The Effect of Temperature and Exposure Time on The pH of Beverages: A Pilot Study

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Objective: The objective of this pilot study was to determine if temperature and exposure time affected the pH of various beverages. **Methods**: Five types of beverages (fruit drink, juice, carbonated drink, malted drink and sports drink) were selected for the pilot study. The pH of each drink was measured using separate cans at three different temperatures which are 4ºC, 25ºC and 27ºC. The pH of the drinks were recorded in triplicate readings and repeated ANOVA test was done. Separately, each type of drink was assessed at an interval of 10 minutes for a total duration of 30 minutes. Triplicate readings were taken at a consistent room temperature of 27ºC. A repeated ANOVA test was done to determine if there is any significant difference in pH changes caused by the time of exposure. **Results:** With the exception of juices, all other drinks showed significant difference in pH value when drinks are tested in different temperatures. As for the effect of exposure time on pH of beverage, three drinks (carbonated, sports drink and juice) showed significant difference. **Conclusions**: Given the fact that pH readings are different in the same drink in different environments, the timing of reading and the room temperature should be standardized for the main study. Further studies which include longer length of exposure time should be done to assess if there is any recognizable pattern of pH change in the various beverages.

1. Introduction

Acid content of a beverage is best reflected as either pH or titratable acidity[1]. The first component which is the pH of the beverage is defined as the number of hydrogen ions contents in the beverage that are able to shift out the minerals in the tooth. Meanwhile, the titratable acidity is the ability to neutralize the acid in the beverage by alkali which is the most crucial component to identify the erosive potential of a beverage[2].

Compared with the titratable acidity, pH has a more important role in determining the erosive potential of the beverages. Low pH plus with high titratable acidity in the beverages will need a higher amount of alkali in order to neutralize the acid which more potentially leads to the dissolution of the minerals in the tooth. The titratable acidity is the indicator of the buffering capacity of the beverages. As the titratable acidity increases, the buffering capacity of the beverages also increases[2].

Theoretically, there are a few factors that can contribute to the erosive effect when consuming soft drink which are the clearance time[3], the type of drinking method[4] and the protective effect of human saliva[5]. There is lack of data regarding the pH stability of a beverage when it is exposed at different temperatures and various duration. The aim of this study was to determine if temperature and exposure time affected the pH of various beverages.

2. Materials and Method

In this pilot study, five drinks were chosen from the complete list of drinks used in the entire study. Three cans of each drink were purchased. The first can was refrigerated for 24 hours at 4ºC, the second can was left at room temperature with air conditioner (25^0C) and the third can/bottle was left at room temperature (27^0). The pH of the drinks was recorded and repeated ANOVA test was done to assess if there is any significant difference in pH changes at different temperatures. Separately, each type of drink was recorded at an interval of 10 minutes for a total duration of 20 minutes. The readings were taken at a consistent room temperature of 27ºC. A repeated ANOVA test was done to determine if there is any significant difference in pH changes caused by the time of exposure of the drink.

3. Results

The aim of this study was to determine if temperature and exposure time affected the pH of various beverages.

The result of the study showed significant differences in pH value when the beverages were tested at different temperatures. With the exception of juices, all other beverages showed a significant difference in pH value when the beverages are in different temperatures.

	Sports Drink Mean (SD)	Carbonated Drink Mean (SD)	Malted Drink Mean (SD)	Fruit Drink Mean (SD)	Juices Mean (SD)
Temp 4 °C	3.877 (0.0067)	2.910 (0.2082)	6.750 (0.02082)	3.377 (0.2963)	3.937 (0.0033)
Temp 25 °C	3.940 (0.01000)	3.070 (0.02082)	6.843 (0.00667)	3.557 (0.01333)	3.943 (0.01202)
Temp 27 °C	3.813 (0.00882)	3.173 (0.02667)	6.867 (0.02028)	3.503 (0.1453)	3.640 (0.12530)
Repeated Measure ANOVA (p-value)	**0.010**	**0.006**	**0.007**	**0.016**	**0.152**

Table 1: Effect of temperature on pH

The repeated ANOVA test showed that there was a significant value in different temperatures for sports drink (p=0.010), carbonated drink (p=0.006), malted drink (p=0.007) and fruit drink (p=0.016).

	Sports Drink Mean (SD)	Carbonated Drink Mean (SD)	Malted Drink Mean (SD)	Fruit Drink Mean (SD)	Juices Mean (SD)
T=0 mins	3.813 (0.00882)	3.147 (0.02667)	6.867 (0.0208)	3.503 (0.1453)	3.923 (0.02404)
T= 10 mins	3.790 (0.100)	2.950 (0.01528)	6.840 (0.2887)	3.456 (0.00882)	3.900 (0.2646)
T= 20 mins	3.963 (0.00333)	3.090 (0.01732	6.850 (0.01732)	3.427 (0.00333)	3.937 (0.01453)
Repeated Measure ANOVA (p-value)	**0.000**	**0.005**	**0.084**	**0.642**	**0.010**

Table 2: Effect of exposure time on pH

As for the effect of exposure time on pH of beverage, three drinks (carbonated, sports drink and juice) showed significant difference.

After 20 minutes of exposure time, the pH of the beverages were recorded and repeated ANOVA test showed that there was a significant value for sports drink (p=0.000), carbonated drinks (p=0.005) and juices (p=0.010).

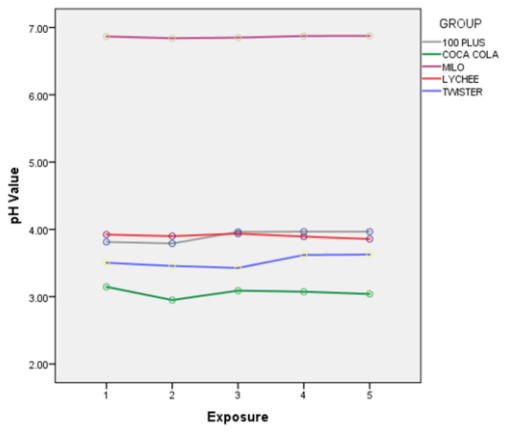

Fig 1: Effect of exposure time on 5 beverages

4. Discussion

It was of an interest to ascertain if there would be a notable change in pH if the beverages were tested at various exposure times. According to Ashton (2011), the activity of the hydrogen ion in a solution will increase if the temperature is increased[6].Thus, it will raise the pH value of the solution. Relating to the study, apart from the juice drinks and sports drinks, the other types of tested beverages have more acidic pH in cold temperature compared to the pH in room temperature. The development of dental erosion has a variable of factors such as frequency, duration of acid contact with the dentition and certain drinking habits such as gurgling the liquid in the mouth before swallowing[1].

5. Conclusion

Given the fact that pH readings are different in the same drink in different environments, the timing of reading and the room temperature should be standardized for the main study. Further studies which include longer length of exposure time should be done to assess if there is any recognizable pattern of pH change in the various beverages.

6. References

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