DOI: *http://dx.doi.org/10.22122/johoe.v8i3.336* *Published by Vesnu Publications*

Received: 26 Feb. 2019 **Accepted: 04 May 2019**

Comparison of the effect of chewing mastic and spearmint sugar-free chewing gum on salivary flow rate and pH

Goli Chamani DDS, MSc[1], Mohamad Reza Zarei DDS, MSc[1], Neda Yazdani-Anaraki DDS[2], Sahar Mafi DDS[3]

Original Article

Abstract

BACKGROUND AND AIM: Hyposalivation can cause many difficulties for patients like opportunistic infections such as candidiasis, mouth sores, and dysphagia as well as reduced quality of life (QOL). Methods such as using sugar-free chewing gum are recommended to treat this complication. Mastic is a natural substance and since it has various properties in addition to increasing salivary flow rate, it can reduce oral complications of patients suffering from xerostomia. In the present study, a comparison was made on the effect of chewing mastic and spearmint sugar-free chewing gum on saliva flow rate and pH.

METHODS: This was a single blind interventional clinical study carried out on 26 healthy individuals (10 men and 16 women). Simple non-probability sampling method was used to select the subjects. Initially, unstimulating saliva was collected and then all subjects were asked to chew Parafilm, mastic, and spearmint sugar-free chewing gum with a randomized order and in a 15-minute interval. Salivary flow rate was estimated by dividing the amount of the collected saliva (weight or volume) by the sample collection period (5 minutes). Saliva pH was measured by a manual pH meter. Data were analyzed using SPSS software by t-test.

RESULTS: A total of 26 volunteers (10 men and 16 women) participated in this study, with a mean age of 23.5 years. The saliva flow rate and pH after chewing mastic (the main substance in this study) were not significantly different from those after consuming the chewing gum ($P > 0.050$). Mastic and chewing gum increased the salivary flow rate significantly compared to Parafilm ($P < 0.001$).

CONCLUSION: The results showed that mastic and sugar-free chewing gum could increase salivary flow rate and pH. Due to the flavor and high price of sugar-free chewing gum, mastic can be recommended instead of sugar-free chewing gums.

KEYWORDS: Mastic Gum; Saliva; Xerostomia; Xylitol

Citation: Chamani G, Zarei MR, Yazdani-Anaraki N, Mafi S. **Comparison of the effect of chewing mastic and spearmint sugar-free chewing gum on salivary flow rate and pH.** J Oral Health Oral Epidemiol 2019; 8(3): 138-44.

Saliva is a compound of different molecules and an essential ingredient in the formation of acquired pellicle on the tooth surfaces and preservation of the integrity of oral and upper digestive tract mucous surfaces.[1] In addition, saliva has an important role in antimicrobial and physicochemical defense and wound healing. Most of the salivary components, including proteins, carbohydrates, lipids, and ions have a delicate role in performing these tasks. Some local and systemic disorders can derange this complex performance and cause dental and mucosal injuries.[1]

Prevalence of dry mouth (xerostomia) is estimated to be about 20% in the general population.[1] The main reasons of feeling mouth dryness (xerostomia) include salivary gland disorders, systemic disorders, drugs,

1- Professor, Department of Oral Medicine and Orofacial Pain, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran
2- Oral and Maxillofacial Radiologist, Kerman, Iran
3- Resident, Department of Oral Medicine and Orofacial Pain, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran
Correspondence to: Sahar Mafi DDS
Email: sahar.mafi86@gmail.com

radiotherapy, and aging.[1-5] Salivary resting flow rate in healthy individuals is about 1 ml/minute.[2] Usually, xerostomia appears when resting flow rate and stimulated flow rate decrease to less than 0.1-0.2 ml/minute and 0.4-0.7 ml/minute, respectively.[3] Hyposalivation can cause many difficulties for patients like opportunistic infection such as candidiasis, sore mouth, and dysphagia.[6] Other concern is the reduced quality of life (QOL) in these patients.[7]

