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Durability of different types of Mouthwashes on the Salivary Buffering system in Orthodontic Patients

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Abstract

The fast elevation of the salivary pH in orthodontic patients has acritical role to safe the teeth and encourage the orthodontic treatment after acidic challenger. As their baseline salivary pH is dropped during fixed orthodontic treatments.

Aims: This study was aimed to evaluate the durability of three types of mouthwashes on the salivary buffering capacity in orthodontic patients at 0, 5, 10, 15 mints after acidic challenger using direct pH meter.

Material and Method: 80 orthodontic patients; age range (13-21years) were distributed into four groups; 20/ each, the salivary pH were recorded using compact pH meter (LAQUAtwin, HORIBA's, Kyoto, Japan) before and after administration of carbonated beverage (100 mm coca cola) and directly after gargling with 5 ml of the tested mouthwashes (herbal, green tea and chlorohexidine mouthwash) beside tap water as placebo control. The pH was documented again at 0, 5, 10 and 15 mins after each mouthwash gargling. One way ANOVA analysis and Duncan multiple were used for salivary pH analysis, p≤0.05.

Results: non-significant differences were found at 0, 5, 10, 15 mints in comparison with baseline pH after herbal mouthwash gargling, the same result was shown with chlorohexidine mouth wash but with less defined border. Salivary pH after green tea gargling showed clear oscillatory results after the same tested periods.

Conclusion: Herbal mouthwash is the best type to improve salivary pH for longer duration after acidic challenger. While Chlorohexidine mouthwash shows beneficial effects in elevation salivary pH with less duration. Green tea mouthwash fail to control salivary pH for long duration.

Keywords: Salivary pH; orthodontic appliance; Herbal mouthwash; Green tea mouthwash; Chlorhexidine mouthwash.

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Introduction

Dental Caries is the highest routine infectious disease worldwide. The interaction of shielding and deleterious factors in saliva and plaque considered as the elements that associate with caries incidence [1]. This incidence have a significant impact on patients wearing fixed orthodontic appliance, as the fixed appliance increase the occurrence of dental caries. Saliva is entirely unique oral fluid secreted from major and minor salivary glands. The usage of saliva in recognizing caries threat status for patients is well believed, which can be performed by evaluation the salivary flow rate, pH stage and lastly, its buffering capability. [1] Saliva pH ranges from (6.2 -7.6) with 6.7 practicality considered as the common pH. Saliva pH of non caries teeth shouldn't fall below 6.3. Saliva, in turn, takes its role to control the pH of the oral cavity, which is maintained near neutrality (6.7 to 7.3). The saliva mechanism to preserve the pH consist of the draught of saliva eliminates carbohydrates that would be metabolized by the bacteria and removes acids that created by microorganism. Also, drinks and foods acidity alongside bacterial waste products, is canceled out by the saliva

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buffering action [2]. The ammonia release from urea metabolism by plague, this ammonia act to buffer the acidity of the saliva. However, the critical pH was reported to be 5.5 or less, in dental studies, thus any further drops in salivary pH would leads to teeth decay as a result of alteration of calcium and phosphate. As this pH is risky on progression of dental enamel [3]. Mouthwashes are antibacterial liquids held in the mouth temporarily and swished by the perioral muscles to eliminate the oral infections. As a liquid, these Mouthwashes reach all mouth areas that are hard to reach using dental brush. According to their content, mouthwashes are generally classified into cosmetic and therapeutic products [4]. Chlorhexidine is the golden option for treatment and controlling dental Plaque and gingival inflammations. It is well known act against Gram-positive and Gram-negative bacteria both aerobes and anaerobes, as well as yeasts, fungi and virus's lipid envelope [5, 6,7]. Up to date, several synthetic mouthwashes are offered in the supermarkets. However, their side effects such as toxicity, hypersensitivity, and tooth staining limited it's used. The alternative option is medicines that are industrialized from medicinal Plants. These Plants are usually containing natural phyto-chemicals and henceforth, can replace synthetic medications [6]. Green tee also, has a multiple advantage for oral health. The previous studies focused on treatment aspects of mouthwashes regardless their effects on the saliva. The public queries that commonly arise is which one is well in improving saliva buffering capacity (chlorhexidine and herbal mouth). Hence, this study was designed to ask this question. Also, this study used to evaluate the effects of herbal, chlorohexidine as well as Green tea as mouthwash to test the durability of buffering capacity of the saliva over 0, 5, 10, 15 mints using direct pH meter.

