International Journal of Clinical Trials
Vivek S et al. Int J Clin Trials. 2015 Feb;2(1):20-24
http://www.ijclinicaltrials.com
pISSN 2349-3240 | eISSN 2349-3259

DOI: 10.5455/2349-3259.ijct20150204

Research Article

Endogenous pH, titratable acidity of commercially available mouthwashes in Indian market

Vivek S[1]*, Shwetha R[2]

[1]Department of Oral and Maxillofacial Surgery, The Oxford Dental College and Hospital, Bengaluru, India
[2]Department of Public Health Dentistry, The Oxford Dental College and Hospital, Bengaluru, India

Received: 26 December 2014
Accepted: 23 January 2015

***Correspondence:**
Dr. Vivek S,
E-mail: viveksathyanarayan@gmail.com

ABSTRACT

Background: The objective of this study was to evaluate in vitro the endogenous pH, titratable acidity of mouthwashes available in the Indian market.
Methods: The study sample was composed of 11 commercial brands of mouthwashes based on different active ingredients. The experiments were performed in triplicate. The endogenous pH was evaluated by using a digital pH meter; titratable acidity was evaluated by the addition of 0.1N NaOH increments to the mouthwashes.
Results: pH values ranged from 4.01(CODE K mouth wash containing Terminalia chebula) to 6.58 (CODE E mouthwash containing Diclofenac), and total of six mouthwashes had pH less than the critical value of 5.5, thus classified as potentially erosive. Titratable acidity values ranged from 0.2 (CODE H- Chlorhexidine Gluconate) to 1.2 (CODE I- Thymol, Eucalyptol).
Conclusions: Some of the mouthwashes evaluated in this study presented low endogenous pH, even below the critical value for enamel dissolution (pH<5.5), high titratable acidity which may be potentially erosive to the dental tissues if not properly used.

Keywords: Mouthwashes, Endogenous pH, Titratable acidity, Potentially erosive

INTRODUCTION

The control of dental biofilm is one of the cornerstones of preventive dentistry and can be achieved by mechanical means, use of chemical agents, or a combination of the two. Mouthwashes are used for centuries as chemical agents in daily oral hygiene, which are beneficial in the prevention and treatment of variety of oral or oropharyngeal diseases such as gingivitis, periodontitis and other inflammatory conditions.[1] A cursory inspection of pharmacies, drugstores, supermarkets, and other commercial establishments reveals a large number of mouthwashes which are formulated for number of oral health benefits and usually do not require a prescription from a dentist, making these products readily available to children and adults.[2] Unfortunately, relatively few mouthwash formulations to date have been proven to produce benefits to oral hygiene.

The indiscriminate use of mouthwashes by the general population has generated concern because apart from the various therapeutically active ingredients in the mouthwashes such as essential oils, chlorhexidine, fluoride, potassium nitrate and benzydamine the presence of acid components in their formulations could make the products potentially erosive to hard dental tissue over time.[3]

Various studies have demonstrated that acidic and low pH (less or equal to 5.5) mouthwashes can cause dental demineralization, erosion and significant loss of enamel within the first few minutes of contact with such acidic solution.[1] The erosive potential depends on low pH and buffering capacity of the mouth washes. It has been accepted that titratable acidity which is a measurement of the total acid content and pH value are important indicator in determining erosive potential of the mouth washes.[3,4] Hence the objective of the present study was to evaluate the endogenous pH and titratable acidity, of commercially available mouthwashes.

METHODS

Eleven commercial brands of mouthwashes comprising various active ingredients were obtained from local drug source of Davangere city, Karnataka for this study. The batch number, manufacturing date and expiry date of the samples were noted. The products were evaluated in a randomized experiment, with 3 repetitions for each sample. Data were collected by a single calibrated examiner (K=0.83) and recorded in study-specific charts. All the samples of mouthwashes were assigned a code. Data were collected by a single calibrated examiner. Mouth washes were selected based on the active ingredient and they were coded which were as follows:

- CODE A (Clohex plus® - Chlorhexidine Gluconate, Sodium fluoride),
- CODE B (AM PM® - Triclosan, Sodium fluoride)
- CODE C (Thermokind® -Chlorhexidine Gluconate, Zinc chloride)
- CODE D (Kidodent® - Triclosan, Xylitol)
- CODE E (Disorol® - Diclofenac)
- CODE F (Sensowash® - Potassium nitrate)
- CODE G (Rexidine Plus® - Chlorhexidine gluconate ,Triclosan),
- CODE H (Hexidine® - Chlorhexidine gluconate),
- CODE I (Listerine® -Thymol, Eucalyptol),
- CODE J (Tantum® - Benzydamine hydrochloride),
- CODE K (Mougel® - Terminalia chebula)

The endogenous pH of each mouthwash was measured immediately after package was opened at room temperature using a digital pH meter.

