Creating High Quality Brownies Using Alternative Sweeteners

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ABSTRACT

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The purpose of this study was to test the effects of alternative sweeteners on the tenderness, flavor, and aftertaste of standard brownies. The variations used were sucralose, xylitol, and fructose. The variations replaced the sucrose as a whole and were not blended in any way. The study was done in the Miami University dietetic laboratory. The brownies were prepared according to a standard Betty Crocker Cookbook recipe, with no modifications to the actual procedure. The brownies were then objectively tested for tenderness using the Texture Analyzer, TA.XT21. The reliability and validity were ensured by testing three samples on three different days of each variation. The reliability and validity were also made certain by following the exact same procedure each of the three days. The brownies were baked at the same time and in the same oven for the same amount of time. The brownies were subjectively tested by a panel of five semi-trained Miami University dietetic students using a high quality brownie scoresheet. Each panelist was presented with three samples in varying order on each of the three testing days. Each panelist scored the brownies and the means of the scores were used for data. The panelists assessed crust appearance, air cell size, tenderness, flavor, and lack of aftertaste. To ensure reliability and validity the panelists were not aware of the variations and each was only offered a white plate displaying the brownies and a glass of room temperature water. After all of the data was compiled the results were analyzed based on if it was objective or subjective. The objective data gained from the Texture Analyzer concluded that the brownies containing xylitol were the most tender. The subjective data gained from the sensory panel concluded that the flavor, tenderness, lack of aftertaste, and crust appearance of the brownies containing fructose were the most desirable. The air cell size was uniform across all the variations. The best quality brownie was determined to be the brownies containing fructose, although they were still not considered high quality as determined by the professor.

INTRODUCTION

Type 1 and Type 2 Diabetes Mellitus are increasingly prevalent health concerns in the United States. Every year over thirteen thousand young adults are diagnosed with Type 1 Diabetes (CDC, 2011). Many of these cases only become diagnosed after an incidence of diabetic ketoacidosis. After being diagnosed, diabetics must restructure their diets and look for alternatives to granulated sugar, or sucrose. By changing the basic ingredients in products, diabetics may find favorite foods are no longer as high quality as desired. If alternatives are not utilized and too much sugar or carbohydrates are taken diabetics run the risk of many complications, some of which can be life threatening. Some of these complications include vision loss or impairment, compromised circulation, increasing risk for chronic kidney disease, and neuropathy. (Bantle, 2009)

Traditional foods need to be altered for diabetics based on the amount of carbohydrates. If there are too many carbohydrates the individual runs the risk of increasing blood glucose to dangerous levels. Typically, a baked good product, such as brownies, contains sucrose which is a combination of glucose and fructose. Ingesting too much sucrose greatly affects glucose metabolism, so sucrose alternatives must be utilized in food products used by diabetics.

Altering the type of sugar in a baked good product poses many challenges. In brownies, sugar is typically used for tenderization, bulking, and flavor. In brownies, sugar competes with protein for moisture which slows gluten development. If sugar is reduced by more than one-third the original amount there is a risk of impaired browning, and loss of tenderness, moisture, and sweetness. (McGee, 1984)

Brownies are typically made with granulated sugar, because it helps maintain the high moisture content, as well as tenderness, and the characteristic sweet flavor. Sucrose is the most common form of sugar, but there are many other alternatives used in the consumer and commercial market. The problems associated with sucrose are that it has a high glycemic value, and must be consumed in minimal quantities by diabetics. Excessive sucrose can also lead to dental caries and other adverse dental conditions.

One of the alternatives to sucrose is polyols. These are sugar alcohols that are naturally occurring and provide some nutritive value. Examples of sugar alcohols are xylitol and erythritol. Both are noncariogenic, which means they combat the formation of dental caries. These products are meant for diabetes management and are often used in either a sugar alternative blend, or as a pure product. The major problem that is encountered when using these sugar alcohols is that there is a lingering bitter aftertaste. For products such as brownies, these sucrose alternatives can be used, because they are all heat stable and suitable for baking.

