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OVERVIEW OF SUGAR-FREE PRODUCTS IN SAUDI ARABIA

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ABSTRACT

Aim: Sugar-free products have several advantages in protecting teeth against dental caries. The objective of this study was to assess the available sugar-free products in the Saudi market and to determine the most common sugar substitutes found in these products.

Materials and Methods: Products carrying the labels such as "sugar-free" or "no sugar" from five major stores in Jeddah, Saudi Arabia were collected. Special emphasis was given to products commonly used as snacks. The type and percentage of each sugar substitute were investigated by checking the product's label or by contacting the manufacturer. Descriptive analysis of sweeteners' type and concentrations were performed.

Results: The majority of products had some missing information regarding the type or concentration. Some products contained some carbohydrates such as sucrose. The main sugar substitutes were sorbitol and sucralose in gums and sweeteners, respectively. Acesulfam-K was found in 64% of the products whereas xylitol was present in only 16% with average concentration of 0.6 g/pellet in chewing gums.

Conclusion: Several products contain a mixture of different sugar substitutes. The type of the main sweetener was dependent on the product category. Acesulfam-K and aspartame were the major sugar substitutes found. Overall xylitol concentration was low.

KEYWORDS: Sugar free products, Sugar substitutes, Xylitol, Caries prevention, Xylitol & caries prevention

INTRODUCTION

The primary reason individuals use sugar substitutes is for caloric control (Olivier, Serge et al. 2015); however, an important benefit that is often overlooked by patients is to use these products to control for dental caries. Still, patients crave the sweet taste; thus, sugar substitutes are used. The main two types of sugar substitutes are *bulk sweeteners* and *intense sweeteners*. Bulk sweeteners, also known as sugar alcohols or nutritive sweeteners, are carbohydrates or carbohydrate derivatives that provide energy and have less of a sweet taste than intense sweeteners. This group

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includes: sorbitol, mannitol, lactitol, isomalt maltitol, xylitol, and erythritol (Ly, Milgrom et al. 2006). Among these, xylitol has the most potential against dental caries owing to its anticariogenic potential (Makinen, Bennett et al. 1995). Multiple studies showed the antibacterial effect of xylitol in reducing the numbers of *Streptococcus mutans* in plaque and saliva (Trahan 1995; Maguire and Rugg-Gunn 2003; Ly, Milgrom et al. 2006; Ghezzi 2014). Another sugar alcohol is sorbitol that is the standard sugar alcohol used in chewing gums as it is cheaper than xylitol and still considered low cariogenic (Burt 2006). Research showed that chewing gums containing sugar alcohols reduces caries occurrence when chewed after meals (Van Loveren 2004; Soderling 2009).

Intense sweeteners provide very little or no energy and produce a more sugary taste; allowing the use of minute amounts to produce a taste comparable to sucrose (Olivier et al. 2015). These non-nutritive sweeteners are not fermented by oral microorganisms and considered as non-cariogenic (Peldyak and Makinen 2002; Zero 2008). This group includes: saccharine, acesulfam-K, neotame, cyclamate, aspartame, and sucralose.

Both types of sugar substitutes can be found in several products ranging from chewing gums and candy to chocolate and confectionaries. Knowledge of these products is very important to both dentist and patient in order to decrease dental caries and improve the caries risk status of patients. Consequently, the main aim of this study was to review sugar-free products available in local stores in Jeddah, Saudi Arabia and report the types and concentrations of the different sugar substitutes.

MATERIALS AND METHODS

Three major grocery stores and two pharmacies in Jeddah, Saudi Arabia were visited and products carrying the "sugar-free" or "no sugar" labels were collected. These products were mainly the food items consumed as snacks or dietary sweeteners. Major sugar alternatives were identified based on nutritional facts box on the product. Products containing any amount of carbohydrates (such sucrose or lactose) as the sweetener were excluded. Percentage of each sweetener was recorded according to label. If such information was not available, contacting the manufacturer was done to determine the concentration of each component. If manufacturer cannot be reached, the concentration for a specific sugar substitute was labeled as "Unspecified" for that particular product. Analysis of the sweeteners' type and concentrations were done.