Titratable acidity was measured by titrating mouthwashes (100ml) adding increments of 0.1 N sodium hydroxide (NaOH) and measuring the pH until it reached equal to or greater than 7 (neutral pH). Values were expressed as ml of NaOH.

Statistical analysis

Mean and standard deviation of different samples were tabulated. Data were analyzed using the SPSS Version 17 software. Statistical significance was measured by using one way ANOVA followed by Tukey's post hoc test. p values <0.05, was considered Statistically Significant.

RESULTS

Distribution of the mouthwashes according to mean pH values and standard deviations is presented in Table 1 and Figure 1. pH values ranged from 4.01(CODE K mouth wash containing Terminalia chebula) to 6.58 (CODE E mouthwash containing Diclofenac), and total of six mouthwashes (CODE A- Chlorhexidine Gluconate, sodium fluoride, CODE C- Chlorhexidine Gluconate, zinc chloride, CODE G- Chlorhexidine Gluconate, Triclosan, CODE I- Thymol, Eucalyptol, CODE J- Benzydamine Hydrochloride) had pH less than the critical value of 5.5, thus classified as potentially erosive. Distribution of the mouthwashes according to mean Titratable acidity values and standard deviations is presented in Table 2 and Figure 2. Titratable acidity values ranged from 0.2 (CODE H- Chlorhexidine Gluconate) to 1.2 (CODE I- Thymol, Eucalyptol).

DISCUSSION

In 1970, Pindborg defined dental erosion as the irreversible loss of tooth structure due to chemical dissolution by acids and not of bacterial origin.[5]

Erosion depends on several intrinsic and extrinsic factors. Acidic drinks, medications and foods lower the pH level of oral cavity hence their consumption causes the teeth to demineralise. Erosion is found initially in the enamel and, if unchecked, may proceed to the underlying dentin.[5]

Mouthwashes have been used for centuries for medicinal and cosmetic purposes, but it is only in recent years that the rationale for use of the active ingredients of these products has been subject to scientific research and clinical trials. Based on studies published in the international dental literature, the present investigation evaluated two important physicochemical properties of mouthwashes commercially available in Indian market i.e pH, titratable acidity.[2,6]

The measurement of the pH is a practical method to assess the erosive potential by measuring acidity of a solution.[1,7]

Table 1: Mean pH and standard deviation of the sample.

Mouth washes	Mean pH	Standard deviation	F value
CODE A	4.16	0.02	385.2 p=0.00 (Significant)
CODE B	6.18	0.015	
CODE C	4.07	0.026	
CODE D	6.16	0.060	
CODE E	6.58	0.098	
CODE F	6.21	0.041	
CODE G	4.59	0.025	
CODE H	5.53	0.036	
CODE I	4.02	0.300	
CODE J	4.86	0.266	
CODE K	4.01	0.010	

Although pH value equal to or less than 5.5 is considered critical for enamel dissolution, mineral loss may begin even at higher pH;6. pH is a logarithmic scale. Small changes in pH values equate with larger changes in the hydrogen ion concentration therefore, the prolonged use of oral rinses with pH below this value may be potentially harmful to dental tissue. In the present study, six mouthwashes which had pH values below the critical value assumed for dental demineralization were classified as potentially erosive (pH<5.5), corroborating the findings of previous investigations done by Cavalcanti AL et al., in Brazil and Pretty IA in UK.[1,3]

The low pH of oral care products increases the chemical stability of some fluoride compounds and favors the incorporation of fluoride ions into the lattice of hydroxyapatite and the precipitation of calcium fluoride onto the tooth surface. Based on this statement, product labels were examined to identify mouthwashes containing fluoride. Among the six mouthwashes with pH less than 5.5, three mouth washes had fluoride (0.05% NaF) in its formulation. The label of the other three mouthwashes with pH below the critical value for enamel dissolution did not list fluoride in their ingredients.[1]

Table 2: Titratable acidity and standard deviation of the sample (ml of NaOH).