The sweet flavor can be maintained through the use of another sucrose alternative, called fructose. Frustose is a naturally occurring sugar found in fruits and vegetables. It is commonly seen by consumers in the form of high fructose corn syrup, but does come in a powdered form that is acceptable for baking (Bantle, 2009). Fructose would work well in the baking process of brownies because it is a hygroscopic substance. Hygroscopic substances pull moisture from the environment, so the brownies would maintain both the flavor and moisture of typical brownies made from granulated sugar. Potential problems of fructose are that it does not brown as well when baking, so color may become an issue, and that volume can be sacrificed because of its hygroscopity (McGee, 1984).

Statement of the Problem

The purpose of this study was to create a high quality brownie that had a low glycemic index utilizing alternative sweeteners.

Hypotheses

Three hypotheses were developed for this study:

1. The brownies made with xylitol will have the best flavor.
2. The brownies made with sucralose will have the least aftertaste.
3. The brownies made with pure fructose will be the most tender.

Definition of Terms

Fructose: An optically active sugar C6H12O6 that differs from glucose in having a ketonic rather than aldehydric carbonyl group. Provides 4 kcal/g. (MediLexicon, 2006)

Glucose: An optically active sugar C6H12O6 that has an aldehydic carbonyl group. The sweet colorless soluble dextrorotatory form that occurs widely in nature and is the usual form in which carbohydrate is assimilated by mammals. Provides 4 kcal/g.(Stedman's, 2006)

Splenda: Brand name of sucralose, C12H19Cl3O8. Noncaloric and not recognized by the body as carbohydrate. Generally regarded as safe for use during pregnancy, for diabetics, and children. Provides 0 kcal/g. (Splenda, 2012)

Sucralose: A white crystalline powder, C12H19Cl3O8 that is derived from sucrose by the chemical substitution of three chlorine atoms for three hydroxyl groups. Used as a low-calorie sweetener, having a sweetness of much greater intensity than sucrose, 600 times. Provides 0 kcal/g. (Medline, 2012)

Sucrose: A sweet crystalline dextrorotatory nonreducing disaccharide sugar, C12H22O11 that occurs naturally in most plants and is obtained commercially from sugar cane or sugar beets. Provides 4 kcal/g. (MediLexicon, 2008)

Xylitol: A crystalline alcohol C5H12O5, that is a derivative of xylose. Obtained naturally from birch bark, and is used as a sweetener, with sweetness equal to sucrose. Absorbed slowly by the body and has a negative heat of solution. Provides 2.4 kcal/g. (Merriam-Webster, 2012)

XyloSweet: Brand name of xylitol. Sweetest of all bulk sugar substitutes and is currently used in many sugar-free products. Prolonged use may reduced tooth decay. Contains only natural xylitol. Provides 2.4 kcal/g. (Xlear, 2012)

REVIEW OF LITERATURE

The use of artificial sweeteners is often cited when preventing complications associated with Type 1 or Type 2 Diabetes Mellitus. The goal of the artificial sweetener is to mimic the sweetness of granulated sugar, otherwise known as sucrose, while maintaining a low glycemic index. The glycemic index is a numerical scale used to indicate how fast and how high a particular food can raise the blood glucose level. A food with a low glycemic index will typically prompt a moderate rise in blood glucose, while a food with a high glycemic index may cause blood glucose levels to increase to dangerous levels. Sugars, such as those found in fruits and packaged sweeteners, can have high glycemic values.

In the brownie baking process sugar is a key ingredient for both the structure and flavor of the final product. Sugar has many structural and chemical components that aid the production of a quality brownie (Mariotti, 2012). A high quality brownie contains two distinct textures. The outside crust should be crisp, while the inside is dense and moist, with a crumbly, cake-like grain and a rich, fudgy center. The flavor should be rich, sweet, and chocolaty, with no bitter aftertaste.

Sugar substitutes or alternatives often have a very low glycemic index and are intended for diabetics. A sugar substitute may be any sweetener used instead of sucrose. Some are manmade and others occur naturally. Removing sugar from the diet is a solution to controlling high blood glucose levels that often plague diabetics. However, the consumer needs to be aware that some artificial sweeteners still contain carbohydrates and must be taken into account while carbohydrate counting.

