

**Preventive Dentistry
5th Year- Dental Students
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Lec. 15: Diet and Dental Caries (2):

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Non Cariogenic Sugar Substitutes:

A sugar substitute (; non-sugar sweetener) is defined as a food additive that provides a sweet taste like that of sugar while containing significantly less food energy. They are divided into **two** large groups:

- Nutritive sweeteners: which add some energy value (; calories) to food. It is sometimes referred as (***bulk sweeteners***).
- Non-nutritive sweeteners: which are also called (high-intensity sweeteners) because they are used in very small quantities as well as adding no energy value to food.

Nutritive and nonnutritive sweeteners enhance the flavor and/or texture of food. Nutritive sweeteners provide the body with calories, while nonnutritive sweeteners are very low in calories or contain no calories at all.

Some sugar substitutes are natural and some are synthetic. Those that are not natural are, in general, called (***artificial sweeteners***).

Nutritive Sweeteners (;bulk sweeteners):

Such as sugar alcohols, the body is unable to fully metabolize them, and consequently they tend to have fewer available calories per gram. The most common type are:

- **Sorbitol**: a polyol (sugar alcohol), a natural product found in many fruits including apples and pears. It is about 60 percent as sweet as sucrose with one-third fewer calories. It has a sweet, cool and pleasant taste. Sorbitol has been safely used in processed foods and also used in other products, such as pharmaceuticals and cosmetics. It is not metabolized by plaque bacteria thus it is **less cariogenic** than sucrose. It produces a cooling effect in the oral cavity thus used in chewing gum, toothpaste and mouthwashes and creates a refreshing effect.

- **Xylitol**: is a sugar alcohol (polyol). It looks and tastes like sugar but has lower calories. It occurs in small quantities in some fruit and vegetables, including strawberries and raspberries. The highest natural concentration being in the bark of birch trees. Xylitol was reported to be anti-cariogenic and therapeutic besides being non -cariogenic. Xylitol cannot be metabolized by cariogenic bacteria, thus it is not acidogenic, as it does not reduce plaque pH. The counts of mutans streptococci was reported to drop as a consequence of constant use of xylitol chewing gum. The replacement of sucrose by xylitol in dental plaque **starves the cariogenic bacteria**. Further, xylitol was reported to **enhance re- mineralization thus arrest initial caries**. Taking xylitol may increase the concentration of basic amino acids and ammonia in saliva and plaque (increase the plaque pH; alkalinity). Thus enhance re-precipitation of calcium and phosphate on tooth surface.
- **Mannitol**: is a sugar alcohol (polyol). It has a good flavor with little or no after taste. Used in a large number of medical applications. It is beneficial in the production of many processed foods and confectionery. It is not metabolized by plaque bacteria so it does not contribute to tooth decay.

Note: Sweetness of sugar: The relative sweetening power varies among sugar, the more easily sugar dissolves in water the greater sweetening power. Example fructose is 70% sweeter than other sugar. ***Sorbitol and mannitol are half as sweet as sucrose, Xylitol has the same sweetness as sucrose.***

Disadvantage of bulk sweeteners is that they are only partially absorbed in the small intestine and pass the colon where they may include osmotic diarrhea. Bulk sweeteners are not recommended for children under three years of age, and care must be taken with sugar – free medicine. In high intakes bulk sweetener may cause gastrointestinal disturbance.

Non- nutritive sweeteners:

They are synthetic compounds (; artificial sweeteners) that range between 160 and 13000 times as sweet as sucrose (; sucrose is the standard for the measurement of sweetness). As they are much sweeter than sugar so only small amounts are needed, thus referred to (**intense sweeteners**). They provide fewer calories per gram than sugar because they are not completely absorbed by digestive system.

Artificial sweeteners

Sweetener	Times sweeter than sugar	Calories	Brand name(s)
aspartame	200	4 kcal/g	Nutrasweet and Equal
saccharin	200–700	0	Sweet’N Low, Twin, and Necta Sweet
acesulfame-K (potassium)	200	0	Sunett and Sweet One
neotame	7,000–13,000	0	Neotame
sucralose	600	0	Splenda

SOURCE: Food and Drug Administration, U.S. Department of Health and Human Services.

