EVALUATION OF CRYSTALLINE AND NON-CRYSTALLINE CANDIES

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NTR 502: Lab 18 - Candy

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INTRODUCTION

Candy can be classified into two categories: crystalline and non-crystalline. Crystalline candies have an organized sugar structure that is characterized by its smooth, soft, and easy to bite texture such as fudge or fondant. A sugar that exists in a solution without a crystalline form is known as non-crystalline, or amorphous, candies. Examples of these are peanut brittle and toffee.

Carefully controlled crystal formation is necessary to obtaining the desired textures of a crystalline or non-crystalline candy. The texture of these candies is dependent upon the concentration of the sugar solution, which depends on a higher boiling point. The higher temperature allows more sugar to be held in solution. A greater sugar concentration results in a harder candy. On the other hand, a lower boiling point leads to a less concentrated solution and a softer candy (McWilliams, 2012, 147).

The agitation of a sugar solution when candy making is an important of proper crystallization. Once a sugar solution has reached the desired boiling point, it is cooled and left undisturbed until a specific temperature is reached. This allows the solution enough time to become more supersaturated and viscous. It is at this time that the mixture must be beaten in order to break up the crystals into small pieces that prevent a gritty texture (McWilliams, 2012, 149).

Most candy recipes often include other ingredients that alters the characteristic of the finished product. For instance, the addition of fat, in the form of cream or butter, to a saturated sugar solution interferes with the formation of crystals and provides a more velvety texture as seen in fudge. Acid is another ingredient that can be added to candies. The presence of cream of
tartar, for instance, hydrolyzes sucrose into its monosaccharides. This also promotes a soft candy (McWilliams, 2012, 148). The higher proportion of interfering agent in a solution, the lower the amount of crystallization occurs. The purpose of this lab experiment is to evaluate the physical characteristics of a selection of five crystalline and amorphous candies. Our results will help us understand the effects of the crystallization of sugar of a solution and how concentration, temperature, agitation, and interfering agents can affect the desired final product.

**METHODS**

The selected candies were prepared and evaluated according to Walter and Beathard’s *Understanding Food: Principles and Preparation* (Walter and Beathard, 2011, 231-242), with some modifications. Parts A-b, E, G, H were omitted from our procedure. In Part D, we omitted the preparation of the non-crystalline candy with sugar substitute. We also omitted the cold water test from all performed experiments.

**RESULTS**

As show in Table 1, the selected candies were evaluated for appearance, flavor, and texture. The candies that were heated to a higher final temperature were found to be the hardest candies. The lollipop, peanut brittle, and toffee were all heated above 300 F and contributed to a harder texture. Conversely, the fudge and fondant had a final temperature of less than 240 °F, which resulted in a softer, smoother texture.

Fudge was prepared with a control group and a modified temperature. The fudge control group was prepared without any variations to the recipe, The modified fudge was prepared
according to the recipe with the exception of being beaten when the solution cooled to 176 ºF, which is 56 F warmer than the control. This change in temperature of agitation resulted in a gritty and crumbly product.

Similarly, two fondant recipes were prepared with one being the control and the other was prepared without the presence of an interfering agent by omitting corn syrup. The fondant prepared with the interfering agent was more smooth than the variable product.

<table>
<thead>
<tr>
<th>Type</th>
<th>Candy</th>
<th>Final Temperature (ºF)</th>
<th>Condition</th>
<th>Appearance</th>
<th>Flavor</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline</td>
<td>Fudge</td>
<td>234</td>
<td>Beating Temperature - 120 ºF</td>
<td>Glossy, smooth</td>
<td>Sweet, more chocolate flavor</td>
<td>Smooth, velvety</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>234</td>
<td>Beating Temperature - 176 ºF</td>
<td>Dry, lumpy</td>
<td>Sweet, less chocolate flavor</td>
<td>Gritty, crumbly</td>
</tr>
<tr>
<td>Fondant</td>
<td></td>
<td>238</td>
<td>With Corn Syrup</td>
<td>White, smooth, rounded</td>
<td>Sweet</td>
<td>Smooth, velvety, more viscous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without Corn Syrup</td>
<td>Off white, smooth</td>
<td>Sweet</td>
<td>Gritty, less viscous</td>
</tr>
<tr>
<td>Non-Crystalline</td>
<td>Lollipop</td>
<td>310</td>
<td>With Granulated Sugar</td>
<td>Transparent, glassy</td>
<td>Sweet, raspberry</td>
<td>Hard, brittle</td>
</tr>
<tr>
<td></td>
<td>Peanut Brittle</td>
<td>306</td>
<td>-</td>
<td>Tan, opaque, bubbles</td>
<td>Buttery, sweet</td>
<td>Brittle, crunchy.</td>
</tr>
<tr>
<td></td>
<td>Toffee</td>
<td>300</td>
<td>-</td>
<td>Light brown, translucent, glassy</td>
<td>Less buttery, sweet</td>
<td>Hard, crunchy.</td>
</tr>
</tbody>
</table>
The selected crystalline candies prepared in this experiment, fudge and fondant, both exhibited smooth and velvety textures in the control group. The fudge prepared with the modified beating temperature of 176 °F, resulted in a gritty and crumbly product. This occurred because we did not allow the solution to become supersaturated and viscous enough, so when we beat it to break up the crystals, they solution was still able to form crystals. The premature beating lead to the formation of crystals which resulted in a gritty texture. When compared to the characteristics of the fudge cooled to 120 °F, we can see how important it is to supersaturate the solution and not agitate the crystals prematurely. The fondant prepared without corn syrup, the interfering agent, also resulted in a gritty and undesirable product. This occurred because the viscous quality of the corn syrup was not present to prevent the sucrose molecules from aligning and forming large crystals. This proves the influence that corn syrup and other interfering agents have on texture of a final product.

The higher final temperatures of the sugar solutions correlated with a harder texture that was glassy in appearance. This was the expected result since a higher boiling temperature leads to a more concentrated solution, and therefore a harder candy which one of the characteristics of non-crystalline candy. A relatively large amount of interfering agents were incorporated into each of the non-crystalline recipes in order to further prevent the formation of crystals. The lollipop used corn syrup as an interfering agent. Corn syrup works by making the solution more viscous and preventing the sucrose molecules from moving around to form a crystalline structure. The peanut brittle and toffee used corn syrup and butter to inhibit crystal formation. The presence of a fat inhibited crystallization by coating the sucrose molecules to make it difficult for the molecules to associate.
Overall, this experiment proved to be a success. All of our final products were able to have all of the physical characteristics expected based on the conditions we set.

CONCLUSION

The purpose of this experiment was to evaluate five selected crystalline and non-crystalline candies based on their appearance, flavor and texture. We found a correlation between temperature, concentration, agitation, and interfering agents. We found a correlation between a higher final temperature of the sugar solutions and how it relates to a hard texture based on the degree of the supersaturation of the final product. We also found how properly timed agitation and presence interfering agents affect texture resulting in a more desirable product.