There are numerous treatment modalities for managing xerostomia,[8-10] most of which being supportive such as drinking small amounts of water or placing a piece of ice in the mouth. These methods can relieve the discomfort of xerostomia to some extent. Methods such as using artificial saliva, taking sympathomimetic drugs such as pilocarpine hydrochloride or bethanechol tablet, using 1% sodium fluoride mouth rinse, limiting caffeine consumption and avoiding alcoholic drinks or alcohol-containing mouth rinses, and using sugar-free chewing gum are also recommended.[11-14] However in most patients, using sympathomimetic drugs such as pilocarpine hydrochloride or bethanechol tablet are contraindicated because of systemic condition and drug interaction.[15]

Orbit[R] sugar-free chewing gum, which has been approved by Iran Food and Drug Administration (IFDA), is available in Iran and also in many other countries.[13] This chewing gum is produced by Wrigley Company, USA. This chewing gum contains xylitol as a sweetener. Xylitol is a natural 5-carbonated sugar and is obtained from birch tree. This sugar naturally exists in some fruits such as strawberry, vegetables (cauliflower), and mushrooms.[11] Despite the safety and effectiveness of xylitol, there are some concerns about dose dependent and long term side effects of consumption of this matter such as tumors, diarrhea, and intestinal gas.[16] On the other hand, a large number of patients cannot afford these products because of their high cost.

Mastic is a natural substance also known as Arabic gum and is extracted from pisticia (Atlantica kurdica) tree which is native to a part of Eurasia as west of Iran. This resin is used in a wide range of industrial applications such as production of medications, food, chemical substances, and chewing gum.[17,18]

Most of the mastic components have strong antimicrobial activities against a wide range of bacteria and probably these components act synergistically. Since mastic is quite compatible with the gastrointestinal tract and has antibacterial nature, it can act against Helicobacter pylori (H. pylori). Studies have shown that mastic gum significantly reduces oral bacterial counts and gingival inflammation.[17,18] In addition, mastic is traditionally used by the elderly people in Iran and is cheaper than other products. These factors make it a preferable choice for stimulating saliva.

This study was designed to investigate the effect of mastic gum as a natural substance on pH and saliva flow rate. Since mastic has various properties besides increasing salivary flow rate, it can reduce oral complications among patients with dry mouth and hyposalivation. In this study, Jajik mastic grown in Kermanshah, Iran, was used. This mastic is one of the best mastics available, and its color, texture, and other physical properties are identical to commercially available chewing gums. The acceptance of mastic flavor over other chewing gum flavors is dependent on each individual taste.

Methods

This was a single blind interventional clinical study carried out on 26 healthy individuals (10 men and 16 women) referred to oral medicine department of Kerman Dental School, Kerman, Iran, for dental checkup. Simple non-probability sampling method was used to select the subjects. This study was approved by the ethics committee board (code: 13488) and volunteers were asked to fill out an informed consent form. They did not show any symptoms or signs of

conditions such as xerostomia or sialorrhea and were not taking any sialogenic or salivary flow suppressing drugs including pilocarpine, cevimeline, anti-depressants, anti-psychotics, and antihypertension medicines. Patient with systemic diseases such as diabetes mellitus (DM), hypertension, cardiovascular diseases (CVDs), Sjogren's syndrome, and connective tissue disorders were excluded from the study. Patients in the age range of 18-50 years old were included in the study. Baseline salivary samples were collected from 7:30 to 11:30 in the morning by a calibrated oral medicine resident while the participants were sitting and bending their heads forward. The volunteers had been asked not to eat or drink anything one hour before sampling. Meanwhile, they were not in a dehydrated condition. At the beginning, unstimulated saliva was collected and its volume was measured to determine the baseline salivary flow rate. Saliva collection was carried out by spitting method and pre-weighed test tube was used for collecting saliva.[1,9,19-22]

In order to collect unstimulated saliva, after a swallow, the volunteers remained still for 5 minutes and spit their saliva passively in a pre-weighed test tube.[23]

