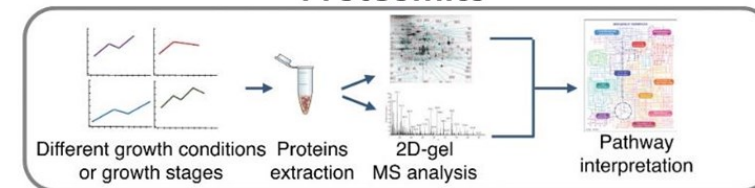
## Genomics



## Transcriptomics



## Proteomics



## Microbiology







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## The ENEA Microbial Culture Collection

ENEA microbial collection has been created over 30 years by an interdepartmental team of researchers that has collected microbial strains (bacteria, fungi, microalgae, microbial consortia, virus) from different environments (contaminated sites, hypogea and archaeological sites, food, lake sediments, sea, soil, rhizosphere, water). ENEA microbial collection comprises approximately 1500 bacteria, fungi, marine microalgae and viruses





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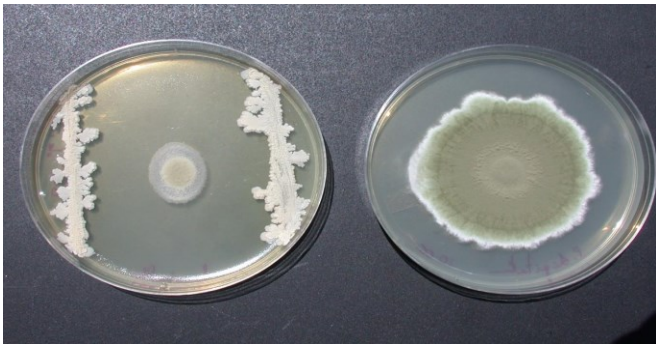
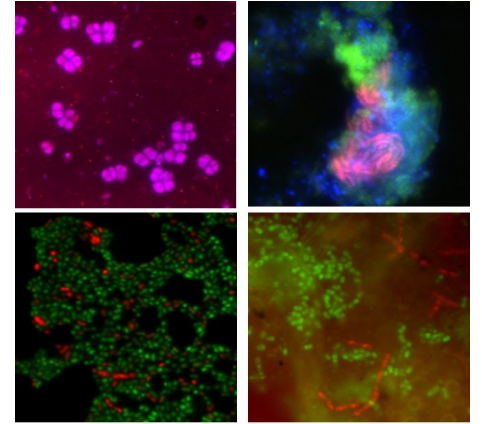
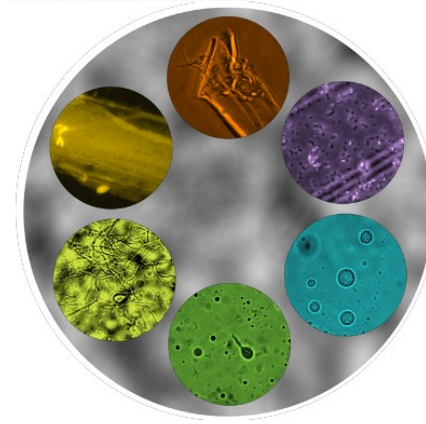
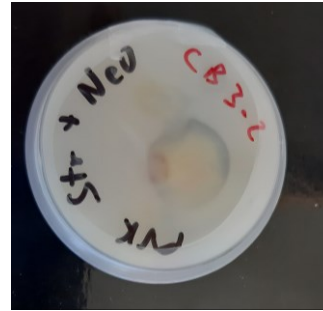
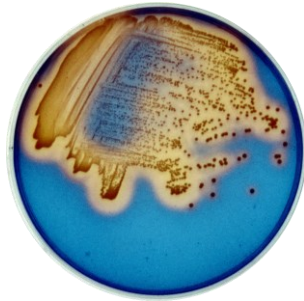
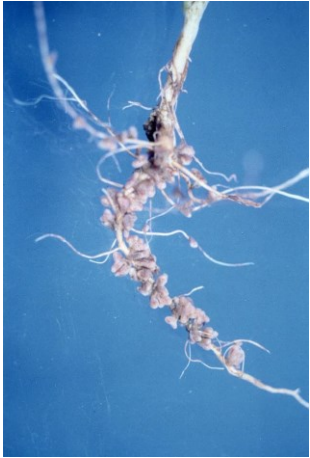


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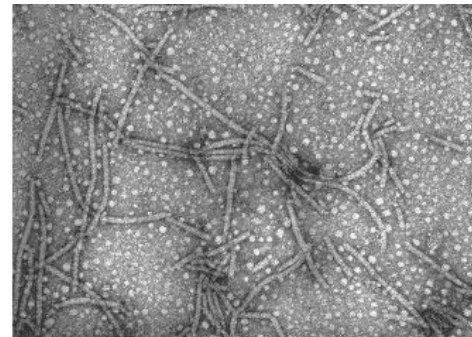
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Sustainability and protection (soil, bioremediation, waste management, biorefinery, reduction of climate-altering gas emissions).

