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Reconstituted yogurt from yogurt cultured milk powder mix has better overall characteristics than reconstituted yogurt from commercial yogurt powder

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ABSTRACT

For manufacture of commercial yogurt powder, yogurt has to go through a drying process, which substantially lowers the yogurt culture counts, so the potential health benefits of the yogurt culture bacteria are reduced. Also, upon reconstitution, commercial yogurt powder does not taste like yogurt and has an off-flavor. The objective was to study the microbial, physicochemical, and sensory characteristics of reconstituted yogurt from yogurt cultured milk powder (YCMP) mix and reconstituted yogurt from commercial yogurt powder (CYP). The CYP reconstituted yogurt was the control and YCMP mix reconstituted yogurt was the treatment. Microbial and physicochemical characteristics of the CYP reconstituted yogurt and YCMP mix reconstituted yogurt were analyzed daily for the first week and then weekly for a period of 8 wk. Sensory consumer testing of CYP reconstituted yogurt and YCMP mix reconstituted yogurt was conducted with 100 consumers. At 56 d, YCMP mix reconstituted yogurt had 5 log cfu/mL higher counts of *Streptococcus thermophilus* than the control (CYP reconstituted yogurt). Also, *Lactobacillus bulgaricus* counts of YCMP mix reconstituted yogurt were 6.55 log cfu/mL at 28 d and were 5.35 log cfu/mL at 56 d, whereas the CYP reconstituted yogurt from 28 d onwards had a count of <10 cfu/mL. The YCMP mix reconstituted yogurt also had significantly higher apparent viscosity and sensory scores for appearance, color, aroma, taste, thickness, overall liking, consumer acceptability, and purchase intent than CYP reconstituted yogurt. Overall, YCMP mix reconstituted yogurt had more desirable characteristics than CYP reconstituted yogurt.
Key words: yogurt, powder, reconstituted

INTRODUCTION

According to the Code of Federal Regulations (21 CFR 131.200), yogurt is the food produced by culturing cream, milk, partially skim milk, or skim milk, used alone or in combination, with lactic acid-producing bacteria *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus*. Yogurt has a titratable acidity (**TA**) of not less than 0.9%, expressed as lactic acid (21 CFR 131.200). The yogurt market has grown considerably since 2003. Yogurt sales and consumption have increased in the last 5 yr (IDFA 2009, 2010, 2011, 2012, 2013). Generally, the recommended total number of active yogurt culture bacteria at the time of consumption should be a minimum of 10^7 cfu/g (Chandan, 1999). To confer health benefits, probiotic bacteria should be viable at the time of consumption at a recommended concentration of 6 to 8 log cfu/g (Ross et al., 2005; Vasiljevic and Shah, 2008).

Many potential health and nutritional benefits from lactic acid bacteria exist. These include improved digestion of lactose and control of intestinal infections, some types of cancer, and serum cholesterol levels (Gilliland, 1990). Some *L. delbrueckii* ssp. *bulgaricus* strains have immunological effects (Ebina et al., 1995; Kitazawa et al., 1998; Kitazawa et al., 2003). Certain strains of *S. thermophilus* produce bacteriocins. Some studies have characterized several bacteriocins (e.g., thermophilin 110 and thermophilin 1277) produced by *S. thermophilus* that are active against *Pediococcus acidilactici*, *Clostridium butylicum*, *Clostridium sporogenes*, *Clostridium botulinum*, *Bacillus cereus*, and *Listeria monocytogenes* (Gilbreth and Somkuti, 2005; Kabuki et al., 2009). To improve the health benefits, the recent trend is to add *Lactobacillus acidophilus* to yogurt (Ashraf and Shah, 2011). *Lactobacillus acidophilus* may prevent diarrhea in children and adults, and it is especially effective in treating rotavirus in children (Lee et al., 2001; Allen et al., 2009). Other health benefits associated with *L. acidophilus* include anticarcinogenic properties, reduction in blood pressure and serum cholesterol concentration, and increased resistance to infectious diseases (Ashraf and Shah, 2011).

