Effect of Consuming Milk Tea with Stevia on Plaque pH among Dental Students: Cross-Over RCT

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

ABSTRACT

Background: Stevia is a natural, healthy, unconventional replacement to the table sugar and artificial sweetener. Phytochemicals present in it exerts an influence on the microbial flora of the mouth. Hence, study was planned to compare the effects of stevia with different sugars on the plaque pH.

Methodology: The present study was carried in department of Public Health Dentistry between 9am-12pm. It was a triple blinded Crossover Randomized Controlled Clinical Trial with LSD design. All the 40 subjects were exposed to all four interventions sequentially, at weekly intervals with 1 week wash out period. (Intervention: A- Table sugar, B- Jaggery, C- Stevia, D- Milk tea without sugar). Inferential statistics was done using Repeated measures of ANOVA followed by Post hoc pairwise comparison and Three-way RMANOVA to determine relationship between SUGAR * WEEK * TIME interaction. Level of significance was set at p value at 0.05.
**Results:** Plaque pH assessments were performed at 4 points of time intervals (at baseline, 1 min, 20min, 60 min). Overall significance differences were seen in plaque pH at different time intervals for all interventions. Intergroup comparison showed potential efficacy of stevia in maintaining plaque pH.

**Conclusion:** In the present study, it was found that stevia has the least cariogenic potential when compared with jaggery and refined sugar. Jaggery also did not show a significant reduction in plaque pH. Therefore, Stevia and Jaggery can be compared for their anti-cariogenic properties. This study has been registered under the Clinical Trial Registry of India CTRI/2020/12/03003

Keywords: Digital pH meter; jaggery; milk tea without sugar; plaque pH; stevia; table sugar; taste perception.

1. **INTRODUCTION**

Diet has an inevitable role to play in the progression of dental caries. Researchers has establish that sugars have a well-founded affinity to effect the oral health of an individual. Diet attacks the hardness of the teeth, it also changes the composition and pH of the saliva; and plaque pH by production of more acid in the oral environment[1].

Past70 years, investigators have concluded that dietary sugars were the ultimate root cause for dental caries[2]. Furthermore, it was found that in today world the diet is majorly accommodated by fermentable carbohydrates, which are greatly composed of processed foodstuffs that are composed of refined sugar and synthetic carbohydrates[3].

In India, drinking milk tea with sugar has been more of a custom that is engraved in ordinary dietary practice[4]. Milk tea is the most popular hot beverage which is infused either separately or with a mixture of milk and sugar and consumed on the daily basis. The universally used sweetener is the table sugar containing 100% of sucrose and zeroes nutritional value simply loaded with empty calories [5]. Besides the inherent cariogenic nature of sugars causing cavitations and tooth decay, its consumption on daily basis leads to many nutritional and medical problems [2]. Excessive intake of sucrose in its refined sugar form which is commonly known as table sugar is responsible for elevated blood glucose causing diabetes[3]. Which further leads to dysfunction of the immune system. Tea consumption with sucrose brought about the downside effects on oral health as well. Therefore, a need of an hour was to replace the refined sugar with an artificial sweetening agent which did not spike blood sugar and at the same time that gives a sweet taste to a beverage as well [6].

Currently, the market is immensely drowned with the usage of artificial sweeteners including Sucralose, Aspartame, Saccharin. Although, overconsumption of these artificial sweeteners could also be detrimental in contributing to various health hazards including the high risk of cancer[7]. These artificial sweeteners also pose certain threats to the nervous system, these releases neurotoxins which exacerbate neuropathy. These also alter the blood chemistry by raising the serum cholesterol levels by changing the metabolism of lipids in the liver[8]. These artificial sweeteners are chemically synthesized which did not get metabolized in the body[9]. On consumption, they started accumulating in the gut of an individual resulting in ill gut health. Further, this leads to bloating, diarrhea, and gas-related pain[10]. Hence, a necessity was felt to switch these artificial sweeteners and to adopt something which was least processed having less chemical retained with some natural properties that suited gut health too. Therefore, it was necessary to replace refined sugar with an absolute natural sugar substitute which would be favorable to oral health and at the same time on the overall general health as well[11].

