Erosive potential associated with the pH of industrialized and natural drinks

Autor:
Amanda Rodrigues Lourenço
Graduação em Odontologia, Universidade Salgado de Oliveira, Niterói, RJ, Brasil.

Renata Porto
Graduação em Odontologia, Universidade Salgado de Oliveira, Niterói, RJ, Brasil.

Daiane Lopes
Graduação em Odontologia, Universidade Salgado de Oliveira, Niterói, RJ, Brasil.

Marjorie Moraes
Graduação em Odontologia, Universidade Salgado de Oliveira, Niterói, RJ, Brasil.

Lucas Rangel
Mestrando em Endodontia, Núcleo de Procedimentos Integrados, Universidade do Estado do Rio de Janeiro, RJ, Brasil

Marcelle Maciel Fernandes de Azevedo
Doutoranda em Odontopediatria, Departamento Odontologia Preventiva e Comunitária, Universidade Estadual do Rio de Janeiro, RJ, Brasil.

Thiago Isidro Vieira
Doutor em Odontopediatria, Departamento de Ortodontia e Odontopediatria, Universidade Federal do Rio de Janeiro, RJ, Brasil

Lucianne Cople Maia
Professora Titular de Odontopediatria, Departamento de Ortodontia e Odontopediatria, Universidade Federal do Rio de Janeiro, RJ, Brasil.

Tatiana Kelly da Silva Fidalgo
Professora Adjunta de Odontopediatria, Departamento Odontologia Preventiva e Comunitária, Universidade Estadual do Rio de Janeiro, RJ, Brasil.

Corresponding Author:
Tatiana Kelly da Silva Fidalgo
E-mail: tatianaksfidalgo@gmail.com
Boulevard Vinte e Oito de Setembro, 157
Vila Isabel, Rio de Janeiro - RJ, 20551-030
Phone: +55 21 2569-0410

ABSTRACT

Nowadays there is an increase in the consumption of acidic drinks, especially the fermented ones. Its ingestion is closely associated with the demineralization of superficial dental tissues, which characterizes dental erosion. The objective of this study was to evaluate the pH of industrialized and natural drinks. The sample consisted of soft drinks, natural and artificial juices, fermented drinks, isotonic drinks and energy from different commercial brands acquired in the city of Niterói (RJ). The products were kept at room temperature (25oC) for 1 hour and were aliquoted 3 mL of each drink to a Becker to measure pH in a specific electrode coupled to a potentiometer. The readings were performed in triplicate. The mean pH ranged from 2.34 to 4.31, the most acidic drink was the refrigerant and the less acidic, the curd. It was found that all drinks analyzed had an acidic pH. Thus, potentially erosive dental structures.

Keywords: Dental erosion; drinks; Hydrogen-Ion Concentration, drinking.

RESUMO

Atualmente, há um aumento no consumo de bebidas ácidas, especialmente as fermentadas. Sua ingestão está intimamente associada à desmineralização dos tecidos dentários superficiais, o que caracteriza a erosão dentária. O objetivo da presente pesquisa foi avaliar o potencial erosivo de bebidas industrializadas e naturais. A amostra de conveniência foi constituída de refrigerantes, sucos naturais e artificiais, bebidas fermentadas, isotônicos e energéticos de diferentes marcas comerciais adquiridas no município de Niterói (RJ). Os produtos foram mantidos em temperatura ambiente (25oC) durante 1 hora e foram aliquotados 3 mL de cada bebida para um Becker para a mensuração de pH em eletrodo específico acoplado a um potenciômetro. As leituras foram realizadas em triplicata. Os valores médios de pH variaram de 2,34 a 4,31, sendo a bebida mais ácida um refrigerante e a menos ácida, a coalhada. Constatou-se que todas as bebidas analisadas apresentaram um pH ácido e abaixo do crítico para a dissolução do esmalte, sendo estas potencialmente erosivas das estruturas dentárias.

Palavras-chave: Erosão dentária; Bebidas; Concentração de Íons de Hidrogênio, Ingestão de líquidos

INTRODUCTION

Erosive tooth wear is the dissolution of dental hard tissues caused by acids of non-bacterial origin, intrinsic or extrinsic in nature (CHAN et al, 2020; MARTÍNEZ et al, 2019). The increasing prevalence of erosive tooth wear has been a concern for dental surgeons, and is currently considered one of the main oral problems in children, adolescents and adults (MARRÓ et al.,2019 ; RACKI et al., 2020). It is estimated that worldwide 30-50% of deciduous and 20-45% of permanent teeth are affected (ORTIZ et al.,2021). Its prevalence in adolescents can vary between 13% and 34% in Brazil. In addition, there are also differences in prevalence depending on the geographic location, the indices used and the variety in the age group (between 10 and 18 years old) studied. (FERREIRA et al, 2009).