Material and Methods

Study design

This study was designed as a double blinded randomized controlled trail. The protocol of this study was revised and accepted by research ethics committee of the Collage of Dentistry, University of Mosul (no. 26139 date 22\9\2019). According to the pilot study results, sample size was calculate utilizing G power software as follow: power of study was 85%, α= 0.05, constant proportion was 0.5, the result was total sample size was 18 per group. We recruited 20 patients per group for more precise the results. Eighty orthodontic patients seeking dental treatments in dental hospital at the dental school/ university of Mosul were asked to participate in this study. Each patient signed special constant form, which was previously prepared for this purpose. The patients' age range was (13-21 years). The inclusion criteria include healthy orthodontic patients wearing fixed orthodontic appliance (Roth "22 stainless steel brackets, Ultratrim, Dentaurum, Ispringen, Germany) within the last two months that were neither complain from any systemic disease nor under daily drug course that could excreted in the saliva and hinder the results. The recruited patients were divided into four groups (20 for each) according to the type of the mouthwashes under investigation as follow: Herbal group (HG), Chlorohexidine group (CG), Green tea Group (FG) and tap water group (TG) which act as placebo negative. The patients and the observer were blinded to the type of the mouth wash used.

Measurement procedure

Each patient was instructed to stop eating and drinking at all for an hour before the morning appointment after well brushing of his teeth one night before. The patient set at morning in upright

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position in the dental chair and initial salivary pH was measure by spitting a sufficient amount directly on the dish part of the pH meter (HORIBA's LAQUAtwin, Horbia instruments incorporated, Kyoto, Japan). Then the subject was instructed to gargle with a (100 ml) of Coca Cola® (Carbonated beverage) for 10 seconds before swelling it. Patient saliva pH was re-measured and recorded immediately after Coca Cola swallowing and 5, 10, 15 mints after respectively, using the same above procedures and device.

For HG, the above procedure was repeated one day after, as the patient was instructed to gargle with constant amount (5 ml) of herbal mouthwash (Vitex maximum orthodontic care mouthwash (CJSC "Vitex" in Republic of Belarus) for 5 - 10 sec [according to British National Formulary 77] before Coca Cola swallowing. The salivary pH was measured immediately after that and 5, 10, 15 mints subsequently. The same above procedure was repeated using the chlorohexidine mouth wash (Biofresh, Scitra Co. in United Arab Emirates), tap water and Green tea (Ahmad tea, London, United Kingdom) according to their group. Green tea mouth wash was prepared by dipping five tea bags in 100ml of boiling water, then let it cool at room temperature for about one hour before give it to patients. All the mouthwashes were packed in totally black bottles to a chive a double blind of the observer and participates.

The pH meter was cleaned and washed with plenty of distal water after each measurement and re calibrated using special well-known pH liquids that was provided with it.

Statistical analysis

The data that had been collected throughout the study have been processed and analysed by using SPSS 23 (Statistical Package for the Social Sciences) (SPSS Inc., Chicago, USA). It was used to calculate mean and stander deviation for each salivary pH measurement for all groups. One way ANOVA analysis and Duncan multiple range test was used to find differences in salivary pH measurements for mouthwashes in compare with baseline salivary pH and to find differences in salivary pH measurement between all locally active tested products ($p \leq 0.05$).

Results

Table 1. shows the mean age for all patients participated in this study classified according to type of mouth wash used, which was (15.97 SD 4.01) years, with no significant difference between age groups, female represent (80%) for whole patients that participate in our study compare with (20%) for male with no significant difference between the two genders at ($p \leq 0.05$) p value was 0.763.

Salivary pH measurement after Herbal mouthwash gargling

Herbal mouthwash pH was (7.2). The results of measurement salivary pH for patients after herbal mouthwash were shown in *Table 2*, that shows the means and stander deviation of each salivary pH measurements, and the result of comparison of salivary pH for patients at different intervals from gargling with herbal mouthwash using One way analysis of variance (ANOVA) that reveal a significant difference in salivary pH after Coca cola in compare with Baseline, 0, 5, 10 and 15 min salivary pH after gargling with herbal mouthwash ($p \leq 0.05$), while there were no significant differences between the salivary pH at 0, 5, 10 and 15 and baseline pH at ($p \leq 0.05$).

