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**Original Article**

# Erosive Potential of Commercially Available Candies

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**Abstract**

**Objective:** To measure the acidity of commercially available candies. **Material and Methods:** Tic Tac® candies with the following flavors were selected: mint, orange, extra-strong, cinnamon, strawberry, cherry/passion fruit, acquired in supermarkets. Candies were triturated and from the resulting powder, 3 samples of 5 grams were separated and dissolved in 10ml of doubly deionized water. This process has allowed reading pH in triplicate, measured with the aid of an in vitro combined potentiometer and electrode, previously gauged with pH 4 and 7 with standard solutions before reading. In candies with pH values under 5.5.pH, tritatable acidity was verified. Three 15-gram candy powder samples were separately dissolved in 30 ml of doubly deionized water. In this solution, aliquots of 100 µl 1N NaOH were added to reach pH 5.5. Mineral water was used as control. The results were submitted to Analysis of Variance (ANOVA). The comparisons of means were carried out by the Tukey test at 5% significance level ($p<0.05$). **Results:** Only orange (pH 2.17), cherry/passion fruit (pH 2,26) and strawberry flavors (pH 2.46) have shown pH values under the critical point for enamel dissolution, significantly diverging from control and the other flavors. The volume of 1N NaOH used to raise the pH to 5.5 ranged from 2,000 to 2,800 µl, and the strawberry flavor has presented the highest tritatable acidity, significantly differing from the others. **Conclusion:** Candies of orange, cherry/passion fruit and strawberry flavors presented erosive potential and their frequent consumption can contribute to the development of dental erosion.

**Keywords:** Dental Erosion; Food Habits; Hydrogen-Ion Concentration.

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## Introduction

Dental erosion is the result of chemical wear of the hard tooth tissues caused by acids of intrinsic and extrinsic origin and / or chelating substances without bacterial involvement [1]. Intrinsic acid source comes from chronic vomiting caused by eating disorders and gastroesophageal reflux disease [2]. Extrinsic acid source is derived from the environment (acidic pH of pools, corrosive industrial gases), diet (acidic foods and drinks), medicines (ascorbic, acetyl salicylic acids, antihistamines) and use of illegal drugs [3-5].

The constant contact with acid taste at an early age increases the preference for acidic foods throughout life. A wide variety of acid sweets offered in supermarkets and school cafeterias are being produced in industrialized countries, accompanied by strong commercial appeal to stimulate their consumption [6,7].

Erosion prevention requires knowledge of the role that diet plays in its development. In this context, the establishment of healthy eating habits is very important in its prevention. Currently, dental erosion is considered a significant problem for oral health and its significant prevalence (25.11% to 51.6%) is directly associated with the increased consumption of industrial acid products, especially by children and adolescents [8-12].

Several factors can influence the degree of erosive wear. Literature suggests that the frequency and duration of exposure to erosive agents are important parameters in the development of dental erosion [13]. In this sense, candies stand out, since their residence time in the oral cavity tends to be prolonged, increasing the salivary cleaning time [7,14,15]. Currently, the consumption of acid candies is recognized as a potential risk factor for the development of dental erosion [10].

On the other hand, there are few studies on the erosion potential of these products and their possible contribution to the development of dental erosion. Candies can have in their composition organic acids such as citric acid, malic acid, tartaric acid and fumaric acid. Thus, abusive consumption can contribute to the development of dental erosion [14].

The erosivity of foods is influenced by physicochemical factors such as acid type, pH, titratable acidity, chelating potential, calcium and phosphate concentration, temperature and adhesion [4,16]. Among these factors, pH, titratable acidity and calcium content stand out as the parameters that best show the erosive potential of a product [16-17]. The knowledge of these factors becomes an important tool for understanding the erosivity of products. According to the above, the aim of this study was to measure the acidity of commercially available candies.

## Material and Methods

TicTac® candies (Table 1) with the following flavors: mint, orange, extra-strong, cinnamon, cherry and passion fruit and strawberry were selected. These candies were acquired in supermarkets. Mineral water without gas (Vila Nova Água Mineral Natural, Concessionária Ind. Vila Nova Ltda. Joinville-SC-Brazil) was used as the negative control.

