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Strategic Research and Innovation Agenda on food system microbiomes

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Microbes and microbiomes, i.e. microbial communities …

Often associated with diseases

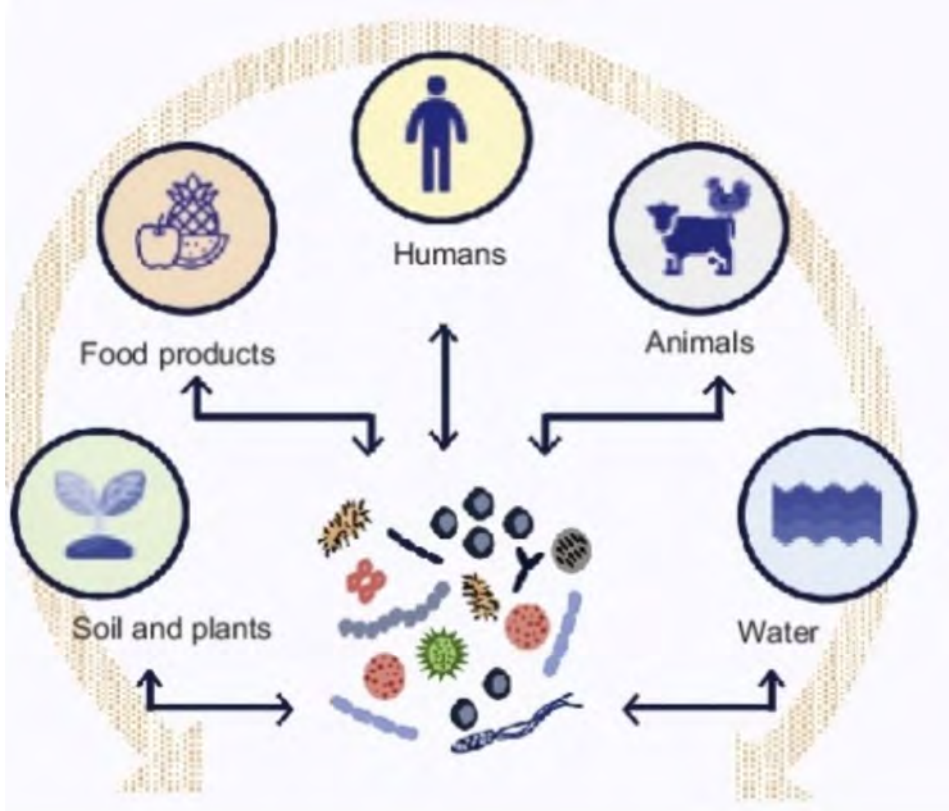
and food spoilage

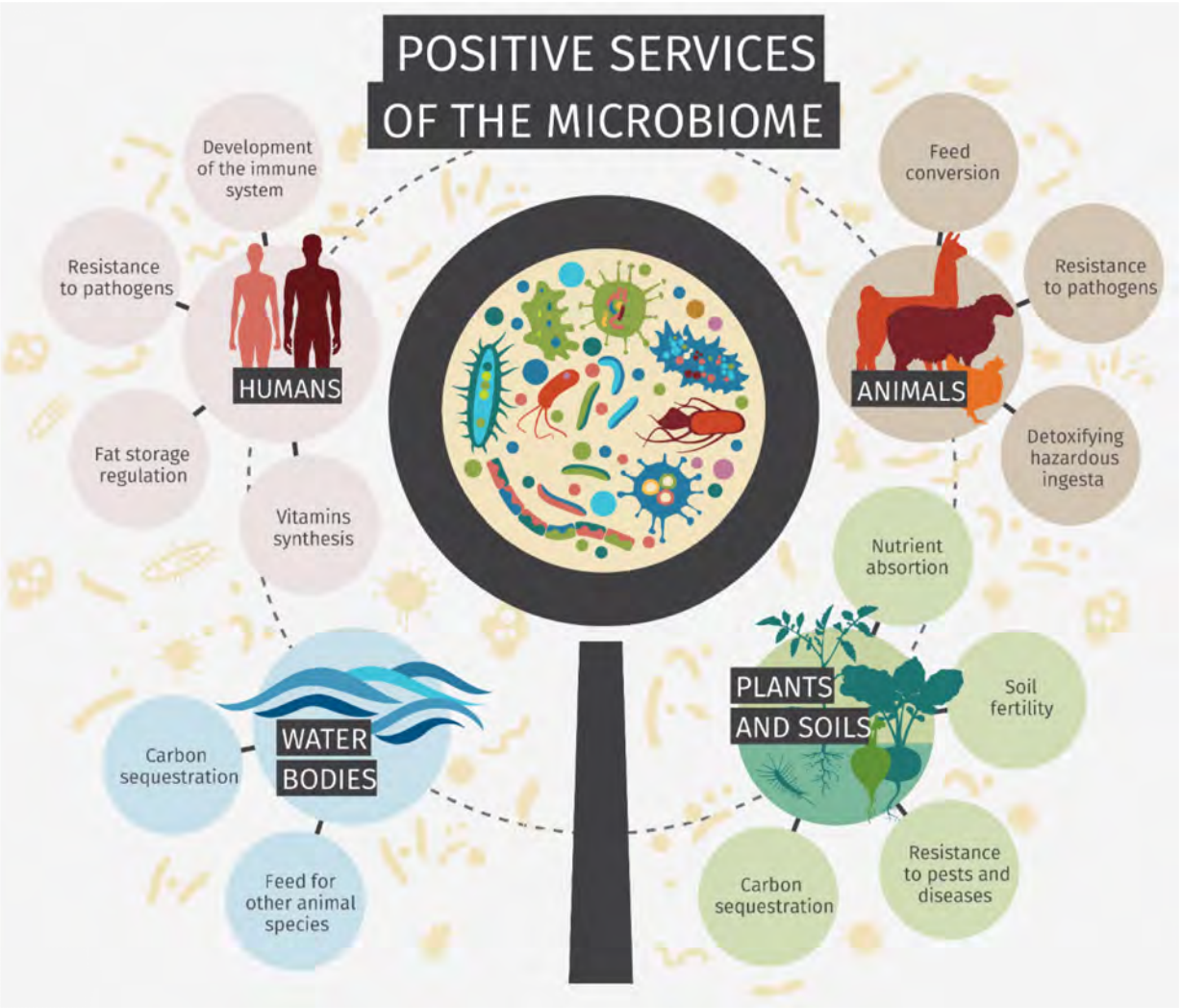
or at best with fermented foods

Adapted from Meisner A. et al 2020

Why should we better consider food systems' microbiomes?

microbiomes occur everywhere in food system and they provide many services

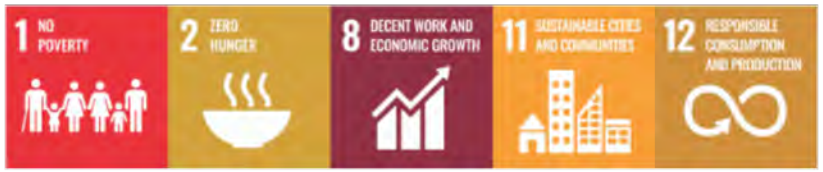




Adapted from Meisner A. et al 2022; FAO report, microbiome the missing link?

Food system microbiomes could contribute to SDGs
Microbiome is an action pathway listed in the Food 2030 agenda

Food supply in industrialized & urbanized societies



Clean environment

Climate change mitigation

Healthy lives

D'Hondt, *et al.* *Nat Microbiol* 6, 138–142 (2021)

Why a Strategic Research and Innovation Agenda (SRIA)?

- Microbiome research is fragmented with a specific focus on one food system area/environment (plant, animal, processing plants, food, human, waste,…)
- Developing a comprehensive microbiome knowledge base in support of sustainable agriculture, biodiversity, environment, and circular economy requires large scale, international, multi-year, and multi-disciplinary effort
- A single country, research entity cannot tackle the entire topic or even individual fields in a satisfactory manner

Why a Strategic Research and Innovation Agenda (SRIA)?