RESULTS

Forty nine products labeled as "sugar-free" or "no sugar" were identified (Figure 1). Among these, five products were excluded because they contain sugars or due to missing information about the sweetener used. The 44 remaining products distribution was as follows: 10 brands of chewing gum (Table 1), 8 Candies, 4 lozenges (Table 2), 9 chocolates (Table 3), 6 sweeteners, and 7 drinks (Table 4). Approximately 55% (24 products) of these products contained some missing information regarding all or some of the sweeteners found within them.

Table 5 shows the distribution of the 11 most commonly found sugar substitutes across the six product categories. The main sugar substitute in chewing gums was sorbitol that was found in all of the brands and as the main sweetener in 60% of chewing gums (Table 5 and Figure 2). Aspartame and acesulfame-K were found in 9 out of the 10 chewing gum brands and were followed by mannitol and xylitol. Isomalt was the most common sweetener in lozenges while sucralose was the most abundant in dietary sweeteners used for coffee or tea. The most common sweeteners in sugar-free chocolates were maltitol and acesulfame-K. Regarding sugar-free drinks, acesulfame-K and aspartame were the most common sweeteners.

Overall, regardless of concentration, the most common sugar alcohol was sorbitol and was found in 19 out of the 44 products (43.2%). Intense sweeteners were found in the majority of the products with acesulfame-K found in 63.6% of the products followed by aspartame (50%) and sucralose (38.6%).

Due to the importance of xylitol in caries prevention and management, the xylitol concentration needed to produce an anticariogenic effect (6 grams daily) was calculated for the major xylitol-containing chewing gums (Table 6). Only two products can produce such an effect with the consumption of a reasonable amount of chewing gum pellets.

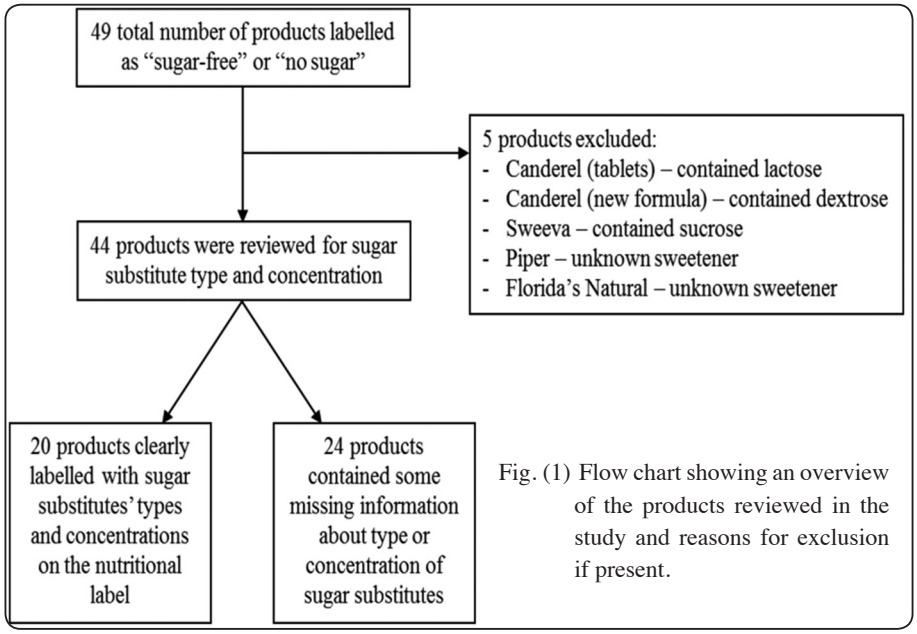

Fig. (1) Flow chart showing an overview of the products reviewed in the study and reasons for exclusion if present.

