Evaluation of the Erosive Potential of Acidic Candies Consumed by Children and Teenagers

Jeison Gabriel da Silva[1], Maria Mercês Aquino Gouveia Farias[2,*], Eliane Garcia da Silveira[1], Silvana Marchiori de Araújo[1] and Beatriz Helena Eger Schmitt[1]

[1]*Rua Uruguai, 458, Centro, Itajaí, Santa Catarina, Brazil*

[2]*Rua Bartolomeu de Gusmão, 209, Carianos, Florianópolis, Santa Catarina, Brazil*

Abstract: This research aims at investigating the acidity of candies commonly consumed by children and teenagers. Eight flavors of candy produced by the brand Halls Kraft Foods Brazil Ltda.®: cherry, extra strong, watermelon, strawberry, mint, menthol, wild strawberry and chantilly cream strawberry were analyzed. The candies were crushed. Five grams of crushed candy were added to 10 ml of doubly deionized water and stirred until all candy was dissolved. The pH was measured in triplicate using a potentiometer and combined glass electrode (Tec-2 Tecnal). Fifteen grams of crushed candy were added to 30 ml doubly deionized water. The titratable acidity was measured by adding 100 µl of 0.1 M NaOH to the solution under constant stirring until a pH of 5.5 was reached. This procedure was performed for each of the flavors. Mineral water was used as a negative control and citric acid as positive control. The results were statistically analyzed by the Variance Analysis (ANOVA). Comparisons of means were performed by the Scott Knott Test, at a 5% level of significance ($p < 0.05$). The results showed that all candies had pH values below 5.5, ranging from 3.6 to 5.2. These values were significantly different from the positive and negative controls. The flavors Chantilly Cream Strawberry and Wild Strawberry have shown to be the candies with highest erosive potential due to their lower pH values and higher intrinsic buffer capacity. It is concluded that the candies have erosive potential and their frequent use can contribute to the development of dental erosion.

Keywords: Candy, dental erosion, erosion potential, hydrogen-ion concentration, acidity.

INTRODUCTION

Recent studies have shown concern with the high prevalence of dental erosion and its relation to children's dietary habits, where findings are related to the abusive consumption of acidic foods with increased risk for developing dental erosion [1-3].

The clinical term dental erosion and/or perimolysis is used to describe the physical effects of a localized, chronic, and pathological loss of hard tissue (enamel and dentin), removed chemically from the dental surface by means of acid or chelating substances, without bacterial involvement. The clinical picture is related to a frequent intake of acidic foods or exposure to stomach products [4].

Recently, literature has pointed to the erosive capacity of acidic candies [5-7]. The presence of acids in their composition, such as the citric acid, malic acid, and fumaric acid, used to impart freshness, can contribute to their erosive potential [5].

From the physical-chemical point of view, the type of acid, pH, titratable acidity, chelating potential, concentration of calcium and phosphate, temperature, and adhesiveness can influence the erosive potential of acidic foods. Individually, pH, titratable acidity, and calcium content are the parameters that best reveal the erosivity of an acid food [8-12]. Knowledge of these properties helps in understanding the erosive potential of acidic foods.

Thus, the objective of this study was to determine the pH and titratable acidity (buffer capacity) of commercially available candies in order to clarify the erosive potential of these foods.

METHODOLOGY

To compose the sample of this study the candies the Halls of the brand Kraft Foods Brazil Ltda.® (Bauru, SP) (Table **1**) were selected with the respective flavors: cherry, extra strong, watermelon, strawberry, mint, menthol, wild strawberry, and chantilly cream strawberry. These candies were collected at supermarkets.

For the negative control, a non-carbonated mineral water (Vila Nova Água Mineral Natural, Concessionária Ind. Vila Nova Ltda., Joinville, SC, Brazil) was used for presenting a pH close to neutral (6.3). Anhydrous citric acid ($C_6H_8O_7$) (ISOFAR Indústria e Comércio de Produtos Químicos Ltda., Duque de Caxias, RJ, Brazil) was used as positive control due to its acidic pH (2.0).

*Address corresponding to this author at the Rua Bartolomeu de Gusmão, 209, Carianos, Florianópolis, SC, Zip Code: 88047-520, Brazil; Tel: 55 (048)-3236-1192/ 55 (48)-9622-1645; E-mail: mercesfarias@gmail.com

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Table 1: Selected Flavors and the Type of Acid Present in the Composition According to the Manufacturer

Flavor	Type of acid in the composition
Cherry	Citric acid
Extra strong	Citric acid
Watermelon	Citric acid
Strawberry	Citric acid
Mint	There is no acid in the composition
Menthol	Citric acid
Wild strawberry	Citric acid, there can be traces of milk
Chantilly cream strawberry	Citric acid

pH and Titratable Acidity Analysis

For each of the selected flavors, the 10 candies of in each package were pounded with a pistil and 305 ml porcelain pounder (Nalgon Equipamentos Científicos, Itupeva, SP). Of the resulting powder, 3 samples of 5 g were weighed with an analytical electronic precision scale (AE200S Mettler-Toledo Ind. E Com. Ltda. Alphaville, Barueri, SP, Brazil). Each sample was dissolved in 10 ml of doubly deionized water until obtaining a homogeneous solution. This process enabled the pH reading in triplicate. The pH was measured under ambient temperature and constant stirring (Fisaton magnetic stirrer), using a potentiometer and a combined glass electrode (Tec-2 Tecnal) previously calibrated with standard solutions of pH 7.0 and pH 4.0, before each reading [6].

