Effects of Black Tea on Salivary pH and Flow Rate

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Abstract: The study evaluated the effects of black tea on salivary pH and flow rate. Saliva samples were taken from 255 healthy subjects between the ages of 25 and 30 before and after drinking black tea. The changes in the unstimulated and stimulated saliva were monitored by measuring the salivary pH with a digital pH meter and the flow rate with a measuring cup. The subjects’ salivary flow rate changed from a mean average of 0.53 to 0.56 after drinking black tea. The level of the subjects’ saliva pH rose from a mean average of 6.04 to 6.13 ($p<0.0004<0.05$). The study demonstrated that drinking black tea causes an increase in salivary flow rate and pH.

Keywords: Saliva; Salivary flow; Salivary pH; Black tea; Oral Health; Dental Caries;

1. Introduction

Saliva is the mouth’s main defense against tooth decay, keeping the mouth’s soft and hard tissues healthy, washing away food and debris and neutralizing acids produced by bacteria. Saliva offers protection from microbial invasion that leads to disease. 1

Dry mouth, the result of salivary glands not working properly, impacts a person’s oral hygiene negatively. Acid-producing bacteria will proliferate, leading to loss of mineral from tooth surfaces and the development of caries. 2

The aim of the study is to evaluate the effect of black tea—the world’s most produced tea—on salivary pH and flow rate. After water, tea is the second most widely consumed beverage globally. 3

Iranians have one of the highest per capita rates of tea consumption in the world. Although only 1% of the world population, Iranians account for over 5% of the world’s total tea consumption. 4

Regular intake of tea has been lauded for improving antioxidant status, contributing to lowering the risk of coronary heart disease, stroke, and certain types of cancer. In the previous decade, there has been significant interest in evaluating the health benefits of tea, specifically in its polyphenolic components. However, little is known of the acid content of tea and its influence on salivary pH and salivary flow rate during consumption.5

Adequate saliva is critical for good oral health. Not only is it responsible for lubricating the mouth tissues, it is essential in maintaining a pH environment that is conducive for tooth remineralization. This happens with the deposition of ionic minerals while the immunoglobulins and proteins in the fluid has antimicrobial properties. Digestion, dilution and the clearing of dietary carbohydrates are just some of the functions of saliva. It also buffers acid, a byproduct of sugar metabolism.

The presence of histatins (proline-rich proteins including cystatins and statherin), calcium and phosphate are maintained in supersaturation and are available for remineralization of tooth structure. 6With its enzymes, saliva also aids in maintaining mucosal integrity. It is important in the formation of the pellicle, the membrane that protects the tooth after eruption.
The ability of saliva to wash the tooth surfaces and to control demineralization and mineralization and the antibacterial activity of saliva all contribute to its integral role in the health of the teeth. With salivary flow and pH playing a significant role in the prevention of dental caries, the study was a quest to understand how black tea can impact oral hygiene.

2. Methods and Materials

Two hundred fifty-five healthy subjects between the ages of 25 and 30 took part in the study. Each subject signed a form, giving informed consent. All subjects were asked to drink the same tea.

Black tea leaves from Tehran, Iran were used in the study. It was prepared in the using a ceramic teapot with the measurement of one teaspoon of tea leaves per cup. The tea leaves steeped in boiling distilled water for 7 minutes, following instructions on the tea packaging. The tea was allowed to cool for 3 minutes before being given to each subject. Non-stimulated whole saliva was collected in the morning, 2 to 3 hours after breakfast, in a ventilated and well-illuminated room.

The subjects were requested to rest for 5 minutes, with their eyes open, without stimulating salivation, remaining comfortably seated, with their arms resting on their knees, and their heads lowered and facing slightly forward, between their arms. The participants rinsed their mouth with water before collection. They were instructed to swallow all the saliva present in the mouth and to allow new saliva to accumulate. For the next three minutes, the accumulated saliva was collected in a receptacle. The receptacles containing saliva were then weighed in the precision balance. The weight of saliva was computed by noting the difference in value of the saliva before and after collection.

