10.21608/adjc.2024.293859.1562 Advanced Dental Journal
Volume 6 (2024) | Issue 3| Pages 609-615

Original Article

Effect of Matcha Tea versus Green Tea on Salivary pH and Salivary Flow Rate in High Caries Risk Patients: A Randomized Controlled Trial

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Submitted: 30-5-2024
Accepted: 29-7-2024

Abstract

Aim: To evaluate the effect of Green Tea versus Matcha Tea on the salivary flow rate and salivary pH in patients of high caries risk. **Subjects and methods:** Twenty four patients with high caries risk were equally distributed into two groups randomly (n=12). Group 1 (intervention group) was given Matcha Tea and Group 2 (control group) was given Green Tea. Saliva samples were taken at baseline, immediately, after 5 minutes and after 10 minutes of administration. Salivary flow rate and pH were measured at these time intervals. **Results:** For salivary flow rate; Intergroup comparison between Matcha Tea and Green Tea have shown no statistically significant difference at baseline. While immediately, after 5 and 10 minutes, a statistically significant difference was found where Green Tea showed higher increase in salivary flow rate compared to Matcha Tea. For intragroup comparison within Matcha and Green Tea, between follow-up periods, a statistically significant difference was found where flow rate showed an increase immediately and after 5 mins periods. Then a decline in salivary flow rate occurred after a 10 mins follow up period. For salivary pH; no statistically significant difference was found in intergroup comparison between Matcha Tea and Green Tea at baseline, immediately, after 5 and 10 minutes. Intragroup comparison within Matcha and Green Tea showed statistically significant difference between follow-up where salivary pH showed an increase immediately followed by a slight decline after 5 and 10 mins follow up periods. **Conclusion:** Matcha Tea is effective in increasing both salivary flow rate and salivary pH. Therefore, it can be used as a caries prevention method.

Keywords: Salivary pH, Green Tea, Matcha Tea, Salivary flow rate

I. INTRODUCTION

Dental caries is a multifactorial disease. Its dynamic nature results in a net mineral loss in the hard tissues of teeth. Dental caries is influenced by environmental, behavioural, psychological, and biological factors [(1)]. Dental caries etiology and pathogenesis are complex processes. Saliva constituents, flow rate and pH have a crucial role in the occurrence as well as the progression of dental caries[(2)].

The medical model for caries managements encourages early caries detection and monitoring. This discourages waiting until a cavity forms. As a result, a greater number of people are now receiving prevention protocols for their oral health care. Applying prevention protocols helps in maintaining a healthy tooth structure thus stopping enamel demineralization as well as encouraging the natural healing processes of the body [(3)].

Plants contain polyphenolic chemicals, which have biological qualities such as anti-inflammatory and antioxidant benefits. Green tea has a high concentration of catechins, a subclass of flavonoids with potent antibacterial and bactericidal properties that are essential for sustaining health [(4)].

Around the world, matcha—a powder made from special tea leaves—is becoming more and more popular in functional food and other food categories. The bioactive components in matcha differ from those in green tea and other tea formulations, according to several studies [(5)].

High concentrations of compounds with anti-inflammatory and antioxidant properties can be found in matcha tea. Its high catechin concentration is the primary cause of its encouraging prospective health benefits. When taken on a regular basis, it might aid the body's attempts to stay healthy and fend off illness. Research into the effects of drinking matcha is required. The effect of its components in specific disease entities is still needed[(6)].

II. MATERIAL AND METHODS

Study setting:

This randomized controlled clinical study was performed in the Faculty of Dentistry, Cairo University, Egypt. Registration of study protocol was done in www.clinicaltrials.gov/ database with ID No. NCT06504706. The procedures of this study involving human participants were approved by the Research Ethics Committee of the Faculty of Dentistry, Cairo University with approval number 28-9-23.

Study design and grouping:

This study was single parallel-arm, blinded, randomized clinical trial with 1:1 allocation ratio. Participants were assigned into equal groups randomly.