A Strategic Research and Innovation Agenda

- Defragment microbiome research area through alignment of priorities
- Overcome the barriers of scale, reach sufficient critical mass, share data and link different disciplines
- Favour multidisciplinary and international collaborations

A transparent, multi-stage and multi-actor co-creation process

Mapping & analysis of strategic documents

Common ground workshop

Microbiomes in food systems and the bioeconomy: toward a European SRIA workshop

Draft of pillars 1, 2, 3 and 4

Online survey 1st round

Online survey 2nd round

Opportunities & needs for realising the microbiome promises workshop

Complement to pillar 4

Requirements for education and training workshop

Pillar 5

MicrobiomeSupport Strategic Research & Innovation Agenda

Surveys' feedback at a glance

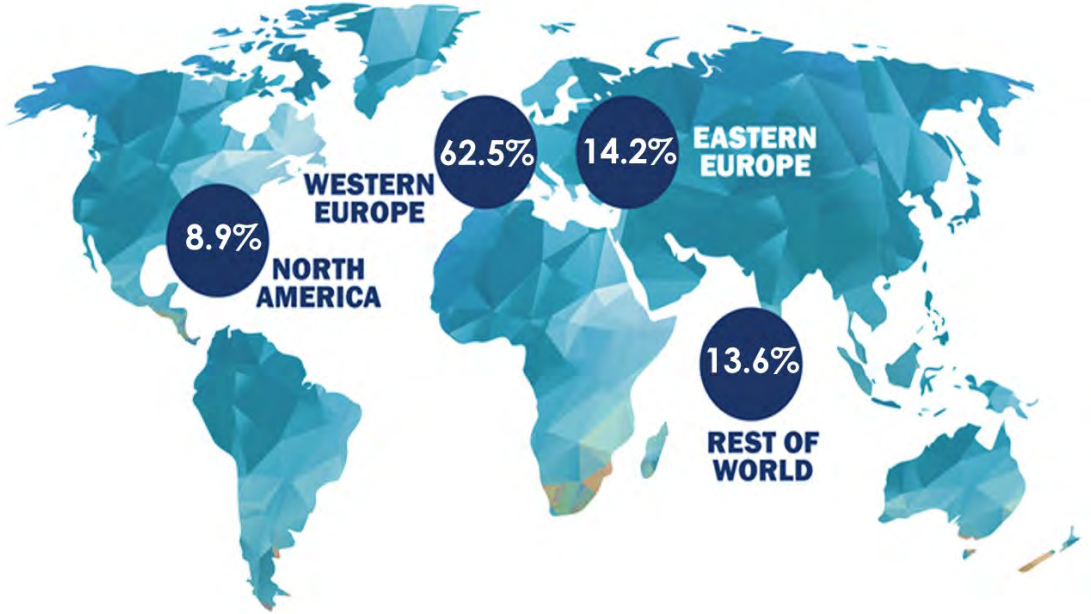
200
PARTICIPANTS

FROM

33
COUNTRIES

88.3%
AGREE

11.7%
DISAGREE

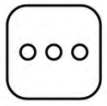


Expertise

77.2%
SCIENCE

9.4%
INDUSTRY

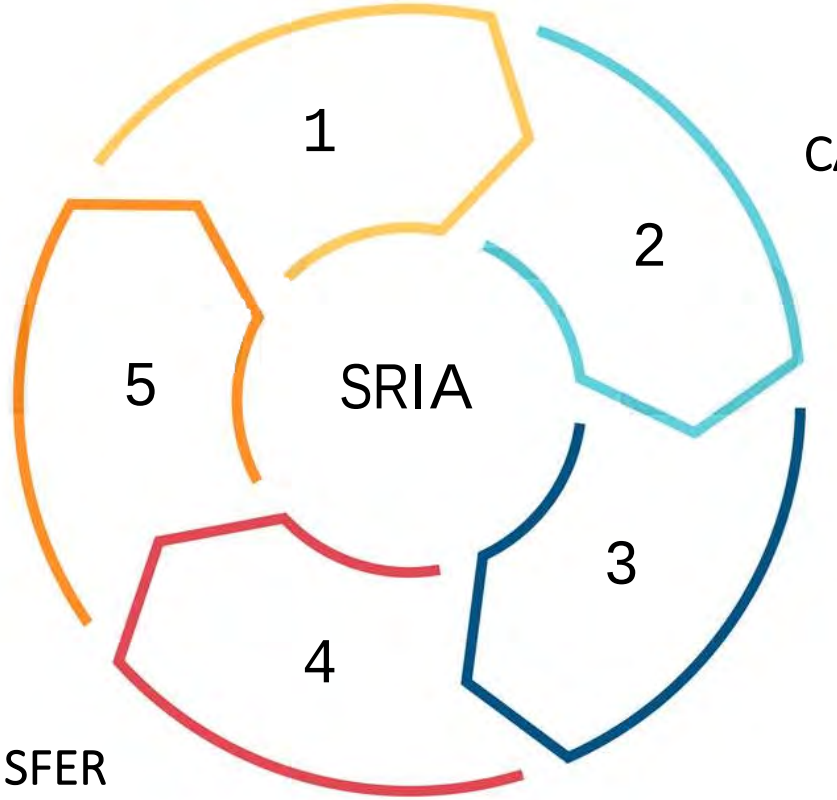
6.7%
POLICY



6.4%
OTHER

A SRIA with 5 interconnected pillars

FRONTIER RESEARCH



CAPACITY BUILDING 

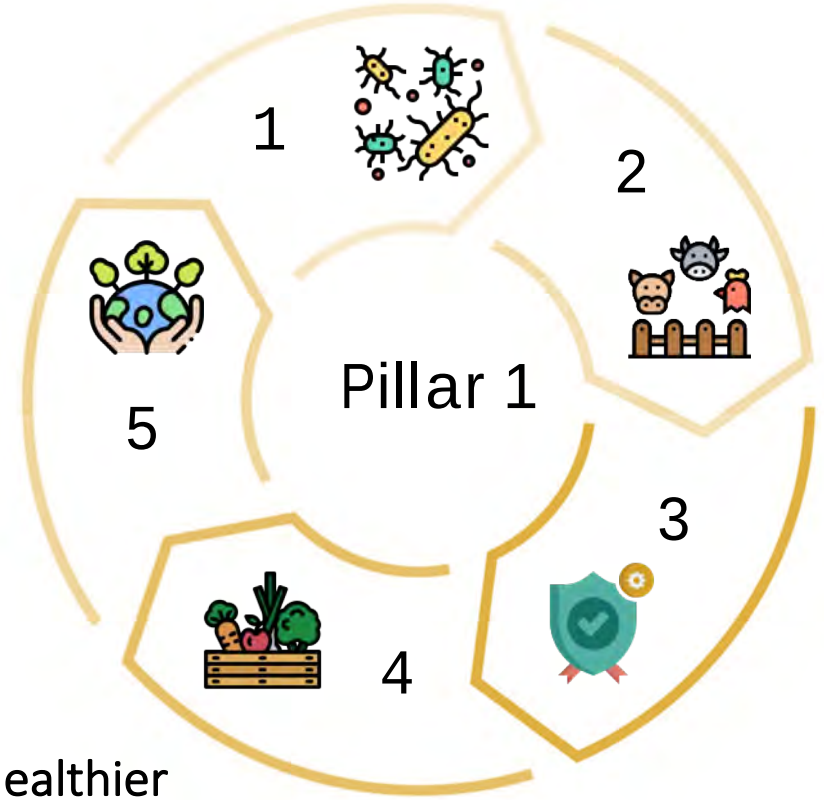