The weight was then divided by the time of duration of the collection (5 min) and the flow rate was calculated in g/min, which is equivalent to mL/min, since over 99% of the saliva is composed of water. The mean salivary flow rate was computed by dividing the amount of saliva in mL, with the time of duration of the collection. The foam was not measured, only the saliva’s liquid component. The measurement of salivary flow before and after drinking the black tea was recorded.

The researcher gathered the saliva of subjects before and after drinking the black tea. The collected saliva samples were immediately subjected for estimation of the pH changes using a calibrated portable digital pH meter in combination with a glass electrode.

3. Statistical analysis

Comparative analysis of data is done using the following statistical tools:

Mean : This was used to get the average of the salivary flow rate and salivary pH samples. Standard Deviation : This was used to measure the dispersion, which depends upon the distance from the mean, with each of the responses on a distribution; the standard deviation is the measure of variability of the mean and is used in connection with that measure. P-value: The P value, or calculated probability, is the probability of finding the observed, or more extreme, results when the null hypothesis (H0) of a study question is true - the definition of ‘extreme’ depends on how the hypothesis is being tested. P is also described in terms of rejecting H0 when it is actually true, however, it is not a direct probability of this state.
4. Results

**Table 1** Salivary Flow Rate Before and After Drinking Black Tea

<table>
<thead>
<tr>
<th>Total number of Samples</th>
<th>Before drinking black tea ml/min</th>
<th>After drinking black tea ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>255</td>
<td>$\bar{x} =0.53$</td>
<td>$\bar{x} =0.56$</td>
</tr>
</tbody>
</table>

Table 1 shows the subjects’ salivary flow rate before and after drinking black tea. It shows that before drinking black tea of the subjects, most of the salivary flow rate is in the normal range, with mean average of 0.53. After drinking black tea, the salivary flow rate increased with the mean of 0.56. It reveals that black tea increases the salivary flow rate.

**Table 2** Comparison of Salivary Flow Rate Before and After Drinking Black Tea

<table>
<thead>
<tr>
<th></th>
<th>$\bar{x}$</th>
<th>SD</th>
<th>P-value</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before drinking</td>
<td>0.53</td>
<td>0.09</td>
<td>0.013&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td>After drinking</td>
<td>0.56</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows comparison between measurements of salivary flow rate before and after drinking the black tea. Upon drinking the black tea, the salivary flow rate increased. The computed P-value is 0.013 reveals that statistically there is a significant difference before and after drinking black tea on salivary flow rate.

**Table 3** Salivary pH Level Before and After Drinking Black Tea

<table>
<thead>
<tr>
<th>Total number of Samples</th>
<th>Before drinking black tea</th>
<th>After drinking black tea</th>
</tr>
</thead>
<tbody>
<tr>
<td>255</td>
<td>$\bar{x} =6.04$</td>
<td>$\bar{x} =6.13$</td>
</tr>
</tbody>
</table>

Table 3 shows the subjects’ the salivary pH level before and after drinking black tea. After drinking the black tea, the pH level of saliva increased. Before drinking the black tea, the pH level of the subjects were in normal levels with the mean average of 6.04 while after drinking black tea, the pH level increased with the mean of 6.13 This shows that black tea can increase the pH level of saliva. But subject’s salivary pH still remained within the normal range.

**Table 4** Comparison of Salivary pH Level Before and After Drinking Black Tea

<table>
<thead>
<tr>
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<th>$\bar{x}$</th>
<th>SD</th>
<th>P-value</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before drinking</td>
<td>6.04</td>
<td>0.55</td>
<td>0.0004&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td>After drinking</td>
<td>6.13</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4 shows Comparison of Salivary pH Level Before and After Drinking Black Tea. The computed P-value is at significant level of 0.0004 reveals that statistically there is a significant difference before and after drinking the black tea on pH level of subject’s saliva.

5. Conclusions

Black tea is capable of increasing salivary pH and flow rate. Consuming it in moderation can help individuals protect their mouths from bacteria. People who are experiencing dry mouth can try drinking black tea to help stimulate saliva flow.

Conflicts of Interest: I testify that this material has not been published in whole or in part elsewhere; the manuscript is not currently being considered for publication in another journal; and the author holds himself responsible for its content.

References