TABLE (1) Sweetener concentrations found in 10 brands of sugar-free chewing gums

Product	Sweetener 1	Conc. (%)	Sweetener 2	Conc. (%)	Sweetener 3	Conc. (%)	Conc. of remaining sweeteners (%)
Extra	Sorbitol	*	Mannitol	*	Aspartame	0.5	0.5
Mentos (White)	Maltitol	27.7	Sorbitol	23.5	Xylitol	15.8	2.8
Mentos (juice Blast)	Maltitol	48.6	Sorbitol	8.1	Xylitol	2.9	4.5
Cheque (Spicy Liquorice)	Sorbitol	37	Isomalt	31	Xylitol	4	2.7
SMINT	Xylitol	37	Sorbitol	32	Aspartame	*	*
Turbulence	Sorbitol	*	Mannitol	*	Aspartame	0.5	0.4
Spearmint	Sorbitol	60.6	Isomalt	5.0	Maltitol Syrup	5.0	*
Klast	Sorbitol	*	Mannitol	*	Aspartame	*	*
Nova	Sorbitol	*	Maltitol Syrup	*	Mannitol	*	*
Elma	Xylitol	*	Sorbitol	*	Mannitol	*	*

**** Unspecified concentration***

TABLE (2) Sweetener concentrations found in 8 brands of sugar-free candies and 4 brands of lozenges

Product	Form	Sweetener 1	Conc. (%)	Sweetener 2	Conc. (%)	Sweetener 3	Conc. of remaining sweeteners (%)
Halls	Candy	Isomalt	97	Sucralose	0.04	Acesulfame-K	0.03
SMINT	Candy	Sorbitol	89.4	Aspartame	0.5	-	-
Werther's Original	Candy	Isomalt	86.5	Acesulfame-K	*	-	-
GoLightly	Candy	Sucralose	*	-	-	-	-
Virginias (FruitSin)	Candy	Maltitol Syrup	*	-	-	-	-
Compass (Black Currant)	Candy	Sorbitol	*	Xylitol	*	Sucralose	*
Ice Breakers (sours)	Candy	Sorbitol	*	Maltitol	*	-	-
NuNu (Tangerine-Watermelon)	Candy	Sorbitol	93.2	Aspartame	0.1	Acesulfame-K	0.04
Pulmoll	Lozenges	Isomalt	87.3	Maltitol Syrup	8.6	Sorbitol	0.4
Ricola	Lozenges	Isomalt	*	Sorbitol	*	Aspartame	*
Vicks	Lozenges	Isomalt	*	Acesulfame-K	*	Sucralose	0.03
Strepsils	Lozenges	Isomalt	*	Maltitol Syrup	*	Saccharine	*

**** Unspecified concentration***

TABLE (3) Sweetener concentrations found in 9 brands of sugar-free chocolates

Product	**Sweetener 1**	**Conc. (%)**	**Sweetener 2**	**Conc. (%)**	**Sweetener 3**	**Conc. of remaining sweeteners (%)**
Balance	Maltitol	21.0	Lactitol	19.5	-	-
Virginias (Chocolate Negro)	Maltitol	*	-	-	-	-
Virginias (B-San)	Maltitol	*	Maltitol Syrup	*	Acesulfame-K	*
Voortman	Sorbitol	*	Aspartame	*	-	-
Dietoos	Maltitol	*	Acesulfame-K	*	Sucralose	0.5
Chocolate Stella (Gianduja)	Lactitol	40.0	Aspartame	*	Acesulfame-K	*
Chocolate Stella (Noir)	Lactitol	36.4	Aspartame	0.04	Acesulfame-K	0.04
De Bron (chocolate Wafer)	Maltitol	*	Acesulfame-K	*	-	-
Canderel (Crispy Almond)	Maltitol	*	Aspartame	0.23	-	-

**** Unspecified concentration***

TABLE (4) Sweetener concentrations found in 6 brands of sugar-free dietary sweeteners and 7 brands of drinks

