POLICY BRIEF

Leveraging Microbiome Research for Sustainable Food Systems and Human Health in Europe

SUMMARY

The Microbiome World was defined in 2020 as one of the 11 pathways for action for the Food 2030 strategy within Horizon Europe. This development highlighted the fundamental role of microorganisms, from field to gut, in paving the way towards healthier and more sustainable food systems that should adequately feed up to 10 billion people in 2050. Microbiome innovations also offer strong perspectives for new developments in industrial sectors such as fermented foods and drinks. Beyond food supply and safety, from a health perspective, microbiome profiling will be pivotal for advancing personalized preventive nutrition and medicine. Growing initiatives in the sector call for an integrated strategy for microbiome given its potential for shaping food systems, bioeconomy and human health.

The event "*Exploring the shared future of microbiome, food and health*" organised jointly by INRAE, AgroParisTech, the Paris-Saclay University and Ferments du Futur on November 18 2024, at the French House of Research and Innovation (Maison Irène & Frédéric Joliot Curie) in Brussels aimed to address most urgent questions related to microbiome research in Europe. More than 60 participants, including representatives from the European Commission, EFSA, the industrial sector and the microbiome R&I community, participated into fruitful discussions on key challenges in deploying microbiome food and health solutions. These included gaps in research and innovation, regulatory and standardisation barriers, and public perception challenges were brought forward by the speakers.

This policy brief seeks to translate those discussions into **actionable recommendations** for capitalising on advances in microbiome research and innovation to support **the transition** to sustainable food systems and improve human health in Europe:

1. **Structure the microbiome community in Europe and globally**
2. **Adopt an integrated strategy for microbiome at EU level**
3. **Provide a supportive regulatory framework to favour EU competitiveness**
4. **Engage civil society, patients and consumers to build trust.**

CURRENT LANDSCAPE: CHALLENGES IN MICROBIOME RESEARCH AND INNOVATION

Over the last 15 years, the combined support of national (e.g. MetaGenoPolis, SAMS - Box 1) and European funds has enabled significant advances in microbiome sciences, confirming Europe's strong potential for innovation in this field. Building on the existing and future knowledge, there is an opportunity to step up and ensure **the leading position of Europe** at the forefront of this growing sector, while meeting EU policy goals in terms of food sustainability and health. In a continuously changing regulatory framework and at a time when the microbiome community is in the process of being structured, researchers and innovators in food and health sectors face numerous challenges. Some of these challenges are common, like the lack of connection with public policies, public acceptance for biotechnology, regulatory barriers to the deployment of innovation and industrial capacities, and a highly competitive global environment. Moreover, the health and food sectors have their specificities that need to be understood to develop the full potential of microbiome.

Box 1.

SAMS is a 7 years flagship research programme funded by France 2030 (58M€), co-directed by INRAE and INSERM. It aims at understanding microbiome-host symbiosis mechanisms as well as the determinants of food consumption. It partners research organisms and hospitals, with links to public health policies.

Microbiome & Health:

Scientific advances in the human microbiome represent a major potential for tackling the global challenges of malnutrition and the rise in Non-Communicable Diseases (NCD). The nutrition-microbiome-health nexus is a key research subject with huge expected impact on the wellbeing of EU populations. As this issue lies at the crossroads of several disciplines, it is important to provide a framework that enables synergies in research.

Recent European initiatives have made it possible to map out the current state of the microbiome research landscape (Box 2). They have shown that **further support is needed to shape the R&I community in human microbiome**, namely through Coordination and Support Actions. This would help to harmonise the development and validation of standards, thus ensuring more accurate and reliable research outcomes. It will also provide consolidated expertise to help establish a regulatory framework tailored to the needs of the emerging human microbiome sector.

Box 2.

Human Microbiome Action, Microbiome Support and the EMIH coalition initiatives made it possible to identify strengths and gaps of microbiome research. The recently launched European Microbiome Centers Consortium (EMCC) aims to promote and harmonize the development and validation of standards in microbiome research, contributing to the evolution of the regulatory framework and Health in Europe.

Research alone does not deliver treatments fast enough. There is a need to translate it to innovative projects among different actors to get more economic value and more solutions for healthy populations. While in Australia and USA therapies based upon microbiome transfer are already approved, Europe still needs to provide regulatory guidelines that will favour translation of robust, safe and accessible developments capitalizing on unique expertise.

Finally, the microbiome will have a key role to play responding to One Health challenges. Today, this dimension is still absent in public policies, even

though it promises innovative approaches to public health.

