Title: The Effect of Sugar Substitutes on Chocolate Chip Cookies.

Abstract:

Using sugar substitutes in baking has many health benefits for people with health issues that require special diets, such as diabetes. Sugar substitutes can be a way to watch their calorie intake and still enjoy the same sweet flavor of sugar (Sweet Choices-Sugar Substitutes).

In my experiment, I substituted honey, splenda, and refined fructose for sugar in chocolate chip cookies. I used two objective methods to evaluate my cookies which were the texture analyzer and the colorimeter. For my sensory evaluation, I used a 7-point consumer preference hedonic scale.

Splenda was the darkest cookie according to the colorimeter results. Most people thought that the cookies made with splenda had the best taste.

The cookies made with refined fructose weren’t that much lighter or darker than honey or sugar. Most people did not like the cookies made with refined fructose.

The cookies made with honey were the moistest. Most people thought that the cookies made with honey were good, but some did not like them as much as the cookies made with splenda because you can taste the honey in the cookies.

There are many benefits to using sugar substitutes in foods, such as less calories, not as bad for your teeth, and do not affect insulin metabolism which is important for people with diabetes (Hermesetas, Aug. 22, 2005). Therefore, it is important to find which sugar substitute gives the best quality cookie.

Introduction:

Using sugar substitutes in place of sugar in cooking has many health benefits for people with special diet needs, such as with diabetes. Sugar substitutes also have fewer calories, are not as bad for your teeth, and aren’t counted as carbohydrates in your meal plan (Sweet Choices-Sugar Substitutes).

In cookies, sugar is not only a sweetener but it has many other functions. Sugar helps maintain moisture and tenderness by drawing water to itself, contributes to browning by absorbing heat, adds bulk, and helps increase cookie volume (American Dietetic Association Complete Food and Nutrition Guide).

Sugar is involved in the browning cookies in a reaction called maillard browning. The maillard reaction is a type of non-enzymatic browning reaction that involves simple sugars (carbonyl groups) and free amino acids in the presence of heat to produce the brown melanoidin pigments (C.G.A. Davies & T.P. Labuza).

Sugar adds to the tenderness of baked goods by competing for water. Water and flour are mixed to produce gluten, and when sugar is present it attracts water to itself and decreases gluten formation, producing a more tender product (James R. Daniel, Ph. D.- Food Chemistry Lecture Notes).
Since Sugar is so important to the quality of cookies, studying how sugar substitutes affect texture, color, and flavor is important in finding which one gives the same quality from using sugar.

The goal of this experiment is to find which sugar substitutes give the best quality cookie.

In this experiment, sugar is the control. The independent variables in this experiment are honey, splenda, and refined fructose. All of the dependent variables stay the same for each independent variable and are in the list of ingredients.

Methods:
Sugar is the control for this experiment. The independent variables are honey, splenda, and refined fructose. All of the dependent variables were the same for each trial.

Follow this procedure to bake the chocolate chip cookies: First wash your hand and preheat the oven to 350 degrees. Then get all of the ingredients ready to begin. To begin cooking, first get a large mixing bowl and mix butter and sugar together until light. Next, beat the eggs and vanilla into the mixture. Begin to sift together the flour, salt, baking powder, and baking soda into the mixture blending it well. Next, stir in the chocolate chips into the mixture. Now shape the cookie dough into balls about 1 ½ inches in diameter and place two inches apart on an ungreased cookie sheet. Bake the cookies in the already preheated oven at 350 degrees from 8 to 10 minutes, or until edges are light brown. Finally, remove the cookies from the cookie sheet when they are done to compare and analyze with the other cookies (Rattray, Diana).

This procedure will be done a total number of four times. One time for the cookie formula with sugar which is the control and three more times for each of the sugar substitutes. Each different sweetener will be added in the procedure where it says to mix sugar with butter in a large bowl.

- Substitute ¾ cup of honey for every cup of sugar (Lauterbach, Sharon).
- Substitute 1 cup of splenda for every cup of sugar (Sugar and sugar substitutes in your holiday cooking).
- Substitute 2/3 cup of fructose for every cup of sugar (Lauterbach, Sharon).

Recipe:
1 cup butter
¾ cup granulated sugar (or sugar substitute)
1 ¼ cups brown sugar
2 eggs
2 teaspoons vanilla extract
2 ½ cups all-purpose flour
¾ teaspoon salt
1 teaspoon baking powder
1 teaspoon baking soda
2 to 3 cups of chocolate chips

Hedonic Scale
Sample:

Very Good Taste  Very Bad Taste
-I had all of my roommates and friends sample my cookies using this sensory hedonic scale. This way I could keep the same people sampling my cookies consistent for each trial.

-My two objective methods of analyzing my cookies were the texture analyzer and the colorimeter. I used a 7-point consumer preference hedonic scale as my sensory method.

Discussion:
In my experiment, splenda did not give the bulk to the cookie like sugar did. This could be because splenda will not activate yeast, so they will not rise as much as they normally would with sugar(Cooking and Baking Tips). Splenda gave the darkest cookie compared to the other sugar substitutes. This could be because cookies made with splenda may bake more quickly than they normally would with sugar and the cooking temperature and time remained consistent for each sugar substitute(Cooking and Baking Tips). The cookies made with splenda gave the taste that most people preferred in the sensory evaluation.

Refined fructose were more moist than the cookies made with sugar, this could be because fructose attracts more water than sugar and tend to be more moist(Sugar and Sugar Substitutes). Refined fructose should make the cookies darker than cookies made with sugar(Sugar and Sugar Substitutes). From the colorimeter results the refined fructose cookies were a little darker than those made with sugar. The cookies made with refined fructose gave the taste that most people liked compared to the other sugar substitutes.

The cookies made with honey were more moist and tender than the other cookies made with sugar substitutes. Cookies made with honey are moist and should be darker than cookies made with sugar but from the colorimeter results they were not as dark(Sugars-The Cook’s Thesaurus). This could be because they were baked for the same time and temperature as sugar and the other sugar substitutes. If allowed to bake longer they may have been darker.

The cookies made with honey seemed to soften the longer that they were kept. According to Vodrey, S. Catherine in the article Cookie Chemistry 101, cookies made with honey soften the longer you keep them. The cookies made with honey do have a distinct flavor and you can taste the honey in the cookies(Sugar and Sugar substitutes).

There are many benefits to using sugar substitutes in foods, such as less calories, not as bad for your teeth, and do not affect insulin metabolism which is important for people with diabetes(Hermesetas, Aug. 22, 2005). Therefore, it is important to find which sugar substitute gives the best quality cookie.

Results:
My results for the Calorimeter: These tables show that splenda had the greatest absorbance out of all the sugar substitutes.
My Results for the texture analyzer: These tables show that sugar has the greatest force to puncture the cookie. Splenda has the greatest force compared to the other sugar substitutes.
My results for the 7-point consumer preference hedonic scale are averages that show splenda gives the taste that most people preferred out of the sugar substitutes.
Bibliography:


James R. Daniel, Ph. D. Food Chemistry 453 Lecture Notes. Department of Foods And Nutrition Purdue University West Lafayette, IN 47907.


