

The Italian network of the microbial culture collections: MIRRI-IT

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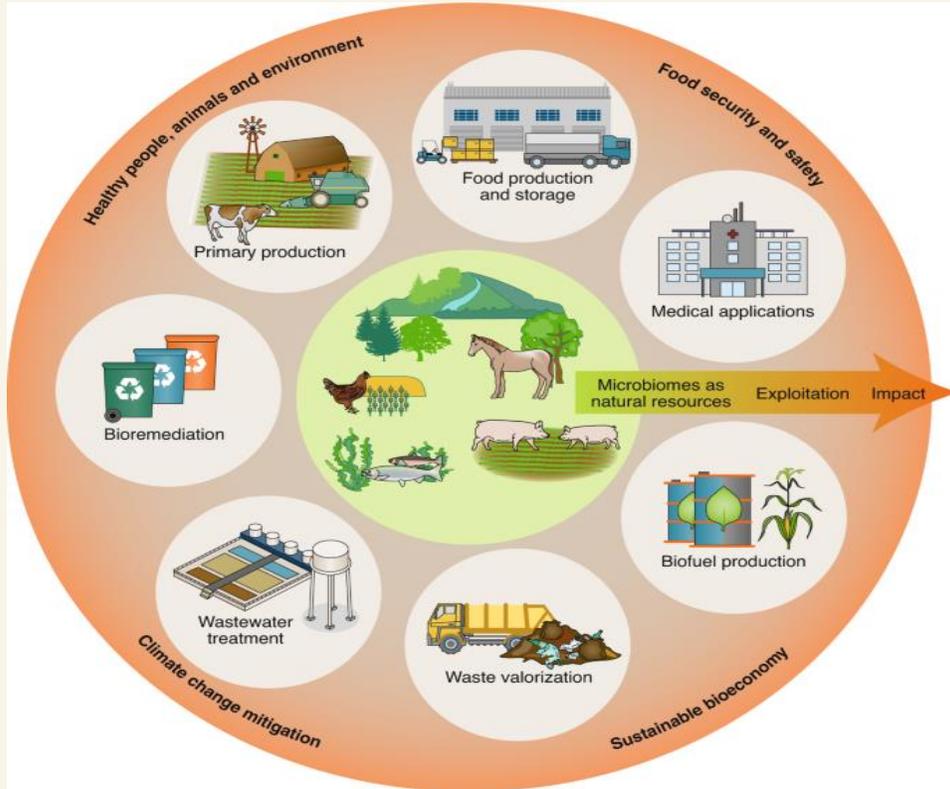
Microorganisms are the predominant life form on our planet.

Microbes are ubiquitous in the biosphere and fundamental for the functioning of ecosystems:

- ◆ regulate biogeochemical cycles and the recycling of organic matter
- ◆ are the main producers and users of greenhouse gases
- ◆ sustain soil and sediment structure and fertility, and support productivity in terrestrial and aquatic environments
- ◆ form essential microbiomes on all living macroorganisms, significantly influencing their physiology, health and well-being

Microbial biodiversity is considered a valuable resource for science and industry, with implications for the economy and finance

>90% of microbial biodiversity is yet to be discovered!



https://www.nature.com/articles/s41564-020-00857-w?utm_source=xmol&utm_medium=affiliate&utm_content=meta&utm_campaign=DDCN_1_GL01_metadata

The **Microbial Resource Research Infrastructure (MIRRI)** is the pan-European network for the preservation, systematic investigation, provision and valorisation of microbial resources and biodiversity (<https://www.mirri.org/>) fostering microbial science and innovation in the domains of Agrofood, Environment, Health and Energy.

Joint Research Unit (JRU) MIRRI-IT: 27 Institutions preserve and harness about **100.000 strains** of viruses, bacteria, yeasts, filamentous fungi and microalgae.