**Table 1. Selected flavors and composition of the product according to the manufacturer.**

| Flavor | Composition according to the manufacturer |
|---|---|
| Mint | Sugar, maltodextrin, rice starch, arabic gum thickener, fructose, flavors, antiwetting agent magnesium stearate, glazing agent carnauba wax. |
| Orange | Sugar, maltodextrin, rice starch, acidulants citric acid and tartaric acid, thickening agent gum arabic, flavors, antiwetting agent magnesium stearate, glazing agent carnauba wax. |
| Extra- strong | Sugar, maltodextrin, rice starch, licorice, thickener arabic gum, flavoring, antiwetting agent magnesium stearate, glazing agent carnauba wax. |
| Cinnamon | Sugar, maltodextrin, rice starch, thickener arabic gum, flavoring, antiwetting agent magnesium stearate, red dye 40, glazing agent carnauba wax. |
| Cherry and passion fruit | Sugar, maltodextrin, rice starch, powdered passion fruit, citric acid, malic acid, tartaric acid, thickener arabic gum, flavoring, antiwetting agent magnesium stearate, carmine dye, beta-carotene, glazing agent carnauba wax. |
| Strawberry | Sugar, dextrin, rice starch, powdered strawberry, powdered lemon juice, acidulants citric acid, tartaric acid and malic acid, thickener arabic gum, flavoring, antiwetting agent magnesium stearate, carmine dye, glazing agent carnauba wax. |

pH and titratable acidity measurement (buffer capacity)

For each of the selected flavors, two packages of 16 g were necessary. The candies present in each package were ground with a pestle and degree of porcelain 305 mL (Nalgon Equipamentos Científicos, Itupeva, SP, Brazil). From the resulting powder, 3 samples of 5 g were weighed for this purpose using an analytical electronic and precision scale (AE200S Mettler-Toledo Ind. e Com. Ltda. Alphaville, Barueri, SP, Brazil). Each powder sample was dissolved in 10 ml of doubly deionized water to reach homogeneous solution. This process allowed the reading of pH in triplicate. The pH was measured at room temperature and constant stirring (Magnetic Stirrer - Fisaton Equipamentos Científicos, São Paulo, SP, Brazil), using combined potentiometer and electrode (Tec-2.TECNAL Equipamentos para Laboratórios, Piracicaba, SP, Brazil) previously calibrated with standard solutions pH 7.0 and pH 4.0 before each reading [15]. The pH measurement was also performed in water used as a negative control.

To assess the titratable acidity (buffer capacity), 15 g of powdered candies were dissolved in 30 ml of doubly deionized water to reach homogeneous mixture. In this solution, aliquots of 100 μL 1N NaOH were added under constant stirring (Magnetic stirrer - Fisaton) to reach pH 5.5. This procedure was performed for each of the flavors [15].

The results were statistically analyzed using analysis of variance (ANOVA). Comparisons of means were performed by Tukey test at 5% significance level ($p < 0.05$).

## Results

Only strawberry, cherry / orange and passion fruit flavors showed pH values below 5.5 (Table 2). These flavors showed varying titratable acidity (Table 3).

**Table 2. Mean and standard deviation of pH values.**

| Flavors | Mean pH | SD |
|---|---|---|
| Mint | $7.19^{a}$ | 0.040 |
| Cinnamon | $7.06^{b}$ | 0.042 |
| Font Life mineral water | $6.24^{c}$ | 0.046 |
| Extra strong | $5.81^{d}$ | 0.023 |
| Strawberry | $2.46^{e}$ | 0.015 |
| Cherry and passion fruit | $2.26^{f}$ | 0.021 |
| Orange | $2.17^{f}$ | 0.072 |

Means followed by same letter do not significantly differ by the Tukey test ($p < 0.05$).

**Table 3. Mean and standard deviation of 1N NaOH volume (µL) to achieve pH 5.5.**

| Flavors | Mean 1N NaOH volume | SD |
|---|---|---|
| Strawberry | 2800[a] | 100 |
| Cherry / Passion fruit | 2100[b] | 100 |
| Orange | 2000[b] | 0 |

Means followed by same letter do not significantly differ by the Tukey test ($p < 0.05$).

## Discussion

Currently, it is observed that acid industrialized products have a strong commercial appeal and are widely offered and produced in developed and developing countries. This availability has increased the exposure of children and adolescents to acids present in the diet [6]. Studies on the prevalence of dental erosion in children and adolescents have shown that the frequent consumption of these products represents a risk factor for dental erosion [10,12].