Sample size calculation:

In a study by Ravikumar et al in 2020 the salivary pH after 10 minutes within Green Tea group was distributed normally with standard deviation 0.251. In cases where the true difference in the experimental and control means is 0.3 (small cohen's d effect size), we will need 12 experimental subjects and 12 control subjects to enable us in rejecting the null hypothesis that the population means of the intervention and control groups are equal with probability 0.8. The Type I error probability present with this test of null hypothesis is 0.05. Sample size calculation was done using PS Power and Sample version 3.1.6 for windows using independent t test.

Eligibility criteria:

Assessment of subjects for eligibility to be engaged in the study was conducted. Subjects with high caries risk that agreed to sign the informed consent were included in the study. Subjects who had salivary gland disorders or undergoing radiotherapy were excluded from the study.

Recruitment:

Participants fulfilling the eligibility criteria were recruited in the study. Screening was done until the required population (24 participants) was reached. An informed consent in Arabic language provided by the Research Ethics Committee at Faculty of Dentistry, Cairo University stating all the ethical concerns of the study was agreed upon by the participants before study initiation.

Randomization, Sequence generation and blinding:

Numbers from 1:24 were generated for simple randomization using Random Sequence Generator (www.randomization.com).

Blinding of the investigator to the material assigned was considered. However, participants could not be blinded owing to the difference between Green Tea and Matcha Tea.

Regimen:

All subjects were instructed to brush their teeth after eating breakfast. For both groups, participants had to drink Matcha Tea and Green Tea. Participants were given instructions to avoid eating, drinking, smoking for 60 min before and during the saliva sampling collection process. They were instructed to continue their dental habits during the time of the study.

Outcome assessment:

Salivary sample collection was done by 2 operators. Participants were asked to sit in an upright position in the dental chair leaning their head forward. This helps in collecting saliva present in the floor of the mouth. The participants were given instructions to avoid swallowing saliva during sample collection. Saliva for all samples were collected at baseline, immediately, after 5 mins and 10 mins. [7]

The participants were asked to maintain saliva in the mouth for 3 min (unstimulated). They were then instructed to expectorate through a funnel into a measuring cylinder that was graduated. The patient's salivary flow rate was measured in ml/min.

Assessment of salivary pH was done by digital pH meter (Isolab Laborgerate pH meter, Wertheim, Germany). Calibration of the pH meter was done before assessment of the samples with buffering solutions.

III. RESULTS

Flow rate:

Intergroup comparison between Matcha Tea and green have shown no statistically significant difference at baseline (P = 0.8595), while immediately, after 5 and 10 minutes there was statistically significant difference (P < 0.05). Intragroup comparison within Matcha and Green Tea have shown statistically significant difference between follow-up periods (P < 0.001).

pH:

Intergroup comparison between Matcha Tea and green have shown no statistically significant difference at baseline, immediately, after 5 and 10 minutes (P > 0.05). Intragroup comparison within Matcha and Green Tea have shown statistically significant difference between follow-up periods (P < 0.001).

	Matcha Tea		Green Tea		P value
	Mean	SD	Mean	SD	
Baseline	0.492[d]	0.1165	0.483[d]	0.1115	**P = 0.8595**
Immediate	0.708[c]	0.1240	0.917[c]	0.1193	**P = 0.0004***
5 minutes	0.942[a]	0.1676	1.583[a]	0.1697	**P < 0.0001***

Table 1: Mean and SD of flow rate for the intergroup comparison between materials within each follow-up and intragroup comparison within each material between different follow-up periods.