PUBLIC ENGAGEMENT
& EDUCATION

HARMONISATION OF
METHODS & TOOLS 

KNOWLEDGE TRANSFER
INNOVATION & REGULATION

Pillar 1, Frontier research
5 areas and 15 key targets

Harness biodiversity



Sustainable food & feed production

Microbiomes for a healthier planet

Enhance food & feed quality

Healthier foods for healthier humans

⇒ Advance knowledge to act for food system transformation, health and climate change and to deliver innovations

Pillar 1, Frontier research
5 areas, 15 key targets

CHARACTERIZE & EXPLOIT BIODIVERSITY

Understand, monitor & leverage diversity

Model & predict microbiome interactions

Reduce Antibiotic Resistance & pathogen flows

Harness unknown functional diversity

BOOST SUSTAINABLE FOOD AND FEED PRODUCTION

Maximize soil quality & resilience

Enhance animal production & health

Improve plant productivity & health

Reduce chemical inputs

IMPROVE QUALITY AND SAFETY OF FOOD AND FEED PRODUCTS

Nutritional quality of food and feed

Traceability & authentification

Improve safety & shelf live to decrease losses

PRODUCE HEALTHIER FOODS FOR HEALTHIER HUMANS

Leverage Foods, diets and food system microbiomes for the preservation & restoration of microbiome-host symbiosis