For the verification of titratable acidity (buffering capacity), 15 g of candy powder were dissolved in 30 ml of doubly deionized water until obtaining a homogeneous mixture. To this solution, 100 µl aliquots of 0.1 M NaOH were added under constant stirring (Fisaton magnetic stirrer) until the pH reached the value 5.5. This procedure was performed for each of the flavors [6].

The results were submitted to a statistical analysis by the Variance Analysis (ANOVA). The mean comparisons were performed by the Scott Knott Test in a 5% level of significance ($p<0,05$).

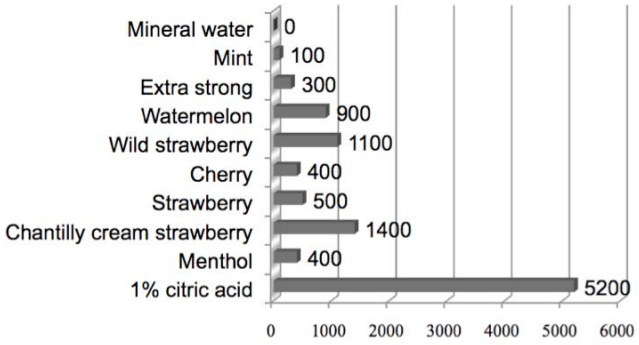
RESULTS

All analyzed candies presented pH values below 5.5 and a varied intrinsic buffering capacity. All flavors differed significantly from the negative and positive controls. The pH values are displayed in Table **2**. The Graph **1** shows the NaOH 1 N volume required to reach a pH 5.5 solution.

Table 2: pH Averages

SAMPLE	pH
1% citric acid	2,0 e
Menthol	3,6 d
Chantilly cream strawberry	3,7 d
Strawberry	3,8 d
Cherry	3,8 d
Wild strawberry	3,9 d
Watermelon	4,2 c
Extra strong	4,3 c
Mint	5,2 b
Mineral water	6,3 a

Average values followed by the same letter do not differ significantly among themselves by the Scott Knott Test ($p < 0,05$).



Graph 1: Volumes (µl) of NaOH 1 N to reach a pH>5,5.

DISCUSSION

Currently, there is a wide variety of industrial candies available in commercial establishments. Today, in addition to the traditional chocolate and caramel, there are new flavors containing acids and/or fruits. The marketing of these acidified candies for children convince through their attractive labels and packaging [13]. This preference for acidic foods is related to the desire of adventure, the sense of danger and excess, which these foods supposedly would provide [14].

Little is known about the impact of acidic candy consumption on the development of dental erosion. A recent study on the prevalence of dental erosion has identified the acidic candy consumption by children and adolescents as a factor related to the development of

erosion lesions, contributing to its prevalence increase [3].

Studies have shown the presence of acids (ascorbic, acetic, citric, fumaric, adipic, lactic, tartaric, and malic acid) as part of the composition of candies, besides other ingredients such as: fruit extracts, concentrated juices, pure juice, juice in purée and paste/pulp extract, which may contribute to their erosive potential [5, 7, 15].

Among the acids, citric acid is the most common agent in these types of products [13]. Citric acid is an organic acid with significant erosive properties. It is able to lower the salivary pH and cause the dissolution of the enamel. In addition, the citrate anion acts as a chelator of calcium ions, increasing dental enamel demineralization. This implies a demineralizing effect even after the dental surface pH be normalized [16, 17].

In this study, most of the candies had citric acid in their composition and they all exhibited pH values below the critical one for enamel dissolution (5.5), ranging from 3.6 to 5.2, for the flavors and Mint and Menthol, respectively. These values differed significantly from the negative and positive controls. Recent studies have also shown the acidity of several industrialized candies [5, 6, 13, 15, 18].

The pH value is a significant variable in the erosive process, but it is not necessarily the most important factor. Other factors, such as the acid concentration, titratable acidity (buffering capacity), exposure time, temperature and type of acid interfere with the erosivity of a food [19].

The analyzed candies showed a varied intrinsic buffering capacity with the flavors chantilly cream strawberry and wild strawberries presenting the highest values. Foods with high titratable acidity keep the oral environment acid for a longer period of time, aggravating its demineralizing effect [9]. This property can be more relevant in foods that remain in the mouth for a longer time, allowing the dissociation of the acid in the mouth.

Saliva and its buffering effect are factors that can change the type and severity of the lesions. Several studies assert that there is an elevation of the salivary flow and decreased oral pH during the consumption of acidic candies [5, 6, 20]. However, despite the protective effects of the saliva (buffering and dilution) the use of acid candies over an extended period of time can exacerbate their erosive potential by prolonging the contact of the dental structures with the acidic substance [21].

A series of recommendations should be made to the patient who uses acidic candies: not to suck, bite or keep acidic candies in the mouth for long periods of time; to wash the mouth immediately with water after ingestion; use milk or cheese after acid candy consumption; to use natural sugar-free chewing gum (mint) with xylitol, which will help to stimulate salivary flow; to avoid natural/artificial fruit flavors; to wait 30 minutes to an hour after eating acidic candies to brush your teeth, avoiding the abrasive wear of structure softened by the acid; to use fluoride toothpaste or one of low abrasiveness, thus decreasing damage to enamel and forming a protective film [13, 15, 20].

Recognizing the wideness of factors that interfere in the development of dental erosion, it is understood that health education is part of this process, in which professionals, consumers and manufacturers are involved. The understanding of the rational consumption of industrialized acidic foods requires the participation of manufacturers, both in improving the chemical characteristics of their products and the information contained in the packaging, as well as that of the professionals, orientating their patients and the people who daily makes their choices.

CONCLUSION

The results indicate that the analyzed candies present an erosive potential and may contribute to the development of dental erosion when consumed abusively.

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