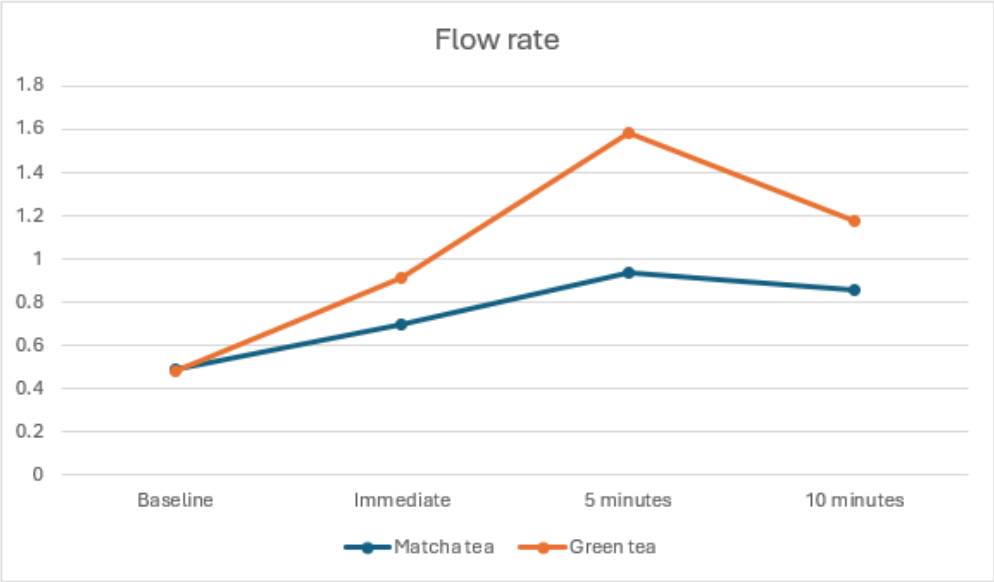

Figure 1: Line chart showing flow rate for each material within each follow-up period

	Matcha Tea		Green Tea		P value
	Mean	SD	Mean	SD	
Baseline	6.883[d]	0.2082	7.050[d]	0.3030	**P = 0.1306**
Immediate	7.417[a]	0.1642	7.567[a]	0.2674	**P = 0.1120**
5 minutes	7.308[b]	0.1832	7.425[b]	0.3194	**P = 0.2843**
10 minutes	7.208[c]	0.1832	7.242[c]	0.3088	**P = 0.7508**
P value	**P<0.001***		**P<0.001***		

Table 2: Mean and SD of pH for the intergroup comparison between materials within each follow-up and intragroup comparison within each material between different follow-up periods.

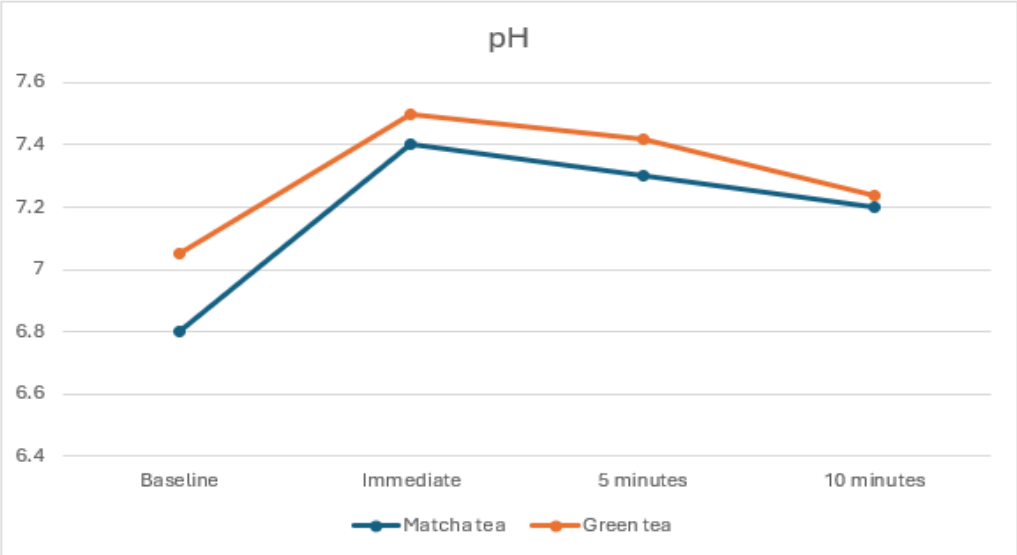

Figure 2: Line chart showing pH for each material within each follow-up period

IV. DISCUSSION

Saliva is a complex dynamic fluid that plays an important role in taste, chewing, protection, lubricating tissues, swallowing, and digestion in the oral cavity. Stimulated and unstimulated salivary flow play a major role in clearance of fermentable carbohydrates.

