

Dark Chocolates: Friend or Foe – A Review

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Abstract:

Dental caries is a complex and dynamic process that involves both physicochemical & biological activities. One of the factors responsible for dental caries is cariogenic food. Chocolate being one of the junk food items, a very common misapprehension states it as main cause of dental caries, which is not true. Chocolates are one of the most beneficial and nutritious foods that nature can provide precisely dark chocolates. It is derived from the cocoa (also called as cacao). Dark chocolates (around 50%-60%) are semisweet in taste and extra dark chocolates (75%-90%) are bittersweet in taste. Plain chocolate, black chocolate or sour chocolate are some another names of dark chocolates. There are various types of chocolates which include dark chocolate. Although not every kind of chocolate is tooth friendly but the cocoa bean is the main good component, that make the chocolate healthier. Cocoa beans contain many minerals, antioxidants that not only good for the mouth and teeth but also the whole body system. Another phenolic compound found in cocoa husk beans is theobromine. These contents according to various studies conducted has shown anticariogenic properties. The most commonly associated microorganisms

identified from carious lesions are Streptococcus mutans and Lactobacillus acidophilus. These substances have been shown to interfere with bacterial adhesion on the tooth surface and thus resulting in decreased microbial count. Polyphenol decreases the microorganisms that are present in the oral cavity, and prevent halitosis. It contains flavonoids that helps to suppress the periodontal problems and also has a role to slow down the caries progression. This review is highlights the different types of chocolates, the contents of dark chocolates, the health benefits of dark chocolates with emphasis on anticariogenic properties.

Keywords: *Dark chocolate, Theobromin, Cocoa, Anticariogenic properties, Plaque control, Dental caries*

Introduction

Is eating “healthy” means eating bland or unflavored food? No, it is not always true. Some of the nutritious foods found in nature are not only healthy but also delicious. For example fruits, herbs, meat and chocolates. But “how come the chocolates are healthy”? Chocolate always receives bad impression as it contains sugar and fat in high amount. It is always associated with obesity, hypertension, coronary heart disease, diabetes mellitus and dental caries.^[1]

What happens if dental caries remain untreated? ^[2] If dental caries remain untreated, there would be not only the caries progression but also other issues could make it a path like unable to eat, sleep, unable to concentrate etc.

Dental caries is a biofilm-mediated, sugar-driven, multifactorial, dynamic disease that results in the phasic demineralization and remineralization of dental hard tissues. ^[3] This disease is one of the most prevalent chronic disease of people. It is a complex and dynamic process that involves both physicochemical & biological activities.^[4] The microorganisms, that are mainly identified from carious lesions are *Streptococcus mutans*, *Lactobacillus acidophilus*, and *Actinomyces viscosus* ^[5]

Dental caries cannot be reversed. Despite the accessibility of paediatricians and paediatric dentists across India, the first dental visit for kids is usually an ignoring aspect.^[6] Therefore, Pediatric dentistry broadly classified the treatment into preventive aspect and the restorative aspect.^[7] In preventive aspect, there are some natural ways that helps to prevent dental caries by avoiding sticky and sweet food stuffs and frequent snacking and sipping, regular tooth brushing with proper technique and by using fluoride toothpaste, consider dental visits and topical applications of sealants and fluorides (if deep pits and fissures), eat tooth healthy foods like low-fat milk, curd, cheese, tofu, soy milk, eggs, nuts, dark green leafy vegetables, fish, lean meat, beans and chocolates.^[8]

Chocolate being one of the junk food items, a very common misapprehension states it as main cause of dental caries, which is not true. Chocolates are one of the most beneficial and nutritious foods that nature can provide precisely dark chocolates. ^[9] It is derived from the cocoa (also called as cacao). Dark chocolates (around 50%-60%) are semisweet in taste and extra dark chocolates (75%-90%) are bittersweet in taste. Plain chocolate, black chocolate or sour chocolate are some another names of dark chocolates. ^[10]

Origin of Dark Chocolates

Dark chocolate was first seen around 3,000 years. ^[11] As a beverage, it was then evolved in Central and South America around 1900 B.C. At that time period, It was the only form of chocolate that was obtainable. Later, it became an unusual and special beverage that offered during ceremonial functions for the Aztecs and Mayans. It was also quite popular as therapeutic purposes. Pure dark chocolates are bitter in nature, therefore being modified over the years.

Production of milk chocolates- Chocolates were discovered in Spain in early 1500s then introduced back to Europe with addition of sugarcane and honey to making it sweeter paving the way of milk chocolate production. Around 1600s, Hans Solan who resided in Jamaica, he added milk to the dark chocolate just to bitter down its taste. In 1847, milk chocolates were invented by two people, first was Daniel Peter and the second one was Henri Nestle, they added “condensed milk”. Then chocolates were prepared into the solid forms. With this around 20th century, there was a mass production of milk chocolates, and soon it became more popular than the dark chocolates. But now dark chocolates has also regained some popularity and attention due to its valuable health benefits. ^[12]

Types of Chocolates ^[13]

Chocolates is of three types

Dark Chocolates

Milk Chocolates

White Chocolates

Composition of Chocolates ^{[12][13]}

Dark Chocolates

the major constituent in dark chocolate is the

- 50%-90% Cocoa beans which includes
 - Theobromine 1.2%-2.4% ^{[14][15]}
 - Minerals contents like iron (Fe), magnesium(Mg), zinc(Zn), copper(Cu), potassium(K), selenium(Se), phosphorus(P), manganese(Mn),
 - antioxidants like tannins, polyphenols and flavanols (flavanols includes monomers, epicatechins, and catechins)
- Cocoa butter
- Sugar