Salivary pH measurement after Chlorohexidine gargling

Chlorohexidine mouthwash pH was 6.3. The results of measurement salivary pH for patients after chlorohexidine mouthwash were shown in *Table 3* that shows the means and stander

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deviation of each salivary pH measurement and the result of comparison for salivary pH measurement at different time from chlorohexidine gargling by One way analysis of variance (ANOVA) that reveal a significant difference in salivary pH after coca cola in compare with baseline 0, 5, 10 and 15min salivary pH after gargling with chlorohexidine mouthwash ($p \leq 0.05$), there were also a significant differences between 0 min salivary pH after gargling with 15 min salivary pH measurement ($p \leq 0.05$), while there were no significant differences between salivary pH measurement at 5, 10 and baseline pH in compare with 0 and 15 min salivary pH measurement after chlorohexidine mouthwash.

Tap water mouthwash and salivary pH Measurements

Tap water pH was (7.4) the results of salivary pH measurement for patients after tap water mouthwash were shown in *Table 4* at which we reveal the means and stander deviation of each salivary pH measurement and the result of comparison for these salivary pH measurement by One way analysis of variance (ANOVA) which reveal a significant difference in Coca Cola salivary pH in compare with Baseline, 0, 5, 10 and 15 min salivary pH after tap water mouthwash ($p \leq 0.05$), There were also a significant difference in 15 min salivary pH from tap water mouthwash in compare with Baseline and 0 min salivary pH from tap water Mouthwash at ($p \leq 0.05$), While there were no significant differences between baseline pH in compare with 0, 5, and 10 min salivary pH measurement after tap water gargling at ($p \leq 0.05$).

Green tea mouthwash and salivary pH measurements

The results of measurement salivary pH for patients after green tea mouthwash (mouthwash solution pH 5.7) were shown in *Table 5* at which we reveal the means and stander deviation of each salivary pH measurement and the result of comparison for salivary pH measurement after green tea mouthwash by One way analysis of variance (ANOVA) that reveal a significant difference in baseline salivary pH in compare with coca cola salivary pH 0, 5, 10 and 15 min salivary pH after gargling with green tea mouthwash ($p \leq 0.05$), There were a significant difference at 0 min salivary pH after green tea mouthwash in compare with coca cola salivary pH 5, 10 and 15 min salivary pH after green tea mouthwash gargling ($p \leq 0.05$) and there were a significant difference between coca cola salivary pH in compare with salivary pH after 15min from green tea mouthwash ($p \leq 0.05$), while there were no significant differences between 0min and baseline, coca cola in compare with 5 and 10 min. also no significant differences between 15 min in compare with 0, 5 and 15 min salivary pH measurement at ($p \leq 0.05$).

Comparison between different mouthwashed used in this study

The results of comparison salivary pH measurement between orthodontic patients' groups after gargling with different mouthwash (Herbal, Chlorohexidine, Green tea and tap water) were shown in *Table 6* at which we reveal the means and stander deviation of salivary pH measurement for each group. The result of comparison by One way analysis of variance (ANOVA) which reveal a significant difference between herbal group and green tea group at 0 min from gargling, a significant difference between green tea groups at 5 min with herbal, chlorohexidine and tap water groups at 5 min, significant difference between green tea groups at 10 min with herbal, chlorohexidine and tap water groups at 10min, also a significant difference between tap water groups at 10min with herbal and green tea groups and a significant difference between herbal at 15min with tap water and green tea groups.

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Table 1. The mean age differences between the groups.

Groups	Age (mean (years) ± SD)	F	P-value
Herbal Mouthwash HG	(17.1 ± 4.35)	0.025	0.994
Chlorohexidine Mouthwash CG	(15.3 ± 3.20)		
Tap water Mouthwash TG	(15.7 ± 2.53)		
Green tea Mouthwash FG	(15.8 ± 4.960)		

$p \leq 0.05$.