In order to measure the salivary flow rate during chewing Parafilm, mastic, and spearmint sugar-free chewing gum, the volunteers were asked to wash their mouth. After a 15-minute break, they were asked to chew a 5 × 5-cm piece of Parafilm, 70 times per minute and spit the saliva every minute.[22]

This process was repeated with 1.5 g of mastic and a piece of sugar-free spearmint chewing gum, 70 times per minute and spitting the saliva every minute. The order of chewing these three substances was different and randomly selected. Since a 15-minute interval was considered between the saliva flow rate measurements, unstimulated saliva before chewing was not collected. Since the chewing order of these three substances was chosen randomly, the probable insufficiency of the15-minute interval was equal in each group. Therefore, this did not affect the results.

Preparing identical mastic pieces indistinguishable from sugar-free chewing gum was not possible, but the individual who measured the pH and saliva flow rate was not aware of the substance that was chewed.

Saliva flow rate was calculated by dividing the amount of the saliva collected (weight or volume) by the sample collection period (5 minutes). Saliva pH was measured by a manual pH meter.

Various factors such as physical position, hydration status, diet, and chronological variations can affect salivary flow rate.[22,23] Since the saliva flow rate was assessed in the same person during the same time and was compared with the subject's own unstimulated saliva, these factors had no effect on the results.

Data were analyzed by SPSS software using the paired t-test.

Results

A total of 26 volunteers (10 men and 16 women) participated in this study, with a mean age of 23.5 years. As mentioned above, the baseline salivary flow rate was measured initially. Then the salivary flow rate was measured after chewing mastic, chewing gum, and Parafilm. Comparison of the salivary flow rate after chewing mastic, Parafilm, and chewing gum with baseline salivary flow rate revealed that these three substances were able to increase salivary flow rate and pH significantly (P = 0.001) (Tables 1 and 2) (Figures 1 and 2).

Table 1. Comparison of mean salivary flow rates after use of chewing gum, mastic, and parafilm with the mean baseline salivary flow rate

Group	Salivary flow rate (mean ± SD)	P
Baseline saliva	0.29 ± 0.13	0.001
Mastic	1.79 ± 0.64	
Baseline saliva	0.29 ± 0.13	0.001
Parafilm	1.24 ± 0.43	
Baseline saliva	0.29 ± 0.13	0.001
Sugar-free chewing gum	1.89 ± 0.61	

SD: Standard deviation

Table 2. Comparison of mean pH of saliva after using chewing gum, mastic, and Parafilm with mean pH of baseline saliva

Group	pH (mean ± SD)	P
Baseline saliva	6.64 ± 0.22	0.001
Mastic	7.02 ± 0.16	
Baseline saliva	6.64 ± 0.22	0.001
Parafilm	7.11 ± 0.23	
Baseline saliva	6.64 ± 0.22	0.001
Sugar-free chewing gum	7.13 ± 0.26	

SD: Standard deviation

pH and Saliva flow rate after chewing mastic (the main substance in this study) were not significantly different from those after the use of the chewing gum (P > 0.050) (Tables 3 and 4) (Figures 3 and 4).

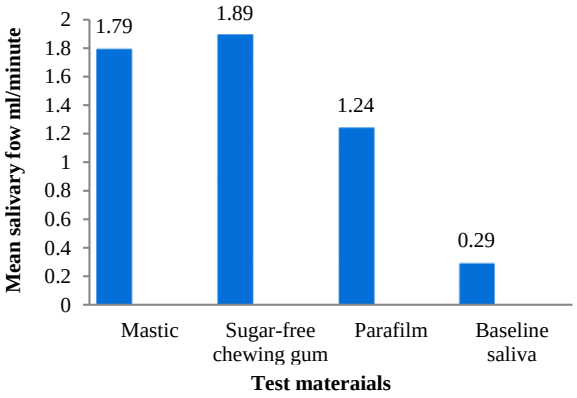

Figure 1. Mean salivary flow rates in different groups

Mastic and chewing gum increased salivary flow rate significantly compared to Parafilm (P = 0.001) (Table 3).

