

Oral health: Role of chewing gum

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ABSTRACT

The prevalence of dental caries in Brunei Darussalam is highly alarming and dental anxiety in general leads to avoidance of dental care. Since this is an era of preventive dentistry utilising a holistic approach, excellent results could be achieved if preventative methods are regularly used by people in day-to-day life. Gum chewing is increasing dramatically despite racial, cultural and religious taboos against them. Many previously considered chewing sugared gum might increase the cariogenic load. However with better understanding of cariology, it is now perceived by many that chewing sugared gum after meals is safe. Sugarless gum has an important role in preventive dentistry. Chewing gum with incorporation of anti-plaque agents and various drug delivery systems is distinctive as a special confectionary item. This article reviews the historical background of gum chewing, the role of various chewing gums in preventing oral diseases like dental caries and periodontal diseases, its role in the management of xerostomia, hypersensitive teeth and as an alternate to cigarette smoking habit.

Keywords: Chewing gum, dental caries, oral diseases, oral health

INTRODUCTION

The prevalence of dental caries in the Brunei Darussalam is alarmingly high and is a concern. ¹ Dental anxiety in general leads to avoidance of dental care and this maybe an important factor. ² As we enter into the era of preventive dentistry utilising a holistic approach, excellent results could be achieved if we practice these preventative methods regularly in our day-to-day life.

Initially, there were concerns that chewing sugared gum might increase the cariogenic load to dietary carbohydrates. However, with better understanding of cariology, it is now perceived that chewing sugared gum after meals and continued for a specific period of time is safe and maybe beneficial. Sugarless gum has an effective role in preventive dentistry. Chewing gum with incorporation of anti-plaque agents and various drugs delivery systems is distinctive as a special confectionary item.

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Gum chewing is a common habit

practiced by children as well as adults in many countries. Although it is satisfying and pleasant to many individuals, it is also a problem for many parents and school teachers. The social acceptance of gum chewing however has increased dramatically over the years in spite of the racial, cultural, and religious taboos against it. ³

The effects of chewing gum on the oral tissues, whether harmful or beneficial have been studied for many years. Many investigators believe that as most chewing gum is sweetened with sucrose, gum products might actually increase the cariogenic load, in addition to dietary carbohydrates. With better understanding of cariology, it is now known that gum chewing after eating leads to increase in the salivary pH to a safe level. Chewing sugarless gum reduces the cariogenic load. ⁴

Brunei Darussalam's Perspective

Currently, there are no published data on the epidemiology of oral health status of the Brunei population except for a report suggesting a high caries prevalence rate in the country. The report based on a study conducted in 1999 stated that the decayed, missing, filled teeth (DMFT) in primary dentition among the 5 year old children was 7.1 with 86% of the decay remained untreated (Figure 1a) and few 3 year old children had lost all 20 milk teeth (Figure 1b). The DMFT in the permanent dentition among 12 year olds was 4.8 with 82% of the decay remaining untreated (Figure 1c).

Brunei Darussalam's Minister of Health held a meeting on 27th November, 2006 on health promotion with village leaders and the teachers. He stated that the status of dental health in Brunei, based on the above stated data, showed that the nation was yet to reach the required standard of the World Health Organisation (WHO). ¹



Fig 1: a) Early childhood (nursing bottle) caries in a 5-year-old child, b) a 4-year-old child with loss of all the teeth (rampant caries) and c) rampant caries in a 12-year-old boy.

The Health Promotion Unit of the Ministry of Health has taken the issue seriously and various community and school based preventive programmes like antenatal oral health programme is planned, implemented, monitored and being evaluated. Other programmes like parents and toddler's oral health education programme, rolling tooth paste programme (RTP) for 5 years old and below and nationwide school daily fluoridated tooth brushing programme (DFTB) are planned for the future. Apart from the above mentioned community based preventive strategies, there should be a method that could be practiced by an individual that should internally motivate him. Every individual should understand that they are the caretakers of their own teeth and the dentists are only their guides.

