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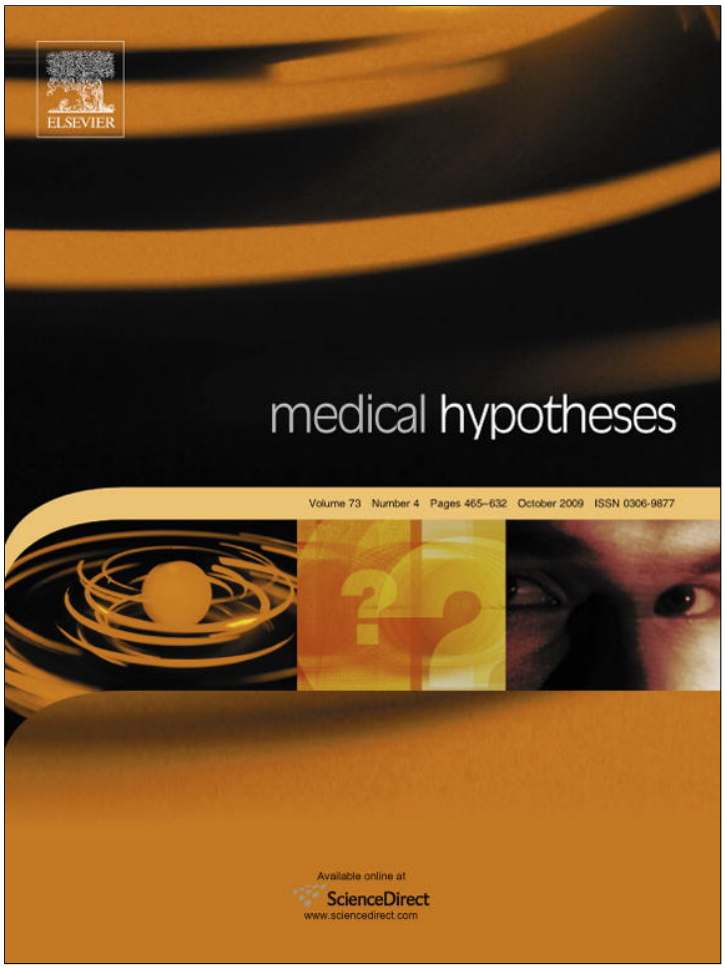

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Towards tooth friendly soft drinks

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SUMMARY

Most soft drinks contain high concentration of simple carbohydrates and have a pH of 3 or even lower. Therefore, they are harmful for tooth structure. A tooth friendly soft drink (T.F.S.D) should have the following characteristics and elements; fluoride (approximately 1 ppm), casein phosphopeptide–amorphous calcium phosphate (2%), xylitol (4–6 g/serving), tea polyphenols (2–4 mg/ml), cranberry extract (250 mg/ml of the flavonoids quercetin and myricetin), sugar free, pH close to 5.5 and super oxygenation (240,000 ppm) vs. carbonation. T.F.S.D can be packaged in a container which gaseous oxygen is dissolved in a liquid in the form of bubbles. However, looking at opportunities for so-called sophisticated soft drinks, T.F.S.D will be an example for a functional and health oriented soft drink.

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Introduction

Tooth decay is caused by specific types of acid-producing bacteria e.g. *Streptococcus mutans.* They ferment carbohydrates such as sucrose and glucose producing organic acids e.g. lactic acid. The mineral content of teeth is sensitive to increases in acidity. Specifically, a tooth (which is primarily mineral in content) is in a constant state of back-and-forth demineralization and remineralization between the tooth and surrounding saliva. When the pH at the surface of the tooth drops below 5.5 demineralization proceeds faster than remineralization (i.e. there is a net loss of mineral structure on the tooth surface). This results in the ensuing tooth decay.

Most soft drinks contain high concentration of simple carbohydrates e.g. glucose and sucrose [1]. Thus, sweetened beverages are likely to increase risk of dental caries. Furthermore, a large number of soft drinks are acidic and some may have a pH of 3 or even lower [1]. Drinking acidic drinks over a long period of time and continuous sipping can therefore be harmful for tooth.

The hypothesis

A tooth friendly soft drink (T.F.S.D) should contain the following characteristics and elements:

Fluoride

It is well known that fluoride is a key agent in reducing the prevalence of dental caries by encouraging repair (remineralization) of early damage to enamel, improving the chemical structure of the enamel and reducing the ability of the plaque bacteria to produce acid [2]. Hence, T.F.S.D should contain fluoride at a concentration of approximately 1–1.2 ppm.

