Chapter 8
Sugar and Other Sweeteners

How Baking Works

Words, Phrases, and Concepts

- Monosaccharide
- Disaccharide
- Higher saccharide
- Polysaccharide
- Sugar crystal
- Boiled confections
- Hygroscopic
- Refiners’ syrup
- Syrup
- Inversion
- Water activity
- Doctoring/interfering agent

Sweeteners

Many sweeteners available.

- Dry sugars.
- Syrups.
- Specialty sweeteners.

Sweeteners vary in sweetness and other functions.

Successful bakers and pastry chefs:

- Know the features of each sweetener.
- Know how to substitute one for another.

Sweeteners

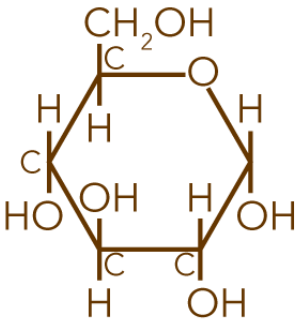
Sugars

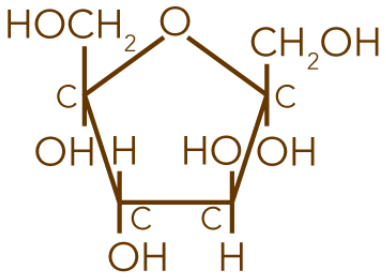
- "Sugar" refers to regular granulated sugar; sucrose.
- Other sugars: fructose, glucose, maltose, lactose.
  - Available as dry sugars but typically purchased in syrup form.
- All sugars are carbohydrates.
  - Molecules made up of carbon (C), hydrogen (H), and oxygen (O) atoms.

Sweeteners

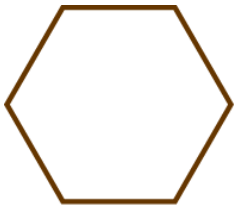
Sugars

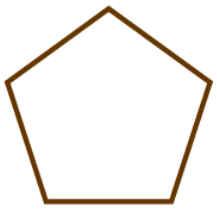
- Some sugars are monosaccharides.
  - Contain one (mono) sugar unit (saccharide).





Glucose *Fructose*



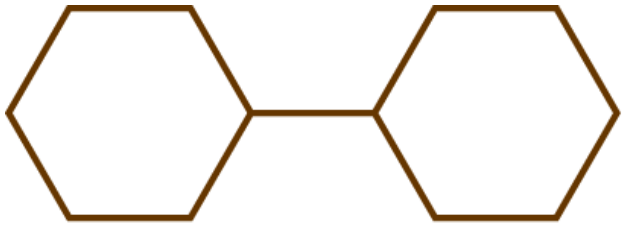


Glucose *Fructose*

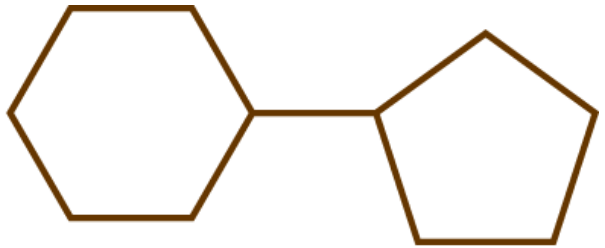
Sweeteners

Sugars

- Other sugars are disaccharides.
  - Contain two (di) sugar units bonded together.



Maltose

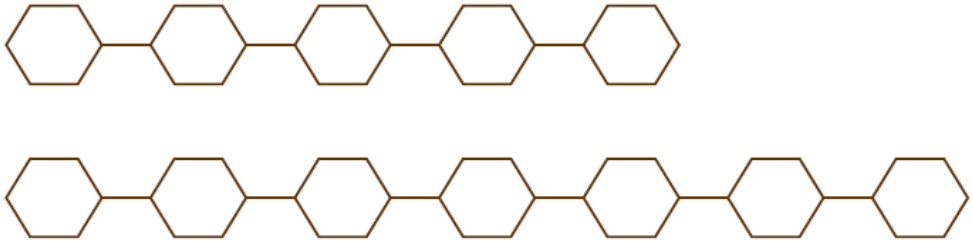


Sucrose

Sweeteners

Some carbohydrates, while not sugars, are made of sugars bonded together.

- Oligosaccharides/higher saccharides
  - About 3-10 sugar units bonded together.
  - Present in many syrups.