Product	Form	Sweetener 1	Conc. (%)	Sweetener 2	Conc. (%)	Sweetener 3	Conc. of remaining sweeteners (%)
Tropicana Slim (packets)	Sweetener	Sorbitol	99.0	Sucralose	0.5	Acesulfame-K	0.4
Sweet' n Low	Sweetener	Aspartame	*	Acesulfame-K	*	-	-
Hermesetas Gold	Sweetener	Aspartame	1.8	-	-	-	-
Steviana	Sweetener	Sucralose	*	Sorbitol	*	-	-
Splenda	Sweetener	Sucralose	*	-	-	-	-
Stevia (Canderel)	Sweetener	Erythritol	98.9	-	-	-	-
Coca Cola (Zero/ Light)	Drink	Aspartame	0.02	Acesulfame-K	0.02	-	-
Darina (Pineapple)	Drink	Aspartame	0.03	Acesulfame-K	0.02	-	-
Red Bull (Sweetener Free)	Drink	Acesulfame-K	*	Aspartame	*	-	-
Vimto Fizzy Zero	Drink	Sucralose	*	Acesulfame-K	*	-	-
Fruit Shoot	Drink	Sucralose	*	Acesulfame-K	*	-	-
B Cola Light	Drink	Aspartame	*	Acesulfame-K	*	-	-
Super Ananas (stick-packs)	Drink	Sucralose	*	-	-	-	-

**** Unspecified concentration***

TABLE (5) Overview of the distribution of sugar substitutes across the six product categories showing the number of products within each category

Sugar substitute	Type	Chewing gum	Candy	Lozenges	Chocolate	Dietary sweetener	Drinks	Total
Sorbitol	Polyol	10	4	2	1	2	0	**19**
Mannitol	Polyol	8	0	0	0	0	0	**8**
Maltitol	Polyol	2	1	0	6	0	0	**9**
Maltitol Syrup	Polyol	4	1	2	1	0	0	**8**
Lactitol	Polyol	0	0	0	3	0	0	**3**
Isomalt	Polyol	2	2	4	0	0	0	**8**
Xylitol	Polyol	6	1	0	0	0	0	**7**
Erythritol	Polyol	0	0	0	0	1	0	**1**
Aspartame	Intense	9	2	1	4	2	4	**22**
Acesulfame-K	Intense	9	4	2	5	2	6	**28**
Sucralose	Intense	5	3	1	1	4	3	**17**

TABLE (6) Overview of the chewing gums containing xylitol

Product	Xylitol concentration (%)	Xylitol order among other sweeteners in the product	Total weight of container (g)	Number of pellets	Weight of pellet (g)	Xylitol weight in each pellets (g)	Number of tablets to reach anticariogenic level*
Mentos (White)	15.8	3rd	540	38	14.2	2.24	2.68
Mentos (juice Blast)	2.9	3rd	13.2	8	1.65	0.05	120.0
Cheque (Spicy Liquorice)	4	3rd	16	12	1.3	0.05	120.0
SMINT	37	1st	13.9	8	1.7	0.64	9.4
Spearmint	5	4th	25	28	0.9	0.04	150.0

**** Based on 6 g/day dose***

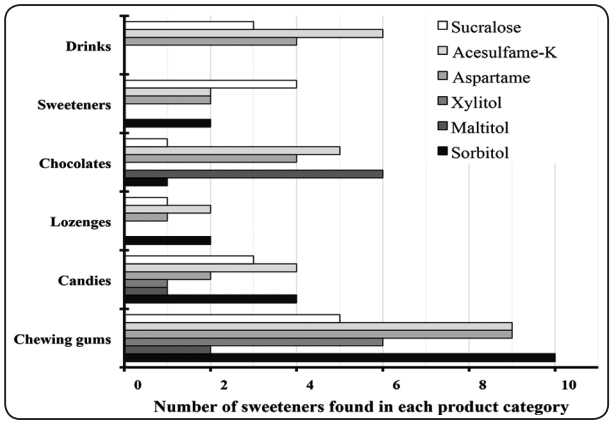

Fig. (2) Bar graph showing the frequency of sugar substitutes in relation to products' categories.

