eVitroKhem. 2023; 2:11
doi: 10.56294/evk202211

ORIGINAL

pH values of fluoride mouthwashes marketed in Peru: an observational study

Valores de pH de colutorios bucales fluorados comercializados en Perú: un estudio observacional

Sheyla Zorrilla-Reyes[1]

[1]Universidad Privada Norbert Wiener. Facultad de Odontología. Lima, Perú.

Cite as: Zorrilla-Reyes S. pH values of fluoride mouthwashes marketed in Peru: an observational study. eVitroKhem. 2023; 2:11. https://doi.org/10.56294/evk202211

Submitted: 02-08-2022 **Revised:** 25-11-2022 **Accepted:** 10-02-2023 **Published:** 11-02-2023

Editor: Prof. Dr. Javier Gonzalez-Argote

Corresponding author: Sheyla Zorrilla-Reyes

ABSTRACT

The objective of this research was to determine the average pH value of fluoride mouthwashes marketed in Peru. The methodological design was experimental-descriptive. Seven commercial brands were evaluated, with a sample of 21 fluoride mouthwashes, three per group, Colgate Plax Ice Glacial Zero Alcohol, Colgate Plax Soft Mint Zero Alcohol, Listerine Total Care Zero, Listerine Anticaries, Oral B Complete, Dento Menta Zero Alcohol and Vitis Orthodontic; a previously calibrated digital pH meter was used to measure the pH and the data was processed with ANOVA and Tukey tests, finding statistically significant differences in the means of the pH values of the mouthwashes p=0,000(p<0,05), these were considered acidic since they obtained values ranging from 3,93 to 6,27, of which 6 of the brands evaluated obtained values below the critical pH=5,5 considered potentially erosive for the enamel, Listerine Anticaries was the most acidic with a pH=3,93 and Dento Menta Zero Alcohol the least acidic with a pH=6,27, being the only brand that was above the critical value. It is suggested that the pH value be expressed on the commercial label, and thus be taken into account when choosing the most appropriate mouthwash according to the patient's needs, evaluating the benefit/side effect.

Keywords: Mouthwashes; Sodium Fluoride; Hydrogen-Ion Concentration; Acidification; Tooth Erosion, Tooth Demineralization.

RESUMEN

Esta investigación presentó como objetivo determinar el valor promedio del pH de los colutorios bucales fluorados comercializados en Perú. El diseño metodológico fue observacional-comparativo. Se evaluaron 7 marcas comerciales, con una muestra de 21 colutorios fluorados, tres por grupo, Colgate Plax Ice Glacial Zero Alcohol, Colgate Plax Soft Mint Zero Alcohol, Listerine Cuidado Total Zero, Listerine Anticaries, Oral B Complete, Dento Menta Zero Alcohol y Vitis Orthodontic; se utilizó un pH-metro digital previamente calibrado para medir el pH y se procesó los datos con pruebas de ANOVA y Tukey, hallando diferencias estadísticamente significativas en las medias de los valores de pH de los colutorios p=0,000(p<0,05), estos fueron considerados ácidos ya que obtuvieron valores que oscilaron entre 3,93 a 6,27; de los cuales 6 de las marcas evaluadas obtuvieron valores por debajo del crítico pH=5,5 considerado potencialmente erosivo para el esmalte, Listerine Anticaries fue el más ácido con un pH=3,93 y Dento Menta Zero Alcohol el menos ácido con un pH=6,27; siendo la única marca que estuvo por encima del valor crítico. Se sugiere que el valor de pH este expresado en la etiqueta comercial, y así tenerlo en cuenta al escoger el colutorio más adecuado según las necesidades del paciente evaluando beneficio/efecto secundario.

Palabras clave: Antisépticos Bucales; Fluoruro; Concentración De Iones De Hidrógeno; Acidificación; Erosión Dental; Desmineralización Dental.

