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Effectiveness of Green Tea Mouth Rinse over Combination Mouth Rinse in Restoring Salivary pH Post Sugar Exposure in Children

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Abstract: **Dental caries is a multifactorial disease. The contents of green tea have been found beneficial in prevention of dental caries. This study compared the effect of green tea mouth rinse and combination mouth rinse on salivary pH post sugar exposure in children. 40 children (6-8years) were randomly selected. Study was conducted over a period of two days. Baseline pH of unstimulated saliva and salivary pH after rinsing with 50% sugar solution was recorded using digital pH-meter on both days. Subjects were asked to rinse with green tea mouthwash on Day 1 and with combination mouthwash on Day 2. Salivary pH was recorded 10 minutes after mouth rinse. The data was subjected to paired T- test. The mean salivary pH after green tea rinse was 7.16 ± 0.27 and after combination mouthwash was 6.61 ± 0.23. On comparing the data of green tea mouth rinse with combination mouth rinse, the difference was found to be statistically significant ($p<0.001$). Green tea was found more effective than combination mouth rinse in restoring the salivary pH post sugar exposure.**

Index Terms: **Catechins, combination mouth rinse, green tea mouth rinse, salivary pH, sugar exposure,**

I. Introduction

Prevention of dental caries is one of the main focus of pediatric dental practice. Dental caries is a multifactorial disease. Interaction of bacteria, diet and host response play a major role in initiation and progression of dental caries (Kamalaksharappa, Rai, Babaji, & Pradeep, 2018). It is one of the most common infectious disease affecting the tooth, and causing its demineralization. One of the major factors leading to demineralization is acidic pH. When a child consumes sugary substance, the bacteria adhered to the tooth metabolize it and produce acid. When the pH of oral cavity falls below the critical pH (5.5), dissolution of minerals starts.

Saliva plays a critical role in the maintenance of optimal oral health. Salivary flow, pH, and buffering capacity play an important role in the initiation and progression of dental caries. However, among these factors, pH of saliva is an important component to maintain the integrity of oral cavity. When the pH increases, the remineralization of tooth surface occurs because of the degree of supersaturation (Kamalaksharappa et al, 2018).

Various methods have been employed to reduce the bacterial count and also to restore the pH back to normal, as early as possible. One such method is use of mouth rinse. Mouth rinses are used in conjunction to other mechanical methods of oral hygiene practice. Mouth rinse is especially beneficial in people lacking manual dexterity.

Green tea extract mouthwash is a nontoxic and safe mouth rinse, particularly for children (Salama & Alsughier, 2019). Green tea is reported to contain nearly 4000 bioactive compounds of which one third is contributed by polyphenols. Other compounds are alkaloids (caffeine, theophylline and theobromine), amino acids, carbohydrates, proteins, chlorophyll, volatile organic compounds, fluoride, aluminum, minerals, and trace elements. Polyphenols found in tea are mostly flavonoids. Major catechins (a subgroup of flavonoids) are (−) epicatechin gallate (ECG), (−) epicatechin, (+) gallocatechin (GC), (−) epigallocatechin (EGC) and (−) epigallocatechin gallate (EGCG). GC, EGC and EGCG possess strong bactericidal as well as antibacterial activity. Certain studies have also shown an inhibitory effect of tea over the acid production by cariogenic bacteria thus imparting a caries protective action (Goenka, Sarawgi, Karun, Nigam, Dutta & Marwah, 2013).

This study was aimed to compare the effect of green tea mouth rinse and combination mouth rinse on salivary pH post sugar exposure in children.

II. Materials and Method

A random sample of 40 schoolchildren aged 6–8 years was included in the study. The study was conducted over a period of 2 days and the study was carried out at a primary school in Bengaluru, Karnataka, India. Informed oral and written consent was obtained from the parents of the children. Permission was

sought from the principal of the school. Ethical consent was obtained from the Institutional Ethical Committee.

A. Sampling

1) Inclusion criteria

- Healthy children aged between 6 and 8 years without any known systemic condition
- Children with written consent from their parents
- Children with no active carious lesions
- No history of use of antimicrobial agents or any other drugs (up to within 4 weeks).