DISCUSSION

Sugars substitutes, including sugar alcohols and intense sweeteners, are considered noncariogenic or low cariogenic and are effective in controlling dental caries (Imfeld 1999). This study was conducted to familiarize dental professionals in Saudi Arabia to the available sugar-free products and their ingredients and concentrations. It is worth noting that some products labelled as "sugar-free" actually contained sugars (Figure 1). Thus, a professional should always check the nutritional label on the product and instruct their patients to do so as well.

The majority of the products had some missing information regarding the type or concentration of the included sweetener. This is a cause of concern since the lack of such detailed information could have some health-related or dietary consequences. Governing agencies should mandate complete details of all ingredients of food products in general and sugar-free items in particular since these are often used by special groups of individuals who might have debilitating conditions.

All products reviewed in the current study contain mixtures of sugar substitutes with some products containing as many as eight compounds (data not shown). However, the first three sweeteners included on the product label are the more relevant since they constitute the main concentration of sugar substitutes. Usually, the fourth compound and onwards constitute a small fraction (<5%); hence they were combined together when presented in the tables.

Although the benefit of xylitol against dental caries is well documented because it is not metabolized by *Streptococci mutans* (Ghezzi 2014), it was found in only 39% of chewing gums and candies in the Saudi market (Tables 1, 2 and 5).

This percentage would be even lower (16%) if we considered the distribution of xylitol across all sugar-free products. The recommended dose of xylitol to achieve a preventive/therapeutic dental effect is 5-6 g per day when used as chewing gum over 3-4 doses with 5-10 minutes of exposure per dose (Peldyak and Makinen 2002; Milgrom, Ly et al. 2009; Twetman 2010). In this study, only two chewing gums can deliver such a dose with chewing of a reasonable number of gum pellets. Still, we found 5 products where the xylitol concentration was clearly labeled. This is in contrast to Alanzi and colleagues who found only one product out of twelve reviewed to be labeled (Alanzi, Soderling et al. 2016); however, they reviewed products from all the Gulf Cooperation Council (GGC) countries. The mean weight of gum pellet recorded was 3.95 ± 5.74 g compared to 1.67 ± 0.38 g in Alanzi's report. This discrepancy is mostly related to the "Mentos – White" product that contained pellets with 14.2 g weight. Xylitol concentration in each pellet was also different (0.60 ± 0.95 g compared to 0.33 ± 0.21 g) for the same reason.

The majority of sugar-free products found in the Saudi market contain sorbitol as a bulk sweetener. Sorbitol is not as effective as xylitol in decreasing the numbers of *S. mutans*. However, it produces less acid when fermented and its use is still recommended from dental point of view (Birkhed, Svensater et al. 1990). Sorbitol concentration was relatively low in chocolates and dietary sweeteners. Maltitol was the second most common polyol; however, it was the most abundant sugar substitute in chocolates indicating a low cariogenic potential of such products.

Nearly all sugar-free products present in this study contain aspartame as an intense sweetener. The consumption of chewing gums is not very high in Saudi Arabia; however, the consumption of tea and coffee is very common. This gives a lot of importance to dietary sweeteners more than other sugar-free forms. The majority of these sweeteners contains forms of intense sugar substitutes as the main ingredient and will not promote dental caries. Only three products (Tropicana slim, Steviana, and Stevia) contain sugar alcohols. Research concerned with depicting the attitudes towards the use of these sugar substitutes in Saudi Arabia is currently lacking and will be the focus of future studies.

The use of sugar-free products is potentially beneficial to certain group of people who have issues with increased consumption of sugars; still in order to decrease the caries risk for the patients, multiple factors including: saliva, fluoride, and improving oral hygiene play a role along with the reduction of sugars and the use of these products (Featherstone 2004). This is really relevant to the Saudi population who does not maintain good oral hygiene and are exposed frequently to cariogenic foods as found in a recent study (Amin and Al-Abad 2008). Findings from the same investigation revealed that 75.5% of children included in the study brush less than twice daily and the majority did not receive instructions regarding oral hygiene practices.

The secondary preventive measures such as the use of polyol-containing chewing gums are seldom used by dental professions despite their proven benefit (Longbottom, Ekstrand et al. 2009; Longbottom, Ekstrand et al. 2009). Awareness towards the use of these measures should be emphasized since they are viable alternatives to the surgical approach of caries management (Longbottom, Ekstrand et al. 2009; Tellez, Gomez et al. 2013).

