

# Endogenous pH, Titratable Acidity and Total Soluble Solid Content of Mouthwashes Available in the Brazilian Market

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## ABSTRACT

**Objectives:** To evaluate in vitro the endogenous pH, titratable acidity and total soluble solid content (TSSC) of mouthwashes available in the Brazilian market.

**Methods:** The study sample was composed of 10 commercial brands of mouthwashes based on different active ingredients: Cepacol®, Clinerize®, Equate®, Listerine Cool Citrus®, Oral-B®, Periogard®, Peroxyl®, Plax Overnight®, Prevident 220® and Sanifill®. The experiments were performed in triplicate. The endogenous pH was evaluated by potentiometry, titratable acidity was evaluated by the addition of 0.1N KOH increments to the mouthwashes, and TSSC readings were performed by Brix refractometry using the Abbé refractometer.

**Results:** pH values ranged from 3.56 (Peroxyl®) to 7.43 (Cepacol®) and three mouthwashes presented pHs below 5.5. The titratable acidity values ranged from 0.007 (Periogard®) to 0.530 (Prevident®). Oral B® and Clinerize® presented the lowest (4.7%) and the highest (23.70%) TSSC, respectively.

**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 and high TSSC, and may be potentially erosive to the dental tissues if not properly used. (Eur J Dent 2010;4:156-159)

**Key words:** Mouthwashes; Hydrogen-Ion concentration; Dental plaque; Tooth erosion.

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## 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.<sup>1</sup> Mouthwashes are used as adjuvant agents in daily oral hygiene routine, aiding in the chemical control of dental biofilm. In Brazil, most mouthwashes are freely available at pharmacies, drugstores, supermarkets, and other commercial establishments and usually do not require a prescription from a dentist, making these products readily available

to children and adults. The indiscriminate use of mouthwashes by the general population has generated concern because the presence of acid components in their formulations could make the products potentially erosive to hard dental tissue over time.<sup>2</sup> Dental erosion is the progressive and irreversible loss of tooth enamel as a result of chemical processes not involving bacterial action.<sup>3</sup> Previous studies have demonstrated that several mouthwashes available in the Brazilian<sup>2,4</sup> and UK<sup>5</sup> markets present low endogenous pH. A pH equal to or less than 5.5 is traditionally considered critical for enamel dissolution, although mineral loss may begin at higher pH.<sup>6</sup>

The purpose of this study was to evaluate the endogenous pH, titratable acidity, and total soluble solid content (°Bx) of mouthwashes available in the Brazilian market.

## MATERIALS AND METHODS

Ten commercial brands of mouthwashes comprising various active ingredients were selected for this study (Table 1). The products were evaluated in a randomized experiment, with 3 repetitions for each sample, with values averaged to provide a single value per sample. Data were collected by a single calibrated examiner (Kappa=0.83) and recorded in study-specific charts. The endogenous pH of each mouthwash was measured immediately after package was opened at room temperature (20°C) using a pH meter (TEC-2; Tecnal, Sion Paulo, SP, Brazil) accurate to 0.1 mm. Titratable acidity was measured according to the method

adopted by the Association of Official Analytical Chemists, that is, the amount of 0.1 N potassium hydroxide (KOH) solution needed for the product to reach pH equal to or greater than neutral pH. An Abbe refractometer (PZO-RL1, Warszawa, Poland) was used to measure °Bx. The equipment was calibrated with deionized water before samples were measured. Mean values and standard deviations were analyzed statistically using SPSS statistical software (SPSS Inc., Chicago, IL, USA).

## RESULTS

Distribution of the mouthwashes according to mean values and standard deviations is presented in Table 2. pH values ranged from 3.56 (Peroxyl) to 7.43 (Cepacol), and three mouthwashes (Clinerize, Listerine Cool Citrus, and Peroxyl) had pH less than the critical value of 5.5, thus classified as potentially erosive. Titratable acidity values ranged from 0.007 (Periogard®) to 0.530 (Prevident®). Oral B® and Clinerize® demonstrated the lowest (4.7%) and the highest (23.70%) °Bx, respectively.