2) Exclusion criteria

- Children with a known history of allergy to any mouth rinse or drug
- Children suffering from any systemic illness
- Children using any other oral hygiene aids other than routine teeth brushing.

B. Materials used

- Digital pocket pH meter (Hanna Instruments)
- Combination mouth rinse (0.05% sodium fluoride, 0.03% triclosan, 5% xylitol) (Kidodent Mouthwash, Indoco Remedies Ltd.)
- Green tea (Tetley Pure Original Green Tea)
- Sugar Solution

C. Preparation of green tea mouth rinse

Tea was extracted by combining 50 grams. of green tea with 500 ml of still (not sparkling, as it is carbonated) mineral water. This was steeped at room temperature for 1 hour and then poured into a lidded container, straining the tea with sieve as it was poured, followed by refrigeration at 4ºC. The loose tea was discarded. The 500 ml concentrated tea was mixed with 1000 ml of distilled water to get 0.5% solution of tea mouth rinse (Hambire, Jawade, Patil, Wani, Kulkarni & Nehete, 2015).

D. Salivary pH measurements

The experiment was carried out in the morning between 10.00 am and 10.30 am on both the days to prevent any bias in the concentration of saliva due to circadian rhythm (Kamalaksharappa et al, 2018). Children were also informed not to eat or drink anything (except water) 1 hour before saliva collection to minimize possible food debris and stimulation of saliva. Salivary pH was measured using Hanna digital pH meter. The bulb of the pH meter was dipped completely into the saliva till it showed the reading, and the pH value was noted.

Unstimulated whole saliva samples were collected using Navazesh spitting method by pooling saliva for 60 seconds and then spitting in a disposable container sitting in an upright position in a well- lit room with good ventilation (Kamalaksharappa et al, 2018). On both the days, 2 ml saliva samples were collected before the commencement of mouth rinsing and baseline pH was recorded. Then children were asked to swish and swift with 10 ml 50% sugar solution for 1 minute. Saliva sample was again collected after 10 minutes to record the pH post sugar exposure.

After this, on day 1, children were asked to rinse the mouth with 10ml 0.5% green tea mouth rinse for 1 minute. Saliva sample was collected after 10 minutes and pH was recorded. On day 2, after the 1st two steps, children were asked to rinse the mouth with 10 ml combination mouth rinse for 1 minute, instead of green tea mouth rinse. Saliva sample was collected and the pH was recorded.

Data from both the days were tabulated and statistical analysis was done using paired t- test. $p< 0.05$ was considered statistically significant.

III. Results

A total of 40 subjects in the age range of 6-8 years participated in the study. They were selected by random sampling based on the inclusion criteria. Table 1 represents the result of complete statistical analysis of the data obtained from the study. The mean pH value post sugar exposure on day 1 was 5.4 and on day 2 was 5.36. The difference between the two was not statistically significant ($p>0.05$). The mean pH value post green tea mouth rinse was 7.16 and post combination mouth rinse was 6.61. The difference in mean pH post green tea mouth rinse and post combination mouth rinse was statistically significant ($p<0.05$).

IV. Discussion

The purpose of this study was to evaluate the effect of green tea mouth rinse and combination mouth rinse (0.05% sodium fluoride, 0.03% triclosan, 5% xylitol) on salivary pH post sugar exposure in children. Salivary pH is one of the key indicators of carious process (Shetty, Hegde, Devadiga & Shetty, 2013). The pH of saliva at rest ranges between 6.5 -7.0 (mean pH – 6.8). Studies suggest that it is pH, rather than sugar, which is the selective factor for caries initiation and progression. Low salivary pH promotes the growth of cariogenic bacteria, thereby creating an inhospitable environment for the protective oral bacteria. This allows for a shift in the environmental balance in favor of cariogenic bacteria, which further lowers the salivary pH. By controlling the salivary pH, it is possible to alter the plaque biofilms, re-mineralize the existing lesions, and perhaps prevent the disease altogether (Scheie, 1989).