CONCLUSION

Sugar-free products contain variety of sugar substitutes. Sorbitol was the most widely used bulk sweetener. Acesulfame-K and aspartame were present in the majority of products with xylitol concentration was very low and found in very few products. It is advisable to recommend these sugar-free products to patients in order to control dental caries.

REFERENCES

1. Alanzi, A., E. Soderling, et al. (2016). "Xylitol Chewing Gums on the Market: Do They Prevent Caries?" Oral Health Prev Dent 14(5): 459-466.
2. Amin, T.T. and B. M. Al-Abad (2008). "Oral hygiene practices, dental knowledge, dietary habits and their relation to caries among male primary school children in Al Hassa, Saudi Arabia." Int J Dent Hyg 6(4): 361-370.
3. Birkhed, D., G. Svensater, et al. (1990). "Cariological studies of individuals with long-term sorbitol consumption." Caries Res 24(3): 220-223.
4. Burt, B. A. (2006). "The use of sorbitol- and xylitol-sweetened chewing gum in caries control." J Am Dent Assoc 137(2): 190-196.
5. Featherstone, J. D. (2004). "The caries balance: the basis for caries management by risk assessment." Oral Health Prev Dent 2 Suppl 1: 259-264.
6. Ghezzi, E. M. (2014). "Developing pathways for oral care in elders: evidence-based interventions for dental caries prevention in dentate elders." Gerodontology 31 Suppl 1: 31-36.
7. Imfeld, T. (1999). "Chewing gum--facts and fiction: a review of gum-chewing and oral health." Crit Rev Oral Biol Med 10(3): 405-419.
8. Longbottom, C., K. Ekstrand, et al. (2009). "Traditional preventive treatment options." Monogr Oral Sci 21: 149-155.
9. Longbottom, C., K. Ekstrand, et al. (2009). "Novel preventive treatment options." Monogr Oral Sci 21: 156-163.
10. Ly, K. A., P. Milgrom, et al. (2006). "Xylitol, sweeteners, and dental caries." Pediatr Dent 28(2): 154-163; discussion 192-158.
11. Maguire, A. and A. J. Rugg-Gunn (2003). "Xylitol and caries prevention--is it a magic bullet?" Br Dent J 194(8): 429-436.
12. Makinen, K. K., C. A. Bennett, et al. (1995). "Xylitol chewing gums and caries rates: a 40-month cohort study." J Dent Res 74(12): 1904-1913.
13. Milgrom, P., K. A. Ly, et al. (2009). "Xylitol and its vehicles for public health needs." Adv Dent Res 21(1): 44-47.
14. Olivier, B., A. H. Serge, et al. (2015). "Review of the nutritional benefits and risks related to intense sweeteners." Arch Public Health 73: 41.
15. Peldyak, J. and K. K. Makinen (2002). "Xylitol for caries prevention." J Dent Hyg 76(4): 276-285.
16. Soderling, E. M. (2009). "Xylitol, mutans streptococci, and dental plaque." Adv Dent Res 21(1): 74-78.
17. Tellez, M., J. Gomez, et al. (2013). "Non-surgical management methods of noncavitated carious lesions." Community Dent Oral Epidemiol 41(1): 79-96.
18. Trahan, L. (1995). "Xylitol: a review of its action on mutans streptococci and dental plaque--its clinical significance." Int Dent J 45(1 Suppl 1): 77-92.
19. Twetman, S. (2010). "Treatment protocols: nonfluoride management of the caries disease process and available diagnostics." Dent Clin North Am 54(3): 527-540.
20. Van Loveren, C. (2004). "Sugar alcohols: what is the evidence for caries-preventive and caries-therapeutic effects?" Caries Res 38(3): 286-293.
21. Zero, D.T. (2008). "Are sugar substitutes also anticariogenic?" J Am Dent Assoc 139 Suppl: 9S-10S.