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Effects of konjac glucomannan and resistant starch on *in vitro* lipid digestion of non-dairy creamers

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Abstract

The effects of konjac glucomannan (KG) and resistant starch (RS) on *in vitro* lipid digestion were examined on two types of non-dairy creamers, produced from palm and soybean oils. KG and RS were added to both types of non-dairy creamers and the samples were analyzed for particle size distribution. Sample emulsions were examined for their lipid digestion using an in vitro digestion model (pH 7.0: 2.0: 5.3: 7.5). Creaming stability, microstructure and free fatty acids (FFAs) were also analyzed. It was found that KG and RS showed different behaviors in controlling lipid digestion, as evidenced by droplet flocculation, phase separation (cream forming) and microstructural changes. In the presence of KG, the emulsions exhibited appreciable droplet flocculation and/or coalescence, resulting in phase separation of the emulsions. In contrast, the samples with RS exhibited no appreciable creaming. All emulsions appeared homogeneous and milky white. The amount of FFAs released after the digestion of the samples with KG was found to be lower than those with RS. Therefore, KG could be more effective in altering lipid digestion of the non-dairy creamers. The information found in this study could be used to create food emulsions with low caloric value or to optimize diets for individuals with lipid digestion problems.

Introduction

The lipids in food may be consumed in a wide variety of different physical structures such as oils, bulk fats or emulsified fats. Nevertheless, most fatty foods are broken down into oil-in-water emulsions in the mouth during mastication and within the stomach and small intestine during the digestion process (McClements and Li, 2010). Consequently, lipid digestion within the gastrointestinal tract typically involves digestion of emulsified fats. Lipid digestion involves several sequential steps that include various physicochemical and biochemical events (Torcello-Gomez *et al.*, 2011). In humans, the digestion of dietary fat commences in the stomach and continues within the small intestine, whilst the absorption of fat digestion products occurs primarily within the small intestine (Mu and Høy, 2004).

Overconsumption of fat is a major contributing factor to obesity, cardiovascular disease and diabetes (Bray and Popkin, 1998; Khogare, 2012). For this reason, there has been considerable interest in the development of effective strategies to reduce the caloric content of foods, or to reduce the spike in blood lipids that occurs after consuming a fatty meal. Several studies have suggested that certain types of dietary fibers can inhibit the digestion and absorption of lipids (Beysseriat *et al.*, 2006; Edashige *et al.*, 2008; Yonekura and Nagao, 2009). Numerous physicochemical and physiological mechanisms may contribute to this effect, including the ability of dietary fibers to alter the rheology of the gastrointestinal fluids, bind digestive components (such as bile salts and digestive enzymes), alter the aggregation state of lipid droplets, form protective coatings around lipid droplets and to be fermented within the large intestine by colonic bacteria (McClements *et al.*, 2008; Grabitske and Slavin, 2009; Lattimer and Haub, 2010). This benefit of dietary fibers has been confirmed in a number of animal and human feeding studies (Lairon, 1996; Carter *et al.*, 1998; Jenkins *et al.*, 1998). Increased consumption of dietary fiber may, therefore, prove to be one method of reducing the effective caloric content of food products.

Dietary fiber, as a class of compounds, includes a mixture of plant carbohydrate polymers, both oligosaccharides and polysaccharides (e.g. cellulose, hemicelluloses, pectic substances, gums, resistant starch (RS), inulin), that may be associated with lignin and other non-carbohydrate components (e.g., polyphenols, waxes, saponins, cutin, phytates, resistant protein). Structurally, fiber can be sub-divided broadly into two forms, RS and non-starch polysaccharides (Elleuch *et al.*, 2011). In this study,

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