Mouth washes	Mean TA	Standard deviation	F Value
CODE A	0.9	0.10	20.30 p=0.00 (Significant)
CODE B	0.4	0.10	
CODE C	0.63	0.05	
CODE D	0.26	0.05	
CODE E	0.3	0.10	
CODE F	0.9	0.10	
CODE G	0.7	0.10	
CODE H	0.2	0.10	
CODE I	1.2	0.20	
CODE J	0.7	0.20	
CODE K	0.7	0.10	

Lack of fluoride and low pH may make these products harmful to dental tissues if not used carefully. Although mouthwashes have been formulated as pre- and post-brushing products for routine use, findings of a previous in situ study conducted by Pretty IA, have suggested that low pH mouthwashes should not be considered for long-term or continuous use and never as pre-brushing. Although baseline acidity is a major factor in determining erosive potential, baseline pH values give only a glimpse of the initial hydrogen ion concentration and therefore provide no indication as to the presence of undissociated acids.[3]

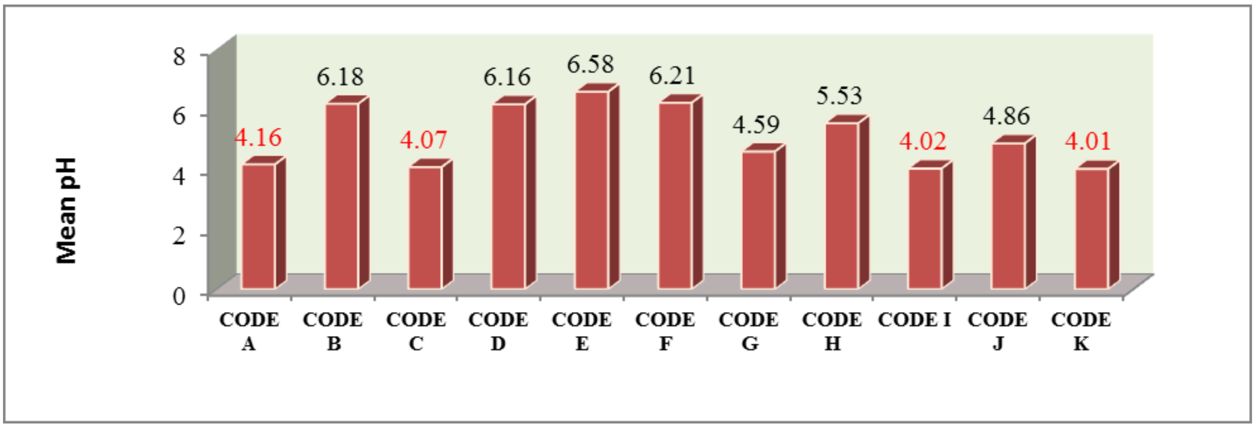

Figure 1: Mean pH values of mouthwashes.

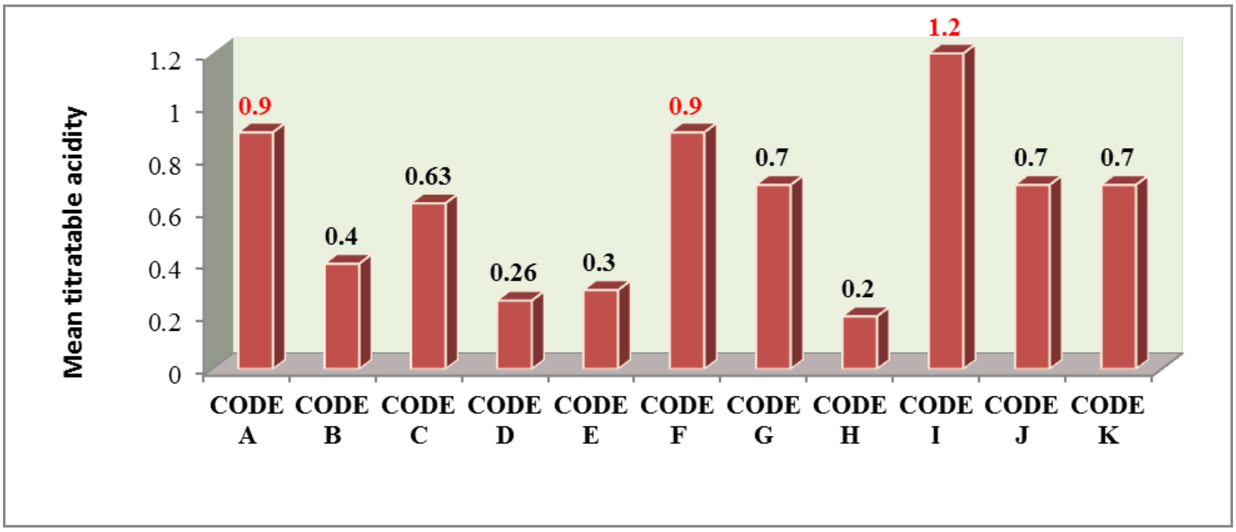

Figure 2: Mean titratable acidity values of mouthwashes.