- Polysaccharides
  - Made of many (poly) sugar units bonded together.

    Example: starch

Sweeteners

Sugar crystals:

- Are highly ordered arrangements of sugar molecules bonded together.
- Are pure; for example:
  - Sucrose molecules bond to form sucrose crystals.
  - Fructose molecules bond to form fructose crystals.
- Are white, unless molasses or other “impurities” are trapped between crystals.
- Are difficult to form or to grow large when more than one sugar is present.
  - One way to minimize crystal growth in confections is to include a mix of different sugars in a formula.

Sweeteners

Sugar crystal growth:

- Is important to control when making *boiled confections*, made by dissolving sugar in water, then boiling to concentrate.
- Sometimes:
  - Large crystals are desired.

    Example: rock candy.
  - Small, uniform crystals are desired.

    Examples: icings and many crystalline boiled confections, including fondant and fudge.
  - No crystals are desired.

    Examples: noncrystalline boiled confections, including nut brittle, caramel; also, poured, spun, and pulled sugar.

Sweeteners

Sugars are hygroscopic.

- They attract and bond to water, pulling water from proteins, starches, and gums.
  - This thins out batters and doughs.

Sweeteners

- Sugars and other carbohydrates vary in their hygroscopic nature.
  - Fructose is highly hygroscopic.
  - Isomalt is not very hygroscopic.

- Hygroscopic nature of sugar and other carbohydrates:
  - Is sometimes desirable.

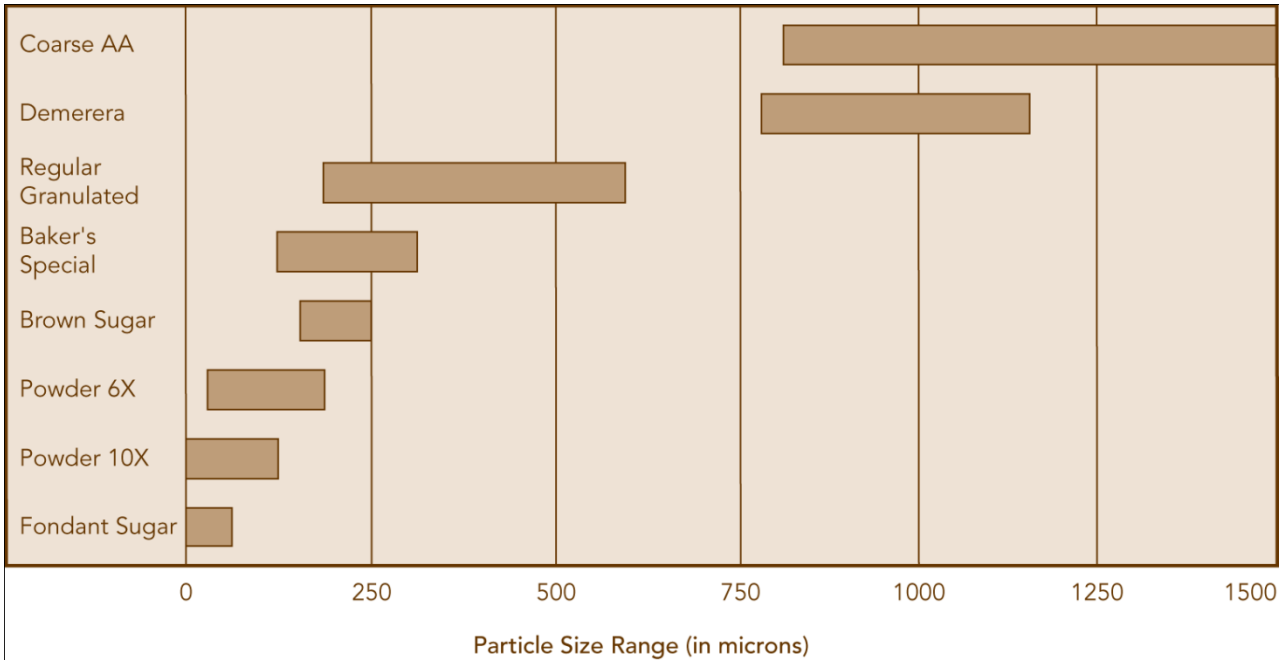
    examples: soft cookies, icings.
  - Is sometime undesirable.

    examples: powdered sugar on doughnuts; spun or pulled sugar.

