

Acidic oral moisturizers with pH below 6.7 may be harmful to teeth depending on formulation: a short report

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Abstract: Xerostomia affects 30% of the population and manifests as a side effect of medications, systemic diseases, or cancer therapy. Oral moisturizers are prescribed to overcome the ailments of dry mouth and its symptoms. It is imperative that these products help to restore hyposalivation and that they do not present any secondary effect that can harm oral health. It has been shown in the literature that some oral moisturizers may have an erosive potential due to their acidic pH, which is below the critical pH of dentin and enamel. The purpose of this paper was to make clinicians aware of the erosive potential of these products and make recommendations to manufacturers for future formulations avoiding acidic pH. For this reason, care should be taken to formulate these products with safe pH values for both enamel and root dentin which, based on specific formulation should be around 6.7 or higher.

Keywords: oral moisturizers, pH, erosion, caries, xerostomia, dry mouth

Dry mouth (also termed hyposalivation or xerostomia) is characterized by partial or total loss of saliva production caused by the hypofunction of the salivary glands. It is quite common, affecting between 15% and 30% of the population.^{1,2} This hypofunction is often a side effect of multiple medications prescribed to treat systemic diseases,³ but can also be due to autoimmune diseases such as Sjögren's syndrome, head and neck irradiation, or systemic cancer therapy.⁴

Chronic xerostomia significantly increases the risk of experiencing dental caries, demineralization, tooth sensitivity, dental erosion, candidiasis, and other oral diseases that may negatively affect the quality of life.^{5,6} It has been estimated that 63% of the 200 most common medications prescribed in the United States have a xerogenic effect, resulting in reduced salivary flow rates.³ With an increased life expectancy and the increasing level of oral disease prevention in the world, the numbers of elderly patients retaining their natural teeth are increasing. The elderly typically have more exposed root surfaces than younger people as a result of advanced periodontal disease, attrition, and restorative procedures throughout the years. This, coupled with several medications taken for systemic conditions and reduced dexterity levels predisposes this group to increased levels of root caries.

Saliva is an essential substance that reduces the incidence and severity of carious lesions and dental erosion by several mechanisms. It neutralizes acids and promotes clearance by swallowing and also provides calcium and phosphate ions to the oral environment.⁷ The critical pH of enamel and dentin is the pH below which tooth structure begins to erode. The critical pH for enamel has been reported to be in

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the range of 5.2–5.5.⁸ The critical pH of dentin was first reported by Hoppenbrouwers et al in 1987 at 6.7,⁹ and it was confirmed 2 years later by Surmount et al.⁸ Several studies have reported the critical pH of dentin to be in a range of 6–6.9.^{10–12}

Oral moisturizers can provide significant comfort to patients suffering from dry mouth and prevent dental erosion and caries. However, it is imperative that the moisturizers themselves do not have pH values below the critical pH of enamel or root dentin. Depending on the solution formulation, this might be erosive and potentially increase the risk for the development of root caries or demineralization. pH values of solutions have been shown to be good indicators for the immediate erosive potential they have.¹³ Along with titratable acidity, these are the most common markers used to determine erosive potential in the literature. The differential buffering capacity is also a very important attribute and has been recommended over pH or titratable acidity as a predictor for erosive potential.¹⁴

Recent studies have concluded that there is a large variation in the pH values among the most common oral moisturizers on the market (Table 1) and that there is a strong correlation between the pH values and the erosive potential of these products.^{12,15} The data presented in this

study show great variation in the composition and pH values among commercially available oral moisturizers. Several of the tested products contained citric acid or citric flavors, most likely to provide a pleasant taste. Candies with citric, maleic, and fumaric acid have also been shown to be erosive on tooth enamel.¹⁶ Another recent study concluded that products claiming to manage xerostomia are associated with the risk of demineralization due to their highly acidic nature.¹⁷ This can lead to dental erosion, sensitivity, and caries. However, the erosive potential relies not only on the pH of the product, but also the complex interplay of other ingredients may have a neutralizing effect; hence, tooth substance loss will not always occur.^{12,15} For example, The addition of calcium into acidic lozenges has been shown to greatly reduce their erosive potential, as well as preventing demineralization of hydroxyapatite even though pH values drop below the critical pH for enamel for a short period of time.¹⁸

