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ORIGINAL ARTICLE

Effect of inulin on the physicochemical properties, flow behavior and probiotic survival of frozen yogurt

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Abstract This study investigated the effect of inulin (0, 1 and 2 %), on some physicochemical properties of frozen yogurt, as well as its effect on flow behavior and probiotic survival. The results showed that the addition of inulin improved overrun, viscosity and melting properties significantly ($p<0.05$); when added at 2 % level, it also had significant effect on pH. Total acceptability of samples revealed that frozen yogurt with 2 % inulin had the most appealing sensory characteristics. The flow behavior of all samples showed their pseudoplastic nature; power law was the best model to predict their flow behavior. In terms of probiotic survival, the sample with 2 % inulin significantly improved the viability of *Lactobacillus acidophilus* and *Bifidobacterium lactis*.

Keywords Frozen yogurt · Inulin · Probiotic · Physicochemical properties · Flow behavior.

Introduction

Frozen yogurt is a complex fermented frozen dairy dessert that combines the physical characteristics of ice cream with the taste and nutritional properties of fermented milk products (Soukoulis and Tzia 2008). Consumers often choose to eat frozen yogurt because they expect that it contains less lactose than ice cream with a similar amount of fat, and provides health benefits from the viable bacteria contained in it (Marshall 2001).

Frozen yogurt supplemented with probiotics provides additional health benefits (Davidson et al. 2000). Probiotics play a major role in health and well being beyond basic nutrition (Vanaja et al. 2011). The frozen yogurt environment is not optimum for survival of bacteria (Davidson et al. 2000). Probiotic microorganisms in aerated and frozen products such as ice cream and frozen yogurt can be injured when subjected to oxygen and freezing temperature. Acidity of yogurt also can be a harmful factor for probiotic viability (Magarinos et al. 2007). The formation of ice crystals due to temperature fluctuations during storage may rupture bacterial cells and reduce viability (Davidson et al. 2000). Consequently, manufacturers are interested in developing a process that can provide high densities of robust probiotic strains in the product (Talwalkar and Kailasapathy 2004).

Inulin is a storage polymer derived from a number of plants. It consists of β-2 1-linked fructosyl unit with a terminal glucosyl unit (Paseephol et al. 2008). Inulin's water-binding and texturizing properties are well-known in the food industry (Kip et al. 2006). Soukoulis et al. (2009) reported that addition of fibers such as inulin, increased viscosity and shear thinning behavior significantly. In some studies inulin was used as a fat replacer in yog-ice cream (El-Nagar et al. 2002). Inulin and other prebiotics also have been used to increase the viability of probiotic bacteria (Akalin and Erisir 2008). The effect of inulin on the viability of probiotics in ice cream was studied (Akin et al. 2007; Akalin and Erisir 2008). They found that addition of inulin improved survival of probiotic in ice cream during storage. Dhewa et al. (2010) also eported that *Lactobacillus plantarum* exhibited the highest specific growth

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