Research Article

Comparison between the effect of plain water, herbal mouthwash, and chlorhexidine mouthwash on salivary pH

P. Kalyani, L. Leelavathi*

ABSTRACT

Objective: The objective of this study is to establish the difference in the salivary pH after rinsing with plain water, chlorhexidine (CHX) mouthwash, and herbal mouthwash and to compare the same. **Materials and Methods:** The sample size of the study is 30. Each participant will be subjected to either plain water or CHX mouthwash or herbal mouthwash rinsing. The salivary pH was measured using uncontaminated pH strips placed in the floor of the mouth for 30 s. The salivary pH was measured before rinsing and after rinsing. The results were compared and analyzed to determine the difference in the salivary pH between the use of plain water, CHX mouthwash, and herbal mouthwash. **Results:** *P* value for the analysis of variance test is as follows: After 5 min, 0.048 <0.05 and after 1 h is 0.042 <0.05. The paired *t*-test was done between every two of the three groups: Between CHX and plain water –0.04 <0.05; between herbal mouthwash and plain water –0.048 <0.05; between CHX and herbal mouthwash –0.045 <0.05. **Conclusion:** CHX mouthwash proves to have a positive effect on the salivary pH, which is also prolonged in nature. This once again proves the substantivity of CHX mouthwash.

KEY WORDS: Chlorhexidine mouthwash, Herbal mouthwash, Plain water, Salivary pH

INTRODUCTION

The oral cavity has a unique environment as it has a continuous interaction among its components – tooth surfaces, saliva, mucous membranes, and microflora. Saliva is an important component as it maintains the oral tissues in a physiologic state. The constituents of saliva include antibacterial factors – sodium, potassium, calcium, bicarbonate, lysozyme, myeloperoxidase, and lactoperoxidase thiocyanate system; salivary antibodies – IgA, IgG, and IgM; enzymes – hyaluronidase, lipase, catalase, and peroxidase; salivary buffers; coagulation factors; and leukocytes. Saliva exerts a major influence on plaque by mechanically cleansing the exposed oral surfaces, by buffering acids produced by bacteria, and by controlling bacterial activity. The normal range of salivary pH is 6.2–7.6, with 6.7 being the average pH. A salivary pH <7.0 is indicative of acidemia and is detrimental to the tissues as it contributes to dental caries, halitosis, and periodontal problems. On the other hand, excessive alkalinity can also bring about the same changes but is relatively rarer.[1] Thus, salivary pH is an important indicator of the oral health and potential pathogens that can inhabit the oral cavity. Dental plaque is an adherent biofilm that forms on the tooth surfaces. The aids for control of plaque can be mechanical or chemical. The mechanical aids include toothbrushes, dentifrice, interdental cleaning aids, oral irrigation systems, and the chemical aids include mouthwashes, antibiotics, and enzymes.

Mouthwashes are antiseptic solutions used for rinsing the mouth. They cannot be used as a sole aid for plaque control but instead should be used along with other mechanical plaque control aids. Mouthwashes are used for both preventive and therapeutic purposes. They can be used for preventing caries occurrence, fluoride delivery, for reducing inflammation, and for treating halitosis.[2]

Mouth rinsing with plain water is one of the most common methods to cleanse the oral cavity. This method of mouth rinsing is still followed regularly not only in rural but also in suburban and urban areas. When it comes to commercial mouthwash

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solutions, chlorhexidine (CHX) mouthwash is one of the most commonly used and commonly prescribed mouthwashes. CHX is a cationic antimicrobial agent which has a broad spectrum of action against both Gram-positive and Gram-negative bacteria, some fungi and viruses. The cationic nature causes it to adhere to the anionic cell membranes. Moreover, an important property of CHX is its substantivity, which is the ability to persist at effective concentrations and to have a prolonged antimicrobial activity.[3] However, these mouthwashes are not prescribed for long-term usage due to proven adverse effects such as staining, burning sensation, and increased calculus deposition.

Herbal mouthwashes do not mostly contain alcohol and/or sugar, which are the most common ingredients in chemical mouthwashes and also contribute to the adverse effects as the bacteria feed on the sugars in the mouthwash compromising oral health.[4] The composition of these mouthwashes includes essential oils such as thymol, methanol, and eucalyptus, in addition to which herbal extracts of neem, tea leaves, and piper leaves are also added in some mouthwashes.

The aim of our study was to compare the effect of using plain water, CHX, and herbal solutions as mouthwashes on the salivary pH.

MATERIALS AND METHODS

Study Design

This was a double-blinded randomized controlled trial. The participants and the observer were blinded to avoid bias. The participants were blinded so that they were not aware of the type of mouthwash prescribed for them. The blinded observer was not aware of the mouthwash they are prescribing.