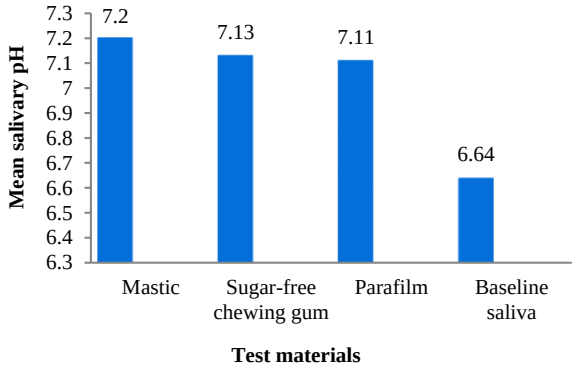

Figure 2. Mean salivary pH in the test groups

Mastic increased pH more significantly than Parafilm (P = 0.031), however chewing gum did not exhibit such an effect (P > 0.050) (Table 4).

Table 3. Comparison of salivary flow rates in different groups of the study

Group	Salivary flow rate (mean ± SD)	P
Mastic	1.79 ± 0.64	> 0.050
Sugar-free chewing gum	1.89 ± 0.61	
Mastic	1.79 ± 0.64	0.001
Parafilm	1.24 ± 0.43	
Parafilm	1.24 ± 0.43	0.001
Sugar-free chewing gum	1.89 ± 0.61	

SD: Standard deviation

Discussion

Saliva secretion is critical for maintaining oral health. A decrease in salivary flow rate is accompanied by numerous harmful clinical effects and reduces QOL.[7]

Table 4. Comparison of mean salivary pH in different groups of the study

Group	pH (mean ± SD)	P
Mastic	7.20 ± 0.16	> 0.050
Sugar-free chewing gum	7.13 ± 0.26	
Mastic	7.20 ± 0.16	0.031
Parafilm	7.11 ± 0.23	
Parafilm	7.11 ± 0.23	> 0.050
Sugar-free chewing gum	7.13 ± 0.26	

SD: Standard deviation

The relatively high prevalence of xerostomia and its significantly long-term effects on oral health and QOL encourage clinicians to seek for the new materials and methods to manage dry mouth effectively.

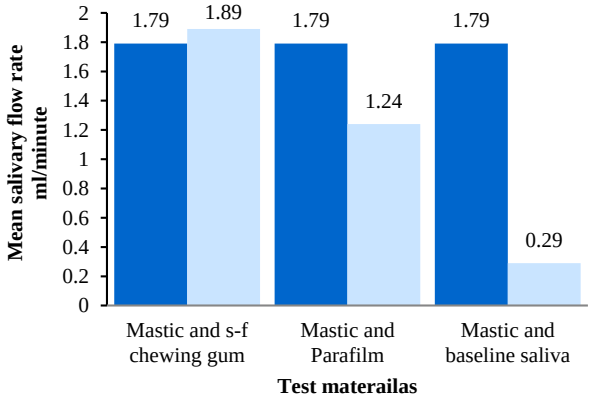

Figure 3. Comparison of salivary flow rates after chewing mastic with salivary flow rate after chewing other test materials

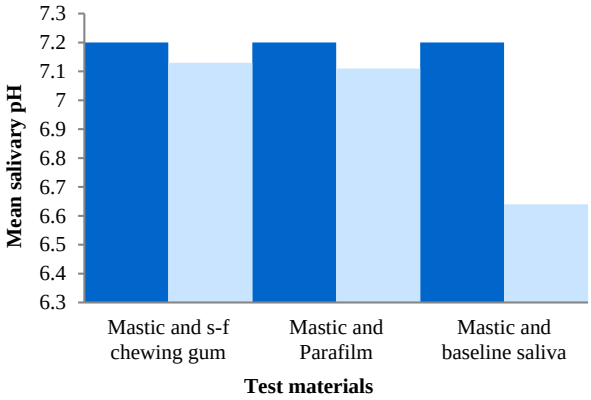

Figure 4. Comparison of mean salivary pH after chewing mastic with mean salivary pH after chewing other test materials