Other products of cacao bean husk origin:

Cocoa husk is routinely used in pellet form for animal feeding, utilized as fertilizers for soil and manufacturing of soft soaps owing to its potash content. ^[16]

Milk Chocolates ^{[14][15]}

- 10-50% cocoa solids which includes
 - Theobromine

- Minerals like iron (Fe), potassium(K), magnesium(Mg), manganese(Mn), copper(Cu), phosphorus(P), selenium(Se), zinc(Zn)
- antioxidants like tannins, polyphenols and flavanols (flavanols includes monomers, epicatechins, and catechins)

- Sugar
- Cocoa butter
- Milk

White Chocolates^{[14][15]}

- Milk
- Cocoa butter
- Sugar

Health Benefits of Dark Chocolates

1. Dark chocolates can reduce risk of atherosclerosis by renewing the flexibility of arteries and prevent the margination of leucocytes .^[17]
2. The cocoa beans containing flavanol that have potential to prevent cardiometabolic disorders.^[18]
3. Dark chocolate contains high amount of polyphenol which improving the endothelial function and lowering down the blood pressure of patients in stage I of hypertension.^[19]
4. Dark chocolate improves the circulation to protect against type II diabetes mellitus and also helps the blood vessels to remain healthy. Dark chocolates contain flavanoids that helps to reduce the insulin resistance. Flavanoid helps the cells to function normally and retrieve its ability to use the insulin efficiently in the body.^[20]
5. Dark chocolate improves the cognitive activity by increasing the brain blood flow as well as heart. The essential compounds contents provide stimulant action causing beneficial effect on brain and the cognitive health. Phenylethylamines incites release of endorphins from brain increasing alertness.^[21]
6. Caffeine content (less than coffee), which is a mild stimulant helps in alertness, weight loss, enhances the sport performance, boost the brain functions, helps in memorizing stuffs etc.^[22]
7. Dark chocolate contains antioxidants that protect against the free radicals (an uncharged molecules) which causes the oxidative stress or damage to the cells.^[23] It protects the body from different type of tumors and cancers and also lower the signs of aging.^[24]

Dark Chocolates with anticariogenic property

Dark chocolates (*Theobroma cocoa*) contains theobromine, that harden the tooth enamel and also reduces the risk of dental caries.

Theobromine

It is also called as xantheose, is a bitter alkaloid of the cocoa plant. Chemical formula is $C_7H_8N_4O_2$. It is chiefly found in the chocolate, tea plant leaves and kola nut.^[25]

Theobromine levels are found more in dark chocolates (around 10 g/kg) than the milk chocolates (approximately 1-5 g/kg). More amount of cocoa beans containing chocolate tends

to contain more theobromine level than the one which has less amount of theobromine level. Naturally, around 300-1200 mg/ounce of theobromine contain in the cocoa beans.^[26]

Anticariogenic action of theobromine

Streptococcus mutans is attributed as the main causative agents of dental caries in humans beings. It produces three types of glucosyltransferase (GTF)- GTFB, GTFC, and GTFD. It synthesizes glucan which is an adherent and water insoluble from sucrose thereby adhering to the surface of the tooth firmly^[27]. The adherent glucan in which the accumulation of acids occurs contributes to dental plaque formation resulting in localized demineralization of the enamel surface of the tooth^[28]. Cocoa bean husk contain higher molecular-weight of polyphenolic compounds that has the firm anti-glycosyltransferase property. The unsaturated free fatty acids contents like oleic acids, linoleic acids etc, have antibacterial activity against *S. mutans*. These biologically functioning compounds confer cacao bean husk cariostatic properties.^[27] Studies done to identify the mechanism of action of anticariogenicity of theobromine compound showed formation of an apatite structure medium that enhances the remineralization of the tooth surface.^[29]

According to the studies, scientists have discovered that the cocoa beans extracts (theobromine) are better than fluorides to protect the teeth.

An in vitro study, there was a comparison between antimicrobial activity in 3 subjects. First is the theobromine toothpaste which is a chocolate based non fluoride toothpaste, rest two were the commercially available fluoride toothpastes.^[30] Results showed that the theobromine toothpaste showed not only the greater zone of inhibition of microorganism compared to other fluoride toothpastes but also showed the re-mineralisation of enamel due to the absence of non-toxic fluoride and therefore it easily blend with calcium and phosphate to increase the enamel remineralization process.

Theobromine toothpaste are also best in the patients who has dental fluorosis, tooth discoloration, enamel hyperplasia.^{[31][32]}

Another study comparing chlorhexidine mouth wash with cacao bean husk extract mouth wash as antibacterial agent showed comparable significant reduction of *Streptococcus mutans* counts in saliva in both the groups at all follow-up intervals thus proving to be a good alternative to chlorhexidine mouth rinse.^[33]

Conclusion

Dark chocolates can actually be good for our teeth. It can prevent dental caries. Although not every kind of chocolate is teeth friendly but the cocoa bean is the main good component, that make the chocolate healthier. Cocoa beans contain many minerals, antioxidants that not only good for the mouth and teeth but also the whole body system. Most importantly, they help to prevent caries by inhibiting the microorganism from sticking to the teeth. Polyphenol decreases the microorganism that present in the oral cavity and prevent halitosis. It contains flavonoids that helps to suppress the periodontal problems and also has a role to slow down the caries progression.

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