The Food and Drug Association (F.D.A) has approved many sugar substitutes and are Generally Regarded as Safe (GRAS). These include sucralose, sugar alcohols, and natural sweeteners (Mariotti, 2012).

Sucralose is made from sucrose but does not have a profound effect on raising blood glucose levels. Sucralose is six-hundred times sweeter than sucrose. The body cannot absorb sucralose so it does not add any calories. This product is heat stable and has a prolonged shelf life. Sucralose can be used as either a table-top sweetener or in baking and cooking (Splenda, 2012). For better baking results it is suggested that consumers use half sucralose and half sucrose (RelayHealth, 2011). A potential problem for consumers occurs when baking with sucralose because the cooking time tends to be shorter, so greater attention is needed to determine doneness. The most well known brand of sucralose is Splenda, which is affordable and widely available.

Many sugar alternatives have a bitter aftertaste, and as generally regarded as unsatisfactory by consumers. The bitter aftertaste is commonly found in saccharin, but appears to be absent in sucralose. When baking with sucralose the conversion between sucrose and sucralose is equal. (Splenda, 2012) While the granulated sucralose provides apparent volume-for-volume sweetness, the texture in baked products may be noticeably different. Sucralose is not hygroscopic, meaning it does not attract moisture, which can lead to baked goods that are noticeably drier and with a less dense texture than those made with sucrose (Filipic, 2004). The biggest advantage of replacing sucrose with sucralose is the absence of an unpleasant aftertaste.

Sugar alcohols are carbohydrates found naturally in fruits and vegetables. Sugar alcohols are not sweeter than sugar and are not considered a noncaloric sweetener (Mariotti, 2012). They can raise blood sugar about half as much as sugar and have fewer calories, which make ployols a good alternative for diabetics. If eaten in large amounts sugar alcohols can cause gas, bloating, and diarrhea. An example of a sugar alcohol that is approved by the F.D.A is xylitol. Xylitol is made naturally by the body at a rate of fifteen grams daily. Xylitol is considered a five-carbon sugar which has many health benefits, such as preventing dental caries and preventing bacterial growth (Sellman, 2002). Xylitol is metabolized by the body slowly, and is a proven insulin stabilizer, as noted by Sellman.

The overall sweetness of brownies is a direct function of sugar. Many sugar alternatives attempt to mimic the sweetness of sucrose. Xylitol is regarded as having a sweetness equal to sucrose. (Michael, 2012) Xylitol is absorbed into the blood stream slowly so it has minimal affect on blood glucose levels. The glycemic index of xylitol is seven, which is considered to be very low (Sellman, 2002). Xylitol has a negative heat of solution and as a result produces a cooling effect in the mouth. This can be seen as a negative effect in overall taste, but the sweetness value makes xylitol the best substitute for sugar based on sweetness value (XyloSweet, 2012).

The F.D.A has approved the use of natural sweeteners as alternatives to sucrose. The most widely used is fructose. Fructose can be used in both blends of alternative sweeteners or as a pure product. Studies of both diabetic and healthy subjects showed that fructose produced a smaller rise in blood glucose than other carbohydrates. (Guthrie, 2000) However, there is a growing concern that a diet rich in fructose as opposed to glucose may contribute to

the growing obesity epidemic currently affecting the world (Bantle, 2009). This is because fructose is shown to lower satiety and create a need for more calories to be ingested (Guthrie, 2000). Another disadvantage of fructose is that it is associated with an increased risk of gout in men, as well as kidney stones (Relay Health, 2011). When cooking with fructose it is necessary to use about one-third less than the original sugar that is used. Fructose also browns quicker, so time and temperature would have to be closely monitored.

