# POLYOLS IN SUGAR-FREE AND REDUCED-CALORIE FOODS AND BEVERAGES

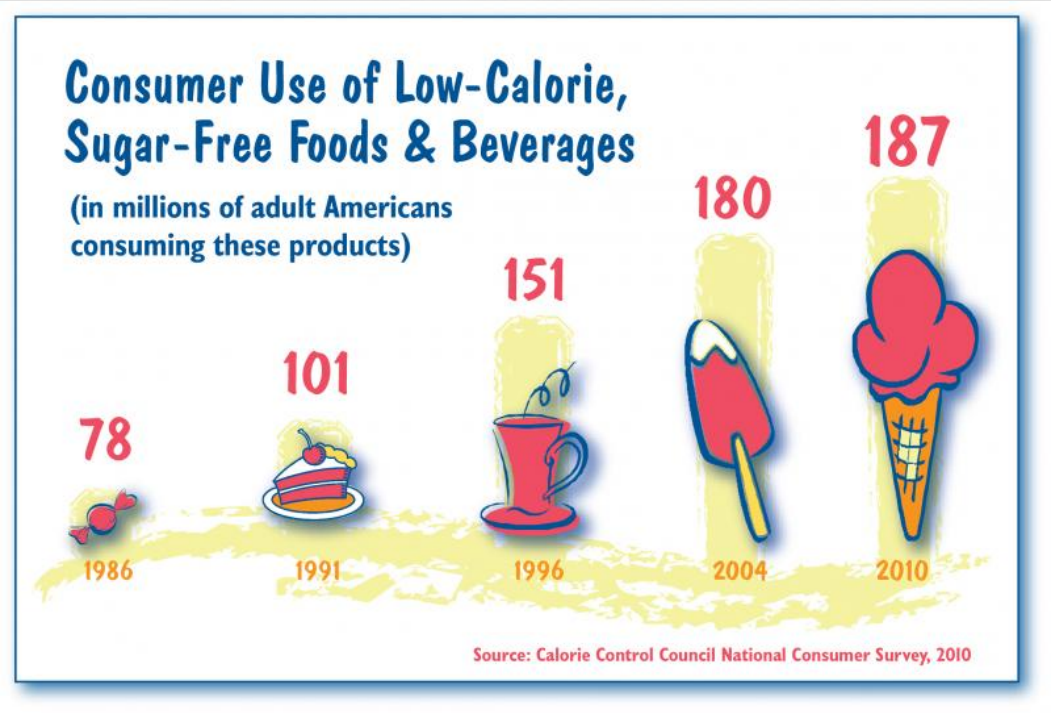
INFORMATION FOR NUTRITIONISTS

# WHAT ARE POLYOLS?

- Low-digestible carbohydrate sweeteners, also known as sugar alcohols, though they are neither sugars nor alcohols
- Hydrogenated forms or mono-, di- or polysaccharides, meaning the hydroxyl group replaces the aldehyde or ketone group[1]
  - Hydrogenated monosaccharides include: D-tagatose, erythritol, mannitol, sorbitol, xylitol
  - Hydrogenated disaccharides include: isomalt, isomaltulose, maltitol, trehalose
  - Hydrogenated polysaccharides include: hydrogenated starch hydrolysates (HSH), polyglycitols (e.g., maltitol and sorbitol syrups)

# POLYOLS AS SUGAR REPLACERS

- According to a 2010 consumer survey by the Calorie Control Council, 78% of Americans who are trying to lose weight use low-sugar, sugar-free and reduced-calorie foods and beverages[2]



# MOST POLYOLS ARE NUTRITIVE

- Polyols are not calorie-free as there is some degree of digestion and absorption of the carbohydrate
- As polyols can be used to reduce the level of sugar in foods and beverages, they are commonly known as:
  - Sugar substitutes
  - Sugar replacers
  - Alternative sweeteners
  - Low-calorie sweeteners[3]

# CALORIC VALUE OF POLYOLS

- Polyols provide fewer calories per gram than sugar, which provides 4 calories/gram

| Polyol | Caloric Value* |
|---|---|
| Erythritol | 0.0 calories/gram |
| Mannitol | 1.6 calories/gram |
| Isomalt | 2.0 calories/gram |
| Lactitol | 2.0 calories/gram |
| Maltitol | 2.1 calories/gram |
| Xylitol | 2.4 calories/gram |
| Sorbitol | 2.6 calories/gram |
| Hydrogenated Starch Hydrolysates | 3.0 calories/gram |
| *Caloric value per the FDA final rule on nutrition labeling[4] | |