In the present study, only orange (pH 2.17), cherry and passion fruit (pH 2.26) and strawberry flavors (pH 2.46) were below the critical pH values for enamel dissolution, i.e., pH <5.5, and significantly differed from control and the other flavors. This finding corroborates previous studies that measured the pH of candies and observed their acidity [15,18,19]. The impact of this chemical property on the oral cavity has been reported by studies showing that acidic candies decrease the salivary pH while they are consumed [15,20]. These conditions can lead to tooth structure demineralization [21].

Saliva has several biological properties such as salivary flow rates, buffer capacity and remineralization capacity that protect hard dental tissues from the erosion process [22]. However, dental erosion is modulated by several factors [23]. Thus, the frequency of consumption and the prolonged contact of acid products on the teeth may partly overlap the protective properties of saliva [14,24]. This is especially relevant in relation to the consumption of hard candies assessed in the present study, whose consumption pattern is slow, allowing a longer contact with the teeth [15,20].

The three flavors that presented pH below critical values contain in their composition citric and tartaric acids and both cause the decrease in salivary pH and enamel dissolution. In addition, when dissociated, citric acid allows the citrate anion to act as a chelator of calcium ions, increasing the tooth enamel demineralization. This leads to a demineralizing effect even after the pH of the tooth surface is normalized [4,16].

Strawberry, cherry / passion fruit and orange flavors demonstrated varied intrinsic buffering capacity, and strawberry flavor required a greater volume of 1N NaOH to reach pH 5.5, significantly differing from the other flavors. This high acidity of strawberry flavor was also observed in a previous study [19]. High titratable acidity increases the time that saliva needs to neutralize the acid and this influences the erosive potential of a given food or drink within the same pH range [4]. In this sense, it was demonstrated by an in vitro study using polarized light microscopy that the lower the pH and the higher the titratable acidity, the greater the depth of lesions exposed to acidic candies, showing the impact of these factors on the erosivity of acid candies [18].

It is noteworthy that the deciduous teeth are more vulnerable to acid dissolution than permanent teeth due to structural differences, since the former have less thick enamel, lower mineralization degree and higher permeability, which could explain the faster progression of dental erosion in the primary dentition [25].

We must keep in mind that product erosivity is also dependent on the presence of phosphate ions, fluoride and calcium, which when present tend to reduce its erosive potential [4,16]. A recent study showed that the consumption of acid candies with calcium resulted in lower critical pH and significantly less erosive potential than acid candies without calcium [26]. However, the lack of measurement of the content of these ions is a study limitation. Thus, it could be inferred that part of the candies analyzed have erosive potential but the confirmation of this erosive potential depends on further studies, especially in situ and in vivo studies.

We emphasize that candies mint and cinnamon flavors do not have erosive potential and are an alternative option over the others.Although it is not the object of this study, all candies have sugar in their composition, which can contribute to dental caries.

Health education is very important for the prevention of dental erosion. To prevent its development, we must recognize the risk and protective factors, so we can appropriately guide parents and children. Thus, some preventive strategies can be adopted by patients such as after consuming acidic candies rinse mouth with water or drink milk / eat cheese; use natural chewing gum without sugar (preferably mint flavor), which stimulates salivary flow; wait from 30 minutes to one hour to brush teeth because it is the time for saliva of remineralize the tooth surface; mouthwash with fluoride and avoid consuming acidic candies for prolonged periods [22].

It is noteworthy that one of the most important measures for the prevention of dental erosion is slowing as much as possible the exposure of children to acid industrialized products, among which are acid candies, thus reducing the risk of developing preference for acidic foods and drinks throughout life and therefore the risk of dental erosion [6].

## Conclusion

It was concluded that candies orange, cherry / passion fruit and strawberry flavors have erosive potential and can contribute to the development of dental erosion when abusively consumed, especially the strawberry flavor, which presented low pH and high acidity.

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## References

1. Gans C. Definition of erosion and links to tooth wear. Monogr Oral Sci 2006; 20: 9-16.
2. Barlett D. Intrinsic causes of erosion. Monogr Oral Sci 2006; 20:119-139.
3. Zero DT. Etiology of dental erosion – extrinsic factors. Eur J Oral Sci 1996; 104(2):162-77.