A characteristic of high quality brownies are that they maintain tenderness, and have a small crumb size. Fructose has a higher solubility than other sugars as well as sugar alcohols. The higher solubility causes fructose to be difficult to crystallize in a solution. Sugar mixes, such as brownie batter, are softer than those containing other sugars because of the greater solubility of fructose (Guthrie, 2000). Fructose is also hygroscopic, meaning that the product pulls moisture from the environment, giving a prolonged moistness and delayed staling. Fructose is quicker to absorb moisture and slower to release it to the environment than sucrose, or other nutritive sweeteners (Penfield, 1990). Fructose can contribute to improved quality, better texture, and longer shelf life to brownies. Fructose is often compared to sucrose in terms of health benefits. There have been zero studies done to prove that fructose has any short or long term effects that differ from those of sucrose (Filipic, 2004). When substituting alternative sweeteners for sucrose there can be many issues affecting both the flavor and structure of the brownie. The most blatant obstacle associated with cooking using alternative sweeteners is the formation of a bitter aftertaste. The taste associated most commonly with fructose is that it tends to be “flat” (McGee, 1984).

When producing brownies, sugar interacts with protein to retain moisture, which interferes with gluten development. In the cooking process sugar helps during the creaming step by creaming air into the fat (Micheal, 2012). Sugar also tenderizes the brownies by maintaining moisture and is a bulking agent. Because the water levels of most brownies are insufficient to the total solubilization of sugar, the crystal size of the sugar is an important quality aspect for the texture of the brownie. Coarse forms of granulated sugar dissolve less readily than fine granulations, resulting in less spread and more surface cracking of the brownie mixture. (Pareyt, 2008)

Consumers worldwide, as well as commercial food industries have expressed a growing interest in sugar substitutes used in products that are typically high in sucrose. Often sucrose is substituted or supplemented with sucralose, sugar alcohols, or natural sugars. All options have strengths and can create potential problems.

PROCEDURE

Three variations of a chocolate brownie were made in the dietetics laboratory at Miami University on three trial dates.

The three variations of brownies prepared were:

1. Xylitol brownies
2. Sucralose brownies
3. Fructose brownies

Each batch of brownies were made following a consistent and standard brownie recipe and procedure. The recipe (Appendix A) was found in the Betty Crocker Cookbook, and the only ingredient that was varied between the batches was the sugar component. The alternative sweeteners were integrated into the recipe as stated on the respective packaging instructions. Fructose was substituted at one-third the sucrose content (Bantle, 2009). Sucralose was substituted at an equal amount to the sucrose. Xylitol was also substituted in an amount equal to sucrose.

Equipment used was consistent with all three batches of brownies, and baked in eight inch by eight inch greased light aluminum baking pans. The brownies baked in the same oven at the same time, set at 350˚F for thirty minutes.

After the brownies had baked and cooled they were tested for tenderness. This was done objectively. The objective test was done using the Texture Analyzer TA.XT21, located in the Miami University dietetics laboratory. The Texture Analyzer determined which brownie

sample was the most tender. To determine tenderness using the Texture Analyzer the probe needed to penetrate into each sample slightly and determine the grams of force needed to penetrate half-way through the sample. Increased number of grams of force needed indicated less tenderness. It was critical that the samples did not dry out between cooling and testing, this was prevented by placing each of the samples in sealed plastic bags. On each day three brownies of each variation were tested using the Texture Analyzer.

The sensory analysis consisted of five semi-trained Miami University dietetic student panelists who filled out a high quality brownie sensory scorecard (Appendix B). The scorecard consisted of a scale to rate tenderness from five to one, with five being very good and one being very poor based on five different characteristics. Each panelist was seated alone at a table in the room adjoining the preparation laboratory area. The panelist was given a sample of each brownie on one plate in varying order over the course of the three experimentation days. The sample was presented on a plain white plate. The panelist was provided a glass of room temperature water.

The reliability and validity of the experiment were ensured by testing the same five panelists on three different days. The samples were presented in varying order and coded with either △, ○, or □. Other controls such as oven temperature and preparation methods were maintained by first calibrating the oven and following the exact same procedure on each testing day.

RESULTS AND DISCUSSION

The brownie variations were tested using the Texture Analyzer, TA.XT21 to measure tenderness. Results of the testing are presented in Table 1. Results showed that the brownies containing xylitol were the most tender.

Table 1

Mean Scores of Brownie Tenderness as Tested on Texture Analyzer[1,2]

	Day 1	Day 2	Day 3	Total[3]
Sucralose	694	816	723	744
Xylitol	524	596	657	**592**
Fructose	628	793	606	675

1. Scores represent the mean for each day of testing using the Texture Analyzer, TA. XT21, program two.
2. Results are displayed to represent force in grams necessary to press into brownies.
3. Total scores represent the mean of all three testing days.

