Erosive potential of five commercially available flavoured drinks in India

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ABSTRACT

The purpose of this in vitro study was to measure the initial pH and buffering capacity of some commonly consumed flavoured drinks in India and to determine their erosive potential. Commercially available five drinks were taken (Pepsi, Appy fizz, Apple juice, Gatorade & a milk based drink). Their initial pH were measured with pH meter and their buffering capacities were measured by adding 1M NaOH in the increments of 0.2 ml into 100 ml of each drink till the pH reached 5.5 and 7 respectively. Total titratable acidity measurement shows that among all the drinks, there was a significant difference between the sports drink and the milk based drink. In conclusion it was found that sports drink had the most buffering capacity with maximum erosive potential whereas milk based drink had the least.

Keywords: *Buffering capacity, Dental erosion, Titratable acidity, Flavoured drinks.*

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INTRODUCTION

Over the last decade, prevalence of dental erosion seems to have increased presumably due to an increase in the consumption of soft drinks and fruit juices.[1]

In their article titled "Risk factors in dental erosion" V.K Jarvinen, I.I Rytomaa and O.P Heinonen[2] stated that Pindborg in 1970 defined dental erosion as an "irreversible loss of dental hard tissue due to a chemical process without the involvement of microorganisms."

It has been accepted that titratable acidity which is a measurement of the total acid content, is a more important indicator than actual pH value in determining erosive potential of beverages[3].

MATERIALS AND METHODS

For this in vitro study five commercially available drinks were tested (Table 1, Figure 1)

Table 1: Tested Soft Drinks; Their Manufacturers, Packaging and Acidulants

S. No.	Soft Drink	Manufacturer	Packaging	Acid
1	**Apple juice**	Tropicana Pvt. Ltd	Paper casing	L-Malic Acid
2	**Appy fizz**	Parle Agro Pvt. Ltd	Plastic bottle	Malic Acid
3	**Flavored drink (milk based)**	Amul Pvt. Ltd	Glass bottle	Conjugated linoleic acid
4	**Pepsi**	Pepsi Co	Plastic bottle	Phosphoric Acid
5	**Gatorade**	Quaker Oats	Plastic bottle	Citric acid

Figure 1: Tested soft drinks

pH measurement: The initial pH of each drink was measured using a pH meter (ELINCO PHX- 1400 pH METER, Figure 2). 100ml of freshly opened drink at room temperature was placed in a beaker and stirred using a non heating magnetic stirrer until a stable reading was obtained. Ten readings were taken of each drink from each group to give a mean measurement for that drink.

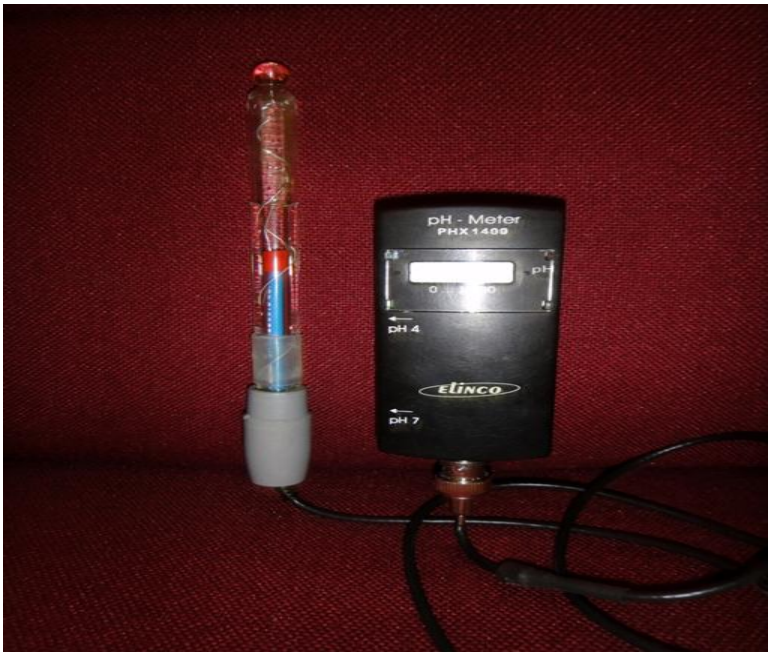

Figure 2: pH Meter

Buffering capacity: 100ml of each drink was titrated with 1M NaOH added in 0.2ml increments until the pH reached 5.5 and 7. This was done by using a non heating magnetic stirrer until a stable pH reading was obtained after each increment (0.2ml) of NaOH. This was done to measure the total titratable acidity.[4]

RESULTS

pH measurement

The pH values are shown in table 2. The initial pH was lowest for Gatorade (2.75) and highest for Milk based drink (7.3). According to this it can be stated that sports drinks were most acidic among all the beverages.