INTRODUCTION

Mouthwashes are liquid solutions used as complements to a good regular oral hygiene routine to control dental biofilm, in addition to the correct daily brushing of teeth and the proper use of dental floss.[1] They are used in various parts of the world. They are categorized as oral hygiene care products, which can be used not only by adults but also by children over 6 years of age (preschool stage) since children under this stage do not have complete swallowing control and may ingest specific amounts.[2] Regular and supervised use of fluoride mouthwashes in children and adolescents is significantly associated with a reduction in the incidence of caries in permanent teeth.[3]

Fluoride is an effective agent used in the prevention of dental caries disease since it intervenes in the remineralization process of tooth structure.[2] It is found in different concentrations. It intervenes in the formation of calcium fluoride on the surface, acting as a reservoir of fluoride that is released when the pH of the oral cavity is in acidic conditions, thereby minimizing the disintegration of hydroxyapatite crystals and promoting the remineralization process of tooth enamel.[4,5] It is found in the form of gels, varnishes, toothpaste, rinses, or mouthwashes; these products facilitate the retention of fluoride ions in the mouth for a more extended period.[3,5]

During the demineralization process, erosions are produced in the dental enamel due to the acid conditions in the oral cavity created by the degradation of carbohydrates in our daily diet, resulting in a drop in pH and the loss of minerals in the dental structure.[5]

In various countries around the world, there is considerable propaganda and marketing regarding the use of toothpaste and mouthwashes, not only focusing on fluorides but also incorporating other components such as triclosan, cetyl pyridine chloride, and essential oils. These products are readily accessible to users and can be found in pharmacies and supermarkets.[2,4,5,6,7,8,9] It should be noted that these products should be offered under the guidance and recommendations of the dentist, tailored to the needs of each patient.

The pH below 5,5 is considered critical since it can dissolve the apatite crystals that are found on the surface of the tooth enamel,[4,5] so it is questionable which is the actual pH value of the mouthwashes that are being marketed and which of these could be below these values, since if they are below the values considered critical, the erosion process would be triggered, which affects the surface of the teeth.[5] It is known that erosion is a dynamic process that starts with the softening of the enamel surface, followed by the loss of tissue. When tissue loss is initiated on the tooth surface, it becomes irreversible, as these enamel minerals cannot be replaced, and in some cases, may also result in exposure to the dentin.[10]

This study aimed to determine the average pH value of fluoride mouthwashes commercialized in the Peruvian market and to analyze whether these products could alter the enamel surface of teeth based on this value.

METHOD

The methodological design was observational-comparative. Seven commercial brands were evaluated, with a sample of 21 fluoride mouthwashes, three per group: Colgate Plax Ice Glacial Zero Alcohol, Colgate Plax Soft Mint Zero Alcohol, Listerine Total Care Zero, Listerine Anticaries, Oral B Complete, Dento Menta Zero Alcohol, and Vitis Orthodontic, using a non-probabilistic sampling by convenience, selecting them according to the following inclusion criteria: mouthwashes marketed in Peru, mouthwashes that on their label indicate containing fluoride expressed in ppm, that have sanitary registration (DIGEMID); subsequently, mouthwashes that mention containing alcohol as an ingredient, visibly contaminated by the presence of particles or others, adulterated or of dubious origin, that have lost their safety seal, if the expiration date has expired, defective, damaged and poorly labeled were excluded.

Forty ml of each selected mouthwash was taken, and the samples were coded. Three measurements were performed for each of the liquid components. The final pH was obtained by calculating the mean of the values obtained, and the pH value was measured with a previously calibrated pen-type digital pH meter; its pH measurement range was from 0,00 to 14,00, acting with an accuracy of +/- 0,01pH, the statistical tests used to analyze the data were Anova and Tukey.

RESULTS

When applying the statistical tests, we obtained the following average values: Colgate Plax Ice Glacial Zero Alcohol, pH = 4,98; Colgate Plax Soft Mint Zero Alcohol, pH = 4,95; Listerine Total Care Zero, pH = 3,99; Listerine Anticaries, pH = 3,93; Oral B Complete, pH = 5,44; Dento Menta Zero Alcohol, pH = 6,27; and Vitis Orthodontic, pH = 4,31. The total average pH value was 4,84.

Listerine Anticaries fluoride mouthwash had the lowest average pH value of 3,93, compared to Dento Menta Zero Alcohol fluoride mouthwash, which had a higher average pH value of 6,27.

When comparing the means of the groups in our study, Oral B Complete, Dento Menta Zero Alcohol, and Vitis Orthodontic mouthwashes presented $p<0,05$, with significant differences, while Colgate Plax Ice Glacial and Colgate Plax Soft Mint Zero Alcohol mouthwashes showed no significant differences between them $p=0,998$; but

they did present substantial differences concerning the other mouthwashes p<0,05; similarly, Listerine Total Care Zero and Listerine Anticaries presented p=0,973 with no significant differences between them, but they did present substantial differences in comparison to the other mouthwashes analyzed.