The results of the objective testing using the Texture Analyzer do not support the hypothesis that the brownies containing fructose would be most tender. The scores associated with the fructose-containing brownies were slightly higher than those of the xylitol-containing brownies. On days one and two the xylitol brownies had scores that showed the brownies were more tender than the fructose brownies. However, on day three the xylitol brownies score was greater than the fructose brownies, showing that on that day the fructose brownies were more tender. On all three testing days the brownies containing sucralose were

less tender than the xylitol brownies, and the total mean score was well above the xylitol brownies mean score. Related research in this area does not specifically cite testing any of these alternative sweeteners against each other, so no data is available that would benefit this study.

The brownies variations were also tested with the high quality sensory scorecard to measure the desirability of the brownies as tested by semi-trained panelists. The results of the sensory scorecard are presented in Table 2. Results indicate that the brownies containing fructose had the best flavor and least amount of aftertaste.

Table 2

Mean Scores of Brownie Characteristics as Tested by Sensory Scorecard[1,2]

Characteristic	Sucralose	Xylitol	Fructose
Crust Appearance	3.9	3.6	4.2
Air Cell Distribution	4.2	4.2	4.2
Tenderness	3.7	4.1	4.1
Flavor	3.1	3.3	3.3
Absence of Aftertaste	3.2	3.4	3.5

1. Scores represent means for the three days of testing by five semi-trained Miami University dietetic students using a high quality brownie sensory scorecard.
2. Scores ranged from five to one, with five representing very good and one representing very poor.

The results of the subjective testing using a panel of five, semi-trained Miami University dietetic students did not support the hypothesis that the brownies containing xylitol would have the best flavor, and that the brownies containing sucralose would have the least aftertaste. Other characteristics tested such as crust appearance and air cell distribution were used to better assess the qualities of a high quality brownie. The fructose brownies had the best crust appearance and all three of the variations had the same results for air cell distribution. Many of the scores showed the same results across characteristics as seen in the air cell distribution. The xylitol and fructose brownies both had the same score in tenderness and flavor, where the sucralose brownies received a lower score. The tenderness scores were concurrent with the objective results. Showing the xylitol was indeed very tender. The xylitol brownies were not the most desirable in lack of aftertaste, however; fructose was considered the best, and the sucralose brownies had the most aftertaste. Related research often cites aftertaste as a major concern for sensory testing and in most studies is seen as an unfortunate short coming of products that cannot be avoided at the time.

Overall, a high quality product was not achieved; despite having many individual characteristic scores that were above the four-point-zero (4.0) determination set by the professor. The best quality as determined by the sensory panel was the fructose brownies, this was determined because that variation had the most scores over 4.0, and high marks in both flavor and tenderness.

CONCLUSIONS

After reviewing the results of both sensory and objective testing, it has been determined that a high quality brownie was not produced. None of the three hypotheses were supported, but important aspects of the production of a brownie containing alternative sweeteners were learned. The potency and effect of the alternative sweeteners used showed a vast disparity to standard granulated sucrose. Standard sucrose provides much better structure, tenderness, and flavor. By utilizing data obtained from this study further research can be done to fully develop a high quality brownie with a low glycemic index that is safe for diabetics to enjoy.

When testing tenderness throughout the study the xylitol brownies were the most tender, but the overall best brownie produced was the fructose-containing brownie. The fructose-containing brownie had the highest scores in both flavor and lack of aftertaste, while still tying the xylitol brownies in tenderness scores as determined by the sensory panelists. The fructose brownies were very poor, however, in volume.

The purpose of the study was partially accomplished, because a good brownie was produced using alternative sweeteners, but not a high quality brownie. Many characteristics of the brownies were considered high quality but none of the variations received high quality scores across all categories.

LIMITATIONS

There were few limitations associated with this study. The most blatant was the proximity of the sensory testing area to the preparation laboratory. The rooms are adjoined and this caused for sounds and smells to drift in, as well as other testing subjects and testers. The general movement of people was chaotic and this could have distracted some panelists. Another limitation was the lack of panelist training. All the panelists were dietetic students and not formally trained. This could have caused some disparities in the raw data gathered. The panelists also had to test multiple products on each testing day, which could have affected the scoring of products.