Dry Crystalline Sugars

Dry crystalline sugars (sucrose) vary in:

- Added ingredients.
  - Molasses, refiners' syrup, cornstarch, carnauba wax.
- Particle size.



Dry Crystalline Sugars

Regular granulated sugar

- Extracted from sugarcane or sugar beets.
- Processing involves two basic steps:
  - Milling: extraction of inedible raw sugar from sugarcane or sugar beets.
    - Molasses is a by-product.
  - Refining: removal of impurities from raw sugar.
    - Refiners' syrup is a by-product.
- Greater than 99.9 percent pure sucrose.
  - Impurities can cause undesirable crystallization and browning in boiled confections; to prevent: add acid.

Dry Crystalline Sugars

- Regular granulated sugar
  - Semi-refined granulated sugar available.
    - Less refined than regular granulated.
    - A specialty sweetener; more expensive.
    - Retains small amount (less than 2 percent) of refiners' syrup.
      - Pale blond or gold in color.
    - Functions like regular granulated sugar in baking.
    - Goes by many names, including first crystallization sugar, dried cane syrup, unrefined milled sugar, natural cane juice crystals.
    - Available as certified organic.

Dry Crystalline Sugars

Coarse sugar

- Also called: sanding sugar, confectioners AA (Con AA).
- Large, glistening crystals.
- Often >99.98 percent pure sucrose; Expensive.
- May contain carnauba wax, for added sheen.
- Uses: garnishing baked goods; also, clear syrups and white boiled confections.

Dry Crystalline Sugars

Powdered sugar

- Also called confectioners' sugar; icing sugar in Canada.
- Made from sugar finely pulverized into powder.
- Contains 3 percent added cornstarch, to prevent caking.
  - Adds a raw starch taste.
- Available in different degrees of fineness.
  - The higher the number, the greater the fineness.

    Examples: 6X and 10X.
- Uses: uncooked icings, decorative dusting on desserts, stiffened meringues and whipped cream.

Dry Crystalline Sugars

Fondant and icing sugars

- Smallest grain size of any sugar (< 45 microns).
  - Smoothest mouthfeel.
- No added cornstarch.
  - Special additives or special process prevents caking.
  - No raw starch taste.
- Uses: uncooked fondant, glazes, cream centers (pralines).
- Examples: Easy Fond and Drifond.

Dry Crystalline Sugars

Superfine granulated

- Smaller than regular granulated sugar, larger than powdered sugar.
- Also called ultrafine.
- Similar in granulation to baker's, bar, caster, and fruit sugars.
- Uses: cakes (for uniform crumb), cookies (increased spread), meringue (reduced beading).

Dry Crystalline Sugars

Regular (soft) brown sugar

- Regular granulated sugar with a small amount (less than 10 percent) of molasses or refiner's syrup.
  - Sometimes contains caramel color, for darker appearance.
- Soft, sticky, tends to clump.
- Flavor and color of brown sugar can vary even as the amount of molasses stays the same.

  Examples: light brown sugar, dark brown sugar.

Dry Crystalline Sugars

Regular (soft) brown sugar (cont.)

- Made one of two ways:
  - Semi-refined cane sugar dissolved in molasses and recrystallized into brown sugar.
  - Cane molasses “painted” onto refined beet sugar.
- Uses: For color and flavor; use in place of regular granulated sugar, pound for pound.
- Can substitute about 1 pound (1 kilogram) molasses and 9 pounds (9 kilograms) sugar for every 10 pounds (10 kilograms).

Dry Crystalline Sugars

Specialty brown sugars

- Muscovado: A soft, moist brown sugar.
  - Dark muscovado is dark, rich, and fruity tasting; high in molasses.
  - Light muscovado also available.

Brown sugar. **Clockwise from top:** regular light brown, dark muscovado, Demerara, and Sucanat

Dry Crystalline Sugars

Specialty brown sugars

- Sucanat: Short for SUgar CAne NATural
  - Free-flowing, unrefined brown sugar.
  - Large porous granules, not crystals.
  - Made directly by concentration sugar cane “juice”.

