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GALACTOOLIGOSACCHARIDES

WHAT ARE GALACTOOLIGOSACCHARIDES

Galactooligosaccharides (GOS) are a group of carbohydrates made up of a chain of galactose units. They are produced commercially from lactose using the enzyme beta-galactosidase (Bhatia, et al., 2015). GOS are similar in structure to oligosaccharides that occur naturally in human milk. Their unique chemical structure enables them to escape digestion by both salivary and intestinal enzymes, allowing them to pass undigested into the colon where they act as prebiotics, stimulating the growth and activity of beneficial bacteria (Bhatia, et al., 2015).

WHAT IS THE CLINICAL RELEVANCE OF GALACTOOLIGOSACCHARIDES

Clinically, GOS have been trialled for use in numerous conditions including constipation, diarrhoea, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), colon and rectal cancers, leaky gut and associated conditions such as asthma, eczema, allergic rhinitis, food allergies and mental health conditions (WebMD, 2018).

In the literature, GOS may also be referred to as transoligosaccharides (TOS) or trans-galactooligosaccharides (TGOS) (Bhatia, et al., 2015).

A number of clinical trials have found GOS to be beneficial in the treatment of gastrointestinal conditions such as constipation and IBS. The effect of GOS on patients with IBS appears to be similar to that found with supplementation of *Bifidobacteria spp*, with positive changes noted in stool consistency, flatulence, abdominal pain/discomfort, bloating/distension, bowel movement difficulty, as well as anxiety in diarrhoea predominant IBS (Silk, Davis, Vulevic, Tzorzis, & Gibsob, 2009). These improvements have been attributed to the bifidogenic effect, which has been demonstrated in various clinical trials using different concentrations of GOS (Silk, Davis, Vulevic, Tzorzis, & Gibsob, 2009) (Nittynen, Kajander, & Korpela, 2007).

GOS and other prebiotics, such as fructo-oligosaccharides and lactulose have been demonstrated to prevent bacterial colonisation and pathogen invasion of the gastrointestinal tract. GOS is similar in structure to cell surface glycoconjugates that are used by pathogens to adhere to the gastrointestinal wall. In addition, in vivo studies have shown GOS to directly modulate expression of goblet cell secretory products and golgi sulfotransferase which together form barrier-enhancing sulfomucins. Through its role in preventing and modulating gastrointestinal infection and inflammation, GOS may also assist in

preventing downstream consequences of leaky gut such as allergies, autoimmune diseases, mental health conditions and metabolic syndromes (Bhatia, et al., 2015).

Owing to its effects on the gastrointestinal tract, GOS supplementation has been shown to improve lactose tolerance in previously lactose intolerant individuals (Azcarate-Peril, et al., 2017) and to enhance nutrient absorption. Clinical trials have indicated GOS supplementation to have positive effects on calcium absorption (Whisner, et al., 2013), with animal models suggesting that a similar scenario may also be true for magnesium, iron and phosphorus (Maawia, Iqbal, Qamar, Rafiq, Ullah, & Ahmad, 2016).

GOS supplementation has been shown to reduce the severity of hyperpnoea-induced bronchoconstriction and the TH2 driven inflammatory response in asthmatic patients (Wilkiams, Johnson, Shaw, Spendlove, Vulveic, & Hunter, 2016). Some research on infants has also suggested GOS along with probiotic supplementation may reduce the risk of eczema development by 2 years (WebMD, 2018) (Kukkonen, et al., 2007).

Investigations on the effect of GOS supplementation on symptoms of stress and anxiety showed GOS reduced the salivary awakening cortisol response in students studying for university exams. Students receiving GOS supplementation also demonstrated a reduced anxiety response with exposure to threatening stimuli. The study authors likened this response to that seen with prescription medication such as citalopram (a selective serotonin reuptake inhibitor) and diazepam (a benzodiazepine) (Schmidt, Cowen, Harmer, Tzortis, Errington, & Burnet, 2015).

The increase in intestinal concentration of lactate and short chain fatty acids associated with GOS supplementation reduces faecal pH. This, along with other benefits of GOS including increased stool frequency and weight, decreased concentration of secondary bile acid lithocholic acid and reduced nitroreductase and beta glucoronidase activities suggest a potential role for GOS in colorectal cancer prevention (Bruno-Barcena & Azcarate-Peril, 2015).

It is now widely recognised that the gastrointestinal microbiota differs between normal weight and overweight individuals, with dysbiosis in overweight and obesity being accompanied by chronic low-grade inflammation. A study performed on 45 overweight adults with clinical signs and symptoms of metabolic syndrome showed microbial changes that occurred with GOS supplementation were accompanied by an increase in faecal secretory IgA and a decrease in faecal calprotectin, plasma C reactive protein, insulin, total cholesterol, triglycerides and the TC:HDL ratio (Vulevic, Tzortzis, & Gibson, 2013).

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GALACTOOLIGOSACCHARIDES

The dose of GOS used in these studies varied from around 3g per day to 15g per day. The interesting factor was that a higher dose did not necessarily confer a more beneficial outcome with higher doses carrying a higher risk of side effects such as flatulence. However, the research indicates that as the gastrointestinal microbiome adapts, side effects such as flatulence decrease significantly with most subsiding over approximately three weeks (Nittynen, Kajander, & Korpela, 2007).

The link between gastrointestinal dysbiosis and systemic disease is now widely established. Galactooligosaccharides have been found to have a bifidogenic effect with numerous beneficial downstream systemic effects.

All references used in this literature review have been uploaded to the Ariya Health resource library.

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