- 🔹 **Single access point** (<https://www.sus-mirri.it/it/>)
- 🔹 **Extensive catalogue of certified microbial resources and metadata** (many of them are exclusively available from Italian collections)
- 🔹 **Innovative research facilities and cutting-edge technological platforms** for different types of microbial analyses
- 🔹 **Excellent technical-scientific expertise & consultancy**
- 🔹 **Advanced training courses**



The MIRRI-IT network guarantee the full supply chain of microorganisms

Isolation

Identification

Preservation

Characterization

Valorization

- Advanced culturomic approaches for single microorganisms and microbiomes
- State-of-the-art molecular and phenotypic identification methods
- Optimised preservation protocols for all microbial groups
- Combined genomic and phenotypic strain/microbiomes characterisation
- Strategic development of microbial applications across various sectors
- Proactive engagement with scientific and industrial partners through transparent data sharing

Open access

Stakeholders

Microorganisms play diverse and indispensable roles in contributing to sustainable and resilient food production systems and mCCs are the key players in harnessing the microbial diversity

Soil Health & Plant Nutrition

- Nutrient cycling and organic matter decomposition for improved soil fertility
- Nitrogen fixation, phosphate solubilization and enhanced nutrient uptake through mycorrhizal fungi
- Reduced dependency on synthetic fertilizers through biofertilization

Plant Protection & Resilience

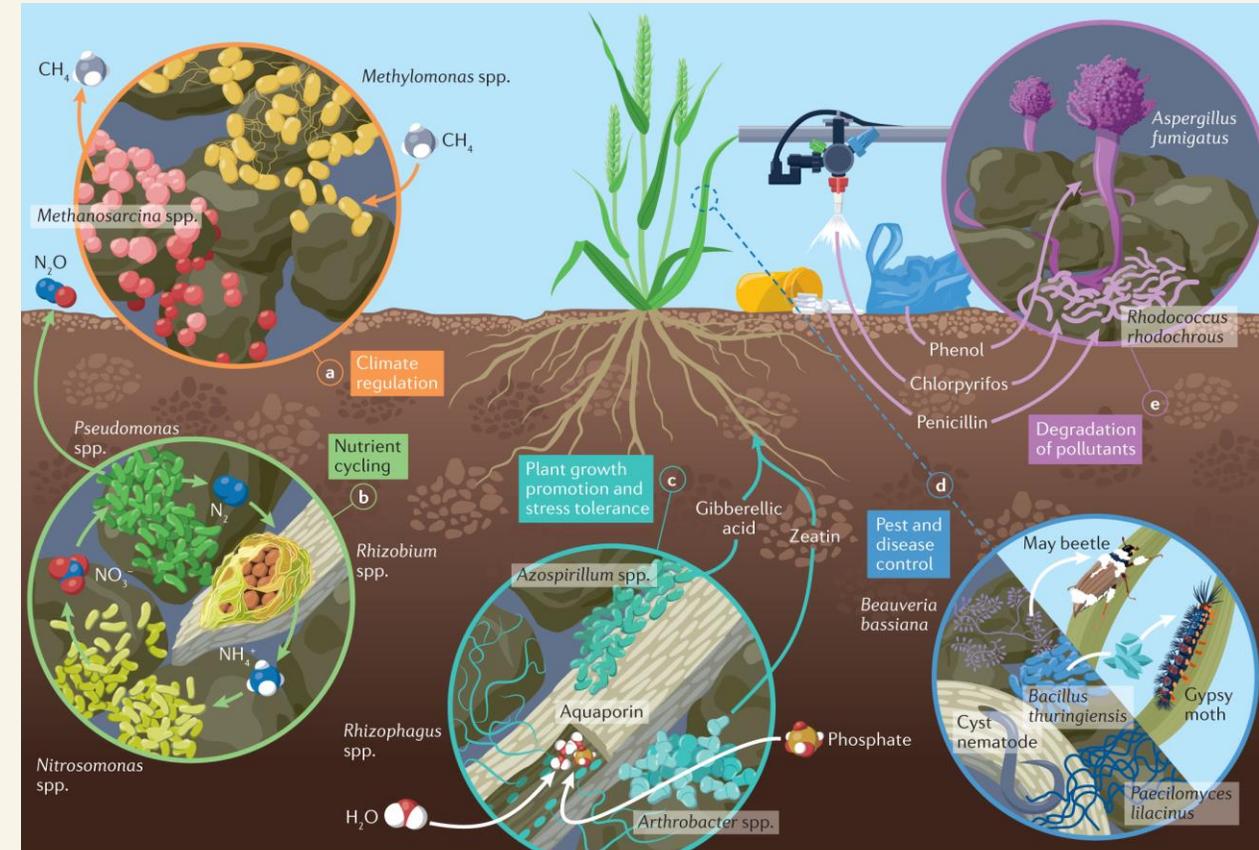
- Natural disease resistance through beneficial microorganisms
- Biological pest control reducing chemical pesticide use
- Enhanced crop tolerance to environmental stresses