DISCUSSION

When analyzing the data obtained, we found that all the mouthwashes selected were acidic, with Listerine Anticaries being the most acidic and Dento Menta Zero Alcohol the least acidic; of which Colgate Plax Ice Glacial Zero Alcohol, Colgate Plax Soft Mint Zero Alcohol, Listerine Total Care Zero, Listerine Anticaries, Oral B Complete and Vitis Orthodontic had values below the critical acidity value pH=5,5.

Valdivia A.[11], in his study, found that of the 14 mouthwashes evaluated, including Colgate Plax Soft Mint, Listerine Anticaries, Listerine Total Care Zero, Oral B Complete, and Vitis Orthodontic marketed in Chile and Brazil, also obtained pH values below 5,5, coinciding with the values found in our study probably because these international brands do not vary much their composition concerning the country.

In our study, the most acidic mouthwash was Listerine Anticaries, presented without alcohol, with a pH of 3,93. In the survey conducted by Rirattanapong P. et al.[12], it was obtained that the mouthwash of the same brand Listerine but in presentation for children in Thailand, was the most acidic with a pH value of 3,73, being below the critical value of 5,5; however being for children, there may be differences in its composition; in turn, Fernandez C.[13] in his study also obtained that the lowest pH was for Listerine mouthwash with a mean value of 4,16 which is still below the critical value.

In another study, Alves D. et al.[14], of the eight brands of rinses that were analyzed, obtained that Colgate Plax, in its presentation for children, had a pH value below the one considered critical for enamel dissolution, similar to our study in which the brands Colgate Plax Ice Glacial and Colgate Plax Soft Mint were also below the critical value, being 4,98 and 4,95 respectively. Also, Hannan S. et al.[4] in their research, when evaluating six brands of fluoride mouthwashes they found in Manau-Brazil, presented acid pH, but two brands were potentially erosive with values below 5,5; among them, the Colgate Plax rinse its presentation for children, in addition, this rinse also showed a higher level of viscosity and higher total soluble solids (TSS).

Both authors mentioned Alves and Hannan not only evaluated the pH value but also the titratable acidity, viscosity, and total soluble solids (TSS) since they indicate that the erosive potential could not only be indicated by the pH value alone but also by predisposing factors such as the other physicochemical properties mentioned,[4,14] but more research is needed to corroborate this statement.

In the study by Eguizabal S.[15], when evaluating the Dento brand mouthwash, he obtained a pH value of 6,462, which indicates approaching an alkalinity value but still being in the acidic value range, similar to our study where the Dento Menta Zero Alcohol mouthwash obtained a pH value=6,27; which is still acidic, but it was the only one that was above the critical value.

However, Belardinelli et al.[16] evaluated the brands Listerine and Periobacter in their research in Córdoba, Argentina, where the pH levels were 4,35 and 5,30, respectively, both of which are acidic. Similarly, in our study, the mouthwashes evaluated in Peru also turned out to have acidic values. Belardinelli indicated that salivary pH rises immediately upon contact with mouthwash, proving that saliva responds to stimuli that have changes in its composition since the biological system neutralizes it and that the pH of the external agent evaluated individually, in this case, mouthwash, is not a sufficient indicator of the erosive potential on tooth surfaces.[16] This could justify why the pH of mouthwashes is acidic, but we conclude that further research is required to corroborate this due to the limited information we found.

CONCLUSIONS

All fluoride mouthwashes of the seven brands tested were acidic, with 6 of these brands found to be below the critical value of pH=5,5, which is considered potentially erosive for dental enamel; Listerine Anticaries was the most acidic mouthwash with pH=3,93 and Dento Menta Zero Alcohol the least acidic with pH=6,27; being the only brand that was above the critical value and there are statistically significant differences (p<0,05) between the average pH values of the fluoride mouthwashes marketed in Peru.

REFERENCES

1. Takenaka S, Ohsumi T, Noiri Y. Evidence-based strategy for dental biofilms: current evidence of mouthwashes on dental biofilm and gingivitis. Jpn Dent Sci Rev. 2019;55(1):33–40.

