Effect of Commercially Available Colgate Sugar Acid Neutralizer Toothpaste on Salivary and Plaque ph: a Randomized Controlled Trial

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ABSTRACT

Introduction: Salivary and plaque pH is the important parameter affecting the carious process. The new Colgate sugar acid neutralizer maximum cavity protection toothpaste is a new technology of toothpaste that claims to fight against cavities. So the aim of the present study was to evaluate the effect of commercially available new Colgate sugar acid neutralizer maximum cavity protection on plaque and salivary pH.

Materials and methods: Dental students were randomly allocated to either to Colgate sugar acid neutralizer toothpaste (group1, n=16) and to Colgate cibaca group (group2, n=15). Baseline plaque and salivary pH (pre- brushing) were recorded for all the study subjects and compared with the pre-brushing and post-brushing pH after 1 month intervention with the assigned toothpaste. Plaque and saliva pH were measured using a portable pH meter.

Results: There was no statistically significant increase in the mean plaque and salivary pH value between baseline and pre-brushing mean pH value after 1 month intervention in both the groups. But there was a statistically significant rise in mean salivary and plaque pH value between pre-brushing and post-brushing (after intervention) in the new colgate group (group 1) which was not statistically significant in group 2.

Conclusion: The pH of plaque and saliva increases after brushing in each commercially available dentifrice group. But the pH rise was higher and statistically significant with group 1.This shows that toothpaste with arginine and fluoride which is present in the new toothpaste, had an influence on the increase of pH value.

Keywords: toothpaste, colgate sugar acid neutralizer, plaque, saliva, pH

INTRODUCTION

Dental biofilm is a site of bacterial proliferation and growth, in addition to being a location of acid production. Miller (1890) proposed a two step process whereby mixed bacteria, when exposed to fermentable carbohydrates, produced acids which, in a second step, acted on tooth structure to dissolve hydroxyapatite and release free calcium and phosphates. Plaque accumulation, subsequent production of acids within the plaque in response to a glucose exposure and subsequent recovery of the plaque pH was demonstrated by Stephan (1940, 1944).[1]

Saliva is a complex fluid consisting of 99% of the water and remaining 1% of organic and inorganic molecules. The interface between the saliva and oral tissue is the site of many dynamic reactions which affect both the soft tissue and hard tissues of the mouth. The pH at which any particular saliva ceases to be saturated is referred to as 'critical pH' and below this value; the inorganic material of teeth may dissolve in it resulting in dental caries.[2]

Saliva interacts with the biofilm, and is important in reducing the cariogenic effects of dental plaque as acidogenic bacteria consume fermentable carbohydrates producing acids that may result in tooth demineralization. The introduction of dietary carbohydrates, even in thin layers of plaque, results in significant production of acid.[1]

Dentifrices are the major products for routinely administering effective cosmetic and therapeutic agents in the mouth. They serve as an abrasive that aids in removing the dental plaque and food from teeth, assists in suppressing halitosis, and delivers active ingredients (most commonly fluoride) to help prevent tooth and gum disease (gingivitis). Because of their widespread and regular use they serve as the most effective tool for oral disease prevention and control. The attributes of the dentifrices which may affect their cosmetic or therapeutic effect are their physical form, chemical composition, their pH, their solubility.[2]

Dental caries is not a self-limiting disease and without proper oral hygiene, it progresses until the tooth is destroyed. It is a multifactorial disease in which, Streptococci mutans and Lactobacilli in dental plaque, play an important role.[3]

The prevalence of dental caries in the developing countries like India remains a significant clinical problem. A very extensive and comprehensive National Health Survey conducted in 2004 throughout India has shown dental caries in 51.9% in 5 year-old children, 53.8% in 12 year-old children and 63.1% in 15 year-old teenagers.[4]

The colgate sugar acid neutralizer maximum cavity protection toothpaste is a new technology that claims to fight against cavities. Sugar acid neutralizer technology is a composite of arginine in insoluble calcium base which claims of neutralizing sugar acids in plaque and saliva- the cause of

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cavities.