Brown sugar. **Clockwise from top:** regular light brown, dark muscovado, Demerara, and Sucanat

Dry Crystalline Sugars

Specialty brown sugars

- Turbinado: Large, dry, free-flowing crystals.
  - Similar to light brown sugar in taste and color.
  - Semi-refined; sometimes deceptively called raw, washed raw, or unrefined sugar.
- Demerera: Little to no difference from turbinado.

Brown sugar. **Clockwise from top:** regular light brown, dark muscovado, Demerara, and Sucanat

Syrups

Syrups are mixtures of:

- One or more sugars.
- Water.
  - Amount varies, but often 20 percent.
- Acids.
  - Lower pH helps prevent growth of microorganisms.
  - Can react with baking soda; produces carbon dioxide for leavening.
- Higher saccharides (oligosaccharides).
  - For thickening.
- Small amounts of additional components that provide color and flavor.
  - Often, the darker the color, the less refined; may contain small amounts of vitamins, minerals, antioxidants.

Syrups

Amount of sugar in syrups can be measured using:

- Hydrometers

- Refractometers

Syrups

Syrups sometimes are interchangeable.

– More likely, one syrup excels over others at a particular function, because of its makeup.

TABLE 8.1 COMPOSITION OF COMMON SWEETENERS (%)

SWEETENER	TOTAL SOLIDS	SUCROSE	FRUCTOSE	GLUCOSE	MALTOSE	HIGHER SACCHARIDES
Brown sugar, light	96	95	2	3	0	0
Brown sugar, dark	96	95	2	3	0	0
Maple syrup	67	90	5	5	0	0
Molasses, premium	80	54	23	23	0	0
Invert, medium	77	50	25	25	0	0
HFCS-42	77	0	42	50	2	6
Invert, full	77	6	47	47	0	0
Honey	83	2	47	38	8	5
Agave syrup	71	0	80	14	0	6
Glucose syrup, low-conversion	80	0	0	7	45	48
Glucose syrup, high-conversion	82	0	0	37	32	31
Malt syrup	78	0	0	3	77	20

Syrups

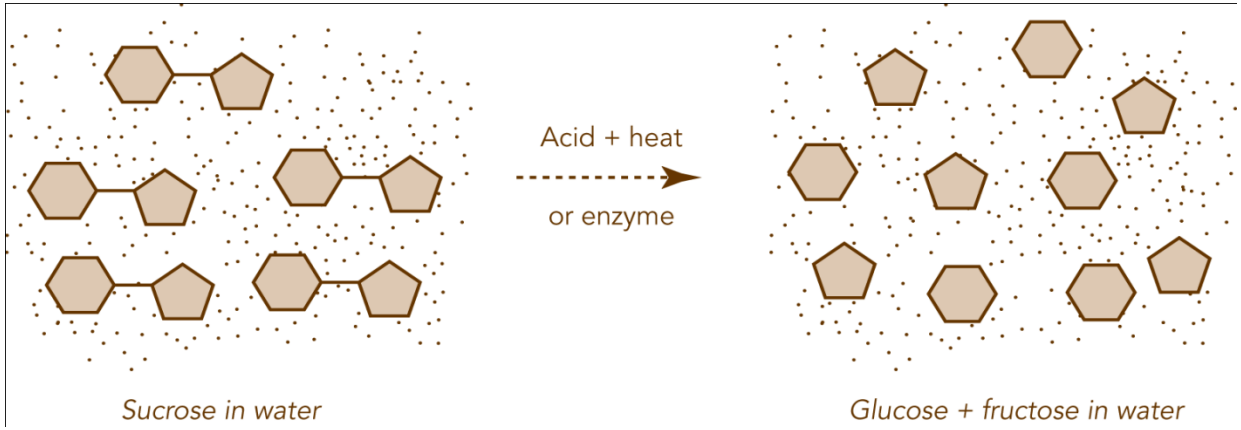
Simple syrup

- Sugar and water, heated to dissolve.
- Often, equal parts sugar and water.
- Small amount of lemon juice or sliced lemon added.
  - Prevents darkening, crystallization, growth of microorganisms.
- Uses: Moistening cake layers, glazing fruit, poaching fruit, preparing sorbets.

Syrups

Invert syrup

- Also called invert sugar, or simply “invert.”
- Clear, light-colored liquid or thicker opaque cream.
- Made from the hydrolysis, or inversion, of sucrose.
  - Occasionally, the term refers to almost any liquid syrup.
- Small amounts produced in the bakeshop any time acid is added to boiling sugar.