For many generations jaggery has been highly featured as a core heart of Indian culture dietary practice[12]. Jaggery has been prepared naturally from the concentrated extract of the sugarcane juice[13]. Disparate to all those refined sugar and artificial sweeteners, jaggery has been renowned by the method of its manufacturing but not by the brand behind its marketing[14]. Its mass production has been practiced for many centuries before sugar even came into existence. It is a concentrated product of date, cane juice, or palm sap without the separation of molasses and crystals[15]. As it is the by-product of sugar cane, it is loaded with minerals and nutrients. Since the chemical constitution of jaggery is much more intricated
than sugar, as it has been composed of extensive chains of sucrose. Hence, it got assimilated in the body at a much slower speed than the Table sugar[16]. Therefore, discharge energy very slowly but not spontaneously as the table sugar spikes. This generates energy for an additional period of time and is not harmful to health [17]. Since Ayurveda practice in India, it has been suggested to use Jaggery after a meal which also gave wholesome benefits to the health of an individual [18].

Currently, Jaggery is a good quality unrefined sugar that is consumed in whole over Asia, Africa, Latin America, and also the Caribbean [19]. However, its chemical composition clearly has stated it almost equal calories to Table Sugar. Therefore among diabetics it does not go well because they already have insulin resistance problems as it is already high on the glycemic index [20]. Hence it is not advisable for diabetic people additionally its excess consumption also resulted in weight gain, as it is sucrose only. Due to its overeating it also lead to dental decay. There is a current need to shift from the consumption of caloric natural sweeteners to non-caloric natural sweeteners. To ameliorate oral as well as general body health [21].

In the recent past, a sugar procured from the plant Stevia rebaudiana became evident in the market as a natural, healthy, unconventional replacement to the table sugar and artificial sweetener [22]. “Stevia rebaudiana Bertoni is the biological name of stevia. It is a perennial bush that belongs to the family Compositae (Asteraceae) [23]. Stevia is native to Paraguay and Brazil and it is regularly referred to as the sweet herb of Paraguay [24].” Researchers track down the presence of many biologically active compounds which were available in green plants including Stevia. These were the phytochemicals which were asturoinulin, β-carotene, dulcoside, niacin, oxides rebaudi, riboflavin, steviol, stevioside, and thiamine[25]. All these alimentary substances exert an influence on the microbial flora of the mouth. Tannin, xanthines, and flavonoids are also present in stevia which has anti-plaque activity and is not even cariogenic[26]. Stevia has no calories and does not raise blood sugar levels. Hence, it is safe for diabetics.

Currently, a large number of investigations are on their way which is focusing on identifying the various foods and factors that defend and control dental caries and stevia is one of them. Hence, the present study is planned to compare the effects of sugar, jaggery, and stevia with Milk tea without sugar which does not have any form of sugar on the plaque.

2. METHODOLOGY

The present study was a triple-blinded Crossover Randomized Controlled Clinical Trial with LSD design. This was chosen to carry out the present study to limit the experimental error.

This study has been registered under the Clinical Trial Registry of India CTRI/2020/12/03003, http://cri.nic.in/Clinicaltrial regist/trial.php?modid=1&compid=19&EncHid=15 634.77428. This trial was conducted and documented under the Declaration of Helsinki and CONSORT guidelines. There were no changes made after the trial commencement.

2.1 Sample Size

The Sample Size was calculated using G Power Software (version 3.9.1.1). Anticipating an effect size of 0.221, 5% level of precision, 95% confidence level, and 90% power with the minimum sample size required for the study was calculated as 40.

The Recruitment flow diagram of the participants is given in Fig. 1. Dental students of 18-25 years of age, who were having a DMFT score of at least 1 were included in the study. Participants who were on medications affecting their salivary flow rate, appointment schedules, already on any mouthwash regime, and were undergoing orthodontic treatment were excluded from the study.

A total of 84 dental undergraduates were screened. Forty-four screened participants who did not meet the inclusion criteria were excluded. As it was a triple-blinded study, participants, investigators, and data analysts were kept blinded.

2.2 Intervention

All the 40 subjects were exposed to all four interventions according to Latin Square Design, sequentially, at weekly intervals (Table 1). In this manner, a washout period of one week was implemented for each study participant, so that to limit the carry-over effect of each intervention with the subsequent one. Initially, participants
were randomly allocated to the four intervention groups using the lottery method. Forty slips were made using numbers from 1-40 and the participants were asked to pick the slip so that number was automatically got assigned to that participant.