As the consumption of refined and junk foods has been increasing rapidly among people in India, which correspondingly increases the prevalence of dental caries, the new colgate sugar acid neutralizer maximum cavity protection toothpaste will be like a boon if it proves to fight against cavities.So the present study aimed to evaluate the effect of commercially available new toothpaste on plaque and salivary pH.

MATERIALS AND METHODS

The present randomized controlled double blind controlled trial was conducted to evaluate the effect of new colgate toothpaste on salivary and plaque pH. The ethical clearance was obtained from the ethical committee of Sumandeep Vidyapeeth University. Study subjects were selected from undergraduate and post-graduate students of KM Shah Dental College, Sumandeep Vidyapeeth University, Vadodara. Consent was obtained from the study subjects. The inclusion criteria for the subjects included:

*   Subjects voluntarily participating in the study.
*   Subjects having plaque score $\geq$ 1(Loe and Silness Plaque Index)
*   Subjects having DMFT > 0. (DMFT Index WHO modification 1987)

The exclusion criteria included:

*   Currently participating in any other trial or study involving oral cavity
*   Patients on medication like steroids, antihistaminics, antianxiety drugs etc, which reduces salivary flow.
*   Subjects who are medically compromised.

Sample size

Per group sample size of 15 achieve 80% with a significance level (alpha) of 0.05000. So total sample size came out to be 30. Hence each group consisted of 15 subjects.

The study was conducted in 3 phases:

In the first phase

1. Loe and Sillness Plaque index and DMFT index were recorded.
2. Baseline plaque and salivary pH were recorded early morning prior to brushing
3. These subjects were randomly allocated to the study and control groups by flipping a coin method.
4. Masking was done by painting white colour over the interventional toothpastes by a co-investigator and coded as 1 and 2.

In the second phase

1. Subjects were provided with their assigned products and instructed to brush their teeth with a pea sized amount

of the allocated toothpaste for 2 minutes twice a day for a period of 1 month. Subjects were instructed to refrain from any other means of plaque control and continue their routine dietary habits. Reinforcement was done once in a week throughout to improve compliance.

2. Compliance assessment was also done by checking the amount of used paste tubes.

In the third phase

The unstimulated salivary samples and plaque samples were collected from the subjects in morning before brushing. Then the subjects were asked to brush with the assigned toothpaste which they were given to them for last 1 month and salivary and plaque samples were collected immediately.

Plaque pH Measurement: A calibrated portable digital pH meter was used for measurements.

STATISTICAL ANALYSIS

The analysis was done using SPSS 20. The mean and the standard deviation calculated for the plaque pH and salivary pH using descriptive statistics. Paired t test was used to compare the changes in the mean plaque and salivary pH after treatment within each group. Independent sample t test was used to compare the plaque and salivary pH between the two groups.

RESULTS

There was no statistically significant increase in the mean plaque and salivary pH value between baseline and pre-brushing mean pH value after 1 month intervention in both the groups. But there was a statistically significant rise in mean salivary and plaque pH value between pre-brushing and post-brushing (after intervention) in the new colgate group (group 1) which was not statistically significant in group 2.

DISCUSSION

Salivary and plaque pH are an important biomarker for dental caries. In the group 1, it was found that there was significant increase in mean pH of study subjects after brushing with this new dentrifice. But there was no statistically significant difference found in pH at baseline and after 1 month intervention pre-brushing in group 2.

