# Selected Specialty Food Ingredients & their benefits for gut microbiome and health

EU specialty food ingredients

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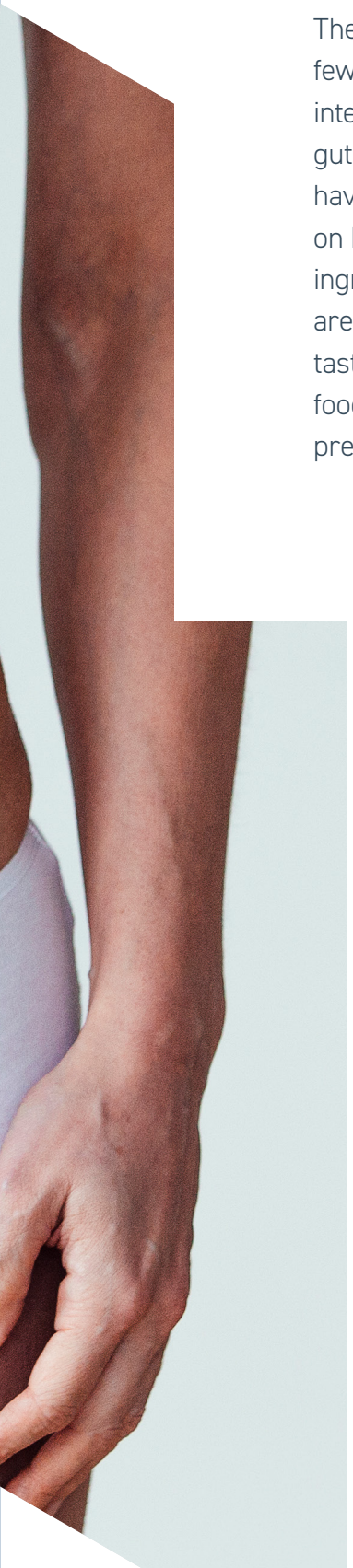
# INTRODUCTION



The field of microbiome research has evolved rapidly over the past few decades and has become a topic of great scientific and public interest.[1] One of the studied aspects is the impact of nutrition on the gut microbiome, which shows that some specialty food ingredients have a beneficial effect on the gut microbiome and consequently on human health.[2] Specialty food ingredients are a wide group of ingredients with functional and/or technological properties, which are essential in providing today's consumer with a wide range of tasty, safe, healthy, affordable, qualitative, and sustainably produced food. The focus of this paper is on the benefits of probiotics, prebiotics, dietary fibre, synbiotics and postbiotics.[2, 3, 4, 5]

# WHAT IS A MICROBIOME

Microbiomes are defined as characteristic microbial communities, which include prokaryotes, fungi, protozoa, other micro-eukaryotes and viruses, that occupy well defined habitats.[6] The term microbiome is broader than other terms, for example, microbial communities, microbial population, microbiota or microbial flora, because microbiome refers to both, its composition (the microorganisms involved) and its functions (their members' activities and interactions with the host/ environment), which contribute to ecosystem functions.[6] The human microbiome is a complex aggregate of the microbes residing at various sites in the human body and consisting of communities of a variety of microorganisms including Eukaryotes, Archaea, Bacteria, and the viruses that reside in the different body habitat including the skin, the oral cavity, respiratory tract, gastrointestinal tract, urinary tract, reproductive tract etc.[7] In short, microbiome is the genetic material of all the microbes - bacteria, fungi, protozoa and viruses - that live on and inside the human body, including the digestive system. The gut microbiome comprises of diverse community of different microorganisms which differ from each other depending upon their location along the length of GI tract (oesophagus, stomach, the small and the large intestine with colon at the end).[7] Around a thousand of the bacterial strains in the gut are present in the large intestine or colon.[2] The large and diverse groups of microorganisms that resides various parts of the human body have a highly coevolved relationship with the human health.[7]

The human gut microbiome plays an important role in digestion and nutrition.[8] Bacteria along the GI tract have several possible functions, many of which are beneficial for health including vitamin production, support in the absorption of ions (Ca, Mg, and Fe), protection against pathogens, histological development, enhancement of the immune system, and the fermentation of "non-digestible foods substrates" to short chain fatty acids (SCFA) and other metabolites, which are increasingly implicated in systemic health effects in the body.[8]

It is widely known that a good balance and healthy function of microorganisms' groups in the colon are necessary to maintain homeostasis and preserve health. The composition of the gut microbiome is influenced by several factors. Besides the diet,[9] the human microbiome may be impacted by other factors such as the lifestyle,[9] age,[10] environmental chemicals[11] and the use of medicines.[12]

Modulation of the human gut microbiota through probiotics, prebiotics and dietary fibres are recognised strategies to modify the gut microbiome and contribute to improving health.[13] Probiotics and prebiotics are present naturally in foods but also belong to the group of specialty food ingredients, which are added to foods for their functional and/or technological benefits. Specialty food ingredients are essential in providing today's consumer with a wide range of tasty, safe, healthy, affordable, qualitative and sustainably produced food.

# DEFINITIONS

As there are no set definitions in the EU legislation for the below listed terms except for dietary fibre, the most relevant definitions were selected for the purpose of this paper.

