

“Polyols: A primer for dietetic professionals” is a self-study module produced by the Calorie Control Council, an accredited provider of continuing professional education (CPE) for dietetic professionals by the Commission on Dietetic Registration. It provides one hour of level 1 CPE credit for dietetic professionals. The full text of the module is in the notes section of each page, and is accompanied by summary points and/or visuals in the box at the top of the page. Directions for obtaining CPE are provided at the end of the module.

LEARNING OBJECTIVES

- Define polyols.
- Identify the various types of polyols found in foods and beverages.
- Understand the uses and health effects of polyols in foods.
- Counsel clients on how to incorporate polyols into an overall healthful eating pattern.



After completing this module, dietetic professionals will be able to:

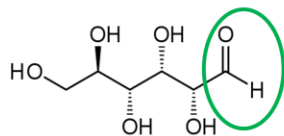
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- Counsel clients on how to incorporate polyols into an overall healthful eating pattern.

DEFINITIONS AND USES

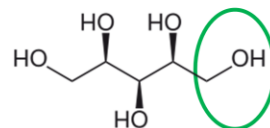


WHAT ARE POLYOLS?

- Hydrogenated forms of mono-, di-, or polysaccharides
 - Mono: erythritol, xylitol, sorbitol, mannitol, D-tagatose
 - Di: lactitol, isomalt, maltitol, isomaltulose, trehalose
 - Poly: hydrogenated starch hydrolysates (HSH) or polyglycitol (eg, maltitol and sorbitol syrups)



Glucose
(monosaccharide)



Xylitol
(monosaccharide polyol)

Polyols are carbohydrates that are hydrogenated, meaning that a hydroxyl group replaces the aldehyde or ketone group found on sugars.

Hydrogenated monosaccharides include erythritol, xylitol, sorbitol, and mannitol. Hydrogenated disaccharides include lactitol, isomalt, and maltitol. And hydrogenated starch hydrolysates (HSH), or polyglycitol (a wide range of corn syrups and maltodextrins), are formed from polysaccharides (Grabitske and Slavin 2008).

POLYOLS IN CONTEXT

78% of Americans who are trying to lose weight use low-sugar, sugar-free, and reduced-calorie foods and beverages



Nearly 54 percent of Americans are trying to lose weight, more than ever before. Increasingly, they are turning toward no- and low-sugar, and reduced calorie, foods and beverages to help them achieve their weight loss goals (78% of Americans who are trying to lose weight) (CCC 2010). Polyols, found in many of these foods, are becoming a subject of more interest.

COMMON NAMES FOR POLYOLS*

- Low-digestible carbohydrates
- Sugar replacers
- Alternative sweeteners
- Low-calorie sweeteners
- Sugar alcohols

* Appropriate term depends on properties of polyol.



They are incompletely digested , therefore are sometimes referred to as “low-digestible carbohydrates.”

Polyols are not calorie free, as there is some degree of digestion and absorption of the carbohydrate. Therefore, they are technically not “non-nutritive sweeteners.” Some can be used to reduce sugar in foods, thus can be referred to as “sugar substitutes,” “sugar replacers,” “alternative sweeteners,” or “low-calorie sweeteners” (Academy of Nutrition and Dietetics 2012).

Another common term that is currently used on food labels is “sugar alcohols.” However, these carbohydrate-based food ingredients are neither sugar nor alcohol. This is part of the basis for a 1995 Calorie Control Council petition to the Food and Drug Administration (FDA) to require that the term “polyol” be used instead of “sugar alcohol” on food labels (Warshaw 2004, Wheeler 2008, IFIC 2009, Grabitske and Slavin 2008, Grabitske and Slavin 2009).

POTENTIAL USES OF POLYOLS IN FOODS*

- Sweet flavor
- Bulking for desired food volume and mouth feel
- Moisture retention
- Water activity inhibition
- Sugar crystallization inhibition
- Viscosity
- Flavor retention at high temperatures

** Polyols are a class of sweeteners with some variation in properties from product to product.*



Some polyols, such as erythritol, sorbitol, and mannitol, occur naturally in foods. All can be manufactured (Saulo 2005, Patra 2009, Grabitske and Slavin 2009). They are a class of sweeteners with some variation in properties from product to product. Generally speaking, polyols retain much of the chemical structure of sugars, therefore have many of the properties of sugar in foods. For example, the sweetness of polyols varies, having anywhere from 40 to 100 percent of the sweetness of sugar (Grabitske and Slavin 2008). Some impart bulking, which means that they can be used in an equal volume or equal weight to replace sucrose or corn syrups without a negative effect on food volume or mouth feel (Grabitske and Slavin 2008, Kroger 2006). Certain polyols can help retain moisture in foods, lower water activity to help protect against spoilage, impart smoothness and creaminess by inhibiting sugar crystallization, provide viscosity, and/or assist in retaining flavor at high temperatures (Kroger 2006, IFIC 2009, Warsaw 2004).