- Contains equal amounts of the monosaccharides glucose and fructose.

Syrups

Invert syrup: Two main types

- Full (total) invert; contains little remaining sucrose. Syrups that are equivalent to full invert include:
  - Honey, nature's invert syrup.
  - High fructose corn syrup.
- Medium invert; has only half its sugar inverted. Syrups that are equivalent to medium invert include:
  - Golden syrup
  - Premium molasses

Syrups

Invert syrup: Properties and uses

- Sweetens as well as sugar.
- Browns faster than sugar.
  - To prevent excessive browning, lower oven temperature by about 25ºF (15ºC).
- More hygroscopic than sugar.
  - Keeps baked goods soft and moist longer.
  - Keeps icings, fondants, and boiled confections smooth, shiny, free from cracking.
- Lowers water activity better than sugar.
  - Lower water activity means less water is available for the growth of microorganisms.
  - Fondant cream centers are less likely to spoil.
- Lowers freezing point better than sugar.
  - Prevents iciness in frozen desserts.

Syrups

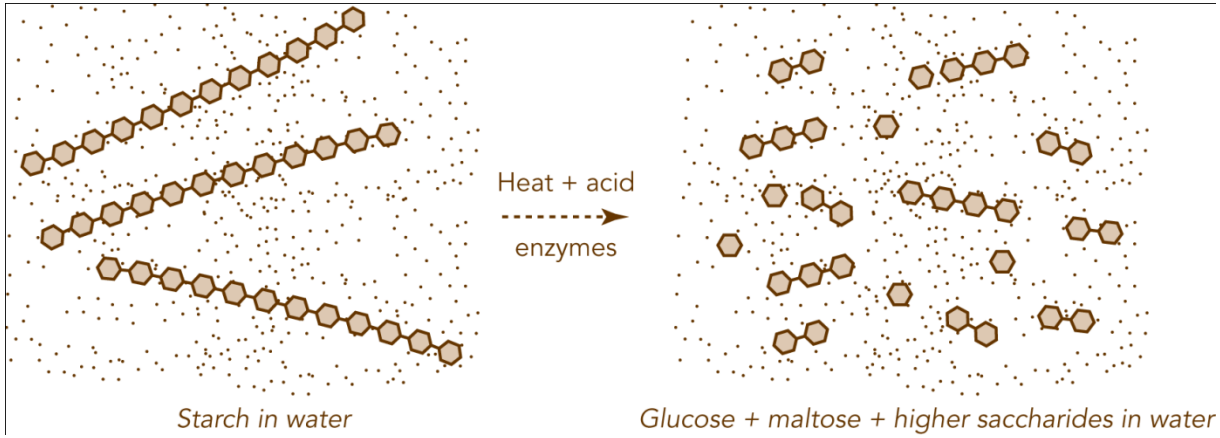
Molasses

- Concentrated juice of sugarcane.
  - Sugar beet molasses is inedible.
- Different grades available:
  - Premium or fancy; made by directly boiling and concentrating sugarcane.
    - A medium invert syrup.
  - Lower grades; by-products of cane sugar milling.
    - Darker in color, less sweet, more bitter than premium.
- Uses: color and flavor in gingerbread cake, cookies; also provides moistness from hygroscopic sugars, and acids for leavening.

Syrups

Glucose corn syrups

- Also called “glucose.”
- From the hydrolysis (breakdown) of starch.
  - Most common starch used: cornstarch.
    - Glucose syrup from cornstarch is commonly called corn syrup.
  - Other starches used: potato, wheat, rice.



- Filtered and refined, to remove flavor and color.
  - The more refined, the milder its flavor, clearer its appearance, less likely it darkens over time or when heated.

Syrups

Glucose corn syrups

- Process is controlled by the manufacturer.
- Classified by the amount of hydrolysis (conversion):
  - High-conversion (high DE, or dextrose equivalent).
    - High in sugars, low in higher saccharides.
    - Sugars sweeten, moisten, tenderize, brown, etc.
  - Low-conversion (low DE).
    - Low in sugars, high in higher saccharides.
    - Higher saccharides are not sugars; they thicken, primarily.

Syrups

Glucose corn syrups: Several different types.