Table 1 and Table 3 presents the mean plaque and salivary pH at baseline and post-intervention (i.e. after 1 month pre-brushing and post-brushing pH). It was found that there was a statistical difference between the 2 groups in the mean pH of plaque and saliva post-brushing after 1 month intervention where group 1 showing higher value than group 1. Similarly a study conducted by Chand S et al[2], who demonstrated the effect of Colgate, Neem active toothpaste, Vicco,

	Groups	N	Mean	Std. Deviation	Std. Error Mean	P value
Bas Pq	Group-1	16	5.650000	.6271629	.1567907	.297
	Group-2	15	5.433333	.4952152	.1278640	
Pre Pq	Group-1	16	5.687500	.6280923	.1570231	.316
	Group-2	15	5.480000	.4901895	.1265664	
Post Pq	Group-1	16	6.237500	.5251984	.1312996	.004
	Group-2	15	5.666667	.4730851	.1221501	
Table-1: Mean plaque pH before and after treatment						

Triguard, Colgate active salt, Dabur meswak, Dabur babool, Close-up active gel, RA Thermoseal, Dabur lal dant manjan and Colgate powder on salivary pH. The study found that the pH of different available dentifrices used in the study were in the range of 5.6 – 8.4, highest pH being reported for Colgate and lowest being reported for Dabur lal dant manjan respectively.

Fluoride has long been recognized for its anti-caries benefits and the efficacy of fluoride dentifrices in preventing caries has been well documented.[14,15] However, fluoride has limitations under pathogenic conditions, because it does not target dental plaque as its primary mode of action. New strategies to deliver superior caries prevention would ideally complement the effects of fluoride while targeting plaque pathogenicity.[16] A new approach in caries research is focused on the fact that alkali generation from salivary substrates, like urea and arginine, may play an important role in biofilm pH, homeostasis and in inhibiting dental caries.[17,18] Saliva is the principal biological protective factor against tooth demineralization. Both its quantitative and qualitative properties are important determinants of the risk of developing dental diseases. One of the key factors in the pathogenesis of caries is dental plaque pH. Saliva modifies plaque pH in a number of different ways, one of which is enhancement of alkali production. Therefore, provision of alkali-producing substrates such as L-arginine and urea which can be metabolized by plaque bacteria to yield base (principally ammonia) could contribute to caries prevention by favouring higher local pH values.[19-21]

Table 2 shows the mean change in pH value of plaque for both the groups before and after treatment from baseline to pre-brushing and post-brushing. The change from baseline to pre-brushing (after treatment) was 0.037 for group 1 and 0.046 for group2 which was not statistically significant. There was a statistical significant difference found in change in pH value between pre-brushing and post-brushing (after intervention) which was 0.55 for group 1 and 0.18 for group 2. The change from baseline to post-brushing was 0.58 and 0.23 for group1 and 2 which was statistically significant.

Similarly a study a 12 week clinical study conducted by Santarpia RP et al to assess the clinical effect on plaque metabolism of a dentifrice containing 1.5% arginine and 1,450 ppm fluoride compared to a dentifrice containing 1,450 ppm fluoride in a silica base. It was found that subjects using the test dentifrice had significantly higher plaque pH values before sucrose challenge.[2] Another invivo study conducted by Wang XL et al to investigate the neutralising effects of subsequent arginine bicarbonate rinse on sucrose-induced decrease in plaque pH with interdental plaque pH telemetry. It was concluded that regular use of an arginine bicarbonate rinse after carbohydrate consumption could help prevent caries.[23]

Table 4 shows the mean change in pH value of saliva for both the groups before and after treatment from baseline to pre-brushing and post-brushing. There was a statistical significant difference found in change in pH value between pre-brushing and post-brushing (after intervention).

Further to see the effect of arginine, which is present in the new colgate toothpaste, on salivary pH a study was conducted by Vuletic et al[20], assessed if the consumption of 3 g of a commercially available L-arginine dietary supplement causes a post-absorptive rise in urea concentration or pH of unstimulated saliva. The results showed pH was significantly higher only for the study group who was given L-arginine

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Pq Pre-Bas	Group-1	16	.037500	.0806226	.0201556	.758
	Group-2	15	.046667	.0833809	.0215289	
Pq Post-Pre	Group-1	16	.550000	.2190890	.0547723	.000
	Group-2	15	.186667	.1302013	.0336178	
Pq Post- Bas	Group-1	16	.587500	.2093641	.0523410	.000
	Group-2	15	.233333	.1345185	.0347325	
Table-2: Mean values of change in plaque pH in both groups						

