

## ORIGINAL RESEARCH

# To Determine the Effect of Selected Beverage on Tooth Enamel: An In Vitro Study

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### ABSTRACT

**Background:** Primary teeth are highly susceptible for microbial attachments and encroachments. This is particularly true since primary teeth have comparatively low enamel surface hardness and less thickness of enamel and dentin. Commonly consumed beverages also impart significant role in affecting the surface roughness of primary enamel which needs to be taken care of for longevity of primary teeth. **Aim:** To evaluate and compare the effects of commonly consumed soda beverage on the surface roughness of primary tooth enamel. **Materials and Methods:** A total of 20 samples of primary enamel were utilized for testing purpose. Sectioned enamel surfaces were categorised into 2 groups of 10 samples each as per their requirements. The surface roughness of these samples was assessed using a profilometer. Group 1 was control group while group 2 was test group which consisted of tooth samples to be immersed into soda beverage. Group 1 samples were unexposed to any beverage, therefore, they were tested once for their surface roughness. The enamel surface roughness of Group 2 samples was measured using profilometer following which they were kept in test solution for fixed durations and reevaluated for changes in enamel surface roughness. **Results:** Data was collected and tabulated into excel sheet for statistical analysis. Statistical analysis was attempted by G power software latest version. Enamel surface roughness for each sample was measured. P value less than 0.05 was taken as significant. Mean and SD evaluation confirms that immersion into soda beverage solution generally increases the enamel surface roughness. Paired t test was used for comparison of proportions among groups and ANOVA (one way) was also employed for strengthening the results. Significant results were noticed for samples of group 2. **Conclusion:** Within the limitations of the study, authors concluded that soda beverage increases primary enamel roughness in immersed group when compared to control specimens. Therefore, consumption of such beverage is related to high incidence of primary tooth wear.

**Key Words:** Enamel, Profilometer, Surface Roughness, Soda Beverage, Teeth

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### INTRODUCTION

Diet and oral health are linked in many ways. Food has very important nutritional impact on tooth enamel. Proper care of primary teeth must be carried out to prevent any damage to permanent tooth buds. Primary teeth are highly vulnerable for bacterial intrusion and invasion due to their low enamel surface hardness and less thickness of enamel and dentin.<sup>1,2</sup> Many beverages consumed regularly by today's children lead to destruction of their teeth enamel. These beverages primarily alter the surface roughness of primary tooth enamel. Many studies have been undertaken in the recent past which compared the surface discolorations produced by different beverages like fruit juices, tea, soft drinks.<sup>3-8</sup> Discoloration of enamel may be due to intrinsic or extrinsic factors. Intrinsic factors involve alterations

within the enamel itself and extrinsic factors involve adsorption or absorption of stains in the oral cavity via several food products. In order to prevent enamel damage by carbonated and non-carbonated beverages, it is important to understand their effect on surface roughness of tooth enamel. Despite the extensive assessments of surface discolorations, surface roughness of teeth was evaluated in few studies only.<sup>9-13</sup> These studies have used very expensive methods like Scanning electron microscopy, Laser microscopy etc. There is very important need to use cheaper and easier methods to measure surface roughness of tooth enamel. Therefore, this in-vitro study was conducted to evaluate and compare the effects of usage of commonly consumed beverage (soda) on the surface roughness of primary tooth enamel using profilometer, which is easier and

cheaper technique than Scanning electron and Laser microscopy.

### AIM OF STUDY

To evaluate and compare the effects of commonly consumed soda beverage on the surface roughness of primary tooth enamel.

### OBJECTIVES OF THE STUDY

To individually assess the effects of usage of commonly consumed soda beverage (Cola) on the surface of primary tooth enamel.

### MATERIALS AND METHODS

This in- vitro study was approved by Institutional Human Ethics Committee, Hind Institute of Medical Sciences, Barabanki (U.P). Authors utilized precise equipment i.e. Profilometer to evaluate surface roughness of tooth enamel. Sample size has been calculated by using G Power software where power is 80% and Confidence interval is 95%. So, the final calculated sample size of this study was 20. Healthy, non-carious primary incisors and atraumatically extracted teeth were included for testing purpose. Carious teeth, teeth with enamel defects, stained teeth, fractured or brittle teeth were excluded.

### METHODOLOGY

A total of 20 selected samples of extracted primary maxillary incisor teeth were collected from pediatric patients of dental department of Hind Institute of Medical Sciences, Barabanki for testing purpose. Sectioned enamel surfaces were divided into 2 groups of 10 samples each as per their requirements. For ease of methodology and evaluation purpose, grounded sections were prepared for each sample. These ground sections of tooth enamels were utilized accurately for each primary maxillary incisor. Group 1 was taken as control group, including samples which were unexposed to soda beverage. Group 2 consisted of test group, whose samples was immersed in 100 ml soda beverage (Cola). Each tooth sample was immersed in 10 ml Cola with a frequency of 30 times for 1 minute at 5°C. The enamel surface roughness of these sample groups was measured before and after

immersion into testing solution (soda beverage). The surface roughness of all samples was measured using Profilometer (Crysta-Apeks, Mitutoya, Japan).

