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gut reaction

Prebiotics

Confused by the number of products claiming to offer health benefits in the form of one kind of 'good' bacteria or another? Just as we become familiar with the term probiotics, we are now being urged to incorporate another type of bacteria into our diet – prebiotics.

Like probiotics, prebiotics are widely available both as supplements and in foods ranging from bread to chocolate. Sales are predicted to soar but are prebiotics more than just big business? What is the difference between a probiotic and a prebiotic, how do they affect gut function and, even if they are beneficial for our guts, can they really help IBS?

Common sense tells us that foods claiming to contain healthy bacteria but which are also high in sugar, such as chocolate spread, are probably best consumed occasionally rather than every day.

It is difficult to draw general conclusions when products vary so much, not only in general nutritional content but also in the amount of prebiotic they contain. Sometimes articles refer to the two together as if they were one and the same. Storage and shelf-life can also affect the product (see Jackie Holley's article on pg 6).

Guidelines from the National Institute for Clinical Excellence (NICE) are vague on the use of probiotics, and don't mention prebiotics. However, general advice would be to take prebiotics for at least one month and if there is no improvement in that time then discontinue their use.

It also appears that people who experience travellers' diarrhoea might gain some protection from taking prebiotics for a month before they travel and that those recovering from surgery or a course of antibiotics might also benefit.

In search of more informed guidance we sought the help of research scientist George Tzortzis, who has spent much of his career looking down a microscope, and he kindly supplied the accompanying article.

How 'good' gut bacteria

There is a growing body of evidence linking good gut bacteria, specifically bifidobacteria, with significant health benefits, including the alleviation of IBS symptoms. This article is the first part of a review of some of the latest research and explains what bifidobacteria are, how they can help regulate the digestive system and how you can help increase your levels of bifidobacteria by taking prebiotics, particularly the type of prebiotic known as galacto-oligosaccharides (GOS).

What are bifidobacteria and why are they important?

The human gut is packed with bacteria that play an important role in maintaining health and the normal functioning of the digestive and immune systems. Although there are over 1,000 species of bacteria in the human gut¹ (many it is believed have not yet been fully identified) most belong to just a few predominant species including Bifidobacterium, Bacteroides, Eubacterium, Clostridium and Streptococcus while subdominant species include Lactobacillus, Enterococcus and coliforms.²

For more than a century it has been known that common species including bifidobacteria, together with some Lactobacillus play a particularly important role in health. For example, as early as 1906, Tissier noted that children who had significant amounts of bifidobacteria in their bowel (as measured by levels in the stool) were much less likely to develop diarrhoea.³ In terms of health-related properties, bifidobacteria could be said to be the best of the good gut bacteria and their number and activity in the gut very much influence the functioning of both the digestive and immune system.⁴

In recent years, bifidobacteria, together with some Lactobacillus species, have been linked to specific health benefits including:

- Alleviation of IBS symptoms⁵
- Growth inhibition of pathogens associated with gastro-enteritis⁶
- Increased resistance to infection and diarrhoeal disease⁴
- Reduction of levels of pathogenic bacteria, including E.coli and Salmonella^{6,7}

- Potential protection against cancer⁸
- Stimulation and modulation of immune system activity⁴
- Production of cell energy that helps to keep the lining of the gut healthy. This acts as a shield, blocking antigens (toxins, pathogenic bacteria, viruses and foreign substances) from entering the body through the gut^{9, 10}

In short, a healthy gut consists of plenty of good bacteria. The gut bacteria balance can be upset however by internal and external factors including; stress, illness, recovery from surgery, poor diet, overseas travelling, ageing and antibiotics. When the 'good' gut bacteria levels are compromised and 'bad' or pathogenic bacteria can take hold, this can cause symptomatic problems including diarrhoea, constipation, bloating and IBS and can also increase susceptibility to other health problems due to lowered natural defences.¹¹

Increasing bifidobacteria with GOS prebiotics – what they are and how do they work?

Prebiotics are "non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or more bacterial species already resident in the colon".¹²

Simply put, they act as food for indigenous good gut bacteria, stimulating their growth and increasing their numbers. Prebiotics are different from the more widely known probiotics which are food supplements, often prepared yoghurt drinks, containing the same strain or several strains of live bacteria which add to the 'good' bacteria levels in the gut. The main advantages prebiotics have over probiotics is that they are non-digestible so reach the gut intact, are selectively fermented by the beneficial gut bacteria already present in the large intestine, stimulating their growth and consequently providing an arguably more efficient way of modulating the gut bacteria.

There are two main types of prebiotics proven to conform to the official prebiotic definition including: fructans (such as inulin and short chain fructo-oligosaccharides (sc-FOS)) and galacto-oligosaccharides (GOS). Studies looking at different types of oligosaccharides have shown that novel GOS have a greater bifidogenic effect (particularly stimulate the growth of bifidobacteria) compared to sc-FOS and inulin and therefore have more potential health benefits.^{13,14}

In addition, side effects associated with prebiotics including flatulence and a potential laxative effect at high doses are mostly linked to the fructans. Prebiotics occur naturally in food sources such as onions and bananas or in larger amounts as supplements (available to buy in high street pharmacies) usually in powdered form (see table). It is recommended that around 5g¹⁵ of prebiotics daily, in addition to a regular diet, is needed to boost bifidobacteria levels, therefore, when considering a supplement it is worth checking the amount of prebiotic it contains. Currently there is only robust data linking health benefits with novel GOS.