History of Chewing Gum

It was reported that in 50 AD, the Greeks sweetened their breath and cleansed their teeth by using mastiche, a resin from the bark of mastic tree (masticate is derived from the root word mastiche). The ancient Mayan Indians of Yucatan chewed tree resin (chicle) from the sapodilla tree. Spruce gum became the first chewing gum to be manufactured commercially as "State of Maine Pure Spruce Gum" in 1848. However its use was eventually replaced by paraffin, which is still being chewed in some areas.³

The first patent for chewing gum was filed by William F Sample (1869), a dentist from Mount Vernon, Ohio. This was initially intended to be used as a dentifrice. William Wrigley Jr. launched his first chewing gum (Lotta and Vassar) in the 1890s, followed by Juicy Fruit and Wrigley's Spearmint gum.³

Sugarless gums was introduced in early 1950s with Sorbitol used as sugar substitute. The first brand to be marketed was Harvey's followed by Trident and Carefree in 1975. W. Wrigley Jr. introduced Freedent designed especially for denture wearers, which do not stick to the dentures.³ Recaldent (Casein Phospho Peptide Amorphous Calcium Phosphate (CPP-ACP), a milk produce that can strengthens teeth and help prevent dental caries was introduced in 1999.⁵

The global market for chewing gum is estimated to be 560,000 tonnes per year. Approximately 374 billion pieces of chewing gum are sold globally every year; representing 187 billion hours of gum chewing if each piece of gum is chewed for 30 minutes. Chewing gum can thus be expected to have an influence of oral health.⁶

Sugar-Free Chewing Gums

The main ingredients of a modern day chewing gum is a combination of powered cane or beet sugar (50-65%) chewing gum base (18-30%) corn syrup (12-20%) colour and flavouring agents (1-2%) and softeners (0.3-3%). Importantly more than half of its ingredients are sugar. The sugar used in sugared gum is sucrose, fructose and or hydrogenated glucose. In sugar-free gums sugar substitutes are used. The term sugar-free may be misleading. The sugar substitutes commonly used may be bulk sweeteners like sorbitol, mannitol or xylitol or intense sweeteners like aspartame.⁷

Sorbitol and mannitol are polyols that are metabolised by oral bacteria so slowly that any acid produced is simultaneously neutralised; hence they are considered non-

cariogenic.⁸ Aspartame *in vitro* as well as in rats have shown their ability to reduce adherent plaque formed by *Streptococci mutans* and considered as non cariogenic as well as anticariogenic,^{9, 10} however no clinical studies in humans have been reported.

Xylitol is the most widely used sugar substitute in chewing gum. There is still an uncertainty about the nature of the effect of xylitol in caries. One view is that it merely replaces sucrose with a non-metabolised substance and thus prevents acid production by *Streptococci mutans*, which thrives best on sucrose. On this basis xylitol can be described as a non-cariogenic, but not anticariogenic. However, Schienin and Makinenin (1975) suggested that xylitol has specific anticariogenic activity although its nature is not clearly established.¹¹ Several studies indicate that xylitol possess an antibacterial property¹² including the fact that it is not metabolised to acids either in pure cultures of oral micro organisms *in vitro*¹³ or in dental plaque *in vivo*.^{14, 15}

Chewing Gum and Dental Caries

Recently there has been considerable interest in the use of sugar free chewing gums as they stimulate salivary flow and prevent the formation of dental caries. A number of studies have shown that chewing gum increases salivary flow, enhancing the buffering capacity of saliva, thereby neutralising the decrease in the plaque pH/saliva pH that occurs after meals.¹⁶

Both sucrose-containing and sugar-free gums stimulate salivary flow due to a combined effect of gustatory stimulation and mechanical stimulation from chewing. Chewing is effective at the inter-proximal site due

to physical thrust of saliva into these relatively inaccessible areas.¹⁷ Increase in salivary flow will lead to more frequent replenishment and supply of antibacterial factors, sialin, buffers, minerals and other beneficial constituents, reducing plaque acidogenicity as well as raising the salivary pH.¹⁸

Stephan Moss gave the classical Stephan's curve, which showed that upon a sucrose intake the salivary/plaque pH drops sharply and comes back to the original level over a period of time. The mono and disaccharides are the most vulnerable to rapid fermentation, though some of the highly processed starches have also been shown to contribute to acid production. The acids resulting from carbohydrate fermentation are weak organic acids and in most cases will only cause chronic low grade demineralisation. However, when a high frequency of sugar consumption is maintained over a prolonged period, or there is a serious deficiency of natural host protective factors, caries will progress more rapidly. The curve obtained is a net result of acid production in plaque, its neutralisation by salivary and plaque buffers.¹⁹ This may vary from individual depending upon their level of caries activity.