It is currently thought that titratable acidity is a more accurate measure of the total acid content of a solution and therefore, more realistic means of predicting erosive potential. In this study, titratable acidity determined the amount of acid present and the volume of NaOH necessary to buffer the test solution, a characteristic directly related to the buffering capacity of the saliva. Substances with low titratable acidity are readily neutralized by oral fluids, while those with high titratable acidity cause a prolonged drop in pH and greater demineralization of dental tissues.[7,8]

In the present study, three mouthwashes (CODE I, CODE F and CODE A) exhibited high titratable acidity .The majority of medicinal formulations, if not all, have some side effects, whether local or systemic. In each case, it is important to assess the benefit-to-risk ratio. Risk clearly will be influenced by the likely incidence and severity of side effects. In the case of dental erosion, the regimen and duration of use of a potentially erosive agent will be critical to the outcome.[9]

Although the erosive potential of various mouthwashes can be compared it is not possible to define the degree to which it will damage teeth. It mainly depends on protective effect of pellicle and the buffering capacity of saliva of individual.

CONCLUSION

The findings of this in-vitro investigation cannot be directly extrapolated to the clinical situation; however, results indicate that some of the mouthwashes evaluated exhibited low endogenous pH, even below the critical value for enamel dissolution (5.5), high titratable acidity, which may make these products potentially erosive to dental tissue if not properly used. Modification by adding calcium and phosphate to the mouth rinses may be a helpful measure to reduce the erosive potential of these products.

There is clearly a great need for more in vivo studies to know the possible detrimental effect of mouthwashes in order to balance formulations more advantageously for benefits provided by them. Oral hygiene products have to be regulated by regulatory bodies for their safety, efficacy, acceptability and quality control.

ACKNOWLEDGEMENTS

The authors are grateful to the Department Of Public Health Dentistry and Department of Oral And Maxillofacial Surgery, College Of Dental Sciences Davangere, Karnataka and to Department of Biochemistry, JJM Medical College Davangere, Karnataka.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Cavalcanti AL, Ramos IA, Leite RB, da Costa Oliveira M, de Melo Menezes K, Fernandes LV, et al. Endogenous pH, Titratable Acidity and Total Soluble Solid Content of Mouthwashes Available in the Brazilian Market. Eur J Dent. 2010;4(2):156-9.
2. Pontefract H, Hughes J, Kemp K, Yates R, Newcombe RG,Addy M. The erosive effects of some mouthrinses on enamel. A study in situ. J Clin Periodontol. 2001;28(4):319-24.
3. Pretty IA, Edgar WM,Higham SM. The erosive potential of commercially available mouthrinses on enamel as measured by Quantitative Light-induced Fluorescence (QLF). J Dent. 2003;31(5):313-9.
4. Cairns AM, Watson M, Creanor SL,Foye RH. The pH and titratable acidity of a range of diluting drinks and their potential effect on dental erosion. J Dent. 2002;30(7-8):313-7.
5. Jarvinen VK, Rytomaa, II,Heinonen OP. Risk factors in dental erosion. J Dent Res. 1991;70(6):942-7.
6. Adams D,Addy M. Mouthrinses. Adv Dent Res. 1994;8(2):291-301.
7. Addy M, Loyn T,Adams D. Dentine hypersensitivity--effects of some proprietary mouthwashes on the dentine smear layer: a SEM study. J Dent. 1991;19(3):148-52.
8. Singh S,Jindal R. Evaluating the buffering capacity of various soft drinks, fruit juices and tea. J Conserv Dent. 2010;13(3):129-31.
9. Lee CK,Schmiz BC. Determination of pH, total acid, and total ethanol in oral health products: oxidation of ethanol and recommendations to mitigate its association with dental caries. Journal of Dentistry, Oral Medicine and Dental Education. 2009;3(1):1-4.

DOI: 10.5455/2349-3259. ijct20150204
Cite this article as: Vivek S, Shwetha R. Endogenous pH, titratable acidity of commercially available mouthwashes in Indian market. Int J Clin Trials 2015;2:20-4.