4. Lussi A, Jaeggi T. Extrinsic causes of erosion- diet- chemical factors. Monogr Oral Sci 2006; 20:77-87.
5. Xavier AF, Moura EF, Azevedo WF, Vieira FF, Abreu MH, Cavalcanti AL. Erosive and cariogenicity potential of pediatric drugs: study of physicochemical parameters. BMC Oral Health 2013; 13:71.
6. Gambon DL, Brand HS, Veerman ECI, Dental erosion in the 21 st century: What is happening to nutritional habits and lifestyle in our society? Br Dent J 2012; 213(2):55-7.
7. Stewart KF, Fairchild RM, Jones RJ, Hunter L, Harris C, Morgan MZ. Children's inderstandings and motivations surrounding novelt sweets: a qualitative study. Int J Paediatr Dent 2013; 23(60):424-34.
8. Waterhouse PJ, Auad SM, Nunn JH, Steen IN, Moynihan PJ. Diet and dental erosion in young people in south-east Brazil. Int J Paediatr Dent 2008;18(5):353-60.
9. Correr GM, Alonso RC, Correa MA, Campos EA, Baratto-Filho F, Puppin-Rontani RM. Influence of diet and salivary characteristics on the prevalence of dental erosion among 12-year-old schoolchildren. J Dent Child 2009; 76(3):181-7.
10. Correa MSNP, Corrêa FNP, Correa JPNP, Murakami C, Mendes FM. Prevalence and associated factors of dental erosion in children and adolescents of a private dental practice. Int J Paediatr Dent 2011; 21(6):451-8.
11. Murakami C, Oliveira LB, Sheiram A, Corrêa MSNP, Haddad AE, Bonecker M. Risk indicators for erosive tooth wear in Brazilian preschool children. Caries Res 2011; 45(2):121-9.
12. Farias MMAG, Silveira EG, Schmitt BHE, Araújo SM, Baier IBA. Prevalência da erosão dental em crianças e adolescentes brasileiros. Salusvita 2013; 32(2):187-98.
13. Zero D, Lussi A. Extrinsic causes of erosion- diet- behavioral factors. Monogr Oral Sci 2006; 20:100-5.
14. Gambon DL, Brand HS, Amerongen AVN. Acidic candies affect saliva secretion rates and oral fluid acidity. Ned TijdschrTandheelkd 2007; 114(8):330-4.
15. Brand HS, Gambon DL, Paap A, Bulthuis MS, Veerman EC, Amerongen AV. The erosive potential of lollipops. Int Dent J 2009; 59(6):358-62.
16. Furtado JR, Freire VC, Messias DCF, Turssi CP. Aspectos físico-químicos relacionados ao potencial erosivo de bebidas ácidas. RFO UPF 2010; 15(3):325-30.
17. Lodi CS, Sassaki KT, Fraiz FC, Delbem AC, Martinhon CC. Evaluation of some properties of fermented milk beverages that affect the demineralization of dental enamel. Braz Oral Res 2010; 24(1):95-101.
18. Wagoner SN, Marshall TA, Quian F, Wefel JS. In vitro enamel erosion associated with commercially available original and sour candies. J Am Dent Assoc 2009; 140(7):906-13.
19. Silva JG, Farias MMAG, Silveira EG, Araújo SM, Schmitt BHE. Evaluation of the erosive potential of acidic candies consumed by children and teenagers. J Pharm Nutri Scien 2013; 3:262-5.
20. Brand Hs, Gambon DL, Van Dop LF, Van Liere LE, Veerman EC. The erosive potential of jawbreakers. Int J Dent Hyg 2010; 8(4):308-12.
21. Dawes C. What is the critical pH and why does a tooth dissolve in acid? J Can Dent Assoc 2003; 69(11):722-24.
22. Feltham EB. The Power of sour candies: A dental hygienist's battle against dietary dental erosion. CDHA J 2010; 25(1):16-8.
23. Lussi A. Erosive tooth wear- a multifactorial condition of growing concern and increasing knowledge. Monogr Oral Sci 2006; 20:1-8.
24. Jensdottir T, Nauntofte B, Buchwald C, Bardow A. Effects of sucking acidic candy on whole-mouth saliva composition. Caries Res 2005; 39(6):468-74.
25. Johansson AK, Sorvari R, Birkhed D, Meurman JH. Dental erosion in deciduous teeth-an in vivo and in vitro study. J Dent 2001; 29(5):333-40.
26. Jensdottir T, Nauntofte B, Buchwald C, Bardow A. Effects of calcium on the erosive potential of acidic candies in saliva. Caries Res 2007; 41(1):68-73.