Fig. 1. Flow chart describing patient recruitment

Table 1. Sequence of interventions

<table>
<thead>
<tr>
<th></th>
<th>Monday (1-10)</th>
<th>Tuesday (11-20)</th>
<th>Thursday (21-30)</th>
<th>Friday (31-40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Week 2</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>Week 3</td>
<td>C</td>
<td>D</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Week 4</td>
<td>D</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>
Table 2. Intragroup comparison of plaque pH for all the interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>6.90 ±0.39</td>
<td>6.92 ±0.41</td>
<td>6.96 ±0.40</td>
<td>6.99 ±0.43</td>
</tr>
<tr>
<td>T2</td>
<td>4.90 ±0.79</td>
<td>6.63 ±0.39</td>
<td>6.85 ±0.39</td>
<td>6.92 ±0.43</td>
</tr>
<tr>
<td>T3</td>
<td>5.80 ±0.66</td>
<td>6.74 ±0.42</td>
<td>6.88 ±0.41</td>
<td>6.96 ±0.43</td>
</tr>
<tr>
<td>T4</td>
<td>6.78 ±0.39</td>
<td>6.89 ±0.41</td>
<td>6.95 ±0.42</td>
<td>6.99 ±0.43</td>
</tr>
<tr>
<td><strong>P value of Repeated measures of ANOVA</strong></td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Post hoc Boneferroni Pairwise comparison</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1*T2</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
<tr>
<td>T1*T3</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
<tr>
<td>T1*T4</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
<tr>
<td>T2*T3</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
<tr>
<td>T2*T4</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
<tr>
<td>T3*T4</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
<td>-&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3. Intergroup comparison of plaque pH among different interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Baseline</th>
<th>1 min</th>
<th>20 min</th>
<th>60 min</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table sugar</td>
<td>6.90 ±0.39</td>
<td>4.90 ±0.79</td>
<td>5.80 ±0.66</td>
<td>6.78 ±0.43</td>
</tr>
<tr>
<td>Intervention B</td>
<td>6.92 ±0.41</td>
<td>6.63 ±0.39</td>
<td>6.74 ±0.42</td>
<td>6.89 ±0.41</td>
</tr>
<tr>
<td>Intervention C</td>
<td>6.96 ±0.40</td>
<td>6.85 ±0.39</td>
<td>6.88 ±0.41</td>
<td>6.95 ±0.42</td>
</tr>
<tr>
<td>Intervention D</td>
<td>6.99 ±0.43</td>
<td>6.92 ±0.43</td>
<td>6.96 ±0.43</td>
<td>6.99 ±0.43</td>
</tr>
<tr>
<td><strong>P value of Repeated measures of ANOVA</strong></td>
<td>0.292, NS</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>P value of Post hoc Boneferroni Pairwise comparison</strong></td>
<td>A*B – 0.999</td>
<td>A*B –&lt;0.001</td>
<td>A*B –&lt;0.001</td>
<td>A*B –0.506</td>
</tr>
<tr>
<td></td>
<td>A*C –&lt;0.001</td>
<td>A*C –&lt;0.001</td>
<td>A*C –&lt;0.001</td>
<td>A*C –0.002</td>
</tr>
<tr>
<td></td>
<td>A*D –0.536</td>
<td>A*D –&lt;0.001</td>
<td>A*D –&lt;0.001</td>
<td>A*D –0.001</td>
</tr>
<tr>
<td></td>
<td>B*C –0.999</td>
<td>B*C –&lt;0.001</td>
<td>B*C –&lt;0.001</td>
<td>B*C –0.043</td>
</tr>
<tr>
<td></td>
<td>B*D –0.237</td>
<td>B*D –&lt;0.001</td>
<td>B*D –&lt;0.001</td>
<td>B*D –0.225</td>
</tr>
<tr>
<td></td>
<td>C*D -0.999</td>
<td>C*D –0.127</td>
<td>C*D –0.306</td>
<td>C*D –1.000</td>
</tr>
</tbody>
</table>
Table 4. Statistics derived from three way repeated measures of ANOVA

