Determination of suitable palate cleanser for spicy tom yum soup

KEYWORDS: palate cleanser, tom yum, spiciness, capsaicin, mouth-burn, milk and sucrose.

Abstract

Palate cleansers are required in sensory tests as they help improve the accuracy for sensory responses, especially for foods containing strong flavour. The objective of this study is to determine a suitable palate cleanser strategy for evaluating basic tastes on reduction of spiciness. The untrained judges rated the spiciness of three levels of spicy tom yum soup before and after using five palate cleanser strategies, water, bread, unsweetened milk, 10 percent sucrose and nothing. One palate cleanser strategy was used per session, thus the judges performed a total of five sessions. All of the palate cleanser strategies have shown to exhibit the ability to relief spiciness of the tom yum soups where milk was most effective. Thus, using milk as a palate cleanser strategy follow by a water rinse is considered to be one of the appropriate palate cleanser choices for spicy soup.

INTRODUCTION

There is a growing application of sensory studies in food products in which minimizing bias is one of the keys to obtain robust result. When conducting sensory experiments, judges are prone to bias, such as adaptation that could alter any perceived taste intensity of foods due to the residual taste/flavour left in the mouth. Accordingly, it is important to the judges to stabilize the oral cavity before evaluating each additional product. It could be done by using a palate cleanser, an important element in sensory evaluation which is commonly used to remove any residuals in the mouth before and during the sensory tests. It also neutralized the oral environment in order to minimize any sensory adaptation or error in sensory judgments. Several studies have shown the importance of palate cleanser for evaluating basic tastes, such as sourness and bitterness, as well as textural or mouth-feel attributes such as astringency. Generally, water is commonly used to rinse the mouth. However, water may not be suitable for certain products that contain chemical irritants such as those in spicy foods. Capsaicin is a compound commonly found in chili peppers which irritates the oral cavity causing mouth-burn. Such burn may affect the perceived taste intensity of products resulting in bias responses. An appropriate palate cleanser is needed in order to remove any residual spiciness so that the experiment in under a control situation and thus sensory responses would be less prone to error or context effects. In the past, research had focused on the effect of water, ethanol, fat, sucrose, and starch on reduction of burn from capsaicin. It is agreed that fat could lessen mouth-burn and that water is ineffective. Other studies have investigated on the effect of the basic tastes on mouth-burn. It was found that sucrose could lessen the spiciness of capsaicin, while sodium chloride and citric acid could not. However, inconsistent findings with regard to the effect of the basic tastes on reduction of spiciness were reported.

The discrepancies among past studies call for more research in this matter. Additionally, the effects of other common palate cleansers on relieving spiciness from capsaicin were not explicitly explored. This paper aims to compare the effectiveness of the palate cleanser strategies and determine the strategy that is most suitable for relieving spiciness from capsaicin containing in liquid-based products as tom yum soup.

MATERIALS AND METHODS

Participants

Thirty judges consisting of students and lecturers at Assumption University, Thailand, ages between 18-40 years old were invited to the sensory laboratory at Assumption University, Hua Mak Campus. They were selected based on good health, time availability, no aversion to spicy products, no allergy to dairy products and willingness to participate.

Sample preparation

Three instant tom yum pastes varying in the level of spiciness (low, medium, high) were used in this study. The samples were prepared according to the instructions labelled on the package. Each sample was stored in thermos to maintain the temperature at approximately 70ºC prior to serving. Five palate cleanser strategies were used, including water, bread, unsweetened milk, 10 percent sucrose and nothing. The selection of palate cleanser strategies were based upon one of the following reasons: their effectiveness in pain reduction of capsaicin solution documented in previous research and regularity of usage in sensory tests. The liquid palate cleansers were served at 10 ml portion in 1-oz plastic cup at room temperature, while bread, the solid palate cleanser were cut into 2x2 inches. When there is no palate cleanser (nothing) used, the judges were instructed to rest for five minutes before evaluating the spiciness of the sample.
Method
Each judge attended a total of five sessions, which were done with at least two days apart to minimize learning effects. Each judge used a single type of palate cleanser strategy per session and were asked to evaluate the spiciness of the three instant tom yum samples before and after using the palate cleanser by rating on a 10-point intensity rating (1=not very spicy; 5=moderately spicy; 10=very spicy). They were instructed to swallow at least two thirds of the sample before giving the ratings and to take five minutes break in between samples. The samples were served in a 1-oz glass cup labelled with 3-digit random number and the presentation order was randomized. The process was repeated until all five palate cleansers were tested. The presentation order of the palate cleansers followed a 5x5 Latin Square design, in which the order was counterbalanced to minimize any order effects.

