Characteristics of Crystalline vs. Non-Crystalline Candy

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Introduction

There are two different categories in which candies can be classified under: crystalline and non-crystalline. Crystalline candy includes fudge and fondant, whereas noncrystalline candy consists of lollipops, toffee, and caramel. These crystalline versus non-crystalline characteristics are influenced by different ingredients as well as preparation techniques. Ingredients, rate of cooking, concentration of sugar, conditions of cooling, and degree of agitation all influence whether a candy is crystalline or noncrystalline (Walter & Beathard, 2011, p. 231). Candy must be prepared carefully with attention to detail in order to create the right product. Crystalline candy involves dissolving the sugar, concentrating the solution, supersaturating the solution, and controlled crystallization (Walter & Beathard, 2011, p. 231). A super saturated solution contains more solute than is able to be dissolved at that temperature (McWilliams, 2012, p. 116). After heating crystalline candy to its final temperature, it is cooled until a specific temperature and then it must be agitated or beaten in order to incorporate air. This promotes formation of many nuclei by redistributing ingredients, and it breaks up large crystals.

Non-crystalline candy is formed due to the presence of an interfering agent, such as fat, milk solids, and acid, which keep sucrose crystals small. In addition to the interfering agent, in order to ensure that no crystals are formed, the substance must be heated to a high degree so that the solution is viscous and the molecules are unable to move, and no beating or agitation to form nuclei for crystals (Walter & Beathard, 2011, p. 231).

In this experiment, fudge, fondant, lollipops, brittle, and toffee were prepared and the ingredients, cooking time, final temperature, potential interfering agents, taste and texture were evaluated. The purpose of the present experiment was to cook the five different candies in order to distinguish between crystalline and noncrystalline properties during preparation.

Methods

All aspects of the following procedures were adapted from *Understanding Food Principles and Preparation* fourth edition by Walter and Beathard (2011). All recipes used were doubled. Part B, preparation of fondant on page 235, only variation one was completed. Part C, preparation of fudge on page 236, both variations were completed. Part D, preparation of non-crystalline candy on page 237, only variation one was completed. The flavors that were used were raspberry and orange. Green food coloring was used with the raspberry flavor and orange food coloring was used with the orange flavor. Part F-a, peanut brittle on page 239, was completed with the peanuts being omitted. Lastly, part F-b, toffee on page 239, was completed in the final experiment.

Results

As shown in Table 1, crystalline candies, fondant and fudge had a final temperature of 238 and 234 degrees Fahrenheit, respectively. The fudge that was agitated while it was still hot (176 degrees Fahrenheit) had a grainy texture.

Table 1: Characteristics of Crystalline Candy

Candy	Final Temperature (^{O}F)	Taste/Flavor	Texture	Appearance
Fondant	238	Sweet	Smooth, some crystals	White
Fudge (176^{O}F)	234	Grainy	Grainy, gooey	Brown
Fudge (120^{O}F)	234	Sweet	Smooth,	Brown

As shown in Table 2, non-crystalline candy had a final temperature above 300 degrees Fahrenheit and no crystals were present in the final product. Lollipops had a final temperature of 310 degrees Fahrenheit, brittle had a final temperature of 306 degrees Fahrenheit, and toffee had a final temperature of 300 degrees Fahrenheit.

Table 2: Characteristics of Non-Crystalline Candy

Candy	Final Temperature (^{O}F)	Taste/Flavor	Texture	Appearance
Lollipops	310	Sweet, Raspberry	No crystals, hard	Shiny, translucent
Brittle	306	Not as sweet as toffee	Lighter than toffee, hard	Opaque, brown
Toffee	300	Buttery/sweet	Smooth, hard	Glossy, brown, opaque

Discussion

The results from the present experiment show that there are many different characteristics between crystalline and non-crystalline candies. The crystalline candies, fondant and fudge, had a lower final temperature and a lower percentage of concentration of sugar. The fudge and fondant were stirred after supersaturation is reached because this stirring breaks up crystals and redistributes interfering agents that disrupt the crystallization (McWilliams, 2012, 149). The two different fudge mixtures were a good example of this process because both fudge experiments were heated until 234 degrees Fahrenheit; however, one was cooled to 176 degrees Fahrenheit before beating the mixture occurred and the was cooled to 120 degrees Fahrenheit before beating. The fudge that was being mixed at 176 degrees Fahrenheit still has enough heat to form crystals, which results in a grainy texture because of the premature crystallization. Therefore, beating the fudge at 120 degrees would obtain a creamy and smooth texture, ideal for fudge.

The fondant was heated to a similar temperature as the fudge, and the texture was somewhat similar because it was smooth, creamy, and very sweet.

The non-crystalline candies had a higher final temperature due to the concentration of sugar, which raised the boiling point. Then, as water evaporates, the solution becomes more

concentrated, which raises the temperature more. The lollipop solution was heated until 310 degrees Fahrenheight, and then it was quickly removed from heat and placed on the cookie sheet and was ready for consumption. When it was removed from heat, this was the hard crack stage, where the solution is very thick and the molecules are unable to move due to the interfering agents. There was a high concentration of corn syrup in the solution, which acted as the interfering agent. Corn syrup is an interfering agent because it is an invert sugar, which means that glucose and fructose are unable to form sucrose during the cooking process as they are with crystalline candy.

Similar to the lollipops, brittle are toffee are also not agitated during the cooling process because that would allow for the formation of crystals. The interfering agent in brittle and toffee is butter and corn syrup. Butter, which is a fat, inhibits crystal growth by coating small sucrose crystals as they form, which makes it difficult for more sucrose molecules to attach to existing crystals (Walter & Beathard, 2011, p. 231). The biggest difference between brittle and toffee is the addition of baking soda. This causes a reaction with the sugar acids and baking soda creates carbon dioxide, giving it a lighter texture than toffee because there are air pockets. Overall, the addition of interfering agents, higher final temperature, and lack of agitation allowed for the non-crystalline candy formation.

References

McWilliams, M. (2012). *Foods: Experimental perspectives* (7th edition). Upper Saddle River, NJ: Prentice Hall.

Walter, J. & Beathard, K.. (2011). *Understanding food principles and preparation lab manual* (4th edition). Belmont, CA: Cengage Learning.