Manufacturers recommend using oral moisturizers as needed through the day, and some products are even intended for swishing or being held in the mouth for as long as possible for the maximum effect. This would seem counter-intuitive if the products are acidic, considering the vulnerability of the target group to dental erosion and root caries. For this reason, care should be taken to formulate these products with safe pH values for both enamel and root dentin which, based on specific formulation, should be around 6.7 or higher. Addition of calcium into these products can also be of great benefit. It would seem reasonable for practitioners to take care in recommending oral moisturizing agents with a safe formulation for their patients.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Shay K. The evolving impact of aging America on dental practice. *J Contemp Dent Pract.* 2004;5:101–110.
2. Thomson WM. Dental caries experience in older people over time: what can the large cohort studies tell us? *Br Dent J.* 2004;196:89–92; discussion 87.
3. Sreebny LM, Schwartz SS. A reference guide to drugs and dry mouth – 2nd edition. *Gerodontology.* 1997;14:33–47.
4. Dost F, Farah CS. Stimulating the discussion on saliva substitutes: a clinical perspective. *Aust Dent J.* 2013;58:11–17.
5. Plemons JM, Al-Hashimi I, Marek CL. Managing xerostomia and salivary gland hypofunction: executive summary of a report from the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc.* 2014;145:867–873.
6. Winston AE, Bhaskar SN. Caries prevention in the 21st century. *J Am Dent Assoc.* 1998;129:1579–1587.
7. DePaola DP. Saliva: the precious body fluid. *J Am Dent Assoc.* 2008;139(Suppl):5S–6S.

Table 1 Name and pH value of commonly used oral moisturizers and dry mouth treatment products

Product	Manufacturer	pH value
CTx2 Spray	Oral Biotech, Albany, OR, USA	9.09
Dry Mouth Spray	Thayers Natural Remedies, Westport, CT, USA	6.30
Mouth Kote	Parnell Pharmaceuticals, Inc. San Rafael, CA, USA	3.03
Oasis	Oasis Consumer Health, Cleveland, OH, USA	6.33
Bioténe Oral Balance	GlaxoSmithKline, Raleigh-Durham, NC, USA	6.61
Bioténe Moisturizing Mouth Spray	GlaxoSmithKline, Raleigh-Durham, NC, USA	6.11
Bioténe Dry Mouth Rinse	GlaxoSmithKline, Middlesex, UK	
Rain	Xlear Inc. American Fork, UT, USA	7.10
Elmex Erosion Protection	GABA, Therwil, Switzerland	4.0
Flux Dry Mouth Gel	Actavis, Petach Tikva, Israel	5.5
Flux Mouthwash	Actavis, Petach Tikva, Israel	5.2
Gum Hydral Gel	Sunstar, Etoy, Switzerland	5.3
Gum Hydral Rinse	Sunstar, Etoy, Switzerland	5.4
Gum Hydral Spray	Sunstar, Etoy, Switzerland	5.3
HAp+	Ice Medico, Reykjavik, Iceland	3.4
Saliva Orthana	A.S Pharma, Hampshire, UK	5.8
Xerodent	Actavis, Petach Tikva, Israel	6.1

8. Surmount P, Martens, LC. Root surface caries: an update. *Clin Prev Dent*. 1989;11:14–20.
9. Hoppenbrouwers PM, Driessens FC, Borggreven JM. The mineral solubility of human tooth roots. *Arch Oral Biol*. 1987;32:319–322.
10. Sung YH, Son HH, Yi K, Chang J. Elemental analysis of caries-affected root dentin and artificially demineralized dentin. *Restor dent Endod*. 2016;41:255–261.
11. Abou Neel EA, Aljabo A, Strange A, et al. Demineralization-remineralization dynamics in teeth and bone. *Int J Nanomedicine*. 2016;11:4743–4763.
12. Delgado AJ, Olafsson VG, Donovan TE. pH and erosive potential of commonly used oral moisturizers. *J Prosthodont*. 2016;25:39–43.
13. Jensdottir T, Holbrook P, Nauntofte B, et al. Immediate erosive potential of cola drinks and orange juices. *J Dent Res*. 2006;85:226–230.
14. Barbour ME, Shellis RP. An investigation using atomic force microscopy nanoindentation of dental enamel demineralization as a function of undissociated acid concentration and differential buffer capacity. *Phys Med Biol*. 2007;52:899–910.
15. Hannesson A, Thrastardottir RA, Arnadottir IB, Holbrook WP, Olafsson VG. Erosive capacity of dry mouth treatments in the Nordic countries. *Iceland Dent J*. 2016;34:6.
16. Brand HS, Gambon DL, Van Dop LF, et al. The erosive potential of jawbreakers, a type of hard candy. *Int J Dent Hyg*. 2010;8:308–312.
17. Pryanka Tayee AH, Messer R, De Rossi S, Ciarocca K, Rueggeberg F. *Evaluation of pH Values of Products Managing Xerostomia*. Dental College of Georgia, Augusta, GA, USA; 2015.
18. Jensdottir T, Nauntofte B, Buchwald C, Bardow A. Effects of calcium on the erosive potential of acidic candies in saliva. *Caries Res*. 2007;41:68–73.

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