2. Botazzo Delbem AC, Takebayashi SK, Castro AM de, Pinto LMCP, Bergamaschi M. Assessment of the fluoride concentration and pH in different mouthrinses on the Brazilian market. J Appl Oral Sci. 2003;11(4):319–23.

3. Marinho VCC, Chong LY, Worthington HV, Walsh T. Fluoride mouthrinses for preventing dental caries in children and adolescents. Public Health Nurs. 2018;35(1):85–7.

4. Hanan A, Souza P De, Filho PZ, Hanan SA, Souza AP De, Pinto R, et al. Avaliação da concentração de flúor, do pH, da viscosidade e do teor de sólidos solúveis totais em enxaguatórios bucais fluoretados disponíveis comercialmente na cidade de Manaus. Pesqui Bras Odontopediatria Clín Integr. 2011.

5. Lima L De, Valença G, Maria A, Albuquerque R De, Albuquerque FR De. Análise do pH e da viscosidade de enxaguatórios bucais fluoretados disponíveis comercialmente na cidade de João Pessoa - PB. Pesqui Bras Odontopediatria Clín Integr. 2005.

6. Alves D, Costa AL, Almeida RF, Carvalho JFC, Felino A. Cloreto de cetilpiridínio - revisão da literatura. Rev Port Estomatol Med Dent Cir Maxilofac. 2012;53(3):181–9.

7. Marchetti E, Tecco S, Caterini E, Casalena F, Quinzi V, Mattei A, et al. Alcohol-free essential oils containing mouthrinse efficacy on three-day supragingival plaque regrowth: a randomized crossover clinical trial. BioMed Cent. 2017;18(1):1–8.

8. Tolentino E de S, Chinellato LEM, 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(2):90–4.

9. Van der Kaaij N, Van der Veen M, Van der Kaaij M, Ten Cate J. A prospective, randomized placebo-controlled clinical trial on the effects of a fluoride rinse on white spot lesion development and bleeding in orthodontic patients. Eur J Oral Sci. 2015;123(3):186–93.

10. Baumann T, Kozik J, Lussi A, Carvalho TS. Erosion protection conferred by whole human saliva, dialysed saliva, and artificial saliva. Sci Rep. 2016;6(June):6–13.

11. Valdivia Tapia AC. Concentración de fluoruro en enjuagues bucales comercializados en Chile y Brasil [tesis]. Universidad de Talca; 2018.

12. Rirattanapong P, Rirattanapong O. Concentrations of fluoride among commercially available mouthrinses for children in Thailand. Southeast Asian J Trop Med Public Health. 2019;50(2):411–5.

13. Fernandez CS. Tipo de almacenamiento y el contenido de alcohol en el nivel de pH de colutorios orales de comercialización local en el año 2018 [tesis pregrado]. Universidad Inca Garcilaso de la Vega; 2018.

14. Alves D, Gondima BLC, Pereiraa IF, Moreiraa M dos SC, Santiagoa BM, Valençaa AMG. Physicochemical properties, labeling and antimicrobial activity of mouthwashes for children. J Dent Sci Rev Odonto Ciência. 2015;30(4):200–4.

15. Eguizabal S. Valoración del pH de cinco marcas de colutorios fluorados comercializados en Lima en el año 2018 [tesis pregrado]. Universidad Inca Garcilaso de la Vega; 2018. Disponible en: http://repositorio.uigv.edu.pe/handle/20.500.11818/344.

16. Belardinelli PA, Morelatto RA, Benavidez TE, Baruzzi AM, López de Blanc SA. Effect of two mouthwashes on salivary pH. Acta Odontol Latinoam. 2014;27(2):66–71.

FUNDING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Sheyla Zorrilla-Reyes.
Data curation: Sheyla Zorrilla-Reyes.
Formal analysis: Sheyla Zorrilla-Reyes.
Research: Sheyla Zorrilla-Reyes.
Methodology: Sheyla Zorrilla-Reyes.
Project Management: Sheyla Zorrilla-Reyes.
Resources: Sheyla Zorrilla-Reyes.

Software: Sheyla Zorrilla-Reyes.
Supervision: Sheyla Zorrilla-Reyes.
Validation: Sheyla Zorrilla-Reyes.
Visualization: Sheyla Zorrilla-Reyes.
Writing - original draft: Sheyla Zorrilla-Reyes.
Writing - proofreading and editing: Sheyla Zorrilla-Reyes.