One of the most important nutritional factors that cause erosive tooth wear is excessive consumption of industrialized and natural drinks, vitamin C tablets, in addition to patient-related factors such as reflux or eating disorders, as scientific evidence suggests (LUSSI A et al., 2019).

Loss of mineral tissue is associated with frequent contact with acidic substances in association with masticatory mechanical forces. Excessive consumption of acidic drinks and foods has been the main focus of erosion research. Enamel dissolution is significantly associated with chemical parameters: pH, buffering capacity, temperature, titratable acidity, viscosity, as well as calcium, phosphate and fluoride concentrations in beverages and foods (SAADS et al., 2019).

Therefore, the objective of the present research was to evaluate the erosive potential of industrialized and natural beverages, based on their intrinsic pH values; with this information, professionals can establish preventive measures and dietary interventions, adapted to each patient, as a way of to delay the evolution of the dental erosion process.

METHODOLOGY

The pH of the drinks (soft drinks, energy drinks, isotonic drinks, fermented drinks, natural and artificial juices) (Box 1) was verified on a specific electrode coupled to a potentiometer (Thermo Scientific Orion, Chelmsford, MA, USA). The sample was acquired in the city of Niterói (state of Rio de Janeiro).

Box 1. Distribution of evaluated products according to the respective categories.

Products					
Soft drinks	**Energetic**	**Isotonic**	**Fermentated Drinks**	**Sucos Artificiais**	**Sucos Naturais**
• Sprite® • Sprite® Zero • Coca-Cola® • Coca-Cola® Zero • Coca-Cola® Stevia • Guaraná® Antarctica • Guaraná® Antarctica Zero • Guaraná® Antarctica Black	Energetic Zero (TNT)	• Isotonic Grape (Ironage)	• Danoninho Stroberry (Danone) • Yogurt Stroberry (Paulista) • Chamyto (Nestlé) • Skymmed curd (Itambé)	• Orange juice (Del valle) • Orange juice (Del valle home made orange) • Tang* (Tangerine) • Tang* (Lemon) • Tang* (Mango) • Grape juice (Aliança)	• Orange natural juice** (Seleta) • Lemon natural juice**

* Tang = 2g/200 ml of water; ** Natural juice = 50 ml of juice/200 ml of water

For this purpose, 3 mL of each drink was aliquoted for a Becker. The samples remained at room temperature (25oC), for one hour prior to pH measurement. Immediately before the readings, the device was properly calibrated with previous buffer solutions of recognized acid (4.00), neutral (7.00) and basic (10.00) pH values. The tests were performed in triplicate.

Each pH value was registered and tabulated in SPSS software, version 20.0 (SPSS 20.0; Chicago, IL, USA). The averages of the pH values and their respective standard deviations (SD) were obtained using SPSS 20.0. The data were analyzed using descriptive statistics.

RESULTS

Based on the tests performed to measure the pH of the drinks, the average pH of all drinks was 3.59, it was also verified that the most acidic drink was Guaraná Antarctica® Black, with an average pH value equal to 2.34, and the least acidic drink was the curd (average pH = 4.31) as can be seen in Table 1.

Table 1. Average pH values and standard deviation of the analyzed drinks.

	DRINK	Average	Standard deviation
SOFT DRINK	Sprite®	3.06	±0.07
	Sprite® Zero	2.95	±0.06
	Coca-Cola®	2.41	±0.01
	Coca-Cola® Zero	2.89	±0.02
	Coca-Cola® Stevia	2.72	±0.01
	Guaraná Antarctica®	3.15	±0.02
	Guaraná Antarctica® Zero	3.30	±0.01
	Guaraná Antarctica® Black	2.34	±0.01
ENERGETIC	TNT® Zero	2.39	±0.00
ISOTONIC	Ironage® Uva	2.96	±0.00
FERMENTED DRINK	Danoninho® Strowberry	4.17	±0.01
	Strowberry Yogurt – líquiq Paulista®	3.98	±0.00
	Chamyto®	3.65	±0.00
	Skymmed Curd Itambé®	4.31	±0.00
ARTIFICIAL JUICE	Orange juice DEL VALLE®100%	3.96	±0.00
	DEL VALLE® Home made Orange	3.70	±0.01
	TANG® Tangerine (2g/200 ml water)	2.92	±0.01
	TANG® Lemon (2g/200 ml de water)	2.82	±0.00
	TANG® Mango (2g/200 ml water)	3.29	±0.00
	Grape Juice (Aliança® - 100% juice)	3.34	±0.01
NATURAL JUICE	Orange Natural Juice (Seleta)	4.00	±0.01
	Lemon Natural Juice	2.40	± 0.01
Avarage ± SD	Global	3.59	±1.20

DISCUSSION

The present work evaluated the pH of some main drinks that constitutes part of the liquid diet of children and adolescents. It was observed that all the analyzed products had a lower pH than critical pH for the dissolution of the enamel. The values reported here ranged from 2.34 (Guaraná Antartica® Black) to 4.31 (Curd Itambé® Desnatado).