<table>
<thead>
<tr>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>P value</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUGAR</td>
<td>77.573</td>
<td>3</td>
<td>25.858</td>
<td>204.034</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>WEEK</td>
<td>640</td>
<td>3</td>
<td>.213</td>
<td>.682</td>
<td>0.571</td>
</tr>
<tr>
<td>TIME</td>
<td>39.767</td>
<td>1.466</td>
<td>27.121</td>
<td>165.602</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SUGAR * WEEK</td>
<td>7.169</td>
<td>3.083</td>
<td>2.325</td>
<td>.911</td>
<td>0.451</td>
</tr>
<tr>
<td>SUGAR * TIME</td>
<td>68.036</td>
<td>1.998</td>
<td>34.044</td>
<td>128.932</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>WEEK * TIME</td>
<td>1.647</td>
<td>3.971</td>
<td>.415</td>
<td>3.171</td>
<td>0.025</td>
</tr>
<tr>
<td>SUGAR * WEEK * TIME</td>
<td>4.135</td>
<td>3.906</td>
<td>1.059</td>
<td>2.953</td>
<td>0.034</td>
</tr>
<tr>
<td>TIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Interventions were as follows:

Group A: Table sugar (sucrose, 1 teaspoon [10 grams]/cup)
Group B: Jaggery (2 teaspoons [10 grams]/cup)
Group C: Stevia powder (0.5 grams/cup)
Group D: Without sugar

2.3 Preparation and Standardisation of Tea

Interventions were carried in the Department of Public Health Dentistry between 9:00 am - 12:00 pm. Tea was prepared in the department only (Cow milk and 60 grams of tea powdered Plain Tata Tea Agni). Participants were instructed to refrain from eating one hour before the collection of unstimulated saliva to refrain from any diet-related variation in the quality of collected saliva. Participants were dispensed with 50 ml of tea in disposable glasses. The consumption time of 4 minutes was allotted to each Participant.

2.4 Outcome Assessment

Plaque pH assessments were the primary study outcome. GE Filtration digital pH meter with 0.05 pH accuracy were used to measure the plaque pH. The measurements were taken at 4 different points of time; i.e immediately before consuming tea (baseline), immediately after drinking tea, 20 minutes, and 60 minutes after consuming tea were summarized as mean Plaque pH scores. Comparison of plaque pH according to type of sweetener & different time points were done by using Repeated measures of ANOVA (RMANOVA) along with Post hoc Bonferroni test. Three-Way RMANOVA was used to determine the three-way relationship between SUGAR * WEEK * TIME interaction. The level of statistical significance was set at 0.05.

3. RESULTS

A total of 40 study participants i.e 40 in each group viz Intervention A of Table sugar group, Intervention B of Jaggery group, Intervention C of Stevia group, and Intervention D of Milk tea without sugar group were recruited. The study population was found to be heterogeneous with age and gender distribution as three-quarters of it was comprised of females and the rest males. The mean age of female study participants was 21.57±1.61 and the mean age of male study participants was 22.0±1.33.

Table 2 depicted the intragroup comparison, using Repeated measures of ANOVA to assess the statistical significance of the change in mean plaque pH from T1 to T2, from T2 to T3, and from T3 to T4, among all study groups i.e Table sugar group, Jaggery group, Stevia group, and Milk tea without sugar group.

In the Table Sugar group, the mean plaque pH reduced significantly from T1 to T2, then it
showed a significant increase in the mean plaque pH from T2 to T3 and then further from T3 to T4. Overall, compared to T1 (baseline), the mean plaque pH was significantly low at T4 (60 minutes).

In the Jaggery group, the mean plaque pH reduced significantly from T1 to T2, then it showed a significant increase from T2 to T3 and then further from T3 to T4. Overall, the mean plaque pH at T1 and T4 did not show any significant difference. In other words, it can be concluded that the plaque pH returned to baseline level after 60 minutes in the Jaggery group.

In the Stevia group, the mean plaque pH reduced significantly from T1 to T2, then it showed an increase from T2 to T3 but this increase did not reach the level of statistical significance. Then it further increased significantly from T3 to T4. Overall, the mean plaque pH at T1 and T4 did not show any significant difference. Hence, it's concluded that the plaque pH returned to the baseline level after 60 minutes in the Stevia group.