Table 2. One way ANOVA for salivary pH after Herbal Mouthwash

Groups	pH (mean ± SD)	F	P-value
Baseline	(6.65 ± 0.303) a	22.254	0.000
After Coca Cola	(5.47 ± 0.689) b		
0 min from gargling	(6.79 ± 0.110) a		
5 min from gargling	(6.7 ± 0.115) a		
10 min from gargling	(6.58 ± 0.139) a		
15 min from gargling	(6.53 ± 0.188) a		

a: homogenous group, b and c: significant differences at $p \leq 0.05$.

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Table 3. One way ANOVA of salivary pH after chlorohexidine mouthwash

Groups	pH (mean ± SD)	F	P-value
Baseline pH	(6.54 ± 0.195) ab	18.494	0.000
After Coca Cola	(5.65 ± 0.636) b		
0 min from gargling	(6.73 ± 0.231) a		
5 min from gargling	(6.59 ± 0.159) ab		
10 min from gargling	(6.51 ± 0.166) ab		
15 min from gargling	(6.37 ± 0.194) b		

a: homogenous group, b significant differences at $p \leq 0.05$.

Table 4. One way ANOVA of salivary pH after tap water mouthwash

Groups	pH (mean ± SD)	F	P-value
Baseline pH	(6.61 ± 0.281) a	23.184	0.000
After Coca Cola	(5.54 ± 0.532) b		
0 min from gargling	(6.62 ± 0.155) a		
5 min from gargling	(6.49 ± 0.129) ac		
10 min from gargling	(6.42 ± 0.114) ac		
15 min from gargling	(6.31 ± 0.099) c		

a: homogenous group, b and c: significant differences at $p \leq 0.05$.

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Table 5. One way ANOVA of salivary pH after green tea mouthwash

Groups	pH (mean ± SD)	F	P-value
Baseline pH	(6.69 ± 0.202) a	6.496	0.000
After Coca Cola	(5.91 ± 0.574) b		
0 min from gargling	(6.54 ± 0.408) ac		
5 min from gargling	(6.02 ± 0.426) bc		
10 min from gargling	(6.18 ± 0.234) bc		
15 min from gargling	(6.32 ± 0.244) c		

a: homogenous group, b and c: significant differences at $p \leq 0.05$.

There were no significant differences at 0 min salivary pH between all groups as they elevated salivary pH directly after gargling. Herbal mouthwash has the highest pH (7.2), chlorohexidine was in the second place by (6.73), Tap water at the third place by (6.62) and lastly home-made green tea mouthwash (6.54). After five minutes from gargling with mouthwashes there were a significant difference between green tea (6.02) in compare with Herbal (6.7), chlorohexidine (6.59) and tap water (6.49) that is also lesser than baseline salivary pH, these mean mouths become more acidic after 5 minutes from green tea mouthwash. After 10 minutes from mouthwashes gargling there were a significant difference between green tea pH (6.18) with herbal (6.58), chlorohexidine (6.51) and tap water (6.42) mouthwashes, also there were significant differences between tap water (6.42) with herbal (6.58) and green tea (6.51) mouthwashes. After 15 minutes from gargling with mouthwashes there were a significant difference between green tea (6.31) salivary pH with herbal mouthwash (6.53) also, significant differences between tap water (6.32) mouthwashes with herbal mouthwash (6.53), while there were no significant differences between chlorohexidine (6.37) and other mouthwashes after 15 minutes from gargling.

The durability of each mouth washes used in this study after acid challenger are shown in *Figure 1* for different intervals.

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Table 6. One way ANOVA of salivary pH after green tea mouthwash

Groups	Herbal mouthwash (mean ± SD)	Chlorohexidine mouthwash (mean ± SD)	Green tea mouthwash (mean ± SD)	Tap water mouthwash (mean ± SD)	P- Value
0 min	(6.79 ± 0.110) a	(6.73± 0.231) a	(6.54±0.408) b	(6.62±0.155) ab	0.140
5 min	(6.7 ± 0.155) a	(6.59± 0.159) a	(6.02± 0.426) b	(6.49±0.129) a	0.000
10 min	(6.58 ± 0.139) a	(6.51 ± 0.166) ac	(6.18 ± 0.234) b	(6.42±0.129) c	0.000
15 min	(6.53 ± 0.188) a	(6.37 ± 0.194) ab	(6.32 ± 0.244) b	(6.31±0.099) b	0.033

a: homogenous group, b and c: significant differences at $p \leq 0.05$.