Data analysis
Paired-sample t-test was used to evaluate the effectiveness of each palate cleanser for the three levels of spiciness. To determine the suitable palate cleanser in the discrimination of spicy tom yum soups, analysis of variance (ANOVA) and Fisher’s least significant difference (LSD) were used. A mixed model analysis of variance was used. Statistical analyses were performed using SAS 9.2 (SAS Institute, Cary, NC, USA).

RESULT AND DISCUSSION
The effectiveness of each palate cleanser strategy, water, bread, milk, 10 percent sucrose and nothing, as a medium for hot feeling reduction from consumption of spicy foods was investigated. Despite untrained judges were used in this study, all of them have shown to be able to distinguish the three levels of spicy tom yum soups. The spiciness rating scores for all three tom yum soups were in accordance to their spiciness levels. All palate cleansers used in this study showed a significant decrease in spiciness intensity across all spiciness levels (p<0.05) (Figure 1a, 1b and 1c). This suggested that the five palate cleanser strategies are effective in relieving spiciness of tom yum soups.

Yet, it is important to note that the amount of palate cleanser and the duration of time for using each palate cleanser strategies in this experiment did not remove all of the spicy sensation of tom yum soups across all three spiciness levels. The finding from Hutchinson et al. (1990) suggested that the burning sensation from capsaicin could be reduced when there were foods in the mouth and that rice was effective in relieving the burn due to a strong tactile sensation it produced. It was observed in this study that as the spiciness level increase, the greater reduction in spiciness intensity scores was shown. The average reduction in spiciness intensity scores were 1.7, 2.3, and 2.8 for low, medium, and high spiciness level, respectively. To be able to obtain the most accurate sensory responses with less error, however, it is necessary to compare the five palate cleanser strategies. The effect of different sources of variation was investigated and shown in Table 1. The interaction between order and palate cleanser is not significantly different (p=0.35), indicating that there were not significant occurrence of carry-over effect or adaptation. The interaction between palate cleanser and level of spiciness is not significantly different (p=0.90), indicating that sample discrimination were not significantly different when using each palate cleanser strategies among levels of spiciness. The appropriate palate cleanser for spicy sample discrimination was determined. There was a significant difference in the palate cleansers for all the samples varying in the level of spiciness (p<0.01). Table 2 showed the mean spiciness scores of each sample with respect to the palate cleanser used. The trend in the effectiveness of palate cleanser strategy was the same for low and high spiciness levels, in which milk resulted in a greater reduction of spiciness intensity in tom yum soup, followed by 10 percent sucrose solution, bread, nothing and water. The trend of spiciness reduction for medium spiciness level was slightly different, in which 10 percent sucrose resulted in the greatest reduction in spiciness intensity, followed by milk, bread and nothing resulted in a tie, and lastly, water.
percent sucrose solution was as effective as milk in relieving spiciness of tom yum soup. Nasrawi and Pangborn (1990) determined that 10 percent sucrose at 20°C and milk of 5°C were equally effective in reduction of mouth-burn caused by capsaicin. The reduction effect caused by sucrose cannot fully be explained. It was suggested, however, that sucrose could induce context effect such that sweetness from sucrose stimulate pleasure, which then suppressed the irritation caused by capsaicin (7). They further suggested that sucrose could have a competitive inhibitory effect on capsaicin that prevents the molecule to bind to its chemoreceptors.

CONCLUSION

All palate cleanser strategies used in this experiment showed a significantly reduction in spiciness caused by capsaicin. Milk and 10 percent sucrose were found to be the most appropriate palate cleanser for tom yum soup regarding their effectiveness in spiciness relief. Nonetheless, milk and sucrose solutions could leave flavor and sweet taste, respectively, in the oral cavity. Thus, it is recommended to rinse the mouth with water after applying such palate cleansers in order to minimize the residual flavor and taste that could affect judges’ sensory ratings. Other palate cleanser strategies like bread and water, which were commonly used in sensory experiments, were not effective in relieving burn from capsaicin.

