

# pH Changes Before and After Treatment with GC Tooth Mousse Plus® on Non-Carious and Carious Teeth in Children - A Clinical Trial

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**Abstract:** Dental caries is a major problem concerning both primary and permanent teeth. Currently, caries management in children is to minimize the spread and effective use of a wide range of preventive and management strategies. Widespread research is being carried out to create more successful anti-caries agents for control of caries and to provide a good choice of biocompatible restorations. A total of 30 children, belonging to the age group of 4-6 years, with and without dental caries were included in this study. A brief history of their dietary habits and oral hygiene practice was recorded. Based on carious & non-carious status, children were grouped as Group I and Group II. Saliva samples were collected before and after application of GC Tooth Mousse Plus®, and salivary pH was measured. Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses. GC Tooth Mousse Plus® application in the carious group effectively increased the salivary pH, which was almost similar to the salivary pH of the non-carious group. GC Tooth Mousse Plus® is an effective topical agent used to control caries. However, further studies should be carried out for a longer follow up period.

**Keywords:** GC Tooth Mousse Plus®, Casein phosphopeptide-amorphous calcium phosphate, pH change

## 1. Introduction

Dental caries is a chronic disease in which there is destruction of hard acellular hard dental tissue by acidic by-products from the bacterial fermentation of dietary carbohydrates, especially sucrose<sup>1</sup>.

Dental caries progresses slowly which is a result of an ecological imbalance in equilibrium between tooth minerals and oral biofilm<sup>2</sup> that is characterized by microbial activity, fluctuations in plaque pH due to bacterial acid production, buffering action from saliva and the surrounding tooth structure.

GC TOOTH MOUSSE PLUS®<sup>11</sup> components include Pure Water, Glycerol, CPP-ACP<sup>3</sup>, D-Sorbitol, CMC-Na, Propylene Glycol, Silicon Dioxide, Titanium dioxide, Xylitol, Phosphoric acid, Sodium Fluoride, Flavoring Agents, Sodium Saccharin, Ethyl p-hydroxybenzoate, Zinc oxide, Propyl p-hydroxybenzoate, Butyl p-hydroxybenzoate. GC TOOTH MOUSSE PLUS® contains milk-derived protein<sup>4</sup> (RECALDENT™) which binds calcium and phosphate ions and stabilizes them as amorphous calcium phosphate. Thus CPP-ACP adheres intraorally to the plaque pellicle, biofilm and hydroxyapatite.

Nanocomplexes are formed between CPPs & ACPs. CPPs are phosphorylated casein-derived phosphopeptides<sup>5</sup> made by proteolytic breakdown of milk products  $\alpha$ 1-,  $\alpha$ 2- and  $\beta$ -casein. The CPPs which contain the cluster sequence of Ser(P)-Ser(P)-Ser(-P)-Glu-Glu<sup>6</sup>, stabilize nanoclusters of ACP, resulting in increased calcium phosphate levels in dental plaque.

The ability of CPP to buffer free calcium and phosphate ions enables ACP supersaturation<sup>7</sup> relative to the tooth enamel, thus reducing demineralization and enhancing remineralization. Thus CPP-ACP alone or together with fluoride, has been suggested to be a novel compound to remineralize lost calcium & phosphate, to restore sub surface areas of defective dental enamel. However, there are few studies to compare the effectiveness of GC TOOTH MOUSSE PLUS® on pH changes with respect to caries.

## 2. Aim of the Study

### Methodology

A total of 30 children, belonging to the age group of 4-6 years, with and without dental caries were included in this study. A brief history of their dietary habits and oral hygiene practice was recorded. Clinical examination was performed for the assessment of status of caries. Based on carious &

non-carious status, children were grouped as Group I and Group II. Clinical examination of children was performed using a plain mirror and explorer on the dental chair with optimal light, under aseptic conditions. The activity of cavitated dentinal caries lesion was assessed by visual inspection and aided by tactile detection using an explorer. Each child was examined for carious status using the International Caries Detection and Assessment System (ICDAS).