Plant growth promotion, nitrogen fixation, phosphorous solubilization and plant disease suppression.



A vegetable virus with applications in the biomedical sector, especially for the development of innovative vaccines, diagnostic systems and delivery of targeted cancer therapy.

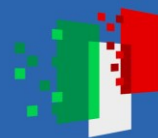




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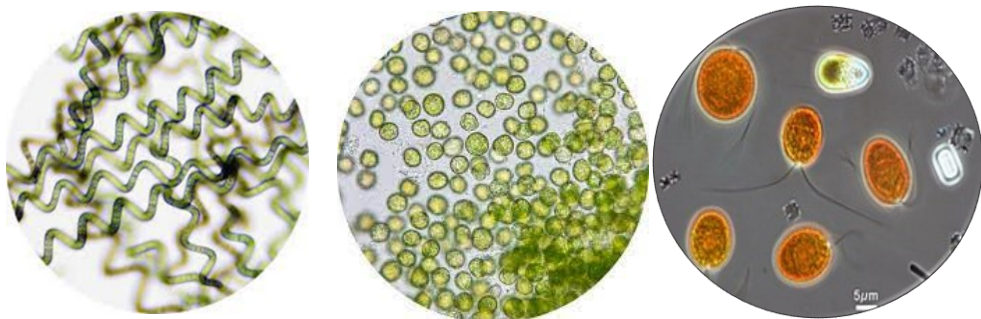


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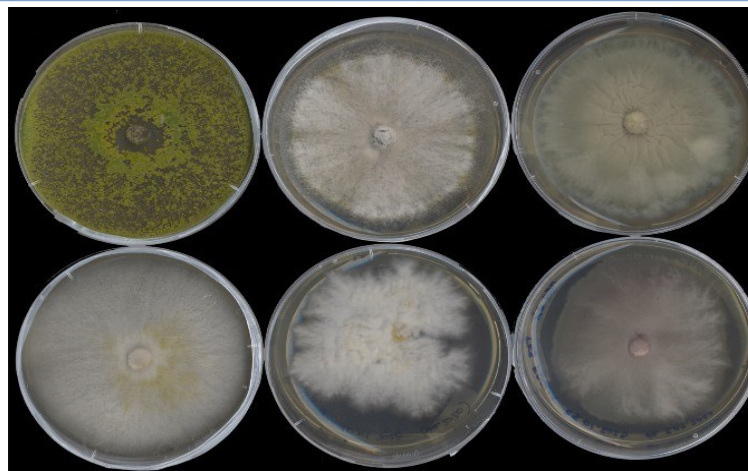


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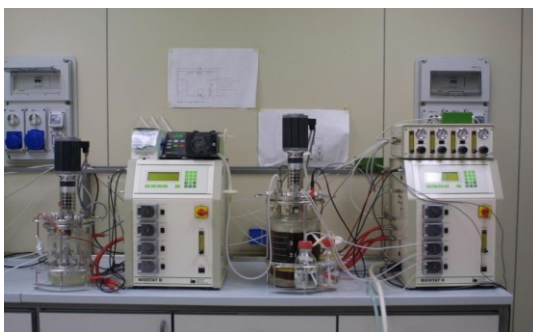
Strains of freshwater and seawater microalgae useful for the production of bio-based molecules in the nutraceutical, cosmeceutical and pharmaceutical sectors or for the production of energy and/or green chemistry products.



Fungi capable of synthesizing ligno-cellulolytic enzymes. They are widely used in the production of biofuels starting from waste materials or in the bioremediation and detoxification processes of industrial matrices.



Strains used for cultural heritage, being able to remove the substances responsible for the deep brown stains on the marble of the Madonna del Parto.



Yeasts to produce bioethanol starting from different types of sugars (xylose, lactose, glucose, etc.).



Microbial strains useful to produce bio-based molecules in the nutraceutical, cosmeceutical and pharmaceutical sectors.





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# ENEA



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