The salivary flow rates with both types of gum peak in the first minute (5ml/minute), which is 10-12 times more than the unstimulated flow rate (0.5-0.1 ml/minute) and falls progressively by the end of 20 minutes of gum chewing (1.25 ml/minute). As the chewing continues there is a rise in the pH level and it reaches above the critical pH (5.1-5.5) within 3-5 minutes.¹⁵ Thus the ability of sugar-free or sugared gum as plaque pH raising agents differentiate them from

other confectionaries routinely consumed.

The plaque pH response to sugared gum is related to the chewing time, since the carbohydrate is dissolved out of the gum very quickly. Jenson and Wefel 1989²⁰ and Dawson in 1993²¹, showed that gum chewing for 20 minutes either sugared or sugar-free gums effectively reverse the low plaque pH caused by food consumption. If xylitol gum were taken after meals or in between meals it resulted in stimulation of salivary flow and recovery of salivary pH²², reduction of dental plaque, suppression of *Streptococci mutans*, and reduced adhesiveness of plaque indicating that it has caries preventing effect (Figure 2).²³

Maternal chewing of Xylitol chewing gum (started at the 6th month pregnancy and terminated 13 months later) reduced the *Streptococci mutans* count in children (until age 24 months) and thus confirming the vertical transmission of *Streptococcus mutans* from the mother to the child.²⁴

Addition of CPP-ACP (1.0%) into sorbitol or xylitol sugar-free chewing gums resulted in 100% increase in enamel remineralisation compared to control gum.⁵ A systematic review with meta-analysis concluded that chewing gum containing CPP-ACP had remineralising potential on short term use and caries preventing potential on long term use.²⁵ CPP has a remarkable ability to stabilise calcium phosphosyl residues by forming clusters, localises ACP in dental plaque which buffers the free calcium and phosphate ion activities, thereby helping to maintain a state of supersaturation with respect to tooth depressing demineralisation and enhancing remineralisation.²⁶

Chewing Gum and Periodontal Health

Presently some of the short-term advantages include mechanical removal of debris and improvement of oral odour have been achieved with chewing gum. Various studies have examined the effect on plaque, oral debris, calculus and gingivitis scores in subjects who

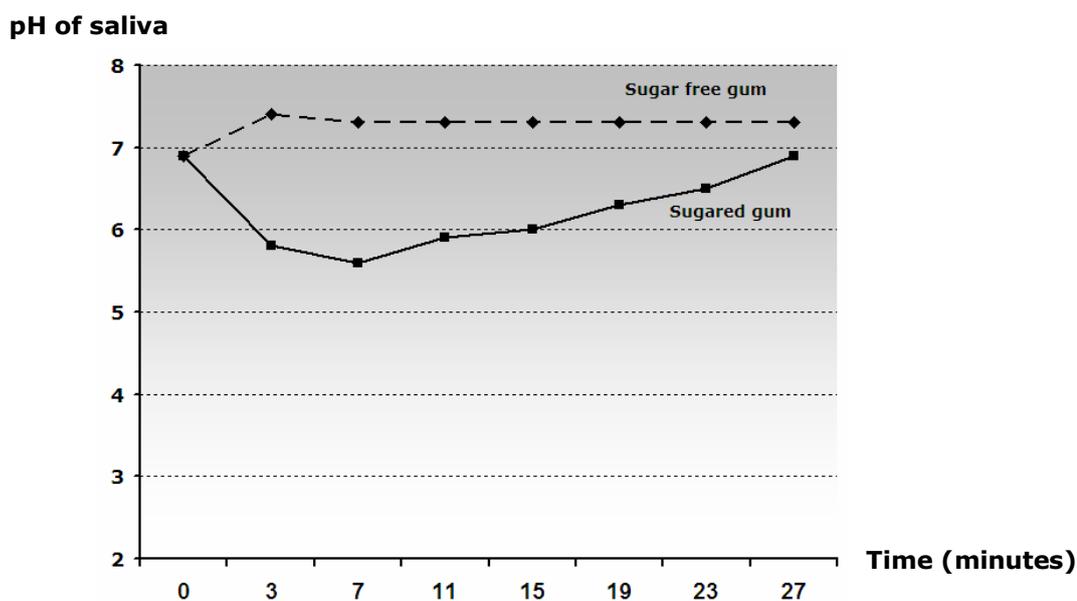


Fig 2: Plaque response in subjects chewing sugared and sugar free gum (adapted from Birkhed D. 1994).

chewed gum, and compared with non chewing gum. The results are varying. However chewing gum, irrespective of sweetener caused significantly less plaque accumulation than not chewing gum.^{27, 28}