### Sample Size

#### Group-1: n=15

In this group, children with no carious lesions were advised to spit the saliva into a graduated container continuously for 2 min. The samples were evaluated for pH immediately after collection.

#### Group-2: n=15

In this group, children with ECC were advised to spit the saliva into a graduated container continuously for 2 min.

A thin uniform layer of GC Tooth Mousse Plus® was applied for both carious & non-cariou children using an applicator and left undisturbed for 3 min. The children were advised to avoid spitting, swallowing as additional contact with saliva for 1-2min gives effective results. The children were not allowed to rinse, eat or drink for 30 min following application.

The saliva samples were collected after 24 hours of application and were immediately subjected to the pH assessment.



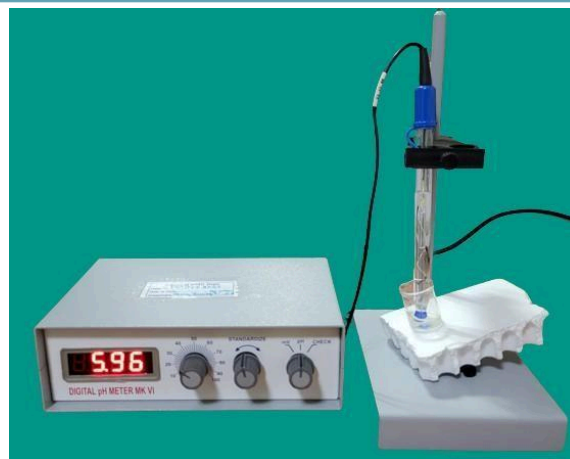
Salivary Samples

#### Salivary Analysis:

Salivary pH was measured with the help of a single-electrode digital pH meter (Electronics, India. Model 111E). The pH meter is calibrated with an electrode. The electrode was kept in double distilled water prior to dipping in the sample, and it was gently dried using fresh sterile filter paper each time after analyzing the pH. The electrode tip was washed with a gentle stream of distilled water and then was kept in double distilled water for the analysis of next sample.

#### Interpretation of pH:

pH	SALIVA
5.0 – 5.8	Highly Acidic
6.0 – 6.6	Moderately Acidic
6.8 – 7.8	Healthy Saliva



Digital pH Meter MK VI

#### Statistical Analysis:

Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses.

#### Descriptive Statistics:

Descriptive analysis includes expression of Salivary pH levels in terms of Mean & SD for each group.

#### Inferential Statistics:

Independent Student t-test was used to compare the mean Salivary pH levels between the carious & non-cariou group before and after 24 hours of intervention period.

Student Paired t-test was used to compare the mean Salivary pH levels between before and after 24 hours of the intervention period in carious and non-cariou groups.

The level of significance was set at  $P < 0.05$ .

#### Sample Size Estimation

The sample size for the present study was estimated using GPower software.

Considering the effect size to be measured (d) at 80% [calculated based on the results of the previous literature (Mayuri M. Tawde et al, 2022)], power of the study at 80% and the alpha error at 20%, the total sample size needed is 30. So, each study group will consist of 15 samples.

**Table 1:** Comparison of mean salivary pH values between carious & non-carious groups before intervention period using Independent Student t-test

Period	N	Mean	SD	Mean diff	95 % CI		p-value
					Lower	Upper	
Carious	15	6.43	0.46	-0.60	-0.86	-0.34	<0.001*
Non-Carious group	15	7.03	0.19				

\*-- statistically significant

The mean salivary pH levels in carious group before intervention period was significantly lesser [6.43± 0.46] as compared to non-carious group [7.03± 0.19] and the mean difference between 2 groups was statistically significant at p<0.001.