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Discussion

Saliva acidity consider as critical factor in dental erosion, which defined as the chemical process that lead to loss of tooth hard tissue without cooperation of bacteria, dental erosion incidence has been expanded in current years and it is presently taken into consideration to be a worldwide oral sickness, for that salivary acidity is the important threshold for this chemical process that cause dental tissue dissolution [7].

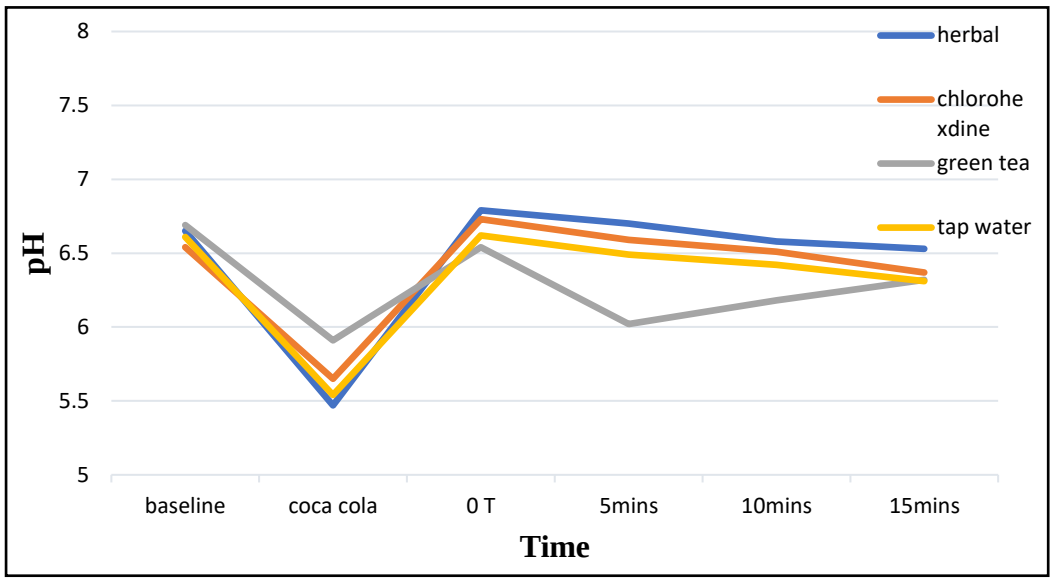

Figure 1 Durability of Salivary pH for different mouthwashes used in this study.

In orthodontic patients, the control of the pH of the saliva has a primary importance, as it was reported that the pH of saliva in orthodontic patients dropped significantly after only one month from starting the fixed orthodontic therapy [8]. Additionally, Toodehzaeim and Khanpayeh, [8], clarified that acidic saliva has an adverse effect on brackets bonding, and archwire surface roughness that could be delay orthodontic treatment. The Checking out of the erosive capability on human teeth makes feel with substances having pH values under 5.5. Saliva had the ability to compensate these dropping in pH by its dynamic system withen 15-60 min, but this not consider a fast process as dental erosion progression start only after 5 min from exposure to acidic challenger [9].

In this study, a new pH meter was used to measure the pH of the saliva of the volunteers, which is more realable and accurate than pH strip, as these strips has no exact clear measurements of the salivary pH.

Three types of mouthwashes were evaluated in this study which are the most popular used, Tap water also was used as placebo control, which is most accessible one. Different intervals were selected (0, 5, 10, 15 mints) to find out the faster mouthwash that could elevated the salivary pH for longer duration.

Coca Cola and salivary pH

Our results showed that the consumption of the Coca Cola dropping the pH of the saliva to reach the critical pH which was reported to be the main causative factor of teeth demineralization and subsequent teeth decays [2]. This could be due to the high percentage of carbonate induced in the Coca Cola. This fallen pH was re-elevated gradually with time to reach 83% from baseline pH after only 5 mints, and to reach 88.95% after 15 mints of beverage intake. However, there are a significant difference between these time intervals. Normally the saliva has an ability to control and balance the acidic challenger within 15-60 mints [2, 10, 11].