Five percent sodium bicarbonate (baking soda) incorporated in chewing gum was found to have properties of reducing plaque, gingivitis and extrinsic stains when chewed two to three times a day.^{29, 30} Incorporation of medicaments in chewing gum had further enhanced periodontal health care. Studies on chlorhexidine showed that chewing two pieces of chlorhexidine diacetate gum for 10 minutes twice a day (20mg/day) were as effective as 40mg/ day from rinses. The bitter taste and staining associated with rinses were overcome by administering chlorhexidine in chewing gum formulation.³¹

A chlorhexidine/Xylitol combination in chewing gum showed reduction in plaque and gingivitis and supported oral hygiene routines for an elderly population when two pellets were chewed twice for 15 minutes.³² Later, studies proved that Pycnogenol 5% an antioxidant incorporated in chewing gum significantly minimised gingival bleeding and plaque accumulation.³³ Recently eucalyptus incorporated in chewing gum (0.6% i.e. 90mg/day) was suggested to be useful in inhibiting dental plaque formation³⁴ and promote periodontal health.

Chewing gum and Xerostomia

Xerostomia is a condition that may benefit from gum chewing. Gum chewing stimulates salivary flow and helps keep the salivary ducts patent.³⁵ People with xerostomia should avoid sugared chewing gums as it seems unlikely that any saliva stimulation

induced would be sufficient to counter balance the cariogenic challenge from sugars.³⁶ Sugar-free chewing gums are recommended. Patients should chew one or two pieces of gum gently for ≥ 10 minutes, six times a day and as desired throughout the day when the mouth feels dry or when they are thirsty. Regular, chronic use of sugar-free gums has been found to raise the unstimulated whole saliva flow rate and increase salivary actions on teeth.³⁷

Chewing Gum as Vehicles for Medicaments

The first medicated chewing gum which contained acetyl salicylic acid was marketed in United States in 1924. However it was not until nicotine containing gums became available in 1978 that chewing gum as a system of drug delivery began to gain acceptability.³⁸ Nicotine-containing gums were used as an adjunct in helping people to stop smoking. The dosage depends on the intensity of the nicotine habit. The high dependent smokers achieve significant benefit from 4mg gum and the low dependents from 2mg gum.³⁹ Hence, incorporating other compounds such as carbamide, fluoride, chlorhexidine, miconazole, vitamin C in chewing gum, which are beneficial to dental hygiene, may be a reasonable way to delivery such products.⁴⁰

Chewing Gum and Hypersensitive Teeth

Dental hypersensitivity has been observed in an increasing number of young patients over the past few decades. Krahwinkel *et al.* showed that chewing gums incorporated with Potassium Chloride chewed at least six times for 10 minutes a day reduced dental hypersensitivity over an extended period of time when used daily.⁴¹

Chewing Gum as a Physical Activity

If gum chewing can be viewed as a physical activity that affects people’s lifestyles, it may be possible to view gum chewing in the broader context of health and wellness. For example, as noted previously, people usually do not eat food at the same time they chew gum. With the prevalence of obesity on the rise in the country, the metabolic syndrome encompasses a constellation of metabolic abnormalities and is thought to place patients at a higher risk of developing diabetes mellitus and cardiovascular disease.⁴² The physical activity of gum chewing may be a cost-effective way of limiting food and caloric intake.³⁵

Chewing Gum available in Brunei Darussalam

Numerous chewing gum companies have come out with sugar free chewing gums with different flavours. These chewing gums contain aspartame, sorbitol or xylitol or a combination of the above mentioned sugar substitutes (Table 1). Not many chewing gums to prevent periodontal disease and as vehicles for medicaments are available in Brunei Darussalam.

OVERVIEW

The considerable volume of literature on the dental effects of chewing gum attests to the importance attached to this confectionary item. It can be concluded that habitual use of chewing gum, especially chewing gum that contains xylitol and/or CPP-ACP, effectively stimulates salivary flow, improves plaque pH and eliminate the caries risk by chewing after meals and snacks at least for 20 minutes.

The incorporation of baking soda and Pycnogenol in chewing gums reduces gingivitis and helps in maintenance of good oral health. In future, drugs may be formulated into chewing gum, in preference to other delivery systems, in order to deliver drugs to the oral cavity, since gum use is convenient, easy to administer and tastes pleasant making it patient acceptable.