Pathologic microorganisms convert fermentable carbohydrates into lactic acid and other organic acids. These acids are incorporated into dental plaque making it cariogenic. Such action causes reduction in pH that subjects teeth to demineralization action leading to carious lesion development. Saliva has a buffering capability that aids in neutralizing and diluting such acids thus protecting teeth from demineralization. [1]

There has been a paradigm shift in management of dental caries from surgical model to prevention model. Such shift encourages caries prevention by controlling diet, maintaining good oral hygiene, applying topical antimicrobials, pit and fissure sealants, and fluoride therapy and promoting salivary functions. [7]

Tea has several health benefits, including antibacterial, anticarcinogenic, anti-inflammatory, and antioxidant properties. Flavonoids, tannins, trace quantities of fluoride and several vitamins are all present in green tea. Certain antioxidants and anti-microbial elements found in green tea have been shown to be beneficial in prohibiting dental caries and promoting dental health. [8]

Green Tea has been proven to increase salivary flow rate and salivary pH in several studies [6,9,10]. Green tea catechin reduces acid production by streptococcus mutans. Such action aids in adjusting salivary pH to be within the normal range. This finding suggests that consuming green tea daily could be effective in dental caries prevention.

Japanese Matcha is a powder that has recently become well-known throughout the world. Biologically active substances, such as theanine, caffeine, chlorophyll, and different kinds of catechins are improved when Matcha plants are shaded during the growth stage. Owing to its high content of antioxidant and anti-inflammatory substances, it is considered health-promoting.[11,12]

The effect of Matcha on prevention of dental caries via its action on saliva has not been investigated in any previous study. In the current study, we compared the effect of drinking Matcha Tea and Green Tea on salivary flow rate and pH.

In the current study, both Green Tea and Matcha Tea showed statistically significant increase in salivary flow rate immediately and after 5 mins. The action of both Green Tea and Matcha Tea on salivary flow rate could be attributed to their catechin content. The content of catechins creates an astringent feeling which can stimulate the central nervous system resulting in an increase in salivary secretion[13]. Such stimulation is considered mechanically a result of the bitter taste sensation of both Green Tea and Matcha Tea[13].

Green Tea showed statistically significant higher potential in increasing salivary flow rate than Matcha Tea. This difference could be found immediately and after 5 mins. Both Green Tea and Matcha Tea showed statistically significant reduction in salivary flow rate after 10 mins. However, salivary flow rate after 10 mins from consumption of both green and Matcha Tea was higher than baseline.

In the current study, both Green Tea and matcha showed statistically significant rise in salivary pH immediately. Such action could be attributed to the fact that both green and matcha tea are alkaline in nature. Also, the elevated salivary flow rate plays an important role in elevating salivary pH [13]. The rise in bicarbonate ion concentration in saliva is directly proportional to the rate of salivary secretion. [1]

There was statistically significant drop in salivary pH for both groups after 5 mins and 10 mins. However, the pH

remained higher than baseline. Based on this result, we can conclude that the action of both green and match tea on salivary pH remains for a while. The maximum effect could be seen immediately.

There was no statistically significant difference between both groups on the effect on salivary pH. Accordingly, Matcha Tea could be comparable to Green Tea in elevating salivary pH. The effect of both Green Tea and Matcha Tea on salivary pH plays an important role in buffering cariogenic acids and thus prevention of dental caries.

V. CONCLUSION

Under the conditions of this clinical trial, we reached a conclusion that Matcha Tea is effective in increasing both salivary flow rate and salivary pH and can be used as a means for caries prevention.

Future Scope / Clinical Significance

This is the first study that investigated the intraoral effect of using Matcha Tea. For high caries risk patients, drinking Matcha Tea is an easy way to elevate both salivary flow rate and pH. Therefore, according to the current study results, it can be used in enhancing the oral status and prevention of caries.

Recommendations:

More studies are needed to investigate Matcha Tea antibacterial effect. Studies with long term follow up periods are needed in future studies to help in identifying its effect on salivary flow rate and pH.

Conflict of Interest:

The study authors declare that there is no conflict of interest.

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Ethics:

This study protocol was approved by the research ethics committee of the faculty of dentistry- Cairo university on: 26-9-2023, approval number: 28923

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