Study Setting

This study was conducted at Saveetha Dental College and Hospitals, Chennai, India.

Informed Consent

This study was approved by the Institutional Ethical Committee and informed consent was obtained.

Selection of Subjects

The subjects were selected based on the following inclusion criteria.

Final year dental students (male and female) aged 18–25 years were included in this study. Only hostel students were included in this study. This is because day scholars have different meal patterns and lack uniformity. It was made sure that the dietary practices and pattern were uniform of all the students. The sample size was calculated based on the previous study results[5] and the required sample size with 90% power is 9 per group and in total 27.

A total of 30 volunteers (male and female) final year dental students formed the study sample. The participants were divided into three groups with 10 individuals in each group. The groups were marked as Group A, Group B, and Group C with plain water, CHX mouthwash, and herbal mouthwash, respectively. For all the participants, the salivary pH before rinsing the mouth was noted down. The amount of CHX mouthwash, herbal mouthwash, and plain water used for the rinsing was 10–15 ml, which was measured with the measuring cup. The after rinsing pH was calculated at the following time intervals: After 5 min and 1 h.

Disposable salivary strips were used during the study to measure the salivary pH. The strips were kept in the floor of the mouth by the examiner for 30 s and the pH was recorded.

Then, the pH strips were removed immediately and color matching was done against the indicators given by the manufacturers. The readings were then noted and tabulated.

The readings were then subjected to statistical analysis using SPSS software. Analysis of variance (ANOVA) and paired *t*-test were done.

RESULTS

Salivary pH Change in Plain Water

An immediate increase in the pH was seen after 5 min to 7.6. However, there was a decrease in the salivary pH after 5 min and remained closed to neutral. At the end of 1 h, the mean salivary pH was 7 [Figure 1and 2].

Salivary pH Change in CHX

The salivary pH showed a steep rise to 10.5 after 5 min, then dropped and after 1 h, the pH was at 7.5 [Figure 1and 2].

Salivary pH Change in Herbal Mouthwash

The salivary pH showed an increase to 7.4 after 5 min interval. However, it approached neutrality very soon in the next time interval, and at the end of 1 h, the mean salivary pH was 7 [Figure 1and 2].

An ANOVA was done between all the three groups for the time intervals of after 5 min and after 1 h. *P* value for the ANOVA test is as follows: After 5 min, 0.048 <0.05 and after 1 h is 0.042 <0.05.

The paired *t*-test was done between every two of the three groups: Between CHX and plain water –0.04 <0.05; between herbal mouthwash and plain water –0.048 <0.05; between CHX and herbal mouthwash –0.045 <0.05. The

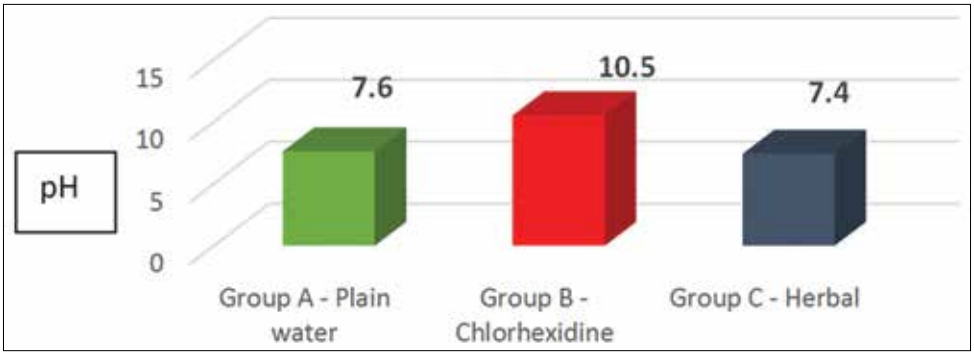

Figure 1: Salivary pH of the study participants after 5 min

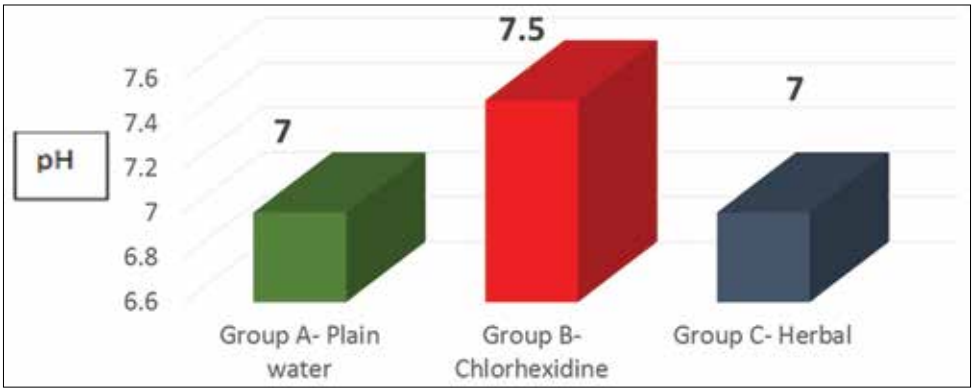

Figure 2: Salivary pH of the study participants after 1 h

graphs for the comparison of pH between the three groups have been attached as follows.