Key differences between commercially available prebiotics and probiotics

Prebiotics

- act as food for the good bacteria that naturally exist in the gut
- stimulate the growth and activity of good gut bacteria
- are non-digestible, remain intact through the digestive system
- achieve greatest effect providing good bacteria are already present in the gut (disease and antibiotic therapy can reduce their numbers)
- are guaranteed to reach and feed good bacteria naturally existing in the gut

Probiotics

- contain live bacteria that are not necessarily indigenous to the human gut
- replenish bacteria levels in the gut with external micro-organisms
- can be destroyed by digestion
- once in the gut, have to compete to find a place among established, colonised bacteria
- it is unclear what proportion of the live bacteria actually reach and colonise the gut

help manage IBS

PREBIOTIC SOURCES

Foods	Supplements
Asparagus	Inulin
Bananas	sc-FOS
Leeks	Floramax
Garlic	EliminEase
Onions	Bimuno 5,5g (novel GOS)

Research has shown that FOS and GOS can be used to selectively manipulate species composition of the gut microflora. The most recent GOS study, reported in the American Journal of Clinical Nutrition, assessed 59 healthy volunteers who were given a novel GOS, Bimuno, for a week.¹⁶ The research found that Bimuno, synthesised by enzymes from *Bifidobacterium bifidum*, exerted a bifidogenic effect (eg was more selective towards stimulating bifidobacteria) in a dose-response relation that was significantly greater than that of a placebo and another GOS prebiotic made from enzymes from *Bacillus circulans*.¹⁶ This research highlights that different prebiotic formulations have different properties and higher selectivity towards specific bacterial groups and most importantly species. Choose the right GOS to maximise the bifidogenic effect.

Bifidobacteria – evidence in Irritable Bowel Syndrome

Despite the wealth of evidence linking bifidobacteria to significant health benefits, there are only a handful of human studies focusing on the benefits of bifidobacteria in IBS. However, the results so far are very encouraging and more trials are being undertaken.

As GOS are a relatively new and improved concept compared to probiotics, the majority of published studies assessing the effect of bifidobacteria in IBS have been probiotic studies where the participants have ingested preparations containing live strains of *Lactobacillus* or *Bifidobacterium*. Research undertaken at the University College Cork, Ireland, reported in Gastroenterology included 77 participants with IBS randomized to take a *Lactobacillus* strain preparation, or *Bifidobacterium* strain in a malted milk drink, or the malted milk drink alone as placebo for 8 weeks.¹⁷ For all symptoms, with the exception of bowel movement frequency and consistency, those taking the bifidobacteria strain experienced a greater reduction in symptom scores for abdominal pain/discomfort, bloating/distention, and bowel movement difficulty. The authors concluded that the *Bifidobacterium* preparation alleviated symptoms in IBS.¹⁷

There have, however, also been studies researching the effects of a combination of probiotic and prebiotic preparations in IBS patients. Bittner et al reported significant reductions in general feelings of ill health and nausea, indigestion, flatulence and diarrhoea after a 14-day period.¹⁸

Most recently, the Dietetics Department at the Central Middlesex Hospital are heading up

interesting research among people with IBS which looks set to show for the first time that a second generation, novel GOS can significantly enhance bifidobacteria levels and effectively improve stool consistency.⁹ The study is also looking at possible symptom alleviation such as flatulence, bloating and anxiety with the potential of providing overall relief from IBS.⁹

Summary

It is an exciting time to be researching further the health benefits conferred by bifidobacteria and ways to best maximise their numbers in a natural way by feeding and energising them with GOS. As more human research is undertaken, particularly in IBS, it is becoming apparent that novel GOS prebiotics should be considered for people with digestive problems.

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The role of the gut beyond digestive function

We generally think of the gastrointestinal tract as an organ system devoted to the processing of food and absorption of vital nutrients and water. However, it has other important roles in addition to digestion.

Perhaps the most important to come to light in the past few decades is its central role in defending the body from infection. Protection against illness-causing antigens (toxins, pathogenic bacteria, viruses and foreign substances) is provided by a mechanism known as mucosal immunity (the mucosa being the tissue layer that lines the internal surface of the gut). Bacteria within the gut play an important part in mucosal immunity.

Within the gut there are billions of micro-organisms – bacteria, viruses and fungi, known collectively as the gut flora. The most common bacteria, such as *Bifidobacterium*, *Bacteroides*, *Eubacterium*, *Fusobacterium*, *Clostridium* and *Lactobacillus*, are organisms which generally live in harmony with the body and some, particularly bifidobacteria, are linked to significant health benefits.

However, there are also other bacteria, which include species such as the cocci (*Enterococcus*, *Staphylococcus* and *Streptococcus*), the enteric bacteria (*E.coli* and *Salmonella* spp.), *Clostridium difficile*, and the yeast *Candida* which are pathogenic bacteria and have the potential to cause infection and disease.

In addition, many food components, environmental particles and chemicals pass through the gut, from where they may be able to penetrate into the body and cause disease such as allergy.

Gastrointestinal mucosal immunity helps protect the body.

The largest organ of the whole immune system can be found within the walls of the gut, where it is continually exposed to a wide range of antigens.

This organ consists of a unique immune network, known as the Gut Associated Lymphoid Tissue or GALT. The GALT contains large clumps of lymphocytes which attack invading organisms and produce antibodies against them. As a result of this activity it has been estimated that the gut controls about 60% of the body's immune system.



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