**Table 2:** Comparison of mean salivary pH values between carious & non-carious group after 24 hours of intervention period using Independent Student t-test

Period	N	Mean	SD	Mean diff	95 % CI		p- value
					Lower	Upper	
Carious	15	7.04	0.16	-0.04	-0.16	0.08	0.58
Non-Carious group	15	7.08	0.15				

The mean salivary pH levels in carious group after 24 hours of intervention period was 7.04± 0.16 and among non-carious group was 7.08± 0.15. However, the mean difference between 2 groups was not statistically significant [p= 0.58]

**Table 3:** Comparison of mean salivary pH values between before and after 24 hours of intervention period in Carious group using Student paired t test

Period	N	Mean	SD	Mean diff	95 % CI		p- value
					Lower	Upper	
Before Intervention	15	6.43	0.46	-0.61	-0.80	-0.41	<0.01*
After 24 hours of intervention	15	7.04	0.16				

\*-- statistically significant

The mean salivary pH levels in carious group after 24 hours of intervention period was significantly higher 7.04± 0.16 as compared to before intervention period 6.43± 0.46 and mean difference between 2 time intervals was statistically significant p< 0.001

**Table 4:** Comparison of mean salivary pH values between before and after 24 hrs of intervention period in non-carious group using student paired t-test

Period	N	Mean	SD	Mean diff	95 % CI		p- value
					Lower	Upper	
Before Intervention	15	7.03	0.19	-0.05	-0.12	-1.28	0.22
After 24 hours of intervention	15	7.08	0.15				

The mean salivary pH levels in non-carious group after 24 hours of intervention period was 7.08± 0.15 and before intervention period was 7.03± 0.19. However, the mean difference between the 2 time intervals was not statistically significant [p= 0.22]

### 3. Results

GC TOOTH MOUSSE PLUS® application in the carious group effectively increased the salivary pH, which was almost similar to the salivary pH of the non-carious group. (Table 2)

### 4. Discussion

Dental caries is a common chronic infectious disease<sup>1</sup> resulting from tooth-adherent cariogenic bacteria, primarily *Streptococcus mutans*, which metabolize sugars to produce acid, demineralizing the tooth structure over time and resulting in the formation of the lesion<sup>14</sup>.

The caries process occurs when the critical pH of dental enamel is 5.5, which is independent of the composition of the saliva to which enamel is exposed. The critical pH varies over a wide range and its value depends upon the concentration of calcium and phosphates. Nevertheless, the factors that influence the solubility of hydroxyapatite, influences the solubility of enamel.

A small amount of hydroxyapatite dissolves, releasing calcium, phosphate and hydroxyl ions. This process continues until the saliva is saturated with hydroxyapatite. At this point, the rate of forward reaction (mineral dissolution) is equal to the rate of backward reaction (mineral precipitation). These activities are inversely proportional to the concentrations of the other ions, thus tooth dissolves in saliva and plaque fluid only if the pH is reduced to less than the critical pH. Thus, caries onset and progression is potentially influenced by “threshold” limit<sup>9</sup> which is decisive for enhanced early childhood caries activity (risk prediction).

A proper nutritional diet is recommended to improve oral health status which decreases the dental caries level.

This process is achieved by remineralization which results in increase in the amount of calcium and phosphate ions to stabilize them as amorphous calcium phosphate in which nano complexes are formed between CPP & ACP<sup>10</sup>.

The ability of CPP to buffer free calcium and phosphate ions enables ACP supersaturation relative to the tooth enamel, thus reducing demineralization and enhancing

remineralization<sup>8</sup>. Thus CPP-ACP alone or together with fluoride has been suggested to be a novel compound of remineralization of lost calcium, phosphate and fluoride content to restore sub surface areas of defective dental enamel<sup>13</sup>.

Hence in our study, GC Tooth Mousse Plus application increases the pH level of saliva in carious and non-carious lesions. Similar results were found in an invitro study conducted by Mayuri et al.<sup>2</sup> and there are no other studies done to know pH changes clinically in preschool children.

Yet in another study during orthodontic treatment<sup>12</sup>, it helped to remineralize the demineralized surface. So, GC Tooth Mousse Plus is proven as an effective remineralizing and anticariogenic agent.

## 5. Conclusion

GC Tooth Mousse Plus® is an effective topical agent used to control caries. However, further studies should be carried out for a longer follow up period.

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