IN WHAT FOODS ARE POLYOLS FOUND?

- Primarily sugar-free, reduced-sugar, reduced-calorie, and no-sugar-added foods, e.g.,
 - Candies, cookies, syrups, frozen desserts (ice cream), chocolate
 - Chewing gum and breath mints
- Also, mouthwash, cough medicines, and toothpaste
- Polyols *not* sold as a food ingredient for home use



Polyols can be found in sugar-free, reduced-sugar, and reduced-fat versions of the following products: candies, cookies, baked goods, syrups, frozen desserts, including ice cream, and chocolate. Polyols are also found in non-food items like chewing gum, breath mints, mouthwash, cough medicines, and toothpaste.

Polyols are not sold as a food ingredient for home use.

CALORIES PER GRAM

Polyols provide fewer calories per gram than sugar (4 kcal/g).

Polyol	kcal/g
Erythritol	0-0.2*
Mannitol	1.6
Sorbitol	2.6
Xylitol	2.4
Isomalt	2.0
Lactitol	2.0
Maltitol	2.1
HSH/Polyglycitol	3.0

*FDA accepts 0.2 kcal/g, but some other countries, such as Japan and the European Union, accept 0 kcal/g.

Polyols provide from 0.2 to 3 kilocalories per gram (kcal/g) from the small amount of carbohydrate in the sweetener that is digested and absorbed, while sugar provides 4 kcal/g (Academy of Nutrition and Dietetics 2012, Grabitske and Slavin 2008, Warshaw 2004, Nabors 2007).

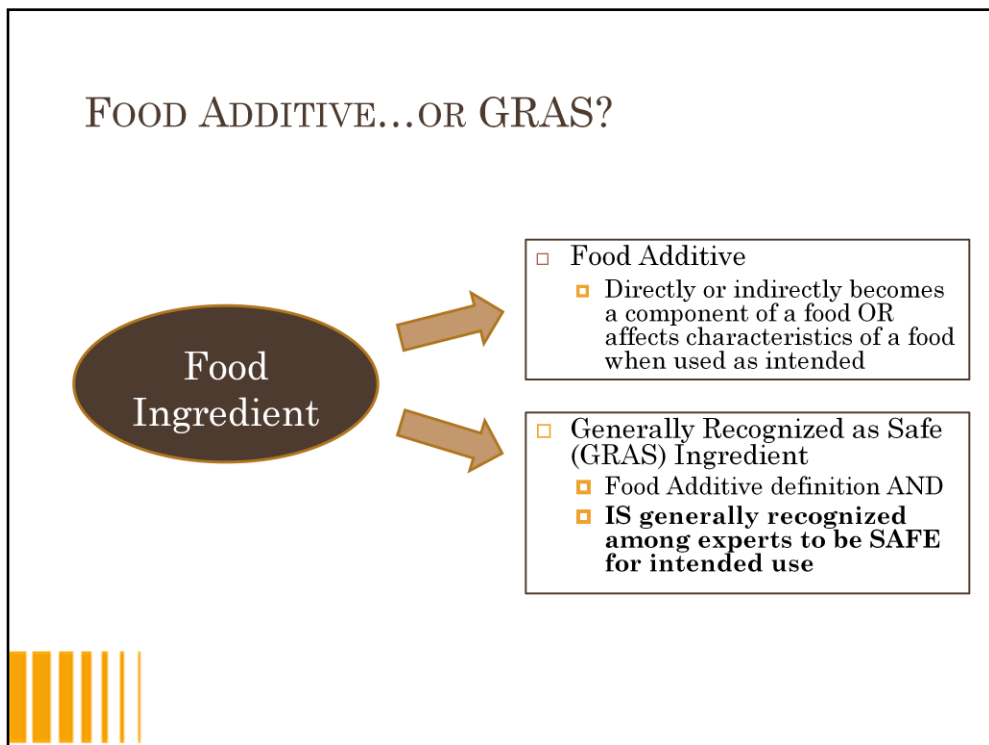
There are eight polyols currently available for use in foods and beverages. They are listed in the chart on this slide from the lowest to highest caloric value. Note that erythritol is listed as having 0 to 0.2 kcal/g. In the U.S., the FDA requires that 0.2 kcal is used, while in some other countries, such as Japan and the European Union, 0 kcal/g is attributed to this sweetener (Wheeler 2008, Kroger 2006, Saulo 2005, IFIC 2009).