- Regular glucose corn syrup
  - Medium-conversion.
  - Features: sweetens, browns, moistens, tenderizes.
  - Uses: pecan pie, general sweetening in baking.
- Glucose used in candies, confections
  - Low conversion.
  - Features: very thick, barely sweet, unlikely to brown or crystallize.
  - Uses: whitest, smoothest, shiniest candies and confections; strong and pliable pulled and spun sugar; smooth frozen desserts.

Syrups

Glucose (low conversion glucose syrup) is an extremely effective doctoring agent, interfering with sugar crystallization.

The result: smooth, creamy fondant and boiled confections.

Syrups

Glucose corn syrups *(types, cont.)*

- Dark corn syrup
  - Regular corn syrup with added refiner's syrup, caramel color, and flavor.
  - Use: inexpensive, mild-tasting molasses substitute.
- High fructose corn syrup (HFCS)
  - Also called glucose-fructose, corn sugar.
  - Features and uses: same as invert syrup.
- Rice syrup
  - Made from rice starch
  - Most often from brown rice, and unrefined.
    - Designed for health food industry; often sold organic.
  - As with other glucose syrups, available in different conversions.

Syrups

Honey

- An ancient sweetener.
- Processed by honeybees, from nectar they collect from flowers.
  - Flavor is characteristic of flower source; most common: sweet clover.
  - Expensive sweetener.
- Gently heated to destroy spoilage yeast, then filtered.
- If it crystallizes, stir before use; or heat to dissolve.
- Natural invert syrup; contains glucose and fructose.
- Use: for its flavor.

Syrups

Maple syrup

- Sap from sugar maple tree, boiled to evaporate water.
  - 1 gallon (liter) of maple syrup from 40 gallons (liter) of sap.
  - Expensive sweetener.
- Produced in northeastern United States and southeastern Canada.
- Graded by color; lighter colored syrup has milder flavor.
- Use: for its flavor.

Syrups

Malt syrup

- Sometimes called malt extract.
- Barley, or other grain, malted (sprouted), extracted with water, then concentrated.
- Two types: diastatic and nondiastatic.
  - Diastase is another name for amylase.
- Brown in color; distinct flavor, similar to molasses.
- High in maltose.
- Uses: Improves yeast fermentation in breads, bagels, biscuits, and crackers.

Specialty Sweeteners

Many specialty sweeteners available.

- Agave syrup.
- Dextrose.
- Doughnut sugar.
- Dried glucose syrup.
- Prepared fondant.
- Isomalt.
- Fructose.
- High-intensity sweeteners.