Herbal mouthwash

As herbal mouthwash has alkaline pH (7.2), saliva pH up surged directly to higher pH than baseline pH after gargling with it, that persist for 5 min then it retains to

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approach baseline pH and dropped after 10, 15 mints respectively with good durability, with no significant between these intervals and base line pH. Herbal mouth washes has a refreshing feeling with no bitter test or loss of sensation which seen with other chemical mouthwash, with less staining and pleasant taste induced in the synthetic mouthwashes and also, they're better in cost [6, 12]. Recently, the trend to used natural products become more popular as they have high antimicrobial efficiency, safe and reasonably-priced as well. Triclosan content of the herbal mouthwashes has an ability to increase the salivary pH immediately [6, 12].

Sandhya, in 2017 [13] reported that the traditional mouthwash comprises of the high alcoholic content which can cause harm to the teeth, gums and the oral mucosa. While the natural mouthwash doesn't contain any alcoholic residue and is gentler on the mouth. Beside all of above, the use of herbal mouthwash enhances the saliva buffering capacity immediately. One of its limitation is that it's difficult to be taking every time as it is bulk to be transported or taking everywhere.

Chlorohexidine mouthwash

Our result showed that taken chlorohexidine mouthwash, which have alkaline pH, directly after carbonated beverage elevated salivary pH directly higher than baseline pH, that persist for 10 min insignificantly, then drop back to have pH lower than baseline pH after 15mins from chlorohexidine mouthwash however with no significant difference between them. Thus, the immediate one time used of chlorohexidine mouthwash has a significant, but a short-lasting effect on salivary pH.

This conclusion is agree with Kalyani & Leelavathi [14] as they found that chlorohexidine mouthwash have a positive effect on the salivary pH, which is also prolonged in nature. On the other hand, this study is in disagreement with Bescos et al., [15] how found that salivary pH and salivary buffering capacity are highly diminished after using chlorohexidine mouthwash, however, their study conducted twice daily for one week, as chlorohexidine use is associated with high increase in saliva lactate, glucose and nitrate concentration.

Green tea mouthwash

As saliva pH drop immediately after drinking carbonated beverage green tea mouthwash succeed to increase pH directly to reach pH higher than critical salivary acidic pH but lower than baseline pH, then it dropped again to almost reach pH after carbonated beverage (after 5 mints), then retain to elevation after 15mins from green tea mouthwash. The green tea mouthwash has a significant, but a short-lasting effect on salivary pH (less durability).

Talreja et al., [16] and Lee et al., [17] uncovered that the catechins (green tea extract) were held for 60 min in saliva and protected plaque pH toward neutrality and also it have antiplaque and antibacterial properties by collaboration with boundary work of microorganism and consumption of this bunch, in this way contributing to caries prevention.

This results agreed with Singh, [18] Kamalaksharappa et al., [19] Srinidhi et al., [20] Rathod, [21] and Sangameshwar, [22] there were a significant increase in salivary pH after rinsing with green tea mouthwash. However, our results shows short improvements effects.

Tap water mouthwash

Tap water mouthwash (pH 6.8), after carbonated beverage, rise the salivary pH directly to reach to pH higher than baseline pH, that persist for few minutes then drop

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back to have pH lower than baseline pH after 15mins, but higher than pH after carbonated beverage. Here we demonstrate that tap water mouthwash has a significant, but a short-lasting effect of salivary pH. This type of mouthwash considers the simplest and most accessible type of mouthwashes, with safe and cheap considerations with insignificant durability from baseline pH after 10 mint.

We agreed with Kalyani and Leelavathi, [14], as they claimed that quick increment within salivary pH after 5 min. from water gargling. Also, we agree with Mosallam & Mohamed, [24, 23] who found that water gargling after dropping in salivary pH leads to neutralization of salivary pH, thus could be consider as a simple preventive measure of caries process in young adults.

In 2014 Lim [23] discover that water mouth rinsing after suppers plays a basic part in maintaining mouth health. As already depicted, water with pH at 7.0 demonstrates to be cost-effective preventive degree to prevent dental caries. Saliva's fundamental constituent is water. In addition to that, there are few chemicals and microscopic organisms which help in oral health status support. It is a well-known fact that the low salivary pH would result in higher rate of caries. The higher pH will alter the ordinary microflora, which in turn will change the mouth balance influencing the periodontium antagonistically. Singh et al., [18] studied reinforce rinsing with plain water may be a good preventive step to be consolidated in preventive, promotive programs pointed at decreasing dental caries and gingivitis. Panchal and Gurunathan, [25] found that water flushing increments salivary pH after the diminishment with 50% sucrose solution. This in a roundabout way improves the caries anticipation and a straight forward mouth cleanliness hone which can be effectively used. In Tolentino et al, [26] study the volunteers flushed with refined water, and they found there was an increment in salivary pH amid the estimations. It can be clarified since of the increment within the saliva's bicarbonate concentration when salivary stream is increased, a condition that's common over time: salivary pH increments with the increment of stream.