REGULATION OF POLYOLS

- Polyols are approved for use in foods by FDA as GRAS or regulated as food additives.
- GRAS
 - erythritol, sorbitol, isomalt, lactitol, maltitol, HSH/polyglycitols
- Food Additive
 - mannitol, xylitol (for special dietary purposes)



Polyols are approved for use in foods by the FDA under either a GRAS (Generally Recognized as Safe) designation or are regulated as food additives (Warshaw 2008, Kroger 2006). Most polyols are considered GRAS, specifically erythritol, sorbitol, isomalt, lactitol, maltitol, and polyglycitols. Mannitol and xylitol (for special dietary purposes) are regulated as food additives. What do these regulatory designations mean?



Prior to marketing, new food ingredients are presumed to be unsafe for their intended uses unless and until they are proven “safe” on the basis of scientific data and information (Rulis and Levitt 2009). The burden of proof lies with the company or any other organization that petitions the FDA. They must provide all safety data (both in support of or questioning safety) relevant to the proposed use of the additive in the form of a Food Additive Petition. For food additives, the FDA reviews and *approves* or denies the use of the additive based on evidence.

Many food ingredients have been safely consumed for generations, such as cinnamon or ascorbic acid. Therefore, ingredients that meet the definition of an additive but are “*Generally Recognized as Safe*,” or *GRAS*, are not considered food additives. A GRAS Notification may be filed, which is evaluated by the FDA and receives either an affirmative response or a rejection.

There is a perception that GRAS ingredients are not as tightly regulated as food additives (Rulis and Levitt 2009). At the request of Congress, the Government Accounting Office (GAO) published a report concluding that the FDA should strengthen its oversight of GRAS, although the Agency must operate within the limits of the FD&C Act (GAO 2010). The GRAS Notification, however, may in some ways be more difficult than a Food Additive Petition (Rulis and Levitt 2009), as the case for safety must be based on publicly available evidence, which may take decades to build, review, and publish.

THE MEANING OF “SAFE”

- New food additives presumed *unsafe* until proven *safe* by the science
- “Safe” is defined as “reasonable certainty of no harm”
- Food ingredients must be safe for *everyone* over a *lifetime* of use
- If needed, labeling alerts used for special populations



Whether GRAS or additive, the anticipated use of the ingredient must meet the standard of “reasonable certainty of no harm” (Rulis and Levitt 2009). *Food ingredients must be demonstrated to be safe for everyone*—infants, children, teenagers, adults, the elderly, and pregnant and lactating women (Rulis and Levitt 2009). If the use of an ingredient that is safe for most consumers could present special risks for certain subpopulations, FDA requires special labeling to alert those consumers (Rulis and Levitt 2009). Polyol examples are sorbitol and mannitol, to be discussed in more detail on page 16.

MORE ON FOOD INGREDIENT REGULATIONS

For an in-depth look at GRAS and food additive regulations, visit

www.caloriecontrol.org/health-professional-library/demystifying-fdas-food-ingredient-approval-process.



For an in-depth look at GRAS and food additive regulations, a self-study module available at www.caloriecontrol.org/health-professional-library/demystifying-fdas-food-ingredient-approval-process provides one hour level 1 CPE credit for dietetic professionals on the topic.

POLYOLS AND HEALTH



DIGESTION AND ABSORPTION OF POLYOLS

- Monosaccharide polyols absorbed more slowly
- Di- and polysaccharide polyols
 - Partially or incompletely digested and absorbed in small intestine
 - Fermented in large intestine
- Because not fully metabolized, provide fewer calories per gram than fully digestible carbohydrates



Digestion and absorption of polyols differs from that of sugars in that polyols are only partially digested and absorbed. Monosaccharide polyols, like erythritol and xylitol, are incompletely absorbed due to a slower absorption rate (compared to glucose), while di- and polysaccharide polyols, like lactitol and maltitol, are incompletely digested because they are more resistant to human digestive enzymes in the small intestine than are sucrose or lactose. Both types of polyols are incompletely absorbed in the small intestine, therefore pass largely undigested into the large intestine where they are fermented by colonic bacteria (Warshaw 2004, IFIC 2009, Grabitske and Slavin 2008, 2009).

Because polyols are not completely digested, absorbed, and metabolized for energy, they provide fewer calories per gram than sugar. To the extent that polyols are metabolized for energy (remember, they provide on average 2 calories per gram), they typically require little or no insulin production (IFIC 2009, Livesey 2003, Warshaw 2004, Saulo 2005). Further discussion of the glycemic properties of polyols will follow in this module.

