Physicochemical characteristic of unstimulated and stimulated saliva with different chewing gum stimulation

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ABSTRACT

Background: Gum chewing is a common habit in many countries. Both sucrose containing and sugar-free gum stimulate salivary flow, increase in saliva flow lead to more frequent replenishment and greater supply of antibacterial factors, saline, buffers, minerals and other beneficial constituents, increase pH and buffer capacity of whole saliva. The aim of the present study was to investigate the effect of different chewing gums on the salivary constituents including some elements (Magnesium, Calcium, Copper and Zinc)(chemical),PH and flow rate(physical)characteristic.

Materials and Methods: Saliva samples was collected from dental students/college of dentistry 23 age stimulated by three types of chewing gum (mastic, Arabic, sugar) and control group (unstimulated saliva), pH and saliva flow rate was recorded for four groups. Biochemical analysis was assessed for some salivary elements, (Magnesium, Calcium, Copper, and Zinc) and its relation with different chewing gum and control group. Student's t-test, ANOVA and LSD test was used for statistical analysis. Also mean and standard deviation was recorded.

Results: Mean value of pH was found to be high in three types of chewing gum with highly significant difference comparing with control group. A significant difference in flow rate was found between control and sugared gum group. Mg and Ca ione was found to be highly significant between mastic gum group and other three groups , as well as highly significant difference was recorded among four groups of saliva in Cu ione, while no significant difference was showed between Zn ione and four groups.

Conclusion: Chewing gum include natural (mastic and Arabic) and sugared was increases salivary pH. Use of chewing gum especially mastic and Arabic can enhance the remineralizing potential of the mouth, probably by stimulating salivary flow which may lead to rise salivary elements.

Key words: Chewing gum, salivary elements, Mastic gum, Arabic gum. (J Bagh Coll Dentistry 2012;24(2):94-98).

INTRODUCTION

Chewing gum probably has its origin in ancient Egypt and in Mayan Indian times as these peoples are known to have chewed the resin of trees[(1)]also, in 50A.D.,when the Greeks sweetened their breath and cleansed their teeth with arsine called mastiche, which was obtained from the bark of the mastic tree so that the chewing gum first became an aid to maintaining oral health[(2)],in addition to that chewing gum increases salivary flow rate and enhance the protective properties of saliva this because the concentration of bicarbonate and phosphate is higher in stimulated saliva, and the, resultant increase in plaque pH and salivary buffering capacity prevent demineralization of tooth structure. Morevere, the higher concentration of calcium, phosphate, and hydroxyl ions in such saliva also enhances remineralization [(3,4)].Many studies have demonstrated the ability of mastic gum to suppress the growth of cariogenic bacteria and to reduce the salivary streptococcus mutans count[(5)],as well as another study concept that the use of mastic gum and xylitol containing chewing gum for 20 minutes after an acidogenic challenge can enhance the remineralizing potential of the mouth, probably by stimulating salivary flow [(6)], also a study by Bakhtiari [(7)]compared the rate of the secreted saliva and its pH after chewing xylitol-containing gum and mastic gum in case and control groups.The results indicated that both mastic gum and xylitol chewing gum increased the rate of secreted saliva and its pH [(7)], Another important sugar free gum was Acacia gum consists primarily of *Arabica,* a complex mixture of *calcium, magnesium* and *potassium salts of* Arabic acid. It contains *tannins* which are reported to exhibit astringent, homeostatic and healing properties. It also contains *cyanogenic glycosides* in addition to several enzymes such as *oxidase, peroxides* and *pectinases,* all of which have been shown to exhibit antimicrobial properties. Acacia Arabica type of chewing gum has potential to inhibit early plaque formation [(8)]. On other hand most chewing gum is sweetened with sucrose, gum products may increase the cariogenic load to dietary carbohydrates [(9)]. The aim of the present study was to investigate the effect of different chewing gums on the salivary constituents including some elements (Magnesium, Calcium, Copper and Zinc), PH and flow rate.

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MATERIAL AND METHODS

The sample of present study composed 80 dental students (college of dentistry, university of Baghdad) aged 23 years, they were divided in to four groups, each group consist of 20 sample, The saliva was collected after taking the medical

history and any medical problems or any systemic diseases were excluded. The collection of stimulated salivary samples was performed under standard condition following instruction cited by [10], while the collection of unstimulated salivary samples was performed under standard condition following instruction cited by Tenovuo and Lagerlof [11]