In the Milk tea without sugar group, the mean plaque pH reduced significantly from T1 to T2, then it showed a significant increase from T2 to T3. Later it showed further increase from T3 to T4, which did not reach the level of statistical significance. Overall, the mean plaque pH at T1 and T4 did not show any significant difference. In other words, it can be concluded that the plaque pH returned to the baseline level after 60 minutes of consumption of the Milk tea without sugar group.

Table 3 depicted the intergroup comparison of mean plaque pH scores of all four interventions at four different points of time i.e., T1, T2, T3 & T4. It showed that at baseline, the mean plaque pH was comparable among the four intervention groups.

A statistically significant difference could not be found among groups regarding plaque pH at baseline. While, at T2 T3 & T4, a statistically significant difference in mean plaque pH of four study groups was detected. Post hoc pairwise comparison analysis revealed that at all points of measurement, i.e., at T & T3 the mean plaque pH after consumption of tea containing table sugar, was significantly lower than that as found in the jaggery group, which was further significantly lower than that among Stevia group & no sugar group.

Stevia group & no sugar group did not present significant differences at any point in time. At 60 minutes, post-consumption, the table sugar group showed significantly lower pH as compared to jaggery, stevia & no sugar. As all the observations were paired in this study, thus, these differences were tested for statistical significance using Repeated measures of ANOVA.

In Table 4, the three-way RM ANOVA showed a significant difference between sugars (p<0.001) over the entire 60 minutes time period (p<0.001) and a significant sugar-by-time interaction, meet-by-time interaction, and sugar-by-week-by-time interaction.

4. DISCUSSION

A dynamic relationship existed between sugars and oral health. It has been proved that Sugars and other fermentable carbohydrates were hydrolyzed by salivary amylase in the oral cavity, which provides the substrate for the actions of oral bacteria, which results in decrease plaque and salivary pH[4].

Stephan and Miller published the first research unfolding the drop in plaque pH after exposure to fermentable carbohydrates. In human studies, the cariogenic risk associated with individual foods has always been challenging in determining because of the variability in salivary flow and salivary and plaque pH, the eating experience (frequency and food combinations), the bioavailability of starch-derived sugars, retention time of food in the oral cavity, and potential interactions between starches and sugar[28].

It has been stated by Robert Stephan in 1943 that the changes in dental plaque pH were in reaction to carbohydrate consumption over a period of time. Routinely, the curve discovered a rapid drop in plaque pH that is attained after the consumption of sugar. It has been proved that the curve normally takes 20 min for the plaque pH to reach its resting value. The usual resting plaque pH is between 6 and 7. Upon consumption of low pH drinks, the pH may fall. Whenever pH drops more than the critical pH it causes the dissolution of dental hard tissues structures including enamel. Though plaque pH
changes are concurrent with salivary pH changes, it is better to measure the plaque pH as
demineralization occurs in the plaque tooth interface. Henceforth, in the present study variations
in plaque pH were assessed instead of variations in salivary pH [28].

Today, everywhere the market has been flooded with sugar-free foodstuff in the forms of food and
drinks because of increased concerns associated with obesity and overweight. This was the reason
behind choosing the specific natural sweetener which further could be used as the substitute to
sugar and artificial sweeteners. Therefore, Stevioside was known as the natural herbal
sweetener which was extracted from the plant Stevia rebaudiana. It greatly benefitted general
and oral health. Stevia and stevioside, both have been widely used in place of saccharose in
in treatment of the diseases like diabetes mellitus, obesity, hypertension, and caries prevention (PöI
et al., 2007). Authors suggested that, besides providing sweet flavor, stevioside, along with its
related compounds which including rebaudioside A, steviol, and isosteviol, offered many therapeutic benefits. Some of these benefits are anti-inflammatory, antitumor antihypertensive, anti-hyperglycemic, anti-diarrhoeal, and
anti-diuretic effects (Chatsudthipong & Muanprasat, 2009). Additionally, it also constitutes a high amount of antioxidants and the phenolic compounds, vitamin C, carotenoids, chlorophylls (Abou-Arab et al[29]).

Results of this study revealed that the study population was not found to be homogeneous
with gender i.e. majority of the students were females. This could be attributed to the fact that
females opt for Dentistry as a career more frequently as compared to males. Sample for the
present study was employed from one setting only i.e undergraduate students living in college
 campuses. Accordingly, the environmental and agent factors influencing them for initiation of
caries microflora were similar. This also eliminated the influence of these factors on
plaque pH.