GASTROINTESTINAL (GI) EFFECTS

- In large amounts or when consumed by sensitive individuals:
 - Gas
 - Bloating
 - Abdominal discomfort
 - Increased laxation, including diarrhea
- “Excess consumption” per FDA: > 50 g/d Sorbitol or >20g/d Mannitol
 - For foods containing enough sorbitol or mannitol to potentially lead to these levels of daily intake, advisory statement required on label



Due to incomplete absorption and fermentation in the large intestine, consumption of polyols, especially in large amounts at one time or when consumed by sensitive individuals, may lead to gastrointestinal (GI) or laxative effects (Grabitske and Slavin 2009, Storey et al 2007). Fermentation of undigested polyols in the large intestine may produce gas, bloating, or abdominal discomfort. Additionally, the prolonged presence of undigested polyols in the large intestine can lead to increased ease or frequency of laxation due to an increased osmotic load (Grabitske and Slavin 2008, Grabitske and Slavin 2009, Kroger 2006).

The Academy of Nutrition and Dietetics (formerly American Dietetic Association, ADA) advises that an excessive polyol load, greater than 50 g/day of sorbitol or greater than 20 g/day of mannitol, may cause diarrhea (Academy of Nutrition and Dietetics 2012). Also, the FDA requires foods containing enough sorbitol or mannitol to have the potential to be consumed in these amounts in a day to bear the following statement: “Excess consumption may have a laxative effect” (Saulo 2005, Academy of Nutrition and Dietetics 2012, IFIC 2009, Warshaw 2004).

VARIABILITY IN GI EFFECTS

- GI effects of polyols vary among individuals and can be influenced by various factors
 - Amount consumed
 - Frequency of consumption / Adaptation
 - Food form / Other foods and nutrients consumed
 - Individual characteristics and conditions



The extent to which polyol consumption leads to GI effects varies among individuals, and is influenced by a number of other factors, including:

- 1) **Amount:** Excessive consumption of polyols either in one sitting or over time may lead to GI effects. Polyols may be better tolerated if consumed in small portions throughout the day (Grabitske and Slavin 2008, Grabitske and Slavin 2009, Warshaw 2004).
- 2) **Frequency:** Consuming small amounts of polyols frequently enough to lead to an excessive total amount in a day can increase risk of GI effects. On the other hand, consuming small amounts over time may be better tolerated (Warshaw 2004, Grabitske and Slavin 2008, Grabitske and Slavin 2009, IFIC 2009).
- 3) **Type/form of food consumed:** Polyols may be better tolerated in solid rather than liquid foods as solids travel through the GI tract more slowly, allowing for increased transit time and the potential for increased digestion/absorption of polyols. The presence of other foods and nutrients may also play a role in polyol tolerance through slowed transit time (Grabitske and Slavin 2008, Grabitske and Slavin 2009, Livesey 2003).
- 4) **Characteristics of the individual and lifestyle.** Even among healthy individuals, GI transit time varies, and may be associated with genetics, gender, personality, age, physical activity level, and body weight. Health conditions that affect the GI system, such as celiac disease or irritable bowel syndrome (IBS), and the GI effects of certain medications may be exacerbated by polyol consumption (Grabitske and Slavin 2009). Also, combining polyol consumption with other foods that also increase gas or bloating, such as beans or whole grains, can increase discomfort (Grabitske and Slavin 2009).

POLYOLS AND CHILDREN

- More sensitive to GI effects due to smaller body size
- Polyols in liquid medications may be less well-tolerated than polyols in chewing gum
- Care should be taken to ensure children consume polyols only in limited amounts



Children are smaller, therefore are generally more sensitive to potential effects of food bioactives and ingredients. The GI effects of polyols are no exception. A review published in 2009 evaluated the limited evidence available regarding GI effects in children (Grabitske and Slavin 2009). They note that polyols in liquids are absorbed more rapidly than polyols in solids or chewing gum, which is of relevance for juices, popsicles, and syrup-based medications, which may be consumed often by some children. The authors concluded:

“Based on these studies, daily intakes of 8–10 g sorbitol and xylitol and 25 g isomalt or polyglycitol may contribute to a mild laxative effect yet may be acceptable for school-age children and adolescents, but the consumption of sugar alcohols by younger children should be more limited.”

Therefore, it would be particularly important that children consume polyols in limited amounts and slowly build tolerance if polyol-containing foods, beverages, gums, or medications are to become part of their usual intake (Kroger 2006).