DISCUSSION

Saliva is one of the important fluids in the body. The secretion of saliva is by the three pairs of major salivary glands, namely the parotid, submandibular, and submental glands, and some minor salivary glands as well. The function of saliva is to lubricate and protect the oral mucosa apart from, acting as a mechanical, thermal, and chemical barrier. There are two main actions of saliva – clearance and buffering. The buffering action of saliva can be attributed to three buffering systems, namely – bicarbonates, phosphate, and urea.

Bicarbonate diffuses into plaque and acts as a buffer by neutralizing acids. The buffering action of urea is due to the release of ammonia through two pathways – urea is acted on bacterial urease to release ammonia and CO_2; plaque also metabolizes urea to release ammonia. The released ammonia serves to increase the salivary pH. Saliva is a supersaturated solution of calcium, phosphate, and fluoride ions when compared with hydroxyapatite crystals in the teeth. The critical salivary pH with respect to tooth mineral is 5.5–6.5. During decreased salivary flow, the saliva cannot raise its pH, leading to an increased susceptibility for caries.[6,7]

Mouth washing or mouth rinsing is believed to increase the stimulated salivary flow rate, thus activating the phosphate buffer system. People commonly use mouthwashes for breath freshness and cleansing the mouth.[8] However, the actual benefits of using mouthwashes arise from the antiseptic and antimicrobial action they hold. Since people consider it to be a mere mouth freshener, they tend to use it occasionally. Thus, plain water is being used regularly for mouth rinsing. Hence, we included plain water as one of our study groups.

CHX is the most commonly prescribed mouthwash. It belongs to the bisbiguanides group of mouthwashes. Marked plaque inhibition is seen on the use of CHX mouthwash which can be attributed to its retentive nature – substantivity. According to Rölla and Melsen, there is a slow displacement of CHX from the carboxyl binding sites in oral mucosa, by the salivary calcium ions. Further, CHX also decreases the amount of bound calcium in plaque which is responsible for the accumulation of plaque. Thus, these actions account for the plaque inhibiting property of CHX.[9]

On the other hand, there is an increasing awareness about the use of natural/herbal products in daily life, particularly in case of health services. This has led to the increased usage of herbal mouthwashes containing tea, neem oil, etc. These are mostly over-the-counter products, rather than being prescribed by a physician.[10,11]

Thus, these 3-mouth rinsing solutions which differ in all aspects for each other were chosen to be our study groups. There was an immediate increase in the pH seen after 5 min, but after 1 h, the mean salivary pH was neutral while using plain water. This indicates that there is not a significant change in salivary pH brought about by the use of plain water for mouth rinsing. In the CHX group, the salivary pH showed a steep rise and remained neutral even after 1 h, which indicates the prolonged action of CHX on salivary pH when compared with plain water.

The salivary pH showed an increase after 5 min interval among the study participants who used herbal mouthwash. However, it approached neutrality very soon in the next time interval indicating its action on salivary pH similar to that of plain water.

Discussing the results of statistical analysis, ANOVA showed that the change in salivary pH between after 5 min and after 1 h time intervals was significant. Further, paired *t*-test revealed that the changes caused by CHX were more significant when compared to that of plain water and herbal mouthwash.

In a similar study by Singh *et al*., the effects of plain water and CHX mouthwash on salivary pH were compared and were concluded that plain water can also be used as a preventive and promotive measure against dental caries and gingivitis.[5,12] On discussing about studies done on the same grounds, there are several contradicting results.

While Balappanavar *et al.* stated that effectiveness of 0.5% tea was more compared to 2% neem and 0.2% CHX mouth rinse,[13] Nagappan *et al*. have concluded that CHX mouth rinse (0.2%) has a better antimicrobial efficacy against *Streptococcus mutans* when compared to herbal mouth rinse.[14] In another study by Tolentino Ede *et al*., it was inferred that only triclosan and essential oil mouth rinses increased salivary pH immediately after rising and enzymatic solution was able to decrease salivary pH immediately after rising.[15-17]

There was a drastic change in salivary pH due to systemic diseases and cough syrup consumption, suggesting as a potential diagnostic marker and hence used in the study.[18-20]

Thus, we can conclude that the gold standard CHX mouthwash has better efficiency in altering the salivary pH in a beneficial manner, rather than herbal mouthwashes or plain water. However, this study needs to be more standardized and the chemical constituents of saliva need to be analyzed further to arrive at a definitive result.