EXPAND THE MICROBIOME POTENTIAL FOR A HEALTHY PLANET

Reducing and improve bioremediation of wastes

Upgrading residues and co-products as high value products including feed and food

Adaptation & mitigation of climate change

Pillar 2, Capacity building (long-term infrastructures)

MICROBIOME BIOBANK

- Address biodiversity decline
- Preserve innovation potential
- Replicate microbiomes => to produce reference material
- Enable the design of functional ecosystems

PLATFORM FOR PAST, CURRENT, FUTURE DATA SHARING

- Based on FAIR guiding principles
- Harmonization and regular update of minimal data and metadata requirements

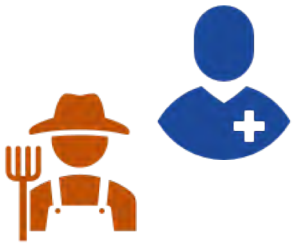
PLATFORM FOR VALIDATED ANALYTICAL TOOLS

- Internationally benchmarked & regularly updated
- Access to consensual informatic mocks

⇒ Capitalize on projects and activities in different part of the world

⇒ Compliance with the rules of open science, ethics and deontology

Pillar 3, Harmonization of methods and tools

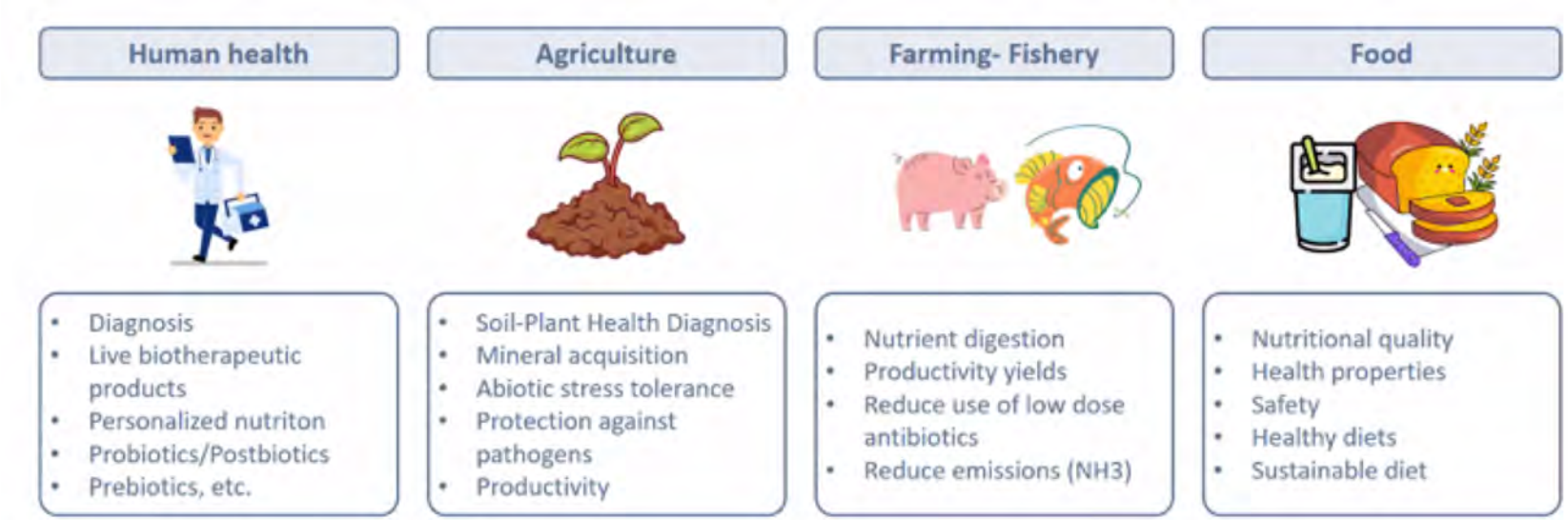


- SET UP AN INTERNATIONAL MICROBIOME STANDARDIZATION CONSORTIUM
  - Speed up the development of Standard Operating Procedures (SOPs) from samples collect to data analysis
  - Agree on reference materials and on minimal requirements for storage & data analysis
  - Co-evolve technologies and analysis tools
- DEVELOP TOOLS FOR MULTI-OMICS DATA INTEGRATION AND ANALYSIS
- PROVIDE ROBUST DIAGNOSTIC AND INTERPRETATION TOOLS FOR END-USERS

⇒ Improve reliability, comparability, and re-use of data and meta-analysis

Pillar 4, Knowledge transfer and innovation in a suitable regulatory framework

- PUBLIC-PRIVATE PARTNERSHIP ON FOOD MICROBIOME
  - Define ways to ramp up and fast-track product development process and identify needs
  - A wealth of innovations and microbiome-based or –derived products but



Adapted from Maguin E. and Sanz Y.