Casein phosphopeptide–amorphous calcium phosphate (CPP–ACP)

It has been shown that CPP–ACP prevent enamel demineralization and promote remineralization of enamel subsurface lesions in animal and human in situ caries models [3]. The anticariogenic potential of CPP–ACP has been attributed to the ability of the CPP to localize amorphous calcium phosphate at the tooth surface, thereby helping to maintain a state of supersaturation with respect to tooth mineral [3]. Recently, the CPP–ACP has been shown to interact with fluoride ions to produce an additive anticariogenic effect through the formation of a stabilized amorphous calcium fluoride phosphate phase [4]. Hence, T.F.S.D should contain CPP–ACP at a concentration of 2%.

Xylitol

Xylitol is a naturally occurring, low-calorie sugar substitute with anticariogenic properties. Xylitol, a sugar alcohol, can reduce the occurrence of dental caries. Short-term consumption of xylitol is associated with decreased *S.* mutans levels in saliva and plaque [5]. Hence T.F.S.D should contain xylitol 4–6 g/serving. Please note Xylitol doses of about 0.5 g per kg body weight may result in transient diarrhea [6].

Tea polyphenols (T.P)

It has been proved that T.P can inhibit the sucrose-dependent adherence of oral cariogenic bacterium to the tooth surface. They can inhibit the preliminary adherence of *S.* mutans and *Actinomyces viscosus* effectively. T.P may prevent enamel from

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caries by decreasing the adherence of main cariogenic bacterium to salivary acquired pellicle [7]. Hence T.F.S.D should contain T.P at a concentration of 2–4 mg/ml.

Cranberry extract

It has been demonstrated that cranberry extract prevented adhesion of the bacteria *S.* mutans to teeth [8]. Flavonoids quercetin and myricetin, and their corresponding glycosides can inhibit the glucosyltransferase enzymes associated with dental plaque formation [9,10]. Also, flavonoids inhibited the drop in pH [10]. Hence, T.F.S.D should contain 250 mg/ml of the flavonoids quercetin and myricetin.

Sugar free

It is clear that T.F.S.D should not contain simple carbohydrates e.g. glucose and sucrose. It can be sweetened with alternative and artificial sweeteners such as aspartame or isomalt or acesulfam K.

pH

Ideally pH of T.F.S.D should be 5.5 or upper. Yet it may cause some difficulties to reach an acceptable taste. Hence, in practice it should be as close as possible to 5.5. An example of this approach is pH of the Baraq's Root Beer/diet which is near to 4.55 [1].

Oxygenated vs. carbonated

Carbonation causes decrease in pH. Yet it is not acceptable in dental point view. We can use oxygenation instead of carbonation. The oxygen content of tap water contains approximately 5–7 ppm, running water of rivers and streams as much as 10 ppm. Currently available super Oxygenated water (S.O.W) contains 24% by volume, or 240,000 ppm oxygen. Manufactures claim that S.O.W cause feeling of increased energy and vitality and to assist in an overall feeling of wellness (http://provitwater.com/html/oxygen.html). Of more interest, oxygenated beverages are effective against oral halitosis [11].

Evaluation of the hypothesis

Oxygen is relatively insoluble in water. Hence, one of the possible problems associated with this hypothesis is packaging of super oxygenated T.F.S.D. A Russian invention [12] helps us in this regard. It relates to containers for storing beverages saturated with oxygen in which gaseous oxygen is dissolved in a liquid in the form of bubbles, at a pressure above the surface of said liquid and in a closed sealed container. The inventive oxygenated beverage-containing container is hermetically sealed, contains an oxygen-saturated liquid and oxygen there above and is made of plastic material, metal, or glass. The container wall thickness is defined by an internal pressure which is equal or less than 7.0 atm. The quantity of oxygen dissolved in the liquid ranges from 5 to 200 mg/l when the liquid is saturated with oxygen by supplying it at a pressure ranging from 1.05 to 7.1 atm and a temperature ranging from 0.5 to 37.5 °C. Said invention makes it possible to ensure a long-term storage of different media in one container without deteriorating the properties thereof, to optimally select conditions and modes of said media, exclude destruction of the containers for storing compressed media by optimally selecting materials for producing said container and to improve conditions for individual use thereof for public catering.

Another criticism with this hypothesis is matter of taste. With respect to upper pH, the taste of T.F.S.D will not similar to routine carbonated soft drinks. As beverage groups increasingly look to launch soft drinks that can shake their often child orientated image, analysts suggest that functionality and health claims will be key factors in meeting this demand [13]. On the other hand, looking at opportunities for so-called sophisticated soft drinks, some company believes that taste, above all else, will be the key driver factor in differentiating its product [13]. Hence, T.F.S.D with different taste and functionality will be useful in this regard.

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