In this study, plaque pH was found to be reduced among the study groups at 1 min after tea
consumption, followed by an increase in plaque pH at 20 min followed by 1 hr. It was observed
that at 1hour after tea consumption, plaque pH was found to be similar to baseline for stevia and
Milk tea without sugar only, suggesting the less cariogenic potential of stevia and Milk tea without
sugar test groups. Similar results were described by Goodson et al study, in which the effect of
stevia mouth rinse measured the plaque pH. Statistically, the significant rise was found in the
plaque pH following Stevia oral rinse as compared to sucrose oral rinse. Tanushree &
Puja have assessed the effect of mouth rinsing with solutions containing the different sugar
substitutes on salivary pH. They proposed that there was a statistically significant rise in salivary
pH values. It was in accordance with the Stevia group at 20 minutes which was also in line with
the results of the present research.

The changes which were seen in pH of plaque values followed by rinsing with the extract made
from Stevia leaf and Stevia product solution has remained even with findings of Brambilla et al. He
investigated the impact of the Stevia extracts which were the stevioside, and rebaudioside A
on plaque pH. Brambilla et al stated that these compounds were not in favor of the acidogenic
metabolism of bacteria residing in supragingival plaque. It was postulated that the mechanism of
action could be due to the inhibitory effect of the two Stevia extracts on the bacterial fermentative
metabolism. Also, the suppression of bacterial growth confirmed the cariostatic potential of the
Stevia extracts[30].

This study revealed that there was a drop of mean plaque pH from baseline to 1 min in the
Table sugar group, then it increased slightly after 20 min, but did not return to the mean baseline
plaque pH value even at the end of 1 hour. A Similar pattern was seen in the jaggery group
due to the large sucrose content.

Several factors including the concentration of substrate surrounding the bacteria, types of
bacteria present which reflects its metabolizing products and nature of acid formed whether they
are less acidogenic or more acidogenic, amount of the time till the substrate is in contact with the
tooth surface, and lastly the diffusion of substrate and its metabolites in plaque. This further creates
an acidogenic environment. Also, the buffering capacity of the saliva affects this process. If
enough clearance time is being provided between the meals which allow saliva to act as a
buffering agent and neutralizes the acidogenic environment[31]. But there is a need to explore
the potential reason for this action.

Since there is non-availability of the evidence, the results of currently available Stevia products
which affect the plaque pH that could not be compared. In 2017, Usha et al. proved that 0.5%
S. rebaudiana extract improved buffering capacity of the saliva in a high caries risk patient and decreased the salivary pH. Abdul Razak et al. had reported that the alternative sweeteners which gave the similar results as Stevia were equally effective as xylitol in decreasing the existence of streptococci in biofilms.

One of the major limitations of the present study was that the effect of consuming stevia tea on plaque pH was studied only by measuring alterations in plaque pH and no microbiological assessments were correlated. The difference in the pH response can be attributed to the presence of plaque bacteria present in the oral cavity but not due to the quantity of all three interventions employed. These microorganisms in plaque may lead to an increase or decrease in plaque pH. Thus further microbiological analysis of stevia on cariogenic microorganisms should be carried out to confirm and substantiate the results of the present research.

The study can be implicated clinically on diabetic patients with high caries risk. Since the taste perception for stevia was poor, this might be due to their perception regarding the sweet taste which became insensitive to stevia as it was natural. Also, young generation which are into fitness and health-conscious people can make their lifestyle modifications to replace refined sugar with this natural sweetener. It not only promotes general health also does oral health.

5. CONCLUSION

Milk tea with Stevia was found to found to cause a lower pH drop as compared to that which occurred in case of milk tea with jiggery and refined sugar. It can serve as a long-term alternative natural non-caloric substitute of refined sugar for regular consumption in milk tea. In the present study, it has been proved that stevia has the least cariogenic potential when compared with jaggery and refined sugar. Therefore, Stevia can be compared for its non-cariogenic properties. Health-conscious young people looking for natural non-caloric sweeteners can, stevia will be a great choice.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

Before the start of the study, an information sheet was provided to each of the study participants and written consent was obtained.

ETHICAL APPROVAL

The protocol was reviewed and approved by the Institutional Ethical Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


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