There are a few limitations to this study. Firstly, the palate cleanser strategies were not able to restore the oral environment to its normal base line. Secondly, this study focused only the effect of different palate cleanser strategies in relieving spiciness in spicy food and did not take into account other sensory attributes. The reason was spiciness, compared to other sensory attributes, is lingering and can vastly affect consumer preference. The effect of other sensory attributes such as sweetness, sourness and other flavor attributes in the oral environment would likely be removed by using water rinse which is commonly used in many sensory tests. Yet, further study is necessary to ensure the most appropriate palate cleanser for spicy foods. That is, the experiment should include other sensory attributes that are important for consumer acceptance and should conduct on several different spicy foods. Choosing an appropriate palate cleanser for foods containing irritants such as tom yum soup would elicit more accurate sensory responses.

It is important to note that the effectiveness of milk and 10 percent sucrose was not significantly different (p>0.05) despite a lower mean spiciness intensity observed when milk was used as a palate cleanser. Bread, water and no palate cleanser were not significantly different (p>0.05) and their ability to relief spiciness were inferior to that observed with milk and 10 percent sucrose. According to the observation, none of the palate cleanser strategies were able to restore the oral environment to “zero” or the base line where no spiciness is present in the mouth. This was due to the limitation in the design of the study. It is hypothesized that the oral environment could return to its normal state if time permits or a greater amount of palate cleansers were given to the judges in order to remove the lingering spiciness. Further investigation is needed on this matter. As a matter of fact, a complete removal of spiciness is ideal of sensory tests, but if taking constraints in sensory tests in industrial settings into account a complete removal of spiciness may be subjected to longer time and higher cost in conducting an experiment.

The spiciness in tom yum soup was mainly due to the presence of capsaicin compound found in chili, one of the important ingredients in tom yum soup. Capsaicin is a hydrophobic molecule, which would tend to dissolve in fat-containing palate cleanser medium as milk. It was evident that the responses to burn from capsaicin decreased as fat content increased (11) and a research indicated that butter was effective at reducing burn from capsaicin (8). Similar findings were supported by Carden et al. (1999). Water appeared to be least effective in relieving spiciness because instead of binding and dissolving capsaicin molecules, the polarity of water cause capsaicin to disperse throughout the oral cavity, causing the burn sensation to remain. The detection threshold of capsaicin in water-based system was lower than in oil-based system (10), which suggested that foods containing higher oil or fat content would tend to be more effective in the reduction of burn sensation from capsaicin. The current study suggested that 10 percent sucrose solution was as effective as milk in relieving spiciness of tom yum soup. Nasrawi and Pangborn (1990) determined that 10 percent sucrose at 20°C and milk of 5°C were equally effective in reduction of mouth-burn caused by capsaicin. The reduction effect caused by sucrose cannot fully be explained. It was suggested, however, that sucrose could induce context effect such that sweetness from sucrose stimulate pleasure, which then suppressed the irritation caused by capsaicin (7). They further suggested that sucrose could have a competitive inhibitory effect on capsaicin that prevents the molecule to bind to its chemoreceptors.

REFERENCES AND NOTES


<table>
<thead>
<tr>
<th>Sources of variation</th>
<th>F-value</th>
<th>p-value</th>
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<tbody>
<tr>
<td>Palate cleanser</td>
<td>6.74</td>
<td>&lt;0.01</td>
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<tr>
<td>Level of spiciness</td>
<td>35.35</td>
<td>&lt;0.01</td>
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<tr>
<td>Order</td>
<td>0.43</td>
<td>0.90</td>
</tr>
<tr>
<td>Palate cleanser x Level of spiciness</td>
<td>0.43</td>
<td>0.90</td>
</tr>
<tr>
<td>Palate cleanser x Order</td>
<td>1.11</td>
<td>0.35</td>
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<tr>
<td>Level of spiciness x Order</td>
<td>1.02</td>
<td>0.42</td>
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Table 1. Analysis of variance showing the sources of variation for reduction in spiciness.

<table>
<thead>
<tr>
<th>Palate cleanser</th>
<th>Low spiciness</th>
<th>Medium spiciness</th>
<th>High spiciness</th>
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<tbody>
<tr>
<td>Water</td>
<td>2.2</td>
<td>2.7</td>
<td>4.1</td>
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<tr>
<td>Bread</td>
<td>1.8</td>
<td>2.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Milk</td>
<td>1.0</td>
<td>1.9</td>
<td>2.5</td>
</tr>
<tr>
<td>10% sucrose</td>
<td>1.4</td>
<td>1.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Nothing</td>
<td>1.9</td>
<td>2.1</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Table 2. Comparison of the mean spiciness scores of tom yum soups after using each palate cleanser.

Note: Different superscripts denotes significant differences (p<0.01).