Generally, yogurt is dried by spray drying, microwave vacuum drying, or freeze-drying. Each drying method has its benefits and drawbacks. Survival of yogurt bacteria is affected by the outlet temperature in the spray drying process. According to Bielecka and Majkowska

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(2000), the best survival at an outlet temperature range of 70 to 75°C was 13.7 to 15.8% for *L. delbrueckii* ssp. *bulgaricus* and 51.6 to 54.7% for *S. thermophilus*. At temperatures below 60°C, wet powder was obtained, whereas at above 90°C, the powder was not acceptable due to browning (Kim and Bhowmik, 1990). In addition, it has been reported that most of the aroma compounds and rheological characteristics of yogurt are lost during the spray-drying process (Kumar and Mishra, 2004). The approximate survival of culture bacteria was 50% in microwave vacuum-dried yogurt below 45°C (Kim et al., 1997). Freeze-dried yogurt has the best flavor and is the more authentic product compared with those obtained using other conventional drying methods (Rybka and Kailasapathy, 1997). The survival of lactic acid bacteria in freeze-dried yogurt was only 50 to 60% (Radaeva et al., 1975). Freeze-drying is the most expensive form of drying and generally not commercially feasible for manufacturing large quantities of yogurt powder.

Yogurt powder can be used in a wide variety of food applications, including instant yogurt and replacement of fresh yogurt for beverage and dip. It can also be used in snacks, confections, bakery items and breakfast cereals, ice cream bars, and yogurt-coated nuts. Upon reconstitution, yogurt powder does not taste like yogurt; it is off-flavored. However, yogurt powder provides longer and more stable shelf life than that of regular yogurt. Moreover, the reduced weight and bulk water of this dehydrated product decreases packaging, handling, and transportation costs. This product is very convenient for consumers to use, as it can be stored at ambient temperature for a long shelf life. Internationally, consumers do not always have access to purchasing natural yogurt in supermarkets. A powdered version can also be shipped to natural calamity areas or for food aid to less-fortunate countries. Other than providing nutrition, a food product also providing convenience in storage and consumption would be an added advantage. For a reconstituted yogurt, consumers would just need to add the powder to water and stir to mix well. The yogurt and yogurt drink market has benefited greatly as consumers have paid greater attention to healthy eating. In the food industry, it is important to produce a high-quality food product with a low cost. Upon reconstitution, having a better quality product than is currently available is desirable and would be beneficial to both the food industry and consumers. Further study on the parameters of this kind of reconstituted yogurt is also valuable. Industry manufactures and sells milk powder but preparation of reconstituted milk is an application at the consumer/household end. This is also true for other industries, such as the vegetable juice powder and fruit juice powder industries. This same concept is being applied here to yogurt cultured milk powder (**YCMP**) mix, which can be a future industry endeavor, and reconstituted yogurt can be the application at the consumer end for convenience in storage and consumption.

The purpose of this study was to determine whether reconstituted YCMP mix would have higher culture bacterial counts and better physicochemical and sensory characteristics than reconstituted commercial yogurt powder (**CYP**) currently available. The specific objectives of this study were to (1) enumerate *S. thermophilus*, *L. delbrueckii* ssp. *bulgaricus*, *Escherichia coli*/coliforms, and yeasts and molds of reconstituted CYP and reconstituted YCMP mix up to 8 wk; (2) elucidate the influence on the physicochemical characteristics (pH, TA, color, and apparent viscosity) of reconstituted CYP and YCMP mix up to 8 wk; and (3) study the sensory characteristics of CYP, YCMP mix, and YCMP mix with *L. acidophilus* (**YCMPA**) upon reconstitution and determine the consumer acceptability of the product.

MATERIALS AND METHODS

Reconstituted Yogurt Manufacture

Reconstituted yogurt formulations are shown in Table 1. The CYP was whey and nonfat milk mixed together, cultured, and spray dried to obtain the nonfat yogurt powder (DairiConcepts LP, Springfield, MO).

Commercial yogurt powder reconstituted yogurt was manufactured with nonfat yogurt powder (DairiConcepts LP), water, and blueberry puree (Sensient Tech-

Table 1. Reconstituted commercial yogurt powder (CYP) and reconstituted yogurt-cultured milk powder mix (YCMP) formulations

	Formulation	
Ingredient	CYP, g	YCMP mix, g
Commercial yogurt powder	948.4	0
Nonfat dry milk	0	810
Water	2,700	2,700
Blueberry puree[1]	720	720
Citric acid[2]	0	23.4
Pectin[3]	0	72
Yogurt starter culture[3]	0	43

[1]Sensient Technologies Corp. (Milwaukee, WI).

[2]Anhydrous, coarse granular 14 to 30 mesh (Sungai Budi Group, Jakarta Selatan, Indonesia).

[3]Low-methoxyl pectin (Gum Technology Inc., Tucson, AZ).

[4]A blend at a 1:1 ratio of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* (FD-DVS YC-380; Chr. Hansen Inc., Milwaukee, WI).