In spite of the treatment options available, because of some limitations of each of the current treatment methods, many patients are still suffering from xerostomia and its side effects.[3,4,24-27] This study showed that mastic and chewing gum increased salivary flow rate significantly compared to Parafilm. Moreover, the saliva flow rate and saliva pH between the subjects who chewed mastic and those who chewed chewing gum showed insignificant differences. These findings suggest that mastic may be considered as a suitable substitute for chewing gum in patients suffering from hyposalivation.

Several studies have assessed the effect of non-organic chewing gums on salivary secretion. Some of the studies, similar to the current study, have shown an increase in pH and saliva flow rate following chewing sugar-free chewing gums.[1,10-12,28-30] Some researchers have studied the antimicrobial, antiplaque, and anticavity properties of mastic and its efficacy in treating the gastrointestinal tract diseases.[17,31]

Mastic gum reduces oral bacterial counts significantly and cures gingival inflammation. Studies have shown the ability of mastic to suppress the growth of cariogenic bacteria and reduce Streptococcus mutans counts.[17,18]

Bakhtiari et al. studied the effect of Orbit[R] sugar-free chewing gum and mastic on salivary flow rate and pH. They concluded that both mastic and sugar-free chewing gum could increase salivary flow rate and pH, but sugar-free chewing gum increased these items more significantly compared to mastic.[13] However, this difference was not significant in the present study. This discrepancy might be attributed to different sampling conditions in these two studies. Furthermore, Bakhtiari et al.[13] measured the salivary flow rate and pH in three consecutive days. As it is clear, alterations in psychological or physical conditions of participants during these consecutive days may change the salivary flow rates and pH. In contrast, the current study was performed using the repeated measures method and all the samples of each volunteer were collected at the same day. This method may increase the liability of the study.

In contrast to the present study, Biria et al. revealed that xylitol mastic gums increased the pH of the saliva insignificantly, however it decreased the pH of the saliva significantly in probiotic mastic gum.[28] In the current study, the results showed an insignificant difference between salivary PH after chewing mastic and xylitol gum.

Karami-Nogourani et al. studied the effect of different flavors of chewing gum on salivary pH. The results indicated that only cinnamon and spearmint gum significantly increased the salivary pH.[12] In the present study, vanilla chewing gum was chosen to minimize simulations by flavor.

Ship et al. studied the efficiency and safety of topical products available for managing xerostomia containing olive oil, betaine, and xylitol in reducing dry mouth and hyposalivation for medication induced xerostomia.[8] The outcome showed that the use of topical treatments increased unstimulated salivary flow rates significantly. These findings are in agreement with those of the present study.

Additionally, in order to eliminate the effect of chewing the preceding substance on the salivary flow rate and pH, a 15-minute rest was set before chewing the next material. In order to increase the reliability of the

results, the resting time was longer than the previous similar studies.[17]

Another interesting result was obtained from the comparison of mastic and sugar-free chewing gum with Parafilm. Contrary to mastic, sugar-free chewing gum did not increase salivary pH significantly compared to Parafilm. Mastic may contain components that effectively increase salivary pH, preventing tooth decay. To the best of the researchers' knowledge, there is no other study comparing the effect of Parafilm and sugar-free chewing gum on salivary pH.

Parafilm was used in this study, which is a neutral, odorless, thermoplastic, colorless, and tasteless substance, in order to stimulate oral baroreceptors, as flavor of the substances used can stimulate salivary secretion. The results showed that both mastic and sugar-free chewing gum can increase salivary flow rate and pH significantly in comparison to Parafilm.