# FUNCTIONALITY IN FOODS AND BEVERAGES

- For the most part, polyols retain the chemical structure of sugars, meaning they have many of the properties of sugar in foods[1]
- While functionality varies between polyols and specific applications, polyols can impart the following properties which impact functionality:
  - Sweetness
  - Bulking, which influences volume and mouthfeel
  - Moisture retention
  - Water activity inhibition
  - Sugar crystallization inhibition
  - Viscosity
  - Flavor retention at high temperatures[1,5-7]

# WHERE CAN POLYOLS BE FOUND?

- Polyols are primarily found in sugar-free, reduced-sugar, reduced-calorie and no sugar added foods and beverages
  - Confectionaries, baked goods, frozen desserts, syrups, beverages
  - Chewing gum, breath mints
- Polyols can also be found in oral health products, including toothpaste and mouthwash, as well as medications, such as cough medicines
- Polyols are not sold as food ingredients for home use

# REGULATION OF POLYOLS IN THE US

- In the US, the Food and Drug Administration (FDA) recognizes polyols as either approved food additives or as Generally Recognized as Safe (GRAS)[5]
  - Approved food additives: mannitol, xylitol (for special dietary uses)
  - GRAS: erythritol, isomalt, lactitol, maltitol, hydrogenated starch hydrolysates/polyglycitols

# FOOD ADDITIVE APPROVAL VS. GRAS

- For the food additive approval process, manufacturers provide safety data to the FDA in the form of a Food Additive Petition, which is reviewed by the Agency and approved or denied[8]
- For those ingredients which meet the definition of a food additive but are "generally recognized as safe," manufacturers can file a GRAS notification with the FDA and can receive an affirmative response ("letter of no objection") or a rejection[8]
  - Ingredients are considered to be GRAS by experts for the intended use in the notification

# DIGESTION AND ABSORPTION OF POLYOLS

- Monosaccharide polyols are absorbed more slowly than glucose[1,6,7,9]
- Di- and polysaccharide polyols are partially or incompletely digested and absorbed in the small intestine and fermented in the large intestine[1,6,7,9]
- Since polyols are not completely digested, absorbed and metabolized for energy, they provide fewer calories per gram than sugar[6,7,10,11]
- To the extent that polyols are metabolized, typically little to no insulin production is required[6,7,10,11]

# POSSIBLE GI EFFECTS

- When consumed in excessive amounts by sensitive individuals, polyols can lead to gastrointestinal (GI) effects, such as gas, bloating, abdominal discomfort and increased laxation (including diarrhea)[1,5,9,12]
- FDA has defined "excessive consumption" for sorbitol (more than 50 grams/day) and mannitol (more than 20 grams/day)[3,6,7,11]
  - Foods which might lead to intake close to these levels are required to include an advisory statement on the label

# VARIABILITY IN GI EFFECTS

- GI effects of polyols can vary among individuals and be influenced by a number of factors
  - Amount consumed[1,7,9]
    - Excessive consumption in one sitting can lead to GI effects
  - Frequency of consumption/adaptation[1,6,7,9]
    - Polyols are better tolerated if consumed in smaller portions throughout the day
  - Food form/other foods and nutrients consumed[1,9,10]
    - Polyols may be better tolerated in solid rather than liquid form as solid foods move through the GI tract more slowly, allowing for more transit time and increased digestion/absorption
  - Individual characteristics and conditions[9]
    - Certain health conditions impacting the GI could lead to increased GI effects (e.g., irritable bowel syndrome (IBS))

# TOLERANCE IN CHILDREN

- Due to their smaller body size, children might be more sensitive to potential GI effects[9]
- Therefore, care should be taken to ensure that children are consuming polyols in smaller amounts[5]

# PROVIDING GUIDANCE ON GI CONCERNS

- If a client is complaining about GI issues, consumption of foods and beverages sweetened with polyols should be assessed alongside other dietary, lifestyle and health factors
- If a client has recently increased intake of polyols, share information about polyols, such as the following:
  - Polyols are better tolerated in solid versus liquid forms
  - Larger intakes may be accepted if gradually increased over days or weeks and divided into portions throughout the day
  - Excess consumption of polyols may signal an assumption that other foods can be consumed without limit; therefore, an explanation of total calories, not just sugar content, should be given

# GLYCEMIC RESPONSE

- Consumption of foods and beverages with polyols produces a lower glycemic response that similar products made with fully fermentable carbohydrates[13]
- Slower and incomplete absorption leads to smaller amounts and/or a more slowly available supply of glucose[10]
- Polyols produce a significantly lower post-prandial blood glucose response compared to fructose, glucose and sucrose[13,14]
- Polyols effect blood glucose to some extent in individuals with and without diabetes[15]

# WEIGHT MANAGEMENT

- Polyols can be used in the context of the overall eating pattern as one way to assist with weight management[7,14,15]
- Due to their incomplete metabolism, polyols provide approximately half the energy of other carbohydrates, so replacing foods and beverages made with polyols for higher-sugar versions might help reduce calorie consumption[1,3]