Environmental Management

- Optimized water use efficiency
- Bioremediation of contaminated soil and water
- Efficient agricultural waste decomposition and recycling

Biosurveillance

- Rapid detection and monitoring of plant and animal pathogens
- Global sharing of microbial strains and data for outbreak prevention



<https://doi.org/10.1038/s43017-022-00366-w>

Pathogen Monitoring & Control:

- Rapid detection protocols for emerging plant pathogens and quarantine organisms
- Prevention of animal pathogen outbreaks and animal → human spillover events
- Early identification of potentially hazardous human pathogens
- Isolation, identification and characterisation of mycotoxigenic fungi and emerging mycotoxins

Advanced Detection Methods:

- Molecular and mass spectrometry techniques for food chain surveillance
- Identification of toxic compounds and antimicrobial resistance
- Prevention of food spoilage and contamination
- Comprehensive pathogen tracking across agricultural systems



@G. Watts 2013

By selecting, preserving, and distributing food starter cultures (SCs - bacteria and fungi) we contribute to the European food safety system

Enhancing Food Safety and Quality:

- Selected SCs prevent spoilage and pathogenic contamination during fermentation
- SCs that meet safety standards protect consumers and promotes confidence in fermented foods
- SCs beneficial for gut health and overall well-being add support healthy food production

Promoting Sustainable Food Production:

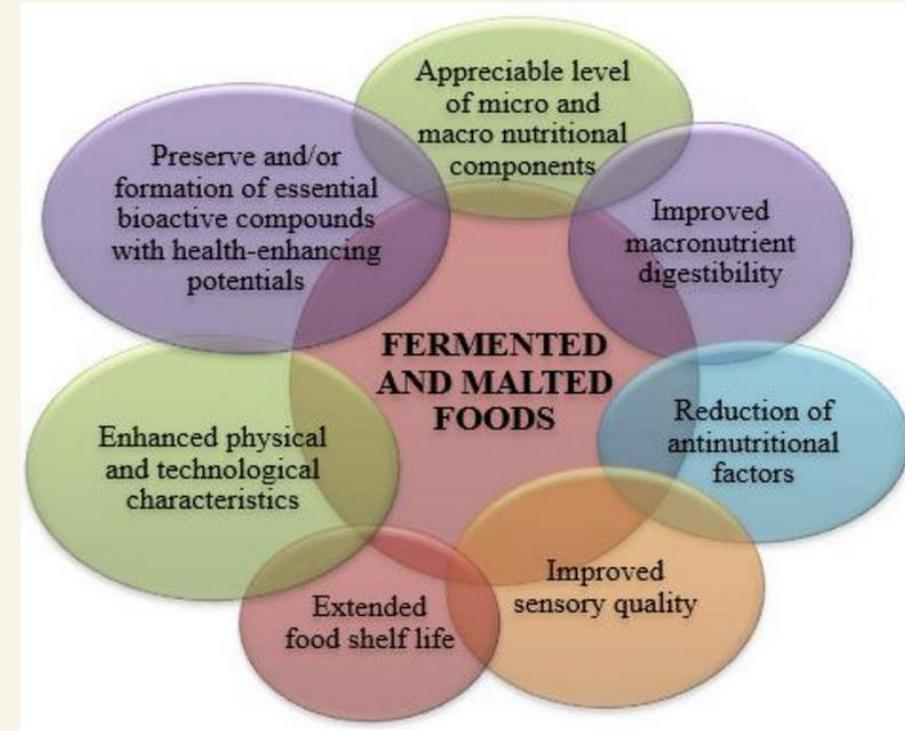
- SCs reduce or eliminate the need for chemical preservatives or artificial additives contributes to safer, more natural food processing methods aligned with the EU's sustainability goals
- Distributing SCs improves fermentation processes, making them more efficient

Ensuring Traceability and Safety in the Food Supply Chain:

- Comprehensively characterized strains ensure robust traceability and safety standards
- Advanced preservation techniques guarantee long-term stability and maintenance of beneficial properties

Supporting the Development of Novel Functional Foods:

- High-quality starter and probiotic strains drive innovation in functional foods, advancing the EU's mission to promote health-enhancing food products.
- Rigorous scientific validation of safety, efficacy, and stability parameters establishes industry best practices and guidelines for their use in food production, ensuring compliance with EU regulations and consumer safety



@Kewuyemi et al., 2021

Reducing meat production and consumption is a must because of its high environmental footprint

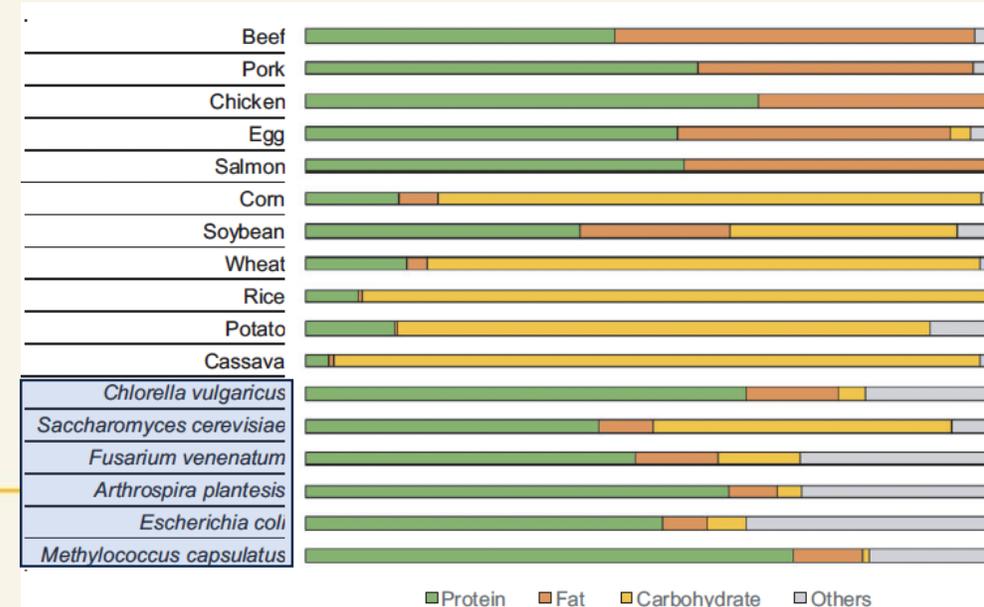
@Graham et al., 2023

Products	Water footprint ^b (m ³ water kg ⁻¹)	Carbon footprint ^c (kg CO ₂ -eq kg ⁻¹)	Land use ^d (m ² kg ⁻¹)
Beef	15 400	99.5	326.2
Pork	6000	12.3	17.4
Chicken	4325	3.5	9
Egg	3300	4.5	6.3
Salmon	1400	5.8	3.7
Soya bean	2145	3.2	3.5
Wheat	1827	1.6	3.9
<i>Fusarium venenatum</i> (Quorn ^e)	500	5.5	2
<i>Methylococcus capsulatus</i> (FeedKind ^f)	20–58	2.2	0.034
<i>Arthrospira plantesis</i> (Spirulina ^g)	104	0	0.086

🔵 **Mycoproteins** rich in proteins and other healthy molecules that can be produced valorizing agro-food byproducts according to circularity principles