Since the results of this study showed that mastic and sugar-free chewing gum can increase salivary flow rate and pH, due to the flavor and high price of sugar-free chewing gum, mastic can be recommended instead of sugar-free chewing gums.

Although comparison of mastic and sugar-free chewing gum was not the aim of this study, all the volunteers were satisfied with the mastic flavor and even some of them preferred mastic.

One of the problems that attracted the attention of researchers was the adhesion of mastic to teeth. This problem was solved by keeping mastic in a refrigerator before chewing. However, there are some variants of mastics that can be used without keeping them in a refrigerator.

The interval duration between chewing the substances may be considered as a limitation in this study because long intervals seem to decrease patient's compliance.

Conclusion

In conclusion, according to the results of this study and the fact that mastic is accompanied by numerous useful properties, chewing mastic is preferred to sugar-free chewing gums in patients suffering from xerostomia.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

This study was supported by Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran. We would like to appreciate our colleagues in oral medicine department of dental school of Kerman University of Medical Sciences who provided expertise that greatly assisted the study, although they might not agree with all of the interpretations provided in this paper. Besides, the patients who participated in this study are appreciated.

References

1. Porter S. PLENARY ABSTRACT: Xerostomia: Prevalence, assessment, differential diagnosis and implications for quality of life. Oral Diseases 2010; 16(6): 501-2.
2. Villa A, Wolff A, Narayana N, Dawes C, Aframian DJ, Lynge Pedersen AM, et al. World Workshop on Oral Medicine VI: A systematic review of medication-induced salivary gland dysfunction. Oral Dis 2016; 22(5): 365-82.
3. Gonzalez S, Sung H, Sepulveda D, Gonzalez M, Molina C. Oral manifestations and their treatment in Sjogren's syndrome. Oral Dis 2014; 20(2): 153-61.
4. Pinna R, Campus G, Cumbo E, Mura I, Milia E. Xerostomia induced by radiotherapy: An overview of the physiopathology, clinical evidence, and management of the oral damage. Ther Clin Risk Manag 2015; 11: 171-88.
5. Mauri-Obradors E, Estrugo-Devesa A, Jane-Salas E, Vinas M, Lopez-Lopez J. Oral manifestations of Diabetes Mellitus. A systematic review. Med Oral Patol Oral Cir Bucal 2017; 22(5): e586-e594.
6. Shinozaki S, Moriyama M, Hayashida JN, Tanaka A, Maehara T, Ieda S, et al. Close association between oral Candida species and oral mucosal disorders in patients with xerostomia. Oral Dis 2012; 18(7): 667-72.
7. Niklander S, Veas L, Barrera C, Fuentes F, Chiappini G, Marshall M. Risk factors, hyposalivation and impact of xerostomia on oral health-related quality of life. Braz Oral Res 2017; 31: e14.
8. Ship JA, McCutcheon JA, Spivakovsky S, Kerr AR. Safety and effectiveness of topical dry mouth products containing