The pH of the oral cavity is close to neutral, this means that when acidic substances come into contact with the oral cavity, the hydroxyapatite crystals decalcify, leading to demineralization of the dental tissues. Drinks in which the pH is lower than 5.5 are the main causes of mineral loss and present greater erosive potential (OLIVEIRA et al., 2017). The curd presented a pH of 4.31, the drink with higher pH in this study, however, it is still considered acidic enough to cause mineral loss, since its pH is lower than 5.5. In addition, the pH values of soft drinks corroborated the findings of Carvalho et al., 2017 (CARVALHO TS). Among the citric drinks, the pH of lemon juice was lower compared to orange juice.

According to Liberali et al, 2020 (LIBERALI R), carbonated drinks presented an increasing in its consumption in recent years, especially in children. Based on the results of the present study, it was found that the most acidic drink was Guaraná Antarctica® Black, with a pH of 2.34, being the drink with the greatest potential for dental demineralization when compared to the others.

The incipient caries lesion is characterized as subsurface demineralization, since the lactic acid produced by the bacteria is a weak organic acid, which results in slow dissolution of the tooth structure, resulting in a sub superficial demineralization. In erosion, the pH value is lower than 5.5, thus causing superficial loss. Associated with this, there is the abrasion of the toothbrush, which if used with force and right after the ingestion of acidic food or drink, causes mineral loss, leading to tooth sensitivity. Dental erosion leaves the dentin vulnerable and the tooth more susceptible to pulp inflammation and caries cavity (ALMOHEFER S et al., 2021).

According to RAJ R et al., 2021, saliva has the main capacity to protect against the demineralization process of the dental structure, because the unbalanced calcium and phosphate ion concentrations lead to the demineralization process, besides it the buffer capacity in a homeostatic condition maintain the salivary pH close to neutral. In the present study, all evaluated drinks had a pH below the critical level and, therefore, sufficient to promote mineral loss. Gonçalves et al., 2012 highlight that the main factor of dental erosion is associated with diet, where the low cost and availability of acidic drinks influence consumption, leading to an increase in the prevalence of dental erosion. In this sense, the concern with the results of the present study becomes even greater, since the erosive potential of the analyzed natural and artificial drinks, based on their pH values, is within a range of values considered potentially erosive.

The period that acidic drinks remain in contact with the oral environment is also an important factor in the severity of mineral loss (Hara AT et al., 2021). Murakami et al., 2016 suggests that children who use a baby bottle during the nocturnal period, containing drinks and do not perform oral hygiene before bedtime are more prone to be susceptible to mineral loss, since the protective capacity of saliva is reduced in the nocturnal period due to the flow rate reduction (MURAKAMI C et al., 2016).

In order to reduce the harmful effect of acidic foods and drinks is less to tooth enamel, it is recommended that oral hygiene is not performed immediately after low pH drinks ingestion because the tooth enamel is still fragile and vulnerable. Another recommendation is the use of straws, to avoid the direct contact of the drink with the enamel, and brush your teeth with fluoride paste and with a low abrasive content before ingesting any acidic food or drink. The professional should do an analysis of the case and providing advice on the patient's diet, guiding the family and the child related to oral health in general and related to healthy dietary habits (HONG DW et al., 2020).

The main target of dental erosion treatment is the habits and disorders that cause this problem. In this context, it is important to understand that there is no permanent solution to the problem without removing the etiological factor that causes the mineral loss process (LUSSI et al., 2014). In cases where the patient has a diet with an excess of acidic foods and drinks, the recommendation is to rinse with water and brushing after consumption is avoided. Another way to minimize the effect of acidic drinks on the enamel is to brush with fluoride toothpaste before consuming low pH foods and avoid direct contact with these foods, such as using a straw to ingest acidic liquids and cut pieces of fruit before eating (MACHADO et al., 2019).

One of the limitations of this work was the assessment of an unique parameter, the pH. Future studies incorporating analyzes of acid titrability and concentration of calcium and phosphate should be carried out to characterize the erosive potential of the drinks reported here.

CONCLUSION

The present study demonstrated that all the drinks analyzed showed an acidic pH lower to the critical pH for the dissolution of the enamel, which are potentially erosive of the dental structures.

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