GLYCEMIC RESPONSE

- Lower postprandial blood glucose response than fermentable carbohydrates
 - Lower GI scores
 - Varies among specific polyols
- Polyols affect blood glucose to some extent; not always a “free food”
- Limited evidence to-date regarding impact on long-term glycemic control



Consumption of foods with polyols produces a lower glycemic response than consuming similar foods with fully fermentable carbohydrates (e.g., sucrose or glucose) (Wheeler and Pi-Sunyer 2008). Slower, incomplete absorption leads to smaller amounts and/or a more slowly available supply of glucose (Livesey 2003). A review of several studies in individuals with diabetes noted that polyols, in comparison to fructose, sucrose, and glucose, produced a significantly lower postprandial blood glucose response (Wheeler and Pi-Sunyer 2008, American Diabetes Association 2008). Polyols, therefore, have low to very low Glycemic Index (GI) scores, although the utility of GI for diabetes or weight management remains unclear (Livesey 2003; Hubrich and Nabors 2006). The Academy of Nutrition and Dietetics Evidence Analysis Library assessed the evidence for metabolic and adverse effects of polyols and found limited evidence with respect to glycemic control (www.andevidencelibrary.com). It is notable, however, that studies addressing this question were excluded due to being published more than 20 years ago, but are available, as noted by Wheeler and Pi-Sunyer (2008).

Polyols do affect blood glucose to some extent in both individuals with and those without diabetes (Freeman 2004). Thus, they should not automatically be considered a “free” food, nor ignored in carbohydrate counting for diabetes. Use of polyols in diabetic eating plans will be discussed in more detail later in this module. Furthermore, because there is limited research on the use of polyols for blood glucose control in individuals with diabetes, it is unclear whether they would have a significant effect on long-term glycemic control (Warshaw 2004, Freeman 2004, American Diabetes Association 2008).

WEIGHT MANAGEMENT

- Fewer calories/gram than other carbohydrates
- May help to reduce total calorie intake when substituting polyol-containing foods for high-sugar versions
- Polyols not calorie-free
 - Read labels for total calories



Polyols can be used in the context of the overall eating pattern as one way to assist with weight management (Freeman 2004, Warshaw 2004, American Diabetes Association 2008). Due to incomplete metabolism, polyols provide approximately half the energy of carbohydrates. Therefore, they may be useful in reducing total calorie intake when substituting polyol-containing foods for their traditional, higher-sugar versions (Academy of Nutrition and Dietetics 2012, Grabitske and Slavin 2008). Foods containing polyols usually also contain calories from protein, fat, and/or other carbohydrates. Thus, it is as always important to look for total calories on the food label to understand how these foods fit into one's overall health goals (IFIC 2009).

There is currently limited direct evidence that polyols contribute to long-term reductions in weight. Therefore, additional research is warranted to evaluate the impact of consuming polyol-containing foods on overall caloric intake and body weight management.

DENTAL CARIES

- Polyols do not promote tooth decay; may aid in dental caries prevention
- Xylitol may also promote tooth remineralization
- FDA health claim variations:
 - Frequent between-meal consumption of foods high in sugars and starches promotes tooth decay. The sugar alcohols in [name of food] do not promote tooth decay.
 - Does not promote tooth decay.
 - May reduce the risk of tooth decay.



There is strong evidence that polyols, particularly xylitol, do not promote tooth decay and may aid in prevention of dental caries. Plaque bacteria rely on fermentable carbohydrates as a food source. When carbohydrates remain in the oral cavity long enough and consistently enough to increase the acidity of the oral cavity and allow for the proliferation of cariogenic bacteria, caries are formed. Polyols, unlike sugars, are a poor source of energy for microorganisms, and thus are metabolized slowly or not at all by plaque-synthesizing bacteria (Livesey 2003, Burt 2006, Kroger 2006). Xylitol, which is used in some chewing gums, may even help to promote tooth remineralization (Livesey 2003, Burt 2006).

A key tenet of caries prevention and control is to reduce exposure of the dental plaque to fermentable carbohydrates. Therefore, if an individual wants to drink something other than water between meals, a sugar-free beverage is a better choice than a sugar-sweetened one (Livesey 2003, Burt 2006).

Because of the wealth of evidence to support the noncariogenic relationship between polyols and caries, the FDA has approved a health claim for use on foods containing these polyols (provided it also meets several other criteria). An example of a health claim used on a sugar-free food containing one of the approved polyols is: "Frequent between-meal consumption of foods high in sugars and starches promotes tooth decay. The sugar alcohols in [name of food] do not promote tooth decay." On small packages, like gum, a shortened claim may state: "Does not promote tooth decay" or "May reduce the risk of tooth decay" (Kroger 2006, Saulo 2005, Warshaw 2004, 21 CFR 101.80).

POLYOLS IN CHEWING GUM

- Reduces exposure of bacteria to sugar when used in place of sugar-sweetened gum
- Chewing enhances saliva production
 - Clears food from mouth
 - Neutralizes pH levels (less favorable conditions for cariogenic bacteria)



Although reducing exposure of plaque bacteria to fermentable carbohydrate is important in caries prevention, there is no need to completely avoid carbohydrates for oral health. The most important step one can take is to brush and floss soon after eating. Because this is not always feasible, however, polyol-sweetened chewing gums can be helpful in several ways:

- As with polyol-sweetened beverages, polyol-sweetened gums do not add fermentable carbohydrate to the oral environment. If used in place of sugar-sweetened gum, there is a reduction in exposure.
- Chewing increases salivary flow, which helps to remove food from the oral cavity and neutralizes the pH level in the mouth (Burt 2006, Deshpande 2008).