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Bas Sal	Group-1	16	6.375	.3376	.0844	.490
	Group-2	15	6.273	.4652	.1201	
Prebrush	Group-1	16	6.381	.3371	.0843	.496
	Group-2	15	6.280	.4739	.1224	
Post	Group-1	16	7.025	.2769	.0692	.004
	Group-2	15	6.573	.5021	.1296	
Table-3: Mean pH of saliva before and after treatment						

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
Sal Pre-Bas	Group-1	16	.006250	.0250000	.0062500	.964
	Group-2	15	.006667	.0258199	.0066667	
Sal Post – Pre	Group-1	16	.643750	.1711481	.0427870	.000
	Group-2	15	.293333	.1334523	.0344572	
Sal Post – Bas	Group-1	16	.650000	.1712698	.0428174	.000
	Group-2	15	.300000	.1309307	.0338062	
Table-4: mean values of change in salivary pH in both groups						

tablets

Recently, however, a new dentifrice technology based upon 1.5% arginine and an insoluble calcium compound to reduce plaque pathogenicity and enhance re-mineralization, in combination with fluoride, has been developed and clinically validated. This dentrifice is launched by colgate with innovative sugar acid neutralizer technology directly fights sugar acids in plaque, clinically proven to provide enhanced cavity protection versus a regular everyday fluoride toothpaste.[24,26]

In the intra group comparison of mean plaque and salivary pH within study groups before and after intervention. It was found that in group 1 the mean value of baseline plaque and salivary pH was raised from 5.65 and 6.3 to 6.23 and 7.02 post-brushing (after 1 month intervention period). The difference was statistically significant. After intervention, the mean value of pH pre-brushing was 5.68 for plaque and 6.38 for saliva which was raised to 6.23 and 7.02 post-brushing which was a statistically significant difference. Similarly statistical significant increase in pH was found in group 2 but not as bigger as found in group 1. This means there was greater increase in the mean plaque and salivary pH after intervention in group 1 i.e. the new colgate toothpaste.

A series of 5 studies of 6 months duration which forms the basis for clinical validity, conducted by Cummins D (2013)[25], Souza MLR et al (2013)[27], Srisilapanan P et al (2013)[28], Yin W et al (2013)[29], Hu et al (2013)[30] assessed the efficacy in arresting and reversing (re-mineralizing) early, reversible enamel lesions and root caries lesions. The studies demonstrated that innovative dentifrices containing 1.5% arginine, an insoluble calcium compound and fluoride provide superior caries benefits in children and adults to dentifrices containing fluoride alone.

Further, it includes in situ clinical studies which showed that these dentifrices inhibit de-mineralization and enhance re-mineralization more effectively than dentifrices with fluoride alone as proved by a study conducted by Cantore et al in 2013.[32]

Also, a study conducted by Nascimento et al in 2013 explored the relationship between oral arginine metabolism and dental caries experience in children. Mixed-model analysis showed that plaque caries status is significantly associated with ADS activity despite children's age, caries status, and dentition, with healthy plaque predicting higher ADS activity compared with diseased plaque.[33]

The present study shows that arginine added along with fluoride to the toothpastes has a positive influence on the quality of the oral environment. No statistically significant increase in the mean pH value from baseline to pre-brushing pH value after 1 month intervention in both the groups was seen. This suggests that further research is needed to test the longevity of action of the new colgate toothpaste to see whether the toothpaste has a long term effect in the quality of the oral environment.

CONCLUSION

The pH of plaque and saliva increases after brushing in each commercially available dentifrice group. But the pH rise was higher and statistically significant with group 1.This shows that toothpaste with arginine and fluoride which is present in

the new toothpaste, had an influence on the increase of pH value. Arginine added along with fluoride to the toothpastes has a positive influence on the quality of the oral environment. Results of this study suggested that the new colgate toothpaste could be used to provide significant caries protection over that provided by conventional fluoride toothpastes.

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