

Prebiotics: A healthy market to operate in

The prebiotic ingredient market is set for a steady growth

Prebiotic carbohydrates are naturally occurring and can be found in numerous foods, including asparagus, chicory, tomatoes and wheat, and it is also a natural component of breast milk. The term prebiotic was first defined by Gibson and Roberfroid in 1995. However, the initial definition proved difficult to verify and since then the authors have further developed the concept proposing a new definition: "A prebiotic is a selectively fermented ingredient that allows specific changes both in the composition and/or activity in the gastrointestinal microflora that confers benefit upon host well-being and health"¹. In order to qualify for prebiotic classification, an ingredient is required to: Resist digestion (gastric acidity, hydrolysis by mammalian enzymes and gastrointestinal absorption); be fermented by the gastrointestinal microbiota; selectively stimulate the growth and/or activity of intestinal bacteria associated with health and well-being¹.

The latter criterion is the main distinguishing feature between a dietary fibre and a prebiotic. Prebiotics are generally recognised for their ability to alter the colonic microbiota, promoting a healthier composition and/or activity by increasing the prevalence of saccharolytic (carbohydrate fermenting) microorganisms while reducing putrefactive (protein fermenting) microorganisms². The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) are still in the process of discussing an official definition.

What constitutes a dietary fibre?

The term "dietary fibre" was first used in 1953 by Hipsley to describe the plant cell wall components of food. Today, there are many definitions of fibre in use, but as yet there is no universally accepted definition. The recent trend has been towards a physiological definition as this is thought to relate best to possible consumer benefits. This was reflected in the suggested definition derived by the CODEX Alimentarius Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)³. Generally, fibres are derived from carbohydrate sources that have a non-digestible component. Fibres are usually divided between two categories: The insoluble fibres such as wheat bran, resistant

starch, hemicelluloses, lignin, etc., and the soluble fibres which can be further classified into two subdivisions: Short chain length soluble fibres including polydextrose, inulin and oligosaccharides, and long chain length soluble fibres including pectins, gums (guar, locust bean, carrageenan, xanthan) and β -glucan (from oat or barley for example).

Prebiotics are dietary fibres because they are not digested by human enzymes but fermented by the flora of the large intestine. Thus, they increase faecal biomass, increase defecation frequency, ease defecation, have a positive effect on reducing constipation and on the health of the mucosa of the large intestine⁴.

Prebiotic food ingredients and their health benefits

Time constraints and modern lifestyle can pose a threat to eating healthily and therefore can impact on one's health. Modern living has become a fast-paced, high-stress existence which can result in a variety of digestive disorders as the digestive tract is sensitive to the effects of stress, "on the go" eating and poor dietary choices. The result can be a general feeling of bloating, constipation or general feeling of malaise. A healthy digestive system is very important to health and well-being, although rarely considered day to day.

The human gastrointestinal tract harbours a complex bacterial ecosystem. Colonisation begins at birth and continues to be a dynamic system throughout life. Interaction between various factors leads to a highly individual and diverse group of microflora that consists of approximately 1,000 species⁵. Although the entire gastrointestinal tract is colonised with bacteria, the colon is most favourable for colonisation due to a neutral pH (5.5 to 6.8) and longer transit time, so therefore contains the largest bacterial counts. These usually exceed 10^{12} /g dry content⁶.

Influencing the composition of the microflora is an important strategy to support human health and well-being. The main means of achieving this are through the consumption of probiotic bacteria and/or through the consumption of prebiotic ingredients.

Established non-digestible carbohydrates that fulfil the prebiotic criteria, based on data from at least two human intervention studies carried out with meaningful dose levels, are fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS), lactulose, inulin and polydextrose³.

Oligosaccharides exhibit properties typical of dietary fibres. They are either not at all or only to a very small extent hydrolysed by the digestive enzymes in the human intestinal tract. Their main function is to act as a fermentable substrate in the colon primarily for the growth of bifidobacteria. During this process they are metabolised to short chain fatty acids (acetic, propionic and butyric) together with other metabolites⁴. Examples of prebiotic fibres are inulin and polydextrose, but depending on the fibre definition and composition of certain oligosaccharides (degree of polymerisation, distribution), FOS, GOS and XOS

(xylo-oligosaccharides) may also partly qualify as dietary fibres in some markets.