POLYOLS IN PRACTICE



PROVIDING GUIDANCE FOR GI CONCERNS

- If recent sudden increase in polyol consumption is possible, provide strategies for improved tolerance:
 - Solids versus liquids
 - Eat with other foods/at meals
 - Increase intake gradually as tolerated to allow for adaptation
 - Portions still matter with reduced-calorie/ sugar foods



If a client is complaining of gastrointestinal issues, use of polyol-sweetened foods should be assessed along with other dietary, lifestyle, and health factors. If the individual has recently increased intake of polyols, share information regarding presence in foods, potential effects, and how to incorporate safely, including the following:

- Polyols are better tolerated in solid versus liquid foods.
- Larger intakes may be accepted if increased gradually over days or weeks and divided into portions throughout day.
- Excess consumption of polyols may signal an assumption that certain foods can be consumed without limits due to being sugar-free. Explain the need to consider total calories, not just sugar content.

USING FOOD LABELS: INGREDIENT LIST

- Specific polyols must be named
- TIPS
 - Most polyols end in “-ol.”
 - Provide a list of the names of all polyols.



Polyols are listed by their specific names in the Ingredients list (Warshaw 2004, IFIC 2009, Saulo 2005). Therefore, it would be helpful for consumers to know the names of polyols they may see in the Ingredients list (see page 4), as well as the rule of thumb that most polyols end in “-ol.”

USING FOOD LABELS: NUTRITION FACTS

- Caloric value of specific polyol must be used in labeling caloric value of Total Carbohydrates
- Listed as component of Total Carbohydrates
 - Identified as “sugar alcohols,” voluntarily
 - If a claim is made about polyols or sugars, “sugar alcohols” listing is *mandatory*
- **TIP**
 - For managing weight, focus on calories.



Because mixtures are often used and specific types may not be declared, the specific portions of each polyol may not be available on the food label. However, the specific calories per gram of the polyols present in a food must be used to calculate calories. Therefore, the calories listed on the Nutrition Facts panel should be used by consumers, regardless of the presence of polyols.

In the Nutrition Facts panel, if polyols are used in a food, the quantity of Total Carbohydrates will include polyols. Polyols may be voluntarily listed as a component of total carbohydrates, similar to dietary fiber and sugars, as “sugar alcohols.” If the food label displays a claim related to the presence of polyols or the level of sugar (e.g., “sugar free”), the listing of grams of “sugar alcohols” as a component of Total Carbohydrates is mandatory. (Warshaw 2004, Grabitske and Slavin 2008, Freeman 2004, Wheeler 2008, IFIC 2009)

Therefore, when consumers are managing weight, the important focus is on total calories.

USING FOOD LABELS: CLAIMS

- Sugar Free
- No Sugar Added
- No Added Sugars



- TIP

- Sugar-related claims signal less sugar. When counting calories or carbs, though, check the Nutrition Facts.



A variety of claims related to sugar content may appear on labels of foods and beverages that contain polyols. It is very important that consumers understand that while such claims may in some cases be a useful flag that the product has less sugar than comparable products, they do not indicate that a product is free of calories, or that they are free of carbohydrates. For those who are counting calories or carbohydrates, the Nutrition Facts Panel will provide quantified information.

FOR EXAMPLE...

Chewing Gum

Nutrition Facts	Amount/Serving	% DV*
Serving Size 2 pieces (3g)	Total Fat 0g	0%
Calories 5	Sodium 0mg	0%
*Percent Daily Values (DV) are based on a 2,000 calorie diet.	Total Carb. 2g	1%
	Sugars 0g	
	Sugar Alcohol 2g	
	Protein 0g	
	Not a significant source of other nutrients.	

INGREDIENTS: SORBITOL, GUM BASE, MALTITOL, MANNITOL, ARTIFICIAL AND NATURAL FLAVORING, GLYCERIN, etc...

For example, this sample label is for a sugar-free chewing gum product. The red arrows highlight the listing of sugar alcohol as a component of total carbohydrate and polyols as the only carbohydrate source.