Table 2: Initial pH and Buffering Capacity of Each Drink

S. No.	Drinks	pH on opening the drink	Volume(ml) of base (NaOH) needed to increase pH to	
			5.5	7
1.	**Pepsi**	2.75	1.5	3.8
2.	**Appy fizz**	6.6	0.5	1.8
3.	**Apple Juice**	5.7	0.5	1.9
4.	**Gatorade**	4.2	7	9.5
5.	**Flavored Drink (Milk Based)**	7.3	0.1	0.4

Buffering capacity

Table 2 shows the amount of NaOH needed to raise the pH of beverages to 5.5 and 7 respectively. Since milk based drink has an initial pH of 7.3, minimum amount of NaOH i.e. 0.4 ml was required to raise the pH to 7. Maximum amount of NaOH i.e.7 ml was required to raise the pH of gatorade to 5.5 and a total of 9.5 ml NaOH was required to raise the pH to 7. Hence it can be stated that more base was required for gatorade to neutralize its acidity.

DISCUSSION

Dental erosion is defined as an irreversible loss of dental hard tissue by a chemical process without the involvement of microorganisms and is due to either extrinsic or intrinsic sources.[5,6,7] Enamel, in spite of being the hardest tissue, has been reported to suffer from the devastating effects of soft drinks.

Dietary erosion may result from food or drinks containing a variety of acidic ingredients.[6] Children and adolescents consume significant amounts of these mostly erosive beverages and therefore their risk of developing dental erosion is high. Soft drink intake in children is generally greater than in adults, but has a huge individual variation.[8]

In the present study the drinks used were Pepsi, Apple juice, Appy fizz, Gatorade (sports drink) and flavoured milk. According to Edwards M., Creanor S.L., Foye R.H., and Gilmour W.H[4] it is generally accepted that titrable acidity, which is the measurement of the total acid content, is a more important indicator than actual pH value in determining erosive potential of beverages.

The pH of all drinks investigated in our study ranged from 2.75-7.30 on opening, amongst which Pepsi (pH-2.7), Apple juice (pH-5.2) and Gatorade (pH-4.2) had values below the critical pH at which enamel dissolution occurs.

This was quite similar to the finding of Touyz[9] who concluded that Canadian fruit juices had pH below the critical dissolving pH of enamel.

Buffering capacity had been found by several studies to affect the erosive potential of soft drinks and Zero[6] has suggested that it should be considered more important than pH in determining the erosive potential of drinks. The buffering capacities of beverages in this study can be ranked as follows: Milk based drink>Appy fizz>Apple juice> Pepsi> Gatorade. The present study showed that fruit juices needed the most base to neutralize thereby having greater erosive potential than the cola and the non-cola drinks. The cola drinks despite having the lowest pH on opening were easy to neutralize than the fruit juices and non cola drinks, i.e. they required only 1.5ml and 3.8 ml of NaOH to make the pH 5.5 and 7.0 respectively; whereas, the sports drink required the maximum amount of NaOH, i.e 7ml and 9.5 ml to make the pH, 5.5 and 7.00 respectively. This was quite similar to the findings of two studies by Jensdottir and co-workers[10, 11] and Bamaise C.T et al.[12] It was also interesting to note that initial pH value gave no indication of the underlying buffering capacity and, therefore, the erosive potential of the drink. Generally, the pure fruit juices had a higher initial pH than the carbonated drinks but required much more NaOH to raise the pH. Hence this study agrees broadly with those already found in the literature which state that fruit juices have greater erosive potential.

CONCLUSION

Thus, from the present study, the following conclusion can be drawn:

- The buffering capacity was found to be lowest for the milk based group. Pepsi having the lowest pH amongst all the drinks used, comparatively needed lesser base to raise the pH to both 5.5 and 7.00, than Gatorade; thus having a lower erosive potential than Gatorade. Gatorade had a higher buffering capacity as compared to Pepsi, Apple juice and Appyfizz.

- There is no correlation between the initial pH of the drink and their erosive potential.

These results provide further information to the dentist regarding carbonated beverages and commercial fruit juices and their potential role in the development of erosion.

So, dietary advice and preventive care is mandatory for anyone who frequently consumes commercially available flavoured drinks and that milk based drinks can be a safer alternative for consumption.

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