olive oil, betaine, and xylitol in reducing xerostomia for polypharmacy-induced dry mouth. J Oral Rehabil 2007; 34(10): 724-32.
9. Guggenheimer J, Moore PA. Xerostomia: Etiology, recognition and treatment. J Am Dent Assoc 2003; 134(1): 61-9.
10. Samarawickrama DY. Saliva substitutes: how effective and safe are they? Oral Dis 2002; 8(4): 177-9.
11. Ur-Rehman S, Mushtaq Z, Zahoor T, Jamil A, Murtaza MA. Xylitol: A review on bioproduction, application, health benefits, and related safety issues. Crit Rev Food Sci Nutr 2015; 55(11): 1514-28.
12. Karami-Nogourani M, Kowsari-Isfahan R, Hosseini-Beheshti M. The effect of chewing gum's flavor on salivary flow rate and pH. Dent Res J (Isfahan) 2011; 8(Suppl 1): S71-S75.
13. Bakhtiari S, Azimi Hosseini S, Esfandiari F, Alavi K. Comparison of the effect of sugarfree orbit chewing gum & natural turpentine on salivary flow rate & pH. J Dent Sch 2007; 24(4): 423-8. [In Persian].
14. Cotomacio C, Campos L, Simoes A, Jaguar G, Crosato EM, Abreu-Alves F. Influence of bethanechol on salivary parameters in irradiated patients. Med Oral Patol Oral Cir Bucal 2017; 22(1): e76-e83.
15. Lopez-Pintor RM, Lopez-Pintor L, Casanas E, de Arriba L, Hernandez G. Risk factors associated with xerostomia in haemodialysis patients. Med Oral Patol Oral Cir Bucal 2017; 22(2): e185-e192.
16. Makinen KK. Gastrointestinal Disturbances associated with the consumption of sugar alcohols with special consideration of xylitol: Scientific review and instructions for dentists and other health-care professionals. Int J Dent 2016; 2016: 5967907.
17. Takahashi K, Fukazawa M, Motohira H, Ochiai K, Nishikawa H, Miyata T. A pilot study on antiplaque effects of mastic chewing gum in the oral cavity. J Periodontol 2003; 74(4): 501-5.
18. Aksoy A, Duran N, Koksal F. In vitro and in vivo antimicrobial effects of mastic chewing gum against Streptococcus mutans and mutans streptococci. Arch Oral Biol 2006; 51(6): 476-81.
19. Kaufman E, Lamster IB. The diagnostic applications of saliva--a review. Crit Rev Oral Biol Med 2002; 13(2): 197-212.
20. Cassolato SF, Turnbull RS. Xerostomia: Clinical aspects and treatment. Gerodontology 2003; 20(2): 64-77.
21. Flink H, Tegelberg A, Lagerlof F. Influence of the time of measurement of unstimulated human whole saliva on the diagnosis of hyposalivation. Arch Oral Biol 2005; 50(6): 553-9.
22. Yamuna Priya K, Muthu Prathibha K. Methods of collection of saliva - A Review. Int J Oral Health Dent 2017; 3(3): 149-53.
23. Fox PC, Busch KA, Baum BJ. Subjective reports of xerostomia and objective measures of salivary gland performance. J Am Dent Assoc 1987; 115(4): 581-4.
24. Fox PC. Differentiation of dry mouth etiology. Adv Dent Res 1996; 10(1): 13-6.
25. Sreebny L, Zhu WX. Whole saliva and the diagnosis of Sjogren's syndrome: An evaluation of patients who complain of dry mouth and dry eyes. Part 1: Screening tests. Gerodontology 1996; 13(1): 35-43.
26. Zaura E, Nicu EA, Krom BP, Keijser BJ. Acquiring and maintaining a normal oral microbiome: current perspective. Front Cell Infect Microbiol 2014; 4: 85.
27. Ghapanchi J, Rezazadeh F, Fakhraee E, Zamani A. Prevalence of xerostomia in patients referred to Shiraz Dental School, Shiraz, Iran during 2006-2013. Iran J Public Health 2016; 45(12): 1665-6.
28. Biria M, Eslami G, Taghipour E, Akbarzadeh BA. Effects of three mastic gums on the number of mutans Streptococci, Lactobacilli and PH of the Saliva. J Dent (Tehran) 2014; 11(6): 672-9.
29. Soderling E, ElSalhy M, Honkala E, Fontana M, Flannagan S, Eckert G, et al. Effects of short-term xylitol gum chewing on the oral microbiome. Clin Oral Investig 2015; 19(2): 237-44.
30. Mercadante V, Al HA, Lodi G, Porter S, Fedele S. Interventions for the management of radiotherapy-induced xerostomia and hyposalivation: A systematic review and meta-analysis. Oral Oncol 2017; 66: 64-74.
31. Sakagami H, Kishino K, Kobayashi M, Hashimoto K, Iida S, Shimetani A, et al. Selective antibacterial and apoptosis-modulating activities of mastic. In Vivo 2009; 23(2): 215-23.