### STATISTICAL ANALYSIS

Data obtained was entered into MS Excel spread sheet and analyzed, using SPSS statistical software. Descriptive statistics was calculated for each variable for two groups. The values of surface roughness were analyzed and compared using paired t test and ANOVA. Mean and SD was computed for data. The normality of the numerical variables was determined through the application of the test of normality. To compare scale scores for two-category variables, ANOVA test was utilized, while paired t test was employed to compare categorical variables for same group. Significance was set at a p-value of less than 0.05.

### RESULTS

The enamel surface roughness (Ra) was greater when teeth samples of group 2 were immersed in soda beverage solution. Table 1 depicts about the descriptive statistical explanation with level of significance evaluation using paired t test for Group 1 (Control Group, n=10). The pre and post immersion surface roughness was similar since samples were not exposed to any solution. P value was not significant here. Table 2 illustrates about the descriptive statistical explanation with level of significance evaluation for Group 2. Pre and post immersion values were differing owing to the effects of Soda Beverage. The surface roughness was clearly increased and significant. Table 3 demonstrated about the paired t- test assessment of mean score and standard deviation in study groups estimated at post immersion stages. It showed highly significant p value for group 2 samples. Table 4 confirms about the basic statistical interpretations of group responses within, and cumulative group responses [ANOVA Analysis]. Test results confirmed highly significant p value for the estimations made within 2 study groups (0.002).

**Table 1: Descriptive statistical explanation with level of significance evaluation using paired t test (Group 1: Control Group, n=10)**

Immersion	Stat. Mean Surface Roughness (Ra)	Std. Dev.	Std. Error	95% CI	df	p value
Without Immersion	0.34	0.025	0.039	1.96	1.0	0.06
<b>*p&lt;0.05 significant</b>						

**Table 2: Descriptive statistical explanation with level of significance evaluation using paired t test (Group 2: Soda Beverage Group, n=10)**

Immersion	Stat. Mean Surface Roughness (Ra)	Std. Dev.	Std. Error	95% CI	df	p value
Pre Immersion	0.32	0.029	0.035	1.96	1.0	0.08
Post Immersion	0.73	0.078	0.756	1.22	1.0	0.01*
<b>*p&lt;0.05 significant</b>						

**Table 3: Paired t- test assessment of mean score and standard deviation in both study groups estimated after immersion**

Paired t- test	Group I		Group II	
	Mean Score	SD	Mean Score	SD
Values	0.34	0.025	0.73	0.078
P-value	0.30 (Non- significant)		0.02 (Significant)	

**Table 4: Basic statistical interpretations of between group responses, within group responses and cumulative group responses [ANOVA Analysis]**

ANOVA					
Parameters	Degree of Freedom	Sum of Squares $\Sigma$	Mean Sum of Squares $m\Sigma$	F	Level of Significance
Between groups	2	1.056	1.507	1.2	0.002*
Within groups	11	1.203	0.342		-
Cumulative	152.10	2.303	* <b>p&lt;0.05 significant</b>		

## DISCUSSION

Defense mechanism of oral mucosa protects tissues from bacterial and viral attacks primarily. Early childhood caries are of multi-factorial origin. Various etiologies have been discussed in the literature by several researchers in the recent past.<sup>16-19</sup> The most critical are usage of sugar products in between meals. Additionally, cooked and refined sugar substitutes are more cariogenic than raw and uncooked sugar. Enamel surface roughness is the primary factor which determines its risk of caries development.<sup>20-24</sup> Low hardness of enamel is acting as an easy gateway for bacterial invasion. However, enamel surface roughness can also be affected due to low enamel thickness. Reasons primarily include prolonged consumption of beverages. This literally stands true for primary teeth since they have already thin enamel and dentin. Any loss of enamel in primary teeth contributes to enamel demineralization in permanent teeth. The consumption of carbonated soft drinks leads to considerable enamel demineralization below the critical pH (5.5).<sup>12-14</sup> The erosive potential of soft drinks is determined by viscosity, buffering capacity and pH which remain the most important chemical parameters.<sup>18-20,28-30</sup> The profilometric measurement for determining erosive effect on dental hard tissue loss has been well experimented in the literature.<sup>11,13,15</sup> Many researchers in the recent past studied in detail about the effects of beverages on enamel hardness of primary and permanent teeth.<sup>2,3,6</sup> Many of them concluded that there is clear and declining effect of beverages consumption on the enamel surface hardness.<sup>25-27</sup> Results of present study also indicated increased pattern of enamel surface roughness after consuming soda beverage. These inferences were in accordance to the recommendations of various previous pioneer researchers.<sup>15-19</sup>

## CONCLUSION

In conclusion, the present study confirmed the erosive potential of soft drinks (especially cola) and tooth erosion had a significant relationship with consumption of soda beverages. Since enamel makes the first line of defense of tooth, therefore quantity and patterns of

consumption of soda beverage is likely to affect the defense mechanism of teeth against microbial attack. Therefore, patients consuming high quantity of soda beverage repeatedly are considered as high risk patients for caries due to increased roughness. Careful examinations and diet monitoring is highly recommended for such patients to avoid any enamel loss in primary teeth which may eventually lead to enamel demineralization in permanent dentition, if not carefully controlled.

**Conflict of Interest:** None

**Source of Support:** Nil

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