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Invited review: Sugar reduction in dairy products

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ABSTRACT

Sugar overconsumption continues to increase worldwide and contributes to multiple health-related issues. Dairy foods represent a large market, grossing more than \$125 billion per year worldwide. Consumer demands for healthier products are leading to a large push for sugar reduction in dairy foods. Sugar plays an important role in dairy foods, not only in flavor but also in texture, color, and viscosity. Replacing sugar can have negative effects, making substitution inherently difficult. Natural and artificial nonnutritive sweeteners exist for sugar reduction. Natural nonnutritive sweeteners are popular, particularly for label appeal, but many consumers still prefer the taste of artificial nonnutritive sweeteners. Sweet taste perception can also be affected by texture of the food matrix and the presence of fat. Other sugar reduction techniques include hydrolysis of lactose, ultrafiltration, and direct reduction. This review will address the role of sugar, alternative sweeteners, and sugar reduction in ice cream, yogurt, and flavored milk.

Key words: sugar reduction, dairy food, sweetener

INTRODUCTION

Humans are born with an innate preference for sweet taste (Behrens et al., 2011). Infant studies have shown that the sweeter a beverage is the more babies will consume of it (Ganchrow et al., 1983; Yebra-Biurrun, 2005). Sugar increases the perceived pleasure of eating and if removing sugar causes a negative impact on product sales through lower consumption, companies will not be motivated to invest in decreasing sugar content unless positive solutions are developed (Yebra-Biurrun, 2005). Furthermore, consumers who tend to consume more sugar-sweetened beverages have a higher affinity for sweet taste, which further encourages companies to add more sugar into products until it reaches the consumer “bliss point” (Mahar and Duizer, 2007; Moss,

2013). Moss (2013) defines the bliss point as the precise amount of sugar that will send consumers “over the moon” for the product, addicting them to the product and causing them to overeat. However, overconsumption of sugar can contribute to a host of issues such as hypertension, type 2 diabetes, cardiovascular disease, and dental cavities (WHO, 2003; Grembecka, 2015). Daily sugar consumption is close to 500 kcal per day worldwide, whereas the recommended daily intake of sugar for a normal weight individual is about 25 g or 96 kcal per day (Lustig et al., 2012; Mann et al., 2013; WHO, 2017). The Centers for Disease Control and Prevention report that an estimated 36% of adults over the age of 20 and 17% of children and adolescents from 2 to 19 yr are obese (Jeong et al., 2014). The World Health Organization (WHO, 2003) suggested that sugar should make up only 10% or less of total dietary energy consumption, but on average, sugar contributes much more. In the United States, a simple reduction in the consumption of added sugar is projected to potentially prevent 2.4 million cases of diabetes, 8,000 strokes, and 26,000 premature deaths per year (Wang et al., 2012; Mekonnen et al., 2013). Although sugar is not the sole cause of the obesity epidemic, it is a major contributor (Pruthi, 2015).

The prevalence and increase of numerous diseases has continued to spark consumer interest in reducing sugar in dairy and other food products. Sugar-sweetened beverages, such as flavored milk, soda, sport drinks, and sweetened tea, are the highest contributors to added sugar in American diets; in 2009, 13.8 billion gallons of sugar-sweetened beverages were consumed (Wang et al., 2012). “Added sugar” refers to sugar added to food before consumption, during preparation, or during processing to enhance flavor or texture of foods, as opposed to the sugar inherently present in a food (Anton et al., 2010; Yoo et al., 2017). Added sugar and sugar naturally present in food do not differ chemically, but there is a large health concern about added sugar due to the addition of unnecessary calories (Edwards et al., 2016).