The power of prescription is a very potent tool from our professional armamentarium. Patients are always seeking a “*magic pill*” rather than reading from a magazine or by anecdotal recommendations from family and friends. The advices we give to our patients carry weight when it is evidence-based. It is now clear that chewing sugar-free gum

Table 1: Types of gums available in Brunei.

Types of gums	Brand name
Sugar free	Wrigley, Babol (Chupa Chups), Dentyne, Highland Strom, Impact, Jila, Jols. Mentos White. Mint-box, Optiments Chlorets, Orion Xylitol, Ricola, Smint & Gum.
Prevention of periodontal disease	Happydent white (Baking soda) - reduces plaque, gingivitis extrinsic stains
Vehicles of medicaments	Nicorette sugar free- Smoking cessation gum Vita C- Vitamin C supplement

can be beneficial to dental health.

In conclusion, as health care providers, we should include in our dental education programmes the role of chewing gum as an adjunct to individual self-care such as routine daily brushing, flossing and regular dental check. With the various community-based preventive measures underway, it is likely that chewing sugar-free gum can play an important role in the improvement of oral health status of the country. However, the choice of gum is important.

REFERENCES

- 1:** Azrol Azmi. Brunei yet to achieve WHO Oral Health goals. Thursday, 18th January 2007. Borneo Bulletin. Available from www.brusearch.com/news (Accessed date 23rd February 2011).
- 2:** Sharif MO. Dental anxiety: detection and management. *J. Appl Oral Sci.* 2010; 18: i.
- 3:** Cloys LA, Christen AG, Christen JA. The development and history of chewing gum. *Bull Hist Dent.* 1992; 40:57-65.
- 4:** Edgar WM, Geddes DA. Chewing gum and dental health-- a review. *Br Dent J.* 1990; 168:173-7.
- 5:** Reynolds EC. Anticariogenic complexes of amorphous calcium phosphate stabilized by casein phosphopeptides: a review. *Spec Care Dent.* 1998; 18: 8-16.
- 6:** Imfeld T. Chewing gum – facts and fiction: a review of gum – chewing and oral health *Crit Rev Oral Bio Med.* 1999; 10:405-19.
- 7:** Makinen KK. Sweeteners and prevention of dental caries. *Oral Health* 1988; 78:57-65.
- 8:** Edgar WM. Sugar substitutes, chewing gum and dental caries: a review. *Br Dent J.* 1998; 184:29-32.
- 9:** Olson BL. An invitro study of the effects of artificial sweeteners in adherent plaque formation. *J Dent Res.* 1977; 56:1426-7.
- 10:** Das S, Das A, Murphy R. Cariostatic aspect of aspartame in rats. *Caries Res.* 1997; 31: 78-83.
- 11:** Schienin A, Makinen KK, Tammissalo E, Rekola M. Turku sugar studies XVIII. Incidence of dental caries in relation to 1-year consumption of xylitol chewing gum. *Acta Odont Scand.* 1975; 33:269-78.
- 12:** Assev S, Vegarud G, Rolla G. Growth inhibition of streptococcus mutans strain. OMZ176 by xylitol. *Acta Pathol Microbiol Scand B.* 1980; 88:61-3.
- 13:** Maki Y, Ohta K, Takazoe I, et al. Acid production from isomaltase, sucrose, sorbitol and xylitol in suspension of human dental plaque. *Caries Res.* 1983; 17:335-9.
- 14:** Muhlemann H, Schmid R, Noguchi T, Imfeld T, Hirsch RS. Some dental effects of xylitol under laboratory and in vivo conditions. *Caries Res.* 1977; 11:263-76.
- 15:** Tanzer JM. Xylitol Chewing gum and dental caries. *Int Dent J.* 1995; 45:65-75.
- 16:** Beiswanger BB, Boneta AE, Mau MS, Kats BP, Proskin HM, Stookey GK. The effect of chewing sugar free gum after meals on clinical caries incidence. *J Am Dent Assoc.* 1998; 129:1623-6.
- 17:** Jensen M. Effect of chewing sorbitol gum and paraffin on human interproximal plaque pH. *Caries Res.* 1986; 20:503-9.
- 18:** Dawes C, Dong C. The flow rate and electrolyte composition of whole saliva elicited by the use of sucrose containing and sugar free chewing gums. *Archs Oral Biol.* 1995; 40:699-705.
- 19:** Nikiforuk G. Understanding dental caries. Ed. 1. Vol.1. Karger Pub. 1985; Pg. 152.
- 20:** Jensen M, Wefel J. Human plaque pH responses to meals and the effect of chewing gum. *Br Dent J.* 1989; 167:204-8.
- 21:** Dawson L. Oral sugar clearance and salivary buffering effects in the control of plaque pH. *J Dent Res.* 1993; 72:691.
- 22:** Ribelles Liop M, Gurnot Jimeno F, Mayne Acién R, Bellet Dalmau LJ. Effect of xylitol chewing gum on salivary flow rate, pH, buffering capacity and presence of streptococcus mutans in saliva. *Eur J Peadiatric Dent.* 2010; 11:9-14.
- 23:** Birkhed D. Cariologic aspects of xylitol in chewing gum: a review. *Acta Odontol Scand.* 1994; 52: 116-27.
- 24:** Nakai Y, SHinga-Ishihara C, Kaji M, Moriya K, Murakami-Yamanaka K, Takimura M. Xylitol gum

