Online Exclusive: HFCS: More Than Just a Sweetener

By John S. White, Ph.D., Contributing Editor

Recent discussions among food and beverage manufacturers about high-fructose corn syrup (HFCS) have focused largely on consumer misperceptions of this ingredient, including the misunderstanding that HFCS is somehow metabolized differently from table sugar (sucrose). In fact, there is medical and scientific consensus that HFCS is safe, and calorically and nutritionally the same as table sugar. Recent national consumer surveys demonstrate that HFCS is not a top of mind issue for American shoppers.

Beyond the nutritional value of HFCS and table sugar, however, such discussions also tend to distract manufacturers from many of the benefits that have made HFCS a widely used ingredient for more than 30 years. These benefits include both functional and cost advantages that can make HFCS an excellent choice for a wide variety of products, including baked goods, beverages and dairy products—advantages that reach beyond the simple function of sweetening.

Moisture retention delays staling and molding. In baked goods, one of the primary advantages of HFCS is derived from the hygroscopicity (ability to attract moisture) and humectancy (ability to retain moisture) of its monosaccharide fructose component. Fructose is quicker to absorb moisture and slower to release it than sucrose, a disaccharide in which fructose is connected to glucose by a covalent bond. The superior moisture retention of fructose is useful in high-fiber, low-moisture foods like bran cereal and granola bars. In addition, this moisture retention leads to delays in both staling and molding, resulting in longer shelf life for breads and other products formulated with HFCS.

Golden brown crusts and glazes. Because the fructose in HFCS is a monosaccharide, it is better suited than the bonded fructose in sucrose (disaccharide) to express its functionality as a reducing sugar in the Maillard series of browning reactions. These reactions result in the browning of breads and cakes, the glazing on prepared meats such as hams, and the aromas and flavors that make these foods so appealing. In sucrose, the reducing end of the fructose molecule is tied up in the bond to glucose, and this reducing character is not expressed.

Softer baked goods. Fructose has higher solubility than sucrose. It is therefore more difficult to crystallize during the baking process. For example, when cookie dough sweetened with HFCS is baked, the glucose and fructose components remain in molten, amorphous form rather than crystallizing, which results in a softer, moister cookie. This characteristic is a key reason why soft cookies were introduced to the marketplace in the 1970s and ’80s, creating a new category for baked goods.

Manufacturers whose products require sugar crystallization (e.g., ginger snaps or other crisp cookies) find sucrose to be a more appropriate sweetener choice.

Enhanced fruit and spice flavors. The sweetness of fructose is perceived differently from that of sucrose in some uses. With fructose, sweetness can be perceived sooner and more intensely, and the perception fades more quickly. The sweetness of glucose is perceived between that of fructose and sucrose. Fruit flavors tend to develop and fade on the palate under the sweetness intensity/duration curve of sucrose and are somewhat masked by this sweetener.

The result of combining the different sweetness perception profiles of fructose and glucose in HFCS is that, when using the same amount of fruit flavor in a product, the perception (and enjoyment) of that flavor is greater with HFCS than with sucrose. Similarly, HFCS provides an enhanced flavor perception when used with spices such as cinnamon.

Improved effectiveness of yeast. A more subtle use of the fructose in HFCS can be to facilitate fermentation in products that rely on yeast, such as breads and yogurts. The microorganisms need an energy source in order to grow, and the monosaccharides fructose and glucose in HFCS provide a better substrate for the yeast fermentation than does sucrose.

Usefulness in controlling the freezing point of products. As mentioned earlier, fructose is highly soluble, which influences its colligative properties (chemical properties that depend on the mass [and concentrations] of a molecule in solution), including depression of a product's freezing point. An ice cream manufacturer, for example, may want to produce both a hard-pack product with a higher freezing point and a soft-serve product with a lower freezing point. One option to achieve the proper characteristics for each is to control the balance of sugars in the ice cream, mixing different proportions of monosaccharides (as in HFCS), disaccharides (sucrose) and larger-polymer carbohydrates such as corn syrup. With each blend, the manufacturer could achieve the freezing point needed for each product's production machinery, freezing equipment, storage, transport and end use.

Direct and indirect cost saving. The direct cost of HFCS has long been one of its major advantages, with prices historically 20% to 30% lower than sucrose. Recently, however, that advantage has been even greater.

In addition, the cost of handling and processing sucrose can be substantially higher than with HFCS. Dry sugar is shipped in bags that must be unloaded from a truck or railcar, transferred to storage and then to the production area, all of which require labor. The bags must then be opened and the sugar transferred to a dilution/makeup tank for processing. Automated handling of the crystalline sugar may require sophisticated, abrasion-resistant blowers and piping. Dilution requires water, heat and agitation—and their corresponding costs.

HFCS is predissolved and can be transferred automatically from truck or railcar to storage and production using pumps. More stable than liquid sugar, HFCS can be stored longer, and compliance with sanitation requirements, such as tank and pipe sterilization and warehouse pest control, is simpler and thus less costly.

As with the functional properties discussed earlier (i.e., moisture retention, Maillard browning reaction, reduced crystallization, fermentation and controlling the freezing point), the cost and handling

advantages of HFCS demonstrate the wide variety of ways a food or beverage manufacturer can use HFCS to maximize both productivity and product quality while still enjoying cost savings. These advantages make HFCS much more than just a sweetener.

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