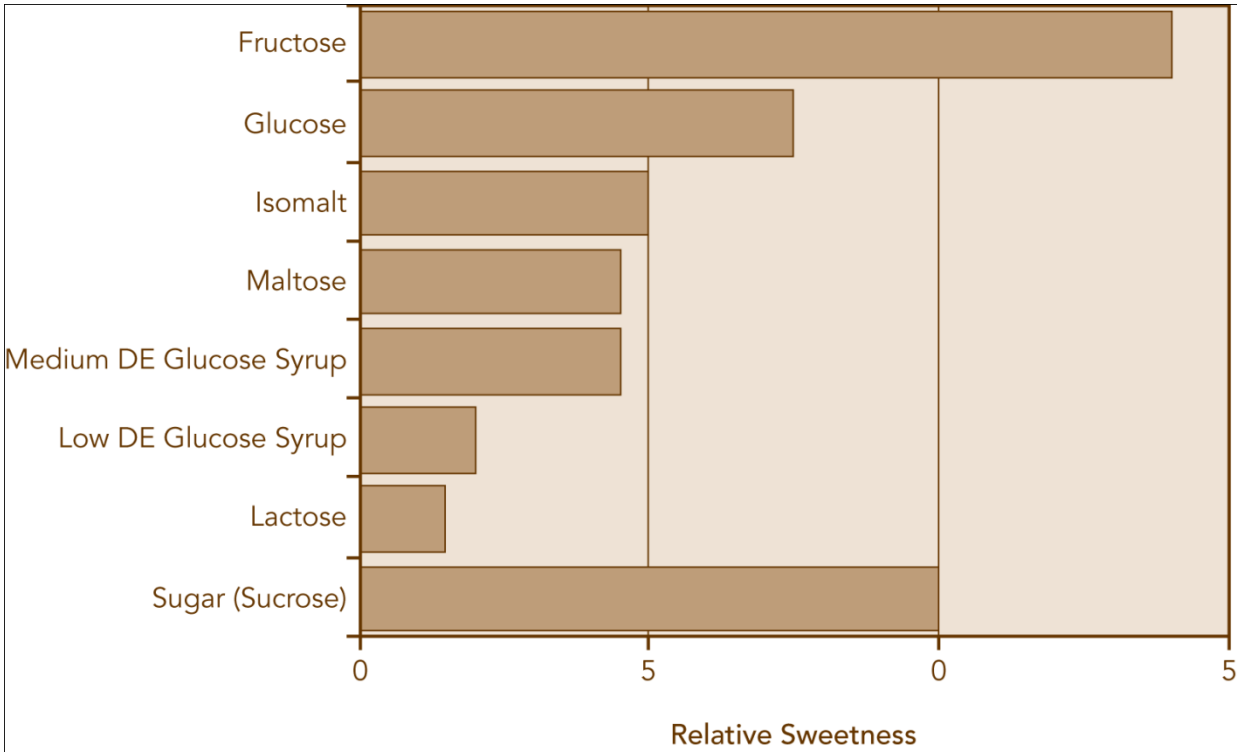
Functions of Sweeteners

Sugar and other sweeteners provide many functions in baked goods.

Functions of Sweeteners

Main Functions

- Sweetening.
  - Sugars vary in their sweetness.



Functions of Sweeteners

- Tenderizing.
  - Sugar slows gluten formation, egg protein coagulation, and starch gelatinization.
- Retaining moistness and improving shelf life.
  - All sugars are hygroscopic and retain moistness in baked goods, but fructose is most hygroscopic.
  - Syrups with fructose: invert, honey, HFCS, molasses, agave.
- Contributing brown color and a caramelized or baked flavor.
  - From caramelization and Maillard browning.

Functions of Sweeteners

- Browning is increased when
  - Proteins are present (Maillard browning).
  - The amount of monosaccharides (fructose and glucose) is increased.
  - The amount of minerals, such as copper and iron, is increased.
    - » Minerals are present in some water supplies.
    - » The less refined the syrup, the higher its mineral content.
  - The pH is increased.
    - » The addition of alkalis, such as baking soda, increases pH.

Functions of Sweeteners

- Assisting in leavening.
  - Sugar assists in the creaming of fats.
- Providing bulk and substance to fondant and sugar-based confections.
  - Primarily from solid sugar crystals.
- Stabilizing whipped egg foams.
  - Egg whites are less likely to collapse and weep when sugar is added during whipping.
- Provides food for yeast fermentation.
  - Sucrose, fructose, and glucose are fermented quickly, maltose slowly, lactose not at all.

Functions of Sweeteners

– Additional functions
  - Adding flavor.
  - Reducing iciness and hardness in frozen dessert.
  - Providing a source of acid for leavening.
  - Preventing microbial growth.
  - Adding sheen to icings.
  - Promoting a crisp crust on certain baked goods.
  - Promoting spread in cookies.
  - Providing energy for the body.

Storage and Handling

- All sweeteners should be stored covered.
  - Prevents pickup of odors.
  - Prevents moisture pickup.
- Use dry utensils when dipping into tubs of syrups or dry sugars.
  - Prevents dry sugars from clumping.
  - Prevents yeast and mold growth in syrups.

Storage and Handling

Most sweeteners have unlimited shelf life.

- Brown sugars may harden. Do not discard; warm gently, then pass through sieve.
- Syrups may darken. Do not discard; use in dark products.
- Honey and other syrups may crystallize. Do not discard; stir well, or gently heat.

Storage and Handling

Doughnut sugar contains oil that oxidizes.

- Purchase 3-6 month supply, only.
- Taste and smell before use; discard if you detect a cardboard-like rancid off-odor.

Maple syrup and simple syrup support yeast and mold growth.

- These syrups are high in moisture.
- Refrigerate to prevent microbial growth.

Storage and Handling

Substituting syrup for sugar:

- Divide the weight of sugar by 0.80 (for syrups that contain 20 percent water).

  Example: for 1 pound (16 ounces) of sugar use 16 ÷ 0.8 = 20 ounces syrup; reduce liquid in formula by 20 – 16 = 4 ounces.

  Example: for 500 grams of sugar use 500 ÷ 0.8 = 625 grams syrup; reduce liquid in formula by 625 – 500 = 125 grams.