Saccharin: has a bitter taste in a concentration over 0.1%, and reported to inhibit bacterial growth, but caries inhibiting effect are small.

Aspartame: consist of aspartic acid and phenylalanine, thus individual with genetic defect with phenylalanine should avoid it.

Acesulfame K: quickly perceptible and diminish gradually without any unpleasant aftertaste. It is useful sweetener in boiled sweet and preservers. The non – nutritive sweeteners are not metabolize by plaque bacteria thus they are not cariogenic.

Intense sweeteners:

- Have negligible energy value
- Cannot act as energy source for bacteria
- Permit caloric reduction
- Used in oral medication, mouth wash, toothpaste and all form of candy
- Chemically heterogeneous and chemically not related to sugar
- Not metabolize to acid by microorganisms
- Disadvantage in taste, stability, lack of volume, low physical weight.

Protective Food Constituents in relation to Dental Caries:

Food constituents may have a cariostatic effect, mostly related to the effect on saliva rather on tooth surface. Certain food factors may stimulate salivary flow rate thus enhancing cleansing activity, or act as a buffer to neutralize

acidity. However, presence of certain dietary minerals as fluoride and zinc may enhance re – mineralization of outer enamel surfaces.

Fibrous foods and caries: their effectiveness in caries prevention is more likely to be related to ***mechanical stimulus of salivary flow*** than effective plaque removal. The consumption of foods that require a lot of chewing produces a more salivary flow with ***an increased buffering capacity***, thereby more effectively neutralizing plaque acids and aiding oral clearance of food debris. Certain fruits however, may possess other anti caries activity. Apples for example, contain condensed tannins which have ***anti- adhesion properties*** that may inhibit some bacteria from bonding to each other and producing dental plaque. Fruits as lemons, fruit juices are sufficiently acidic when in prolong contact with tooth, may cause dental erosion.

Phosphate: Phosphates may cause a significant caries reduction. **Sodium metaphosphate** appears to be most effective. Although the precise mechanisms of action are not known. Unrefined grain, such as oat hulls, that contain a relatively high **phytate** (organic phosphate) content have some inhibiting effects on caries. Several studies have documented significant caries reductions when **dicalcium phosphate dihydrate** was added to chewing gum, and when calcium sucrose phosphate was added to hard candy, flour and bakery products.

Note: phytate: It can bind to minerals as Ca, Mg, Iron reduce their absorption from gut. It is not advice to be used as food additives.

Milk, Cheese and Yogurts: The high calcium and phosphorus content seems to be a factor in the cariostatic mechanism of these food. Both casein and protein in these food seem to be involved in the reduction of enamel demineralization.

Experimental studies have also shown that cheese prevents demineralization, increases salivary flow rate and pH, and raises the calcium concentration of dental plaque, hence favoring re-mineralization. Cheese contains significant amounts of tyramine, which could be used by microorganisms to raise the pH value of plaque. Cheese also contains a diverse range of fatty acids, many of which are potent antimicrobial agents.

Appendix

Taste desire are acquired at:

- Intra uterine life
- Nursing (breast or bottle)
- Solid food eating
- Non -specific food eating
- Specific food eating

At birth taste bud of infants show a preference to sucrose more than other type of sugar.

Sorbitol: a derivatives of glucose found in fruits as apples, pears and peaches and in vegetables. Eating sorbitol reduce the onset of hunger. It is designed with weight – reducing diets, and as non- insulin stimulating carbohydrate used in diabetic food. Oral microflora may adapt to sorbitol so loses its safeness for teeth.

Mannitol: less popular than sorbitol, higher price, and similar dental properties. Used in tooth paste, mouth wash and dusting product in chewing gum.

Human breast milk is higher in lactose and lower in phosphorous and calcium than bovine (cow's milk).

Cow's milk can be used as an artificial saliva because of its protective properties.

It is advice to consume whole fresh fruits as opposed to fresh fruit juices, as their mastication stimulate salivary secretion. Fresh fruit contain non milk extrinsic sugar.