Mouth rinses are widely used as an adjunct to mechanical oral hygiene aids due to its antimicrobial, anti-inflammatory, anti-cariogenic and analgesic properties (Hambire et al, 2015). One of the most commonly used mouth rinse in children is the combination mouth rinse. An approach to increase the efficacy of anti-plaque agent and to reduce the adverse effects may be to combine two or more agents. Triclosan is broad spectrum antimicrobial activity and is effective against *Streptococcus mutans* at low concentration (Scheie, 1989). The effects of fluoride on bacterial metabolism are well-known.

Fluorides inhibit several essential enzymes in oral bacteria

Table I. Change in salivary pH following mouth rinse

	Day 1 baseline	Day1 post sugar exposure	Day1 green tea mouth rinse	Day2 baseline	Day 2 post sugar exposure	Day2 Combination mouth rinse
Average pH	6.82	5.405	7.16	6.9225	5.3675	6.6125
Std. Dev.	0.211466	0.209945	0.2725	0.16716	0.150874	0.235543561
T-test baseline day 1		1.28E-44	2.59E-08	0.018674	1.29E-46	8.61499E-05
T-test baseline day 2					3.46E-56	2.9755E-09
T-test green tea and combination mouth rinse						**8.54988E-15 (p<0.05)**
T-test day1 sugar and green tea			4.88E-45			
T-test day 2 sugar and combination mouth rinse						1.25863E-38
T-test_day1 sugar and day2 sugar					**0.362064 (p>0.05)**	

(Hamilton & Bowden, 1988). Xylitol is non-nutritive sweetener permitted for use in food and has anti-cariogenic effect (Lakade, Shah & Shirol, 2014). Hence, combination mouth rinse of 0.03% triclosan, 0.05% sodium fluoride, and 5% xylitol was used.

There is always quest for newer improved materials with emphasis being placed on natural products. Green tea catechin has also been shown to be effective in altering the flora of the oral cavity. Numerous health benefits of green tea and its constituents have been reported. It is a powerful antioxidant and has anti-inflammatory properties. Catechin was found to have antiplaque and antibacterial properties and contributed in caries prevention. Rasheed and Haider described the antibacterial effect of green tea catechins against *S. mutans* bacteria and stated that catechins are of great value in the reduction of *S. mutans* and caries prevalence (Rasheed & Haider, 1998).

In our study, there was statistically significant increase in pH of saliva after intake of green tea and also after combination mouth rinse. But the increase was significantly higher with green tea when compared to combination mouth rinse. The increase in salivary pH after rinsing with green tea was also observed in studies done by Kamalaksharappa et al (2018), Srinidhi, Basha, Naveen Kumar, Prashant, Sushanth & Imranulla (2014), Chandraker, Rathod, Pundir, Dixit, Chandraker & Desai (2017), Sangameshwar, Vanishree, Surekha, Santosh, Anila & Vardendra (2014). Studies have shown that consumption of green tea reduced caries development, and the effect is attributed to its fluoride content polyphenols and catechin. The catechins present in green tea have a marked effect on pH of saliva and dental plaque. Xu, Zhou & Wu (2011) in their detailed study determined the effect of EGCG on acid production by *S. mutans* by monitoring the glycolytic pH drop of *S. mutans* culture. The acid production by *S. mutans* cells was significantly inhibited by EGCG at subminimum inhibitory concentrations levels. A study conducted by Hamilton- Miller (2001) concluded that rinsing with green tea catechins for a suitable time prevents acid production and preserves pH within the normal range (7.2–7.4), which is not favourable conditions for *S. mutans* growth, and he stated that green tea possesses anticariogenic and antibacterial properties. Hirasawa, Takada & Otake (2006) evaluated plaque pH value at different time intervals before and after rinsing with 2% green tea for 5 min and found that the pH values were significantly higher after treatment with catechins.

Further, long-term clinical studies are required to evaluate the efficacy of probiotic and green tea mouth rinse on salivary pH along with microbiological evaluation.

CONCLUSION

Green tea apart from its anti-cariogenic effect has several benefits for overall oral health, without much known side effects. It is rich in antioxidants and has anticarcinogen properties as well. Its properties are comparable to other mouth rinses and hence can be advised as a natural mouth rinse alternative for regular use.

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