Panchal and Gurunathan, [25] expressed that the clearance rate and the amount of salivary secretion alter the pH. Also, in their study, the protective impact of tap water flush can be ascribed to increments in the clearance rate, treatment changing the pH having a more protective effect toward caries anticipation. Hence, modifying salivary buffering capacity by changing salivary pH can help as a preventive degree in dental caries. Mouth flushing with water having a more alkaline pH leads to extend in salivary pH, which in this manner aids as a halt within the handle of demineralization by acidic corrosive generation.

Comparison between mouthwashes

As these mouthwashes have different pH and different in persisting time in the mouth, herbal mouthwash enhances salivary buffering capacity and show the highest salivary pH in compare with baseline salivary pH and other tested groups as it has highest pH (7.2) and persisted for longer period in the mouth (long durability), chlorohexidine in second place showed result approach to herbal mouthwash, homemade green tea mouthwash increases salivary pH after gargling but not reach baseline pH then pH decrease almost become acidic then increase gradually, green tea mouthwash show no enhancement for saliva buffering capacity, on the other hand tap water mouthwash increase salivary pH approach to baseline pH as it has an alkaline pH, that persist for short period as it

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readily wash from the mouth, that mean enhance saliva buffering capacity for short period. Kalyani and Leelavathi, 2019 [14] concluded that chlorohexidine mouthwash had alkaline pH, which is also drawn out in nature when compared to plain water, but we disagreed that chlorohexidine has higher and prolonger effect on salivary pH than herbal mouthwash as we use different herbal mouthwash. However, they have been measured salivary pH at 5 and 60 mints. The Kukreja and Dodwad, 2012 [27] declared that if people can utilize and advance such cost-effective measures (Herbal mouthwashes) of keeping up the oral health which are moreover destitute of any untoward side impacts, it may offer assistance in overcoming some common dental issues.

Bagchi et al., [6] owing to the side effects reported due to utilize of chlorhexidine mouth rinse and biocompatibility and well acknowledgment of herbal mouthwash by the consumer, it can be viably utilized as a replacing to chlorhexidine mouth rinse.

One of the limitations of the herbal mouthwashes that was reported by Abdullah et al., [1] study, as they found that herbal mouthwashes are corrosive to orthodontic appliance as the number of ions released from orthodontic appliance in herbal mouthwashes was higher than chlorohexidine mouthwash but didn't exceed the daily recommended to be release from orthodontic appliance according to WHO. So prolonged use of these mouthwashes is not recommended. Dehghan et al., [28] found that mouth washing with chlorohexidine after an acidic challenge expanded salivary pH. The chlorohexidine mouthwashes raised pH higher than water. Mouthwashes with a neutralizing impact can possibly decrease tooth disintegration from corrosive presentation. FLÖTRA et al., [29] instructed utilizing of chlorhexidine mouth washes for brief time only, due to their staining effects on the teeth. Vilela et al., [30] study supports the effectiveness of green tea mouthwash as an antibacterial option and as substitutes to chlorohexidine mouthwashes. However our results showed it failed to improve the salivary pH after extended period of time. Kaur et al., [31] study out comes showed that green tea catechin mouthwash contains a comparable antiplaque viability to chlorhexidine when utilized in a period of 7 days. Moreover, green tea catechin mouthwash due to its superior taste and no known side-effects can be utilized on an everyday premise as an elective for chlorhexidine gluconate as an anti-plaque operator. It ought to be investigated as a long-term antiplaque flush with prophylactic benefits.

Conclusion

Herbal mouthwash is the best one to improve salivary pH and for longer duration after acidic challenger. Chlorohexidine mouthwash shows beneficial effects in elevation salivary pH higher than baseline pH and fast return to higher pH of saliva after acidic challenge. While Green tea mouthwash showed limited effects in elevation salivary pH after acidic challenge for long duration.

Conflicts of interest

The authors declare no competing interest.

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