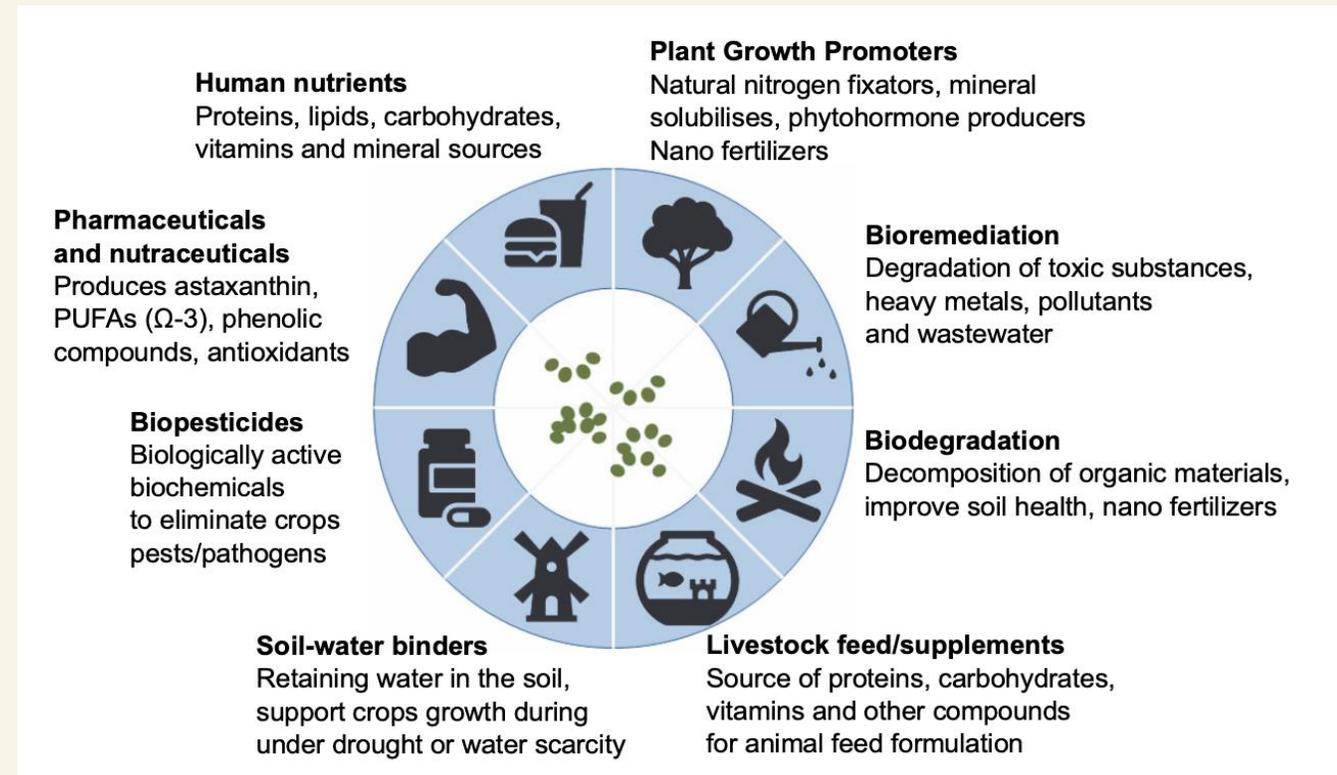
🔵 **Bacteria, Microalgae and cyanobacteria for food and supplements:** *i.e* Spirulina, Chlorella, etc.

🔵 **Precision fermentation:** CO₂ to protein rich food & feed by NGT (new genetic techniques)-acetate microbes used for microbial growth; NGT- bakers yeasts to express animal proteins (meat and milk) to be approved using all parts of the nutritious fungal biomass



MIRRI-IT: advanced technologies, services and training to support European Food Safety and green innovation

- Comprehensive Safety Assessment of Biological Solutions:** conducting advanced evaluation of biocontrol agents, probiotics and starter strains for pathogen control and food quality enhancement
- Innovation in natural preservation methods:** developing and implementing microorganism-based alternatives to replace chemical preservatives and agrochemicals, advancing sustainable food safety practices
- Advanced Supply Chain monitoring:** implementing cutting-edge traceability systems and safety protocols throughout the food production and distribution network
- Research and Development of Innovative Bio-Products:** pioneering the development of novel functional foods and feeds through advanced microbial technologies
- Environmental Biotechnology Solutions:** identifying and optimizing microbial consortia for effective biodegradation of traditional and emerging pollutants



@Noor-Hassim et al., 2023

Unlocking the full potential of microbial biotechnology: promote sustainable agriculture, and climate mitigation solutions, and provide new feeds and foods.

Currently, the use of microbial-based solutions is limited and is yet to reach its full potential because of:

- *Stringent regulations and public skepticism may impede the widespread adoption of microbes including NGT microbes in agriculture and in food production. More advanced regulatory system that actively identifies and approves safely useful and/or edible microorganisms and systematically manages their list is desired to accelerate the development of more diverse microbial foods.*
- *Interdisciplinary collaborations can facilitate the development of holistic solutions for scaling up microbial processes across the agricultural and food sectors*
- *Increased efforts in public engagement and education can address concerns and enhance the acceptance of microbial biotechnologies for different useful applications*
- *Investment and Support: sustainable funding frameworks from both public and private sectors are vital to advance breakthrough research in microbial biotechnology, particularly for addressing climate change and food security challenges*

THANK TO ALL