and maternal transmission of mutans streptococci. *J Dent Res.* 2010; 89:56-60.

25: Bader JD. Casein Phosphopeptide- Amorphous Calcium Phosphate show promise for preventing caries. *Evid Based Dent.* 2010; 11:11-20.

26: Shen P, Cai F, Nowicki A, Vincent J, Reynolds EC. Remineralization of enamel subsurface lesions by sugar-free chewing gum containing casein phosphopeptide – amorphous calcium phosphate. *J Dent Res.* 2001; 80:2066-70.

27: Addy M, Perriam G, Sterry A. Effects of sugared and sugar free chewing gum on the accumulation of plaque and debris on the teeth. *J Clin Periodontol.* 1982; 9:326-54.

28: Hoerman KC, Gasior EJ, Zibell SE, Record D, Flowerdew G. Effect of chewing gum on plaque accumulation. *J Clin Dent.* 1990; 2:17-21.

29: Kleber CJ, Putt MS, Milleman JL, Davidson KR, Proskin HM. An evaluation of sodium bicarbonate chewing gum in reducing dental plaque and gingivitis in conjunction with regular tooth brushing. *Compend Contin Educ Dent.* 2001; 22:4-12.

30: Soparkar P, Newman MB. Effects of a baking soda gum on extrinsic dental stain. Results of a longitudinal 4 week assessment. *Compend Cont Educ Dent.* 2001; 22:25-28.

31: Smith A, Moran J, Danglier L, Leight RS, Addy M. The efficacy of an anti gingivitis chewing gum. *J Clin Periodontol.* 1996; 23:19-23.

32: Simons D, Brailsford S, Kidd EA, Beighton D. The effect of chlorhexidine acetate/xylitol chewing gum on the plaque and gingival indices of elderly occupants in residential homes. *J Clin Periodontol.* 2001; 28:1010-15.

33: Kimbrough C, Chun M, dela Roca G, Lau BH. Pycnogenol chewing gum minimizes gingival bleeding and plaque formation. *Phytomedicine* 2002; 9:410-3.

34: Nagata H, Inagaki Y, Tanaka M et al. Effect of eucalyptus extracts chewing gum on periodontal health: a double-masked randomized trial. *J Periodontol* 2008. 2010; 79:1378-85.

35: DePaola DP. Saliva- The precious body fluid. *J Am Dent Assoc.* 2008; 139:5s-10s.

36: Simons D. Chewing Gum. Trick or treat?: A review of literature. *Dental update.* 1996; 162-9.

37: Bots CP, Brand HS, Veerman EC, et al. Chewing gum and a saliva substitute alleviate thirst and xerostomia in patients on haemodialysis. *Nephrol Dial Transplant.* 2005; 20:578-84.

38: Rassing M. Chewing gum as a drug delivery system. *Adv Drug Delivery Rev.* 1994; 13:89-121.

39: Stead LF, Perera R, Bullen C, Mant D, Lancaster T. Nicotine replacement therapy for smoking cessation. *Cochrane Database Syst Rev.* 2008. Jan 23: CD000146.

40: Dalal K. Chewing gum Trick or treat? *Saudi Dent J.* 1999; 11:27-31.

41: Krahwinkel T, Theiss P, Willershausen B. Clinical effectiveness of potassium chloride containing chewing gum in the treatment of hypersensitive teeth. *Eur J Med Res.* 2001; 6:483-7.

42: Batsis JA, Nieto-Martinez RE, Lopez-Jimenez F. Metabolic syndrome: from global epidemiology to individualized medicine. *Clin Pharmacol Ther* 2007; 82:509-24.