# DENTAL CARIES

- Polyols, and particularly xylitol, do not promote tooth decay and could assist in prevention of dental caries
  - Polyols, unlike sugars, are a poor source of energy for microorganisms in the month and therefore, are metabolized slowly or not at all by plaque-synthesizing bacteria[5,10,16]
  - Xylitol may be beneficial in promoting tooth remineralization[10,16]

# POLYOLS IN CHEWING GUM

- Chewing gum sweetened with polyols, when used to substitute sugar-sweetened gum, can reduce exposure of bacteria in the mouth
- Chewing gum can increase salivary flow, which can remove food from the oral cavity and neutralize pH in the mouth[16,17]

# POLYOLS ON LABELS: INGREDIENT LIST

- Specific polyols must be listed by their name in the ingredient list on food and beverage product labels[6,7,11]
- One tip for consumers is that most polyols end in –ol, so they can look out for these in the ingredient list

# POLYOLS AND ADDED SUGARS

- With the final rule from the FDA in 2016 on nutrition labeling, one of the major changes is the new mandate to list the amount of added sugars on the label[4]
  - The amount of "Added Sugars" will appear under "Total Sugars" on the Nutrition Facts label, which appears under the "Total Carbohydrates" line
- In the final rule, FDA stated that polyols are not considered added sugars, so are therefore not subject to inclusion on the new mandate[4]

# NUTRITION FACTS LABEL AND POLYOLS

- The caloric value of specific polyols must be used in the labeling of the caloric value for Total Carbohydrates
- The amount of polyols in a product can be listed as a component of the Total Carbohydrates[1,4,6,7,15,18]
  - The amount can be voluntarily identified under Total Carbohydrates as “Sugar Alcohols”
  - However, if a claim is made about polyols or sugars (e.g., “sugar free”) on the label, the listing of the amount of “Sugar Alcohols” is mandatory

# SUGAR CLAIMS ON PRODUCT LABELS

- A variety of claims are used on products related to sugar content in foods and beverages which contain polyols, including the following:
  - Sugar free
  - No sugar added
  - No added sugars
- It is important that consumers understand that for products which include these claims, it does not indicate the product is calorie- or carbohydrate-free
- For those counting carbohydrates, the Nutrition Facts table will provide the necessary information

# USE OF POLYOLS IN DIABETIC MEAL PLANNING

- Management of blood glucose is of primary concern to those with diabetes, and since polyols provide fewer calories and provide less glucose than other carbohydrates, they can be beneficial for those with diabetes
- However, those with diabetes should not assume that products made with polyols are “free foods”
  - Those with diabetes should pay attention to the Calories and Total Carbohydrates lines and consider products made with polyols in terms of the overall eating plan and nutrition goals

# CALCULATING CARBOHYDRATES

- As polyols are minimally digested, it is estimated that only half of the polyols in a product should be counted towards the carbohydrate intake[14,18]
  - For example, if a product had only carbohydrates from polyols and there were 10 grams of polyols, 10 grams of carbohydrate would be counted as only 5 grams
- "Free foods" [14,18]
  - If a food provides 5 grams of carbohydrates or less or 20 calories or less
  - If a product contains less than 10 grams of total carbohydrates with all from polyols

# CALCULATING CARBOHYDRATES: EXAMPLE

- If a product lists “Sugar Alcohols” in the Nutrition Facts label, count only half of the polyol grams when calculating carbohydrates
- Example:
  - Total Carbohydrates: 30 grams
  - Sugar Alcohols: 28 grams
  - Carbohydrates: 30 – (28/2) = 16 grams

# TOTAL EATING PATTERN APPROACH

- Consumers should remember that a food is not automatically low-carbohydrate, low-calorie and with a low glycemic response just because it is made with polyols
  - Foods are a mixture of carbohydrate sources, along with other macronutrients (e.g., protein, fat)
  - The macronutrient content affects the glycemic load, which might be more important that the glycemic index of individual foods
- Polyols can be used in the context of an overall healthy way of eating, including a way to enjoy sweet foods and beverages with fewer calories and less sugar

# KEY HIGHLIGHTS

- Polyols used in foods and beverages to replace sugar can reduce calories and carbohydrates
- In addition to regular oral hygiene, products made with polyols, especially chewing gum, can help reduce risk of dental caries
- Consumers should consider the total eating pattern and health goals, especially those with diabetes and those trying to manage their weight
- Polyols are safe and products made with them can be enjoyed by consumers
- For sensitive individuals, excessive intake of polyols can cause GI effects, but this can be addressed through gradual addition of polyols to the diet

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