USE IN DIABETIC MEAL PLANNING

- May offer some benefit in reducing total carbohydrate and caloric content of a food or beverage
- All foods and beverages must fit within context of overall eating plan and nutrition therapy goals



Management of blood glucose is of primary concern for people with diabetes. Because polyols are lower in calories and provide less glucose to the body than other carbohydrates, there are potentially both opportunities and pitfalls for individuals with diabetes. There is potential to reduce carbohydrates or calories in a food or beverage. The pitfall is primarily the misconception that a sugar-free food is a “free food.” It is very important to redirect attention to Calories and Total Carbohydrates listed in the Nutrition Facts panel, and to think in terms of overall eating plan and nutrition therapy goals.

USING FOOD LABELS: CALCULATING CARBOHYDRATES

○ “Free Food”

- ≤ 5 grams total carbohydrates or ≤ 20 calories
- ≤ 10 grams total carbohydrates, all from polyols
- Those with diabetes may include up to 3 free foods per day



Because polyols are minimally digested, it has been estimated that only half of the polyols in a product should be counted toward carbohydrate intake (American Diabetes Association 2008; Wheeler et al 2008). If all of the carbohydrates in the product are from polyols, 10 grams carbohydrate would be counted as only 5 grams.

If a food provides 5 grams carbohydrate or less, or 20 calories or less, it is a “free food” in terms of meal planning for diabetes, whether or not there are polyols in the product (Wheeler et al 2008). An individual with diabetes may eat up to 3 servings of a “free food” each day (Wheeler et al 2008).

USING FOOD LABELS: CALCULATING CARBS

- If “sugar alcohols” are listed in the Nutrition Facts -
 - Count only half of the polyol grams
- For example:
 - Total carbohydrates: 30 grams
 - Sugar alcohol: 28 grams
 - $30 - (28 / 2) = 16$ grams



If the food contains more than 10 grams of carbohydrate, and polyols are listed on the Nutrition Facts panel (as “sugar alcohols”), subtract half of the polyols from the total carbohydrates (American Diabetes Association 2008).

For example, if there are 30 grams total carbohydrate and 28 grams polyols or sugar alcohols, the grams of carbohydrate to be counted in meal planning would be $30 - (28/2) = 16$.

COUNSELING POINTS FOR DIABETES

- “Sugar-free” does not necessarily mean calorie- or carbohydrate-free.
- Foods may contain other ingredients that provide calories and carbohydrates.
- Read labels and ingredients carefully.



In summary, when counseling individuals with diabetes:

- “Sugar-free” does not necessarily mean calorie- or carbohydrate-free.
- Foods may contain other ingredients that provide calories and carbohydrates.
- Read the Nutrition Facts and Ingredients carefully to determine carbohydrates to be counted in meal planning.

TOTAL EATING PATTERN APPROACH

- The complete food and the complete meal matter
- Polyols can fit into context of overall healthy way of eating
- Use polyols as a way to enjoy sweet foods without as many calories, rather than as a way to eat more of these foods



A food is not automatically low-carbohydrate, low-calorie, or low-glycemic index just because it is made with a polyol. A food is usually a mixture of carbohydrate sources, along with protein and fat (Livesey 2003). Also, the macronutrient content of the total meal affects the glycemic load, which is likely more important than the glycemic index of individual foods.

SUMMARY

- For oral health, in addition to regular oral hygiene, chewing polyol-sweetened gum may help to reduce caries risk.
- Polyols used in foods to replace sugar can reduce calories and carbohydrates in foods.
- Consider the total eating pattern and health goals for individuals with diabetes and those who are trying to manage body weight.



In summary:

- For oral health, in addition to regular oral hygiene, chewing polyol-sweetened gum may help to reduce caries risk.
- Polyols used in foods to replace sugar can reduce calories and carbohydrates in foods.
- Consider the total eating pattern and health goals for individuals with diabetes and those who are trying to manage body weight.

SUMMARY

- Polyols are safe.
- Excess intake of polyols may cause GI effects in sensitive individuals, which can be addressed through reduced consumption or by adding polyols to the diet gradually.



- Polyols are safe.
- Excess intake of polyols may cause GI effects in sensitive individuals, which can be addressed through reduced consumption or by adding polyols to the diet gradually.

FOR MORE INFORMATION ON POLYOLS...

- Academy of Nutrition and Dietetics Evidence Analysis Library:
www.adaevidencelibrary.com (log in as Academy member for full access)
- Calorie Control Council:
 - www.caloriecontrol.org
 - www.polyol.org
- International Food Information Council Foundation Web site: www.foodinsight.org



For more information on polyols, the following web sites may be helpful:

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THANK YOU!

- Next Steps
 - Please complete the Learning Assessment Quiz and check Answer Key
 - After this, please complete the Program Evaluation and help the Calorie Control Council to continually improve its CPE offerings
 - Print Certificate of Completion and retain for your records
 - Record completion of module in your Learning Plan



Thank you for completing this 1-hour module on polyols. In order to receive CPE credit:

- Complete the Learning Assessment Quiz and check the Answer Key to evaluate your understanding of the material in this module.
- Complete the Program Evaluation so that Calorie Control Council may continually improve its CPE offerings.
- Print the Certificate of Completion and retain for your records.
- Record completion of the module in your Learning Plan.

