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MINI REVIEW

Galacto-oligosaccharides as functional foods and their properties

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Abstract

Galacto-oligosaccharides (GOS) are classified as prebiotics due to their indigestible nature. GOS are regarded as resistant to salivary digestion and are not utilized by the mouth. Thus, they can be utilized as substitutes for low-cariogenic sugar. The structure of GOS mixtures is determined by the differentiation between the transferase reaction and hydrolysis. Transgalactosylation can be achieved intramolecularly when the glycosidic bond in lactose cleaves and reassembles itself on another glucose molecule. Microbes can be used as a source for the β-galactosidase enzyme or as agents to produce GOS units. Commercial β-galactosidase enzymes likewise do have a great potential for their use in GOS synthesis. These transgalactosyl reactions could find useful applications in dairy. Since 70% of the world's population cannot tolerate lactose, lactose utilization could only be enhanced through hydrolysis into its components, the monomer sugars of D-glucose and D-galactose. GOS can be produced industrially using whey or lactose as the substrate. Trisaccharides (β1-4 or β1-6 galactosyllactose) are generally the major products of this process. In comparison with lactose and other saccharide molecules, GOS has been shown to have low carcinogenicity, low calorific value, and low sweetness. This review focuses on GOS production, and the physicochemical characteristics, physiological effects, and applications of these prebiotics are summarized.

1. Introduction

Galacto-oligosaccharides (GOS), also referred to as oligogalactosyllactose, oligo-galactose, oligo-lactose or transgalacto-oligosaccharide (TOS), are classified as prebiotics due to their indigestible nature. Prebiotics are defined as nondigestible dietary ingredients that have a beneficial effect on the host by boosting the viability and growth of useful bacteria in the colon. The stability of GOS enables them, in addition to their use in infant foods (Vandenplas *et al*., 2015), to be added to other foods such as beverages (fruit juices and acidic drinks), meal replacements, fermented and flavoured dairy products, and pastry products (Sangwan *et al*., 2011). GOS have a good taste, which may enhance the texture and mouth sensation in foods offering saccharose-like bulk properties. GOS are regarded as resistant to salivary digestion and are not utilized by the microbiota of the mouth. Thus, they can be utilized as substitutes for low-cariogenic sugar (Splechtna *et al*., 2006). Furthermore, research has shown that GOS offers multiple benefits, including enhancing immunity, improving mineral absorption, and supporting cardiovascular health. Functional oligosaccharides mainly refer to GOS, fructo-oligosaccharides, etc., which cannot be digested and absorbed by the body, but directly enter the intestinal tract to be utilized by *Bifidobacteria* (Ibrahem *et al.,*2022).

The purpose of this mini-review is, therefore, to analyze and summarize the functional properties and their applications in the food industry of Galacto-oligosaccharides as one of the ingredients possessing health value, prebiotic functions, and their linked possibilities of health promotion and mechanisms.

2. Transgalactosylation reaction

GOS is regarded as a combination blend of galactose -containing oligosaccharides delivered due to the transgalactosylation of a β-galactosidase as D-galactosyl moieties are carried onto the D-galactose component of lactose (Torres *et al*., 2010; Vera *et al*., 2011). There are three main steps in GOS synthesis: (i) hydrolysis, (ii) creation of an intermediary galactosyl-enzyme and (iii) synthesis of GOS (Díez-Municio *et al*., 2014). During

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