First group the individuals were asked to collect unstimulated saliva. Second group the individual were asked to chew a piece of Mastic chewing gum. Third group the individual were asked to chew a piece of Arabic gum. Fourth group the individual were asked to chew sugar gum. For these entire 4 groups the chewing was for one minute all saliva was removed by expectoration, chewing was then continued for ten minutes with the same piece of chewing gum and saliva collected in a sterile screw capped bottle. Salivary pH was measured using an electronic pH meter and flow rate of saliva was expressed as milliliter per minute (ml/min).The salivary samples were then taken to the laboratory for biochemical analysis. Samples were centrifuge by (Gallen kamp, England) at 3000 rpm for 30 minutes; the clear supernatant was separated by disposable micropipette and was divided into 4 portions, stored at (-20°C) in a deep freeze till being assessed. Biochemical analysis of four elements of saliva (Calcium, Magnesium, Copper, Zinc) were done at the Poisoning Consultation Centre / specialized surgeries hospital by flame atomic, using absorption spectrophotometer (Buck scientific, 210VGP, USA) following standardized procedure.

1. Determination of Ca++ :Dilute the samples in four groups with the lanthanum diluents, mix well and take for measurement of calcium by atomic absorption spectrophotometer (AAS)10.a hollow cathode lamp specific for calcium was used at a wave length of 422.7nm.
2. Determination of (Magnesium, Copper, Zinc): the samples in four groups were diluted with deionised water mix well and take for measurement of these elements by atomic absorption spectrophotometer (AAS)[12].

The data was processed with SPSS 9.0 statistical software. ANOVA (analysis of variance), LSD test and Student's t-test served for statistical analyses. The significance level was set at 95% ($P<0.05$).

RESULTS

The mean values of salivary pH ,flow rate for different type of chewing gum stimulation were shown in table 1that shows highly significant difference in salivary pH among different type of chewing gum stimulation ,while the difference were not significant, concerning flow rate. Further investigation using L.S.D test revealed that there is no significant difference between salivary pH, flow rate with different chewing gum stimulation Table 2 .The pH of unstimulated saliva was found in the present study to be 6.8±0556 which was lower that for stimulated saliva with different type of chewing gum and this difference were highly significant for Arabic and sugar chewing gum (-2.958, -3.039) Table (3), this table also revealed the salivary flow rate for unstimulated saliva was lower than for stimulated saliva with different chewing gum but these difference were not significant. Table (4) shows that there is highly significant difference in concentration of Mg, Ca, Cu among different type of chewing gum, while salivary Zinc concentration the difference was not significant..Further investigation using L.S.D test showed that salivary concentration of Mg, Ca and Cu were found significantly higher among group with mastic than Arabic chewing gum stimulation, while opposite figure found concerning salivary concentration of Zinc with significant difference. The L.S.D test also shows that the concentration of salivary Mg, Ca were highly significant, higher among group using mastic chewing gum than that using sugared chewing gum and opposite figure was found concerning concentration of copper as its concentration were highly significant ,higher among group using sugar chewing gum than group using mastic chewing gum Table 5, this table also revealed that the only significant difference was found concentration of salivary copper where company its concentration between person using sugar stimulation. Salivary Mg , Ca, Cu, Zn (mean and SD) among unstimulated and stimulated saliva were shown in table 6 that show the mean of salivary Mg, Ca was higher in mastic chewing gum stimulation than that for unstimulated saliva and these difference were highly significant (-7.610, -8.174), also this table revealed that the mean of salivary Cu was higher concentration in sugar and mastic gum stimulation than that for unstimulated saliva with highly significant difference(-3.023, -11.071), while significantly salivary Zn concentration was higher in Arabic chewing gum than that for unstimulated saliva(-2.413).

DISCUSSION

Chewing gum use has a longer period of exposure to the surface of teeth than a dentifrice or mouth rinse; therefore it can be a useful adjunct for maintaining oral health, especially if it contains a therapeutic agent that is effective topically[13].In