Over the past 2 decades, consumer focus on health has increased, leading to a significant push for healthier

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food choices (Thompson and Moughan, 2008; Chen, 2011; Küster and Vila, 2017). In general, consumers have a basic understanding of nutrition in regards to sugar but what differentiates a healthy consumer from an unhealthy consumer is how they use their nutritional knowledge to make food choices (Yeon and Lee, 2016). Many parents desire reduced-sugar products for their children, and current studies emphasize the importance of developing healthy eating habits at a young age (Chan et al., 2011; Byrd-Bredbenner et al., 2016). Sigman-Grant and Hsieh (2005) found that consumers who selected reduced-sugar versions or a combination of reduced-sugar and full-sugar products in general had more favorable diets. All socioeconomic levels of consumers can achieve healthier dietary practices by simply switching from a full-sugar food product to similarly priced reduced-sugar product. Food and dairy companies should offer consumers healthy alternatives that could help reduce sugar consumption (Küster and Vila, 2017). This review will investigate sugar alternatives and sugar reduction techniques in dairy foods.

WHY IS THE DAIRY INDUSTRY INTERESTED IN SUGAR REDUCTION?

Health Benefits

Dairy foods are popular in consumer food choices and sales gross more than \$125 billion per year (IDFA, 2017). With dairy product popularity comes new demands from consumers for healthier, low-calorie products that taste the same as their higher calorie counterparts. Dairy products such as yogurt, chocolate milk, custards, shakes, and ice cream are potentially high in unwanted added sugar. Some of the standard processes for developing healthier food products, such as fat, sugar, and salt reduction, produce unacceptable flavor in dairy products (Biguzzi et al., 2014). The dilemma of how to reduce sugar content without sacrificing flavor and negatively affecting product sales is challenging. Various methods exist for reducing sugar to improve the healthiness of dairy products without losing flavor, include direct reduction, sugar substitution, ultrafiltration, lactose hydrolysis, and many others, which will be addressed in this review.

Regulatory Perspective

To protect consumers from falsely advertised foods, sugar and sugar-free terms are regulated by the US Food and Drug Administration (FDA) in 21CFR101 (<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=101>). When a food is

labeled “sugar-free,” the claim indicates that the food contains no sugars or sweeteners and the food should be low in calories or significantly reduced in calories. The term “no sugar added” is reserved for foods that have no amount of sugar added and do not contain any ingredient with sugar added, such as jam or fruit juice concentrate. In the Nutrition Facts and Supplement Facts label new rule, added sugar will be declared separately from sugar naturally present in the food item (FDA, 2016a). For example, if the food has 12 g of sugar but 10 g comes from added sugar, that will be declared under the new label regulations. The compliance date for this new rule is currently July 2018 for companies with \$10 million or more in sales, and July 2019 for companies making less than \$10 million. Recently, the FDA proposed a rule to extend the Nutrition Facts and Supplement Facts label final deadline to January 2020 for large companies and January 2021 for smaller companies, but the proposal is still pending at this time (FDA, 2016a). Goldfein and Slavin (2015) point out that this new labeling regulation will create additional cost for ingredient and food manufacturers that will eventually be passed onto consumers. Additionally, Goldfein and Slavin (2015) pointed out that the new labeling will make added sugar “the enemy” to consumers, when it is not the sole cause of obesity.

“Reduced sugar” can be used to describe foods that contain at least 25% less sugar than the reference amount. In general, consumers prefer the “no sugar added” claim to the “reduced sugar” claim, most likely because they assume that other ingredients are added in place of sugar in the latter (Patterson et al., 2012). “Reference amount” refers to the specific amount of that food customarily consumed per eating occasion (21CFR101.12; <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.12>). For example, when a chocolate milk is labeled “reduced sugar,” consumers can know that the milk contains at least 25% less sugar than the original product at the same reference amount (240 mL or 8 fl. oz.).

SWEETENERS

Role of Sweeteners

Sugar has many roles in foods; it not only makes foods more palatable but is also a bulking agent, adds viscosity, enhances flavor, provides texture, adds color, is a preservative, and inhibits protein coagulation (Davis, 1995; Silcock, 2017). Sugar acts as a bulking agent for many foods. When sugar is replaced or reduced, another bulking agent, such as insoluble fiber or polydextrose system, often must take its place (Silcock,

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