Pillar 4, Knowledge transfer and innovation in a suitable regulatory framework

Still a challenge for regulatory science and regulation agencies…

- BUILD A MICROBIOME EXPERTS PLATFORM TO ADVISE REGULATORY BODIES
  - Define metrics, biomarkers, indicators to determine benefits and risks associated with microbiome changes
  - Define methodologies to assess the effects of on or by microbiome on human, animal, plant health and food safety and validate them at the international level
  - Contribute to developing regulatory guidelines to assess the safety and efficacy of microbiome-based products

- DEVELOP NEW PROJECT TYPES
  - systematically involving regulatory science experts
  - Intended to respond regulatory questions related to risk & benefits of microbiome services

⇒ Co-create the right framework to ease the translation of Microbiome knowledge into applications and their uptake in benefit of all

Pillar 5, Public engagement and education

- Enhance public engagement in science and innovation
- Communicate on / develop realistic expectations based upon progress in microbiome research

CONTINUED PROFESSIONNAL EDUCATION

- Develop specific training / education / new curricula to meet the need of industry, policy-makers, regulatory experts, end-users and professionals
- Support networks for the exchange of experiences using microbiomes such as creative living labs or FAO's global learning network

Pillar 5, Public engagement and education

PRIMARY AND SECONDARY EDUCATION

- Teach basic microbiome-related knowledge and foster microbiology skills and understanding
- Improve microbiome literacy and generate teaching materials on microbiomes

UNIVERSITY AND TRADE EDUCATION

- Teach dissemination and communication of research activities and outcomes
- Promote trans- and inter-disciplinarity through training

⇒ Improve awareness on the importance of microbiomes

⇒ Prepare stakeholders and society to innovative microbiome-applications

Take home messages

- A MicrobiomeSupport's transdisciplinary international taskforce elaborated this strategic research and innovation agenda through a transparent and inclusive process.
- This SRIA concretizes the alignment of strategic priorities on 5 pillars
- The implementation of this SRIA ensures that the best use is made of microbiomes to develop healthy and sustainable food systems and meet the current challenges facing the planet and humankind.
- This SRIA provides a first central and consensual building block towards

an International Microbiome Research Consortium/Network which could :

  - **Implement this SRIA** in all its dimensions
  - Be a **resource center** available to policy makers and regulators,
  - **Maximize research impact and sustainability** through coordination,
  - **Enhance sharing and capitalizing on activities, results and innovations** of past, current and future projects

THANKS ++++

to partners who directly contributed to this work


Beatrix WEPNER


Michael DINGES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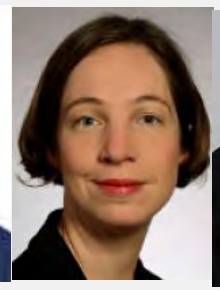
Yolanda SANZ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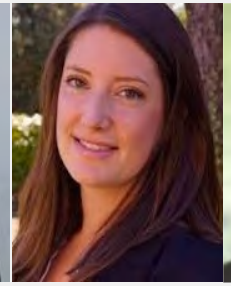
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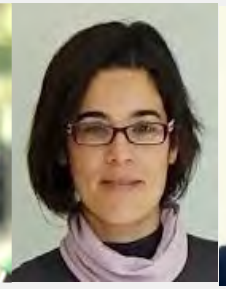
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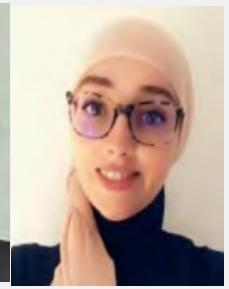
Aicha KRIAA

from AIT, CSIC, DLR, EUFIC, FFoQSI, HMGU, VLO, WR and INRAE

and to all MicrobiomeSupport partners & stakeholders

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microbiome support

Thank you for your attention

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