the present study the pH ,flow rate and some salivary elements of three types of chewing gum and unstimulated saliva was assessed. The present study represented that the pH mean of unstimulated saliva group was found to be lower than other groups with highly significant difference, this may be due to that there is a consequent rise in pH level which reaches a peak (7.6-7.8) after 3-5 minutes of chewing to a level above the critical pH and this agree with previous studies [14,15] Although both sucrose containing and sugar-free gum stimulate salivary flow [9],the higher mean of flow rate was found in 3rd group(sugar chewing gum) in this study with no significant difference between groups of chewing gum and unstimulated saliva, , this may be due to a combined effect of gustatory stimulation from the sweetening and flavoring agents and mechanical stimulation of salivary flow from chewing [16]. Concerning salivary elements the result showed that Mg and Ca ions significantly high in mastic gum group comparing with other groups ,this could be due that the use of chewing gum increases salivary flow rate and enhances the protective properties of saliva. Moreover, the higher concentration of calcium, phosphate, and hydroxyl ions in such saliva also enhances remineralization[1,3].Furthermore, saliva maintains the integrity of the teeth, because ions such as calcium, phosphate, magnesium, and fluoride can diffuse into enamel [17], Regarding calcium, phosphate and zinc ions different previous studies reported a significant role of these elements in relation to increase resistant of teeth to dental caries. Their presence in saliva may enhance remineralization and increase resistant of the outer enamel surface to acid dissolution [18,19,23],thus establishing a natural remineralization
process as these ions increases with increas of salivary flow rate .In the present study the mean of Zn ione was significantly high in Arabic gum group this agree with Al Saadi [20], moreover Acacia gum consists primarily of *Arabica,* a complex mixture of *calcium, magnesium* and *potassium salts of* Arabic acid. It contain *tannins* which are reported to exhibit astringent, homeostatic and healing properties [9].as well as Zinc and Copper are important for the healthy periodontal tissue as they effect on the collagen production [21,22].Finally the results of the present study support the concept that use o1f chewing gum especially mastic and Arabic(natural gum) can enhance the remineralizing potential of the mouth, probably by stimulating salivary flow which may lead to rise salivary elements. Since this is the first study on the effect of different chewing gums on the some salivary elements also a necessity to investigate the effectiveness of this natural product through long-term clinical.

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Table 1: Salivary pH and flow rate (Mean ± SD) among different chewing gum simulation

Variables	Mastic Gum		Arabic Gum		Suger Gum		ANOVA	
	Mean	SD±	Mean	SD±	Mean	SD±	F	Sig
pH	7.100	.458	7.275	.454	7.245	.345	4.464*	.006
Flow rate	2.910	1.208	2.855	1.234	3.420	1.323	1.369	.259

Highly significant p< 0.01

Table 2: Salivary magnesium, calcium, copper and zinc (Mean ± SD) among different chewing gum stimulation

Variables	Mastic Gum		Arabic Gum		Suger Gum		ANOVA	
	Mean	SD±	Mean	SD±	Mean	SD±	F	Sig
Magnesium	4.593	2.242	.338	.212	.455	.156	62.509*	.000
Calcium	15.200	5.207	4.580	1.477	3.190	.748	70.657*	.000
Copper	53.500	13.869	25.500	6.863	75.000	10.000	83.572*	.000
Zinc	16.000	9.403	21.500	8.127	15.500	7.591	2.540	.063

Table 3: LSD test of PH and flow rate among different chewing gum stimulation

	Mastic &Arabic Gum		Mastic &Suger Gum		Arabic &Suger Gum	
	Mean	Sig	Mean	Sig	Mean	Sig
pH	-.175	.232	-.145	.322	.030	.837
Flow rate	.055	.893	-.510	.216	-.565	.171

Table 4: LSD test of salivary electrolytes among different chewing gum stimulation

	Mastic &Arabic Gum		Mastic &Suger Gum		Arabic &Suger Gum	
	Mean	Sig	Mean	Sig	Mean	Sig
Magnesium	4.225*	.000	4.138*	.000	.117	.745
Calcium	10.620*	.000	12.010 *	.000	1.390	.140
Copper	28.000*	.000	-21.000 *	.000	49.000*	.000
Zinc	-5.500*	.037	.500	.848	6.000*	.024

Highly significant p< 0.01

Table 5: Salivary Ph and flow rate among unstimulated saliva and stimulated salivary groups

Variables	Unstimulated		Stimulated				
	mean	SD	Mean		SD	t-test	Sig
pH	6.800	.556	1	7.100	.458	-1.861	.071
			2	7.275	.454	-2.958*	.005
			3	7.245	.345	-3.039*	.004
Flow rate	2.615	1.391	1	2.910	1.208	-.716	.478
			2	2.855	1.243	-.575	.569
			3	3.420	1.323	-1.875	.069

***Highly significant p<0.01**

Table 6: Salivary magnesium, calcium, copper and zinc among unstimulated and stimulated groups

Variables	Unstimulated		Stimulated				
	mean	SD	Mean		SD	t-test	Sig
Magnesium	.777	.491	1	4.468	2.252	-7.610	.000
			2	.338	.212	3.667	.001
			3	.455	.156	2.792	.008
Calcium	4.856	2.224	1	15.200	5.207	-8.174	.000
			2	4.580	1.477	.452	.654
			3	3.190	.748	3.163	.003
Copper	42.500	8.506	1	53.500	13.869	-3.023	.004
			2	25.500	6.863	6.955	.000
			3	75.500	10.000	-11.071	.000
Zinc	15.500	7.591	1	15.150	9.783	.126	.900
			2	21.500	8.127	-2.413	.021
			3	15.500	7.591	.000	1.00

1=Mastic, 2=Arabic, 3=Sugar (chewing gum), df =38, Sig<0.005