CONCLUSION

It can be concluded from the study that CHX mouthwash had increased salivary pH, which is also prolonged in nature when compared to herbal mouthwash and plain water. This once again proves the substantivity of CHX mouthwash.

REFERENCES

1. Baliga S, Muglikar S, Kale R. Salivary pH: A diagnostic biomarker. J Indian Soc Periodontol 2013;17:461-5.
2. Parashar A. Mouthwashes and their use in different oral conditions. Sch J Dent Sci 2015;2:186-91.
3. Quintas V, Prada-López I, Donos N, Suárez-Quintanilla D, Tomás I. *In situ* neutralisation of the antibacterial effect of 0.2% chlorhexidine on salivary microbiota: Quantification of substantivity. Arch Oral Biol 2015;60:1109-16.
4. Gulati RK, Bhatnagar P, Bhatnagar A. Antimicrobial efficacy of chemical and herbal agents against *Streptococcus mutans*: An *in vitro* study. Pesq Bras Odontoped Clin Integr 2018;18:e4008.
5. Singh S, Anuradha P, Sahana S, Narayan M, Agarwal S. Comparative evaluation of mouth rinsing with plain water and an antibacterial mouth rinse on salivary pH: A randomized clinical trial. J Indian Assoc Public Health Dent 2017;15:302-5.
6. Miletic I, Baraba A. Aetiological factors for susceptibility: Saliva (roles, pH scoring) and bacteria. J Minim Interv Dent 2011;4:17-9.
7. Devi TJ. Saliva – A potential diagnostic tool. IOSR J Dent Med Sci 2014;13:52-7.
8. Mat Ludin CM, Md Radzi J. The antimicrobial activity of different mouthwashes in Malaysia. Malaysian J Med Sci 2001;8:14-8.
9. Rölla G, Melsen B. On the mechanism of the plaque inhibition by chlorhexidine. J Dent Res 1975;54:B57-62.
10. Al-Joubori SK, Al-Obaidi WA. Effect of cinnamon extracts on streptococci and mutans streptococci, in comparison to chlorhexidine gluconate. J Bagh Coll Dent 2011;23:141-5.
11. Singh A, Daing A, Dixit J. The effect of herbal, essential oil and chlorhexidine mouthrinse on *de novo* plaque formation. Int J Dent Hyg 2013;11:48-52.
12. Belardinelli PA, Morelatto RA, Benavidez TE, Baruzzi AM, López de Blanc SA. Effect of two mouthwashes on salivary ph. Acta Odontol Latinoam 2014;27:66-71.
13. Balappanavar AY, Sardana V, Singh M. Comparison of the effectiveness of 0.5% tea, 2% neem and 0.2% chlorhexidine mouthwashes on oral health: A randomized control trial. Indian J Dent Res 2013;24:26-34.
14. Nagappan N, John J, Gopinath NM, Elango SK, Mathevan Pillai DD, Mani M. Antimicrobial effectiveness of herbal and 0.2% chlorhexidine mouthrinse against *Streptococcus mutans*: An *in vitro* study. J Int Oral Health 2016;8:683-6.
15. Tolentino Ede S, Chinellato LE, Tarzia O. Saliva and tongue coating pH before and after use of mouthwashes and relationship with parameters of halitosis. J Appl Oral Sci 2011;19:90-4.
16. Mary D, Vishnu Priya V, Gayathri R. Effects of toothpaste and mouthwash on salivary pH in adolescents. Drug Invent Today 2018;10:1731-3.
17. Panchal V, Gurunathan D. Comparison of salivary PH changes with tap water and mineral water rinse after 50% sucrose solution rinse: A cross-over trial. J Clin Diagn Res 2017;6:140.
18. Sindhu S, Jagannathan N. Saliva: A cutting edge in diagnostic procedures. J Oral Dis 2014;2014:1-8.
19. Meghana Reddy J, Gayathri R, Vishnu Priya V. Variation in salivary pH and buffering capacity of saliva in normal and diabetes mellitus patients – A pilot study. Drug Invent Today 2018;10:895-8.
20. Dave PH, Gurunathan D, Vasantharajan MS. Comparison of pH levels of the saliva before and after the consumption of cough syrups in children. Biomed Pharmacol J 2018;11:1443-8.

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