Visit <http://www.caloriecontrol.org/> frequently to learn about other resources for

REFERENCES

- American Diabetes Association (2008). Nutrition recommendations and interventions for diabetes: a position statement of the American Diabetes Association. *Diabetes Care*, 31(Suppl. 1):S61-S78.
- American Dietetic Association (2004). Position of the American Dietetic Association: use of nutritive and nonnutritive sweeteners. *J Am Diet Assoc*, 104:255-75.
- Burt BA (2006). The use of sorbitol- and xylitol-sweetened chewing gum in caries control. *J Am Dent Assoc*, 137:190-6.
- Calorie Control Council (April 2011). Press Release: "Survey: Most Americans are Weight Conscious." Available at <http://www.caloriecontrol.org/pressrelease/national-survey-most-americans-now-worried-about-their-weight>. Accessed October 1, 2011.



REFERENCES

- Calorie Control Council (2010). Trends and Statistics. Available at <http://www.caloriecontrol.org/press-room/trends-and-statistics>. Accessed September 16, 2011.
- Deshpande A, Jadad AR (2008). The impact of polyol-containing chewing gums on dental caries: a systematic review of original randomized controlled trials and observational studies. *J Am Dent Assoc*, 139:1602-14.
- Electronic Code of Federal Regulations, Title 21, Part 101.80 (21 CFR 101.80). Health claims: dietary noncariogenic carbohydrate sweeteners and dental caries. Accessed September 16, 2011.
- Finney M, Smullen J, Foster HA, Brox S, Storey DM (2007). Effects of low doses of lactitol on faecal microflora, pH, short chain fatty acids and gastrointestinal symptomology. *Eur J Nutr*, 46:307-14.



REFERENCES

- Fitch C and Keim KS. Position of the Academy of Nutrition and Dietetics: Use of Nutritive and Nonnutritive Sweeteners. *J Acad Nutr Diet.* 2012;112:739-58.
- Freeman J, Hayes C (2004). 'Low-carbohydrate' food facts and fallacies. *Diabetes Spectrum*, 17:137-40.
- Gostner A, Schäffer V, Theis S, Menzel T, Lühns H, Melcher R, Schaubert J, Kudlich T, Dusel G, Dorbath D, Kozianowski G, Scheppach W (2005). Effects of isomalt consumption on gastrointestinal and metabolic parameters in healthy volunteers. *Br J Nutr*, 94:575-81.
- Grabitske HA, Slavin JL (2009). Gastrointestinal effects of low-digestible carbohydrates. *Crit Rev Food Sci Nutr*, 49:327-60.
- Grabitske HA, Slavin JL (2008). Low-digestible carbohydrates in practice. *J Am Diet Assoc*, 108:1677-81.



REFERENCES

- Hubrich B, Nabors LO (2006). Glycemic response. Published in *Food Product Design* Web site. Available at: www.foodproductdesign.com. Accessed September 7, 2011.
- International Food Information Council Foundation (2009). Sugar Alcohols Fact Sheet. Available at: http://www.foodinsight.org/Resources/Detail.aspx?topic=Sugar_Alcohols_Fact_Sheet. Accessed September 6, 2011.
- Kroger M, Meister K, Kava R (2006). Low-calorie sweeteners and other sugar substitutes: a review of the safety issues. *Comp Rev Food Sci Food Safety*, 5:35-47.
- Livesey G (2003). Health potential of polyols as sugar replacers, with emphasis on low glycaemic properties. *Nutr Res Reviews*, 16:163-91.



REFERENCES

- Nabors LO (2007). Regulatory status of alternative sweeteners. *Food Technology*, 61:24-32.
- Saulo AA (2005). Sugars and sweeteners in foods. University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources Cooperative Extension Service, *Food Safety and Technology* newsletter (FST-16).
- Storey D, Lee A, Bornet F, Brouns F (2007). Gastrointestinal tolerance of erythritol and xylitol ingested in a liquid. *Eur J Clin Nutr*, 61:349-54.
- Warsaw HS (2004). FAQs about polyols. *Today's Dietitian*, 6:36-44.
- Wheeler ML, Pi-Sunyer FX (2008). Carbohydrate issues: type and amount. *J Am Diet Assoc*, 108:S34-9.
- Wheeler ML et al. *Choose Your Foods: Exchange Lists for Diabetes*. 6th Edition, 2008: description and guidelines for use. *J Am Diet Assoc*. 2008;108:883.