### Microbiome

Microbiomes are characteristic microbial communities, which include prokaryotes, fungi, protozoa, other micro-eukaryotes and viruses, that occupy well defined habitats.[6] The term microbiome is broader than other terms, for example, microbial communities, microbial population, microbiota or microbial flora, because microbiome refers to both its composition (the microorganisms involved) and its functions (their members' activities and interactions with the host/environment), which contribute to ecosystem functions.[6]

### Microbiota

The human microbiota is a microbial community that lives on and in the human body.[14]

### Microflora (Microbial flora)

The word microflora has been used for a long time in the scientific and medical literature. However, its definition does not justify its use to describe microbial communities associated with human (i.e., microbiota). Its definition has evolved over time, but remains "microscopic plants, or the plants or flora of a microhabitat." [15]

### Probiotics

Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit on the host.[16]

### Prebiotics

Prebiotic is a substrate that is selectively utilized by host microorganisms conferring a health benefit.[17]

### Synbiotics

Synbiotic is a mixture comprising live microorganisms and substrate(s) selectively utilized by host microorganisms that confers a health benefit on the host.[18]

### Postbiotics

Postbiotic is a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host. Effective postbiotics must contain inactivated microbial cells or cell components, with or without metabolites, that contribute to observed health benefits.[19]

### Dietary fibre [20]

'Fibre' means carbohydrate polymers with three or more monomeric units, which are neither digested nor absorbed in the human small intestine and belong to the following categories:

- edible carbohydrate polymers naturally occurring in the food as consumed,
- edible carbohydrate polymers which have been obtained from food raw material by physical, enzymatic or chemical means and which have a beneficial physiological effect demonstrated by generally accepted scientific evidence,
- edible synthetic carbohydrate polymers which have a beneficial physiological effect demonstrated by generally accepted scientific evidence.

## Probiotics

According to the International Scientific Association for probiotics and prebiotics (ISAPP), probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit on the host.[16] Probiotic strains must be (i) sufficiently characterized; (ii) safe for the intended use; (iii) supported by at least one positive human clinical trial conducted according to generally accepted scientific standards or as per recommendations and provisions of local/national authorities when applicable; and (iv) alive in the product at an efficacious dose throughout shelf life.[21]

## Prebiotics

Another of the dietary strategies for modulating the microbiota is consumption of prebiotics that can be metabolized by microbes in the gastrointestinal tract.[22] Prebiotics are defined by ISAPP as a substrate that is selectively utilized by host microorganisms conferring a health benefit.[17] Typical examples of prebiotics recognised by ISAPP are fructooligosaccharides (FOS), inulin and galactooligocaccharides (GOS), while many candidate prebiotics are being developed such as specific human milk oligosaccharides based on human trial substantiation. FOS, inulin and GOS are selectively utilized by gut microorganisms conferring a health benefit, as shown by molecular gut microbiota studies from human clinicals and demonstrated health benefits in human intervention studies.[2, 23]

Prebiotics improve digestive function (bowel regularity)[24, 25] and improve calcium absorption and bone mineral density[26]. They have also the potential to support the body's natural defences,[27, 28, 29, 30] help regulate the desire to eat and energy balance,[31] and glucose metabolism [31, 32, 33, 34].

## Dietary fibre

Some prebiotics are also dietary fibres or non-digestible carbohydrates. Dietary fibres are defined by Codex Alimentarius[35] or national/ regional regulatory authorities[20]. There is a number of authorized EU Health Claims related to specific fibre ingredients. These approvals are based on a thorough scientific assessment by the competent EU authority – European Food Safety Authority (EFSA) and well documented in the relating scientific opinions confirming the beneficial physiological effect to human health.[36]

Dietary fibres are carbohydrates that cannot be metabolised by digestive enzymes. However, they can be metabolized by certain species of gut microbiota through fermentation. If this process is related to a positive effect on health needs to be demonstrated on a case-by-case basis in several randomized controlled trials. For example, this process may result in the production of SCFAs and bioactive phenolic acids.[37] The availability of SCFAs can results in health benefits, as they can reduce hyperlipidaemia, hyperglycaemia, and hyperinsulinemia. Therefore, increased dietary fibre consumption can positively influence metabolic health by altering the gut microbiota.[38]

## Synbiotics & Postbiotics

There are several concepts combining or developing further the beneficial effect of probiotics and prebiotics. One of them is mixing a probiotic with an appropriate prebiotic – the ISAPP defines synbiotic as a mixture comprising live microorganisms and substrate(s) selectively utilized by host microorganisms that confers a health benefit on the host.[4]

Another ingredient category related to the modulation of the microbiome is related to postbiotics, which is defined by ISAPP as a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host. Effective postbiotics must contain inactivated microbial cells or cell components, with or without metabolites, that contribute to observed health benefits.[39] Postbiotics are functional bioactive compounds, generated in a matrix during fermentation, which may be used to promote health. The term postbiotics can be regarded as an umbrella term for all synonyms and related terms of these microbial fermentation components. Therefore, postbiotics can include many different constituents including metabolites, short-chain fatty acids (SCFAs), microbial cell fractions, functional proteins, extracellular polysaccharides (EPS), cell lysates, teichoic acid, peptidoglycan-derived muropeptides and pili-type structures.[40]

## KEY POINTS

- Some ingredients have a beneficial effect on gut microbiome and consequently on human health.
- The human gut microbiome plays an important role in digestion and nutrition.
- Modulation of the human gut microbiota through probiotics, prebiotics and dietary fibres are recognised strategies to modify the gut microbiome and contribute to improving health.
- Probiotics, prebiotics, and dietary fibre are present naturally in foods but also belong to the group of specialty food ingredients, which are added to foods for their functional and/or technological benefits.
- Specialty food ingredients are essential in providing today's consumer with a wide range of tasty, safe, healthy, affordable, qualitative, and sustainably produced food.

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