GOS (galacto-oligosaccharides)

GOS, or galacto-oligosaccharides, are soluble, non-digestible sugars, which can be synthesised from two sources: Soya beans and lactose (from cow's milk). The latter resemble those oligosaccharides which occur naturally in human breast milk and therefore their primary commercial use has so far been in formulations for the infant formula market. GOS manufacturers have submitted several claims to EFSA (European Food Safety Authority) under article 13 of the nutrition and health claims regulation (referring to normal vital functions of the body to include growth, development, physiological and behavioural functions or slimming and weight control). It is important to note





that article 13 claims have not yet been validated and that the time line for this process can be monitored via the EFSA website. For GOS, these claims include the prebiotic/bifidogenic effect at a daily intake level from 2.5g/day and also immune health claims which are supported by human intervention studies at a daily intake level of 3.6g⁷.

Inulin and FOS (fructo-oligofructose)

Inulin is a term applied to a heterogeneous blend of fructose polymers. Fructo-oligosaccharides are also known as oligofructose, a sub-group of inulin consisting of polymers with a degree of polymerization (DP) ≤ 10 . Both are found widely distributed in nature as plant storage carbohydrates. Commercially available forms of inulin are either synthesized from sucrose or extracted from chicory roots. Inulin and oligofructose are not digested in the upper gastrointestinal tract. Therefore, they have a reduced caloric value⁸. Inulin is widely accepted as a prebiotic and several claims have been submitted to EFSA under article 13 at an efficacious level of 5g/day. These claims are strongly supported by both in vitro and human intervention studies. Several claims for FOS have also been filed under article 13. These range from increased bifidobacteria levels at an intake level of 2.5g/day for FOS derived from sucrose to levels of 10g/day required to support increased

mineral absorption⁷.

Polydextrose

Polydextrose is a polysaccharide composed of randomly cross-linked glucose units with all types of glycosidic bonding (1,6 bonds predominate), containing minor amounts of bound sorbitol and acid⁹. Litesse® polydextrose, first commercialised in the 1980s, is a highly branched gluco-polysaccharide and established fibre. Originally developed as a low-calorie bulking agent (1kcal/g), it is today marketed as a non-glycaemic, speciality carbohydrate with excellent toleration. Litesse polydextrose is resistant to digestion due to its unique arrangement of glycosidic linkages. It is fermented throughout the colon and is particularly efficient at mediating a prebiotic effect in the distal colon¹⁰⁻¹². Human intervention study data demonstrates that Litesse polydextrose enhances both bifidobacteria and lactobacilli in a dose-dependent manner with the effect being seen with a dose as low as 4g/day. A dossier of evidence has been submitted to EFSA under article 13 to support two claims for polydextrose at this efficacious daily dose of 4g. The first claim is specific to its role in improving bowel function and the second addresses its role as a prebiotic with regard to stimulating the growth of bifidobacteria in the colon and lactobacilli bacteria in the gut⁷.



Probiotics are most prevalent in dairy applications.



Emerging prebiotics

Examples of emerging prebiotics are xylo-oligosaccharides (XOS), isomalto-oligosaccharides (IMO) and soy-oligosaccharides (SOS). In addition, lactitol has been described as an emerging prebiotic. Preliminary studies show that lactitol has prebiotic effects in humans at an intake of 10g/day. However, further research is required to confirm its prebiotic properties, particularly at lower, practical dose levels⁹.

Food applications

Prebiotics are extremely versatile in that they not only exhibit proven efficacious health benefits but also deliver strong technical functionality. Prebiotics are living cells (microorganisms) that must remain viable at substantial levels throughout manufacture, over shelf life and in to the gastrointestinal tract. The nature of prebiotics means that they are relatively sensitive to processing conditions which ultimately restrict the number of food applications to which they can be added. Currently in the food market, they are most prevalent in dairy applications. Prebiotics are less sensitive to pH, temperature and water activity and therefore can be used in multiple food applications from dairy through to bakery, confectionery and beverage applications. Due to their chemical and physical structure, they tend to be highly soluble and have the ability to improve body, texture and mouthfeel. Inulin, for example, is suitable for use as a fat replacement in low-fat or

fat-free formulations¹³.

Polydextrose is also suitable for fat replacement. It is widely used as a fibre as well as a sugar replacer. It can be used to help reduce calories, sugar and lower glycaemic load in the finished product.

As the emerging prebiotics become established and consumer demand for functional products remains strong, it is reasonable to anticipate the prebiotic ingredient market will see steady growth. Prebiotics will naturally migrate into other food categories, such as cereal, bakery and confectionery applications, to meet the convenience-driven requirements of busy consumers. It looks to be a very healthy market to operate in. **FBA**

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