## DISCUSSION

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.<sup>7</sup> Based on studies published in the Brazilian<sup>2,4</sup> and international<sup>5,8-10</sup> dental literature, the present investigation evaluated three important physico-chemical properties of mouthwashes commer-

**Table 1.** Distribution of the mouthwashes according to the commercial brand, chemical composition and manufacturer.

Commercial Brand	Active ingredient	Manufacturer
Cepacol®	Cetylpyridinium Chloride	Sanofi-Aventis Farmacêutica Ltda.
Clinerize®	Thymol	Lipson Cosméticos Ltda.
Equate®	Cetylpyridinium Chloride	Ind. Com. Poli Products Ltda.
Listerine Cool Citrus®	Thymol	Laboratórios Pfizer Ltda.
Oral-B®	Cetylpyridinium Chloride	Gillette do Brasil Ltda.
Periogard®	Chlorhexidine Gluconate	Colgate-Palmolive Argentina SA.
Peroxyl®	Hydrogen Peroxide	Colgate-Palmolive Ind. Com.
Plax Overnight®	Cetylpyridinium Chloride	Colgate-Palmolive Ind. Com. Ltda.
Prevident 220®	Cetylpyridinium Chloride	Colgate-Palmolive Argentina SA.
Sanifill®	Cetylpyridinium Chloride	Facilit Odontológica e Perfumaria Ltda.

cially available in Brazil: pH, titratable acidity, and °Bx. Although a pH value equal to or less than 5.5 is considered critical for enamel dissolution, mineral loss may begin even at higher pH;<sup>6</sup> therefore, the prolonged use of oral rinses with pH below this value may be potentially harmful to dental tissue. In the present study, three mouthwashes were classified as potentially erosive (pH<5.5), corroborating the findings of previous investigations.<sup>2,4,5,8,10</sup> 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.<sup>11</sup> Based on this statement, product labels were examined to identify mouthwashes containing fluoride. Among the three mouthwashes with pH less than 5.5, only Oral-B® has fluoride (0.05% NaF) in its formulation. The label of the other two mouthwashes with pH below the critical value for enamel dissolution (Listerine Cool Citrus® and Periogard®) did not list fluoride in their ingredients. Lack of fluoride and low pH may make these products harmful to dental tissues if not used carefully. Although mouthrinses have been formulated as pre- and post-brushing products for routine use, findings of a previous in situ study evaluating the erosive effects of some mouthrinses on enamel have sug-

gested that low pH mouthrinses should not be considered for long-term or continuous use and never as pre-brushing rinses;<sup>8</sup> however, it must be emphasized that erosive potential of a substance cannot be attributed exclusively to pH.<sup>4</sup> Other important physicochemical properties, such as titratable acidity, °Bx, and viscosity, should be also considered. In this study, titratable acidity determined the amount of acid present and the volume of KOH 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.<sup>12</sup> In the present study, Prevident 220® exhibited high titratable acidity even with pH close to 6. A possible explanation for this result is that some ingredients present in its composition did not react with the base used to neutralize the mouthwash (0.1N KOH). Four of the mouthwashes exhibited °Bx greater than 20%, that is, 20 g of solids dissolved in 100 g of mouthwash. Among the tested mouthwashes, Clinerize® presented the highest °Bx. Lack of similar studies evaluating °Bx of oral rinse products hinders comparison of the present results to data published in the literature. Brix refractometry is a physical method for mea-

**Table 2.** Distribution of the mouthwashes according to the mean values and standard deviations for endogenous pH, titratable acidity and total soluble solid content (TSSC).

Commercial brand	Endogenous pH		Titratable acidity		TSSC	
	Mean	SD	Mean	SD	Mean	SD
Cepacol®	7.43	±0.13	0.04	±0.01	9.8%	±0.52
Clinerize®	4.51	±0.12	0.009	±0.00	23.7%	±0.43
Equate®	6.70	±0.22	0.02	±0.00	20.0%	±0.0
Listerine Cool Citrus®	4.16	±0.13	0.07	±0.01	22.7%	±0.28
Oral-B®	5.79	±0.22	0.04	±0.01	4.7%	±0.0
Periogard®	5.92	±0.23	0.007	±0.00	12.1%	±0.28
Peroxyl®	3.56	±0.06	0.05	±0.01	14.0%	±0.0
Plax Overnight®	6.20	±0.15	0.009	±0.00	16.7%	±0.0
Prevident 220®	5.90	±0.03	0.53	±0.03	20.91%	±0.14
Sanifill®	6.36	±0.09	0.09	±0.00	7.9%	±0.14

asuring the amount of soluble solids (sugar, salts, proteins, acids, etc) present in an aqueous solution.<sup>13</sup> 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. Mouthwashes in general have similar regimens of use, namely 10-20 mL rinsed twice a day for 30-60 seconds. It is recommended that low pH oral rinse products be used as short to medium term adjuncts to oral hygiene and never as prebrushing rinses.<sup>8</sup>

## CONCLUSIONS

The findings of this 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, and high total soluble solid content, which may make these products potentially erosive to dental tissue if not properly used.

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