Microbiome & Food:

Microbiome, namely through fermented foods, has been contributing to address several food-related challenges and Sustainable Development Goals, such as the adoption of healthier diets, the transition towards more sustainable food systems via plant-based diets, reduction of food waste, reduction of use of chemicals among other (Box 3).

Box 3.

This cluster gathers projects sharing a commitment to advance sustainable food systems, health and environmental resilience through the study of microbiomes along food system value chain. Two projects highlighted during this event, Horizon Europe DOMINO (*Harnessing the potential of fermentation for healthy and sustainable foods*) and the COST Action PIMENTO (*Promoting Innovation of Fermented Foods*) are part of this cluster.

Nonetheless the potential remains under-exploited. The R&I community still needs to explore its prospects to implement microbial-based innovations.

Moreover, **consumer acceptance** is key to successfully integrate novel microbial-based food products such as fermented foods or proteins from alternative microbial sources such as yeast, fungi, algae or cultured cells. Multidisciplinary approaches are needed to address this challenge, namely through the inclusion of social sciences and citizen science. **Diversity** (geography, psychology, sociology, economy, culture, etc.) must be considered when it comes to food choices.

Global competitiveness:

Europe has strong assets to be at the forefront of microbiome R&I. However, a huge economic potential is currently being lost, while competitors from USA, UK, Australia and Asia are seizing opportunities by massively investing in this emerging field.

For example, the EU's Novel Foods Regulation hampers the wider and fast adoption of microbiome-based solutions (up to 5-7 years). The EU regulatory framework on synthetic biology is also critically slowing down the adoption of precision fermentation innovations. Beyond regulation, better access to fermentation substrate and lower energy cost are two other key success factors for industrial developments.

Following the EC communication *"Building the future with nature: Boosting Biotechnology and Biomanufacturing in the EU"*, a future EU Biotech Act embedding food, bioeconomy and health dimensions could be an opportunity **to reduce hurdles in deploying microbiome-based innovations** and support EU leadership in these very strategic fields.

There is a need to design technological capabilities to support innovation throughout the value chain and at different scales. National and EU Public-Private Partnership such as Ferments du Futur (Box 4) or CBE-JU are good examples for supporting and accelerating R&I translation into market applications.

Box 4.

The 48 M€ French Public-Private Partnership "Ferments du Futur", gathering 42 members (companies, higher education and research institutions, branch organisations, technical institutes, trade unions and competitiveness clusters) was launched in 2022 to accelerate research and innovation in ferments, fermented foods and biopreservation.

POLICY RECOMMENDATIONS FOR LEVERAGING EUROPEAN MICROBIOME RESEARCH

1. Structure the microbiome community in Europe and globally to build solid and shared foundations that will accelerate the path to innovation

- Further support the structuration the R&I microbiome community to better coordinate its research on the basis of robust, common approaches and methodologies.
- Harmonise practices and data to ensure more accurate and reliable research results.
- Support interdisciplinary research and public-private partnerships to bridge translational gaps.
- Facilitate synergies between national, EU and international initiatives (e.g. cohorts).
- Expand international collaborations through platforms like the EMCC, World Microbiome Partnership or the International Bioeconomy Forum.

2. Adopt an integrated strategy for microbiome at EU level to provide coordinated support for food, health and bioeconomy strategies

- Align microbiome R&I with EU green and digital transitions policies to foster sustainable food systems.
- Integrate microbiome dimension into a *One Health* approach and strategies addressing public health issues like NCDs.
- Ensure consistency between the various regulations covering microbiome applications (food, health, biotech…).
- Overcome the current division of R&I into silos to ensure adequate funding for microbiome R&I activities - a cross-cutting theme currently at the frontier of several clusters.

3. Provide a supportive regulatory framework to enable the translation of microbiome R&I into economic growth while favouring the emergence of related EU-based companies and start-ups

- Establish robust regulatory frameworks to streamline innovation pathways for microbiome-based therapeutics and novel fermented food and drinks.
- Develop evidence-based standards to provide a solid foundation for applications in health and nutrition.
- Facilitate public-private support to scale-up industrial deployment of microbiome-based innovations.
- Support industrial developments with better access to fermentation substrates and lower energy costs.
- Devote more resources to collaboration between research organisations and risk assessment agencies to speed up the adaptation of regulation framework.

4. Engage civil society, patients, and consumers to build trust in microbiome-based health interventions and food solutions

- Promote transparency and consumer education to foster understanding and demystify microbiome applications in health and nutrition.
- Raise awareness about fermented foods and their health benefits.
- Address cultural and sensory preferences through consumer-driven innovation projects (e.g. living labs) to enhance acceptability of microbiome-based foods.