These limitations could have been avoided by using a separate room for panelists testing that is not connected to the laboratory preparation area. By using a different room panelists may have been able to focus easier and not be as distracted. More intensive training could also alleviate potential problems for panelists. Better prepared panelists would perform better analysis and provide more conclusive results. Also the panelists should not have to sample multiple different products. By focusing on a certain type of product panelists can better discern subtle differences and provide better data.

RECOMMENDATIONS FOR FURTHER RESEARCH

In the future it is necessary for more research to be done in this area of study. Alternative sweeteners are always changing and those changes will affect the baking process. This specific study can be changed for future research in many ways. Different types of alternative sweeteners can be utilized. Some examples include saccharine, cyclamates (outside of the United States), stevia, and acesulfame-k. All varieties offer advantages and disadvantages to baking, but more research is need to fully understand the effects in brownies. This study did not focus on the affect of alternative sweeteners on volume of the brownies, but future research should closely examine this area. During this study volume was greatly affected and contributed to many low sensory scores. Research related to the use of fructose does not address volume concerns, however, the products tested were not brownies so it may be an isolated problem of the specific product. Xylitol advertises comparable results to sucrose but in this study that did not happen, this may have happened because of environmental controls, or uncontrollable variables. Another area of future research can be the use of blends. This study used a total replacement of sucrose, but by utilizing blends or not replacing the total sucrose amount, the results could be very different. Blends often offer better baking outcomes, and a higher quality product may be able to be produced by using blends. Splenda suggests substituting at half of the original sucrose amount, and by doing so the results may be more favorable.

APPENDIX A

Chewy Choco Brownies-BASE RECIPE

1/3 C. (34 g.) Dutch-processed Cocoa
½ C. (60 g.) Boiling Water
2 oz. (56 g.) Unsweetened Chocolate
4 t. (58 g) Melted butter
½ C. (120 mL) Vegetable Oil
2 Lg. (114 g.) Eggs
2 Lg. (34 g.) Egg Yolks
2 t. (10 mL) Vanilla
2 ½ C. (300 g.) Sugar
1 ¾ C. (176 g.) All Purpose Flour
¾ t. (4 g.) Salt
6 oz. (170 g.) Bittersweet Chocolate, cut into 1/2 –inch pieces

Procedure:

1. Adjust oven rack to lowest position and heat oven to 350˚F. Grease 13 x 9 inch baking pan.
2. Whisk cocoa and boiling water together in large bowl until smooth. Add unsweetened chocolate and whisk until chocolate is melted. Whisk in melted butter and oil. Add eggs, yolks, and vanilla and continue to whisk until smooth and homogenous. Whisk in sugar until fully incorporated. Add flour and salt and mix with rubber spatula until combined. Fold in bittersweet chocolate pieces.
3. Scrape batter into prepared pan and bake until toothpick inserted halfway between edge and center comes out with just a few moist crumbs attached, 30-35 minutes. Transfer pan to wire rack and cool 1 ½ hours.
4. After completely cool, cut into 2-inch squares and serve. Serves 24.

(Betty Crocker, 2012)

APPENDIX B

Date:
Name:

Directions: Sample each brownie. Then score each of the samples on the following criteria:

Brownies

	□	○	△
Crust Appearance 5-Very Good 4-Good 3-Fair 2-Poor 1-Very Poor			
Size of Air Cells (Even) 5-Very Good 4-Good 3-Fair 2-Poor 1-Very Poor			
Tenderness 5-Very Good 4-Good 3-Fair 2-Poor 1-Very Poor			
Flavor 5-Very Good 4-Good 3-Fair 2-Poor 1-Very Poor			
Lack of Aftertaste (Not Bitter) 5-Very Good 4-Good 3-Fair 2-Poor 1-Very Poor			

APPENDIX C

Variation 1	Variation 2	Variation 3
17 g. Dutch-processed Cocoa 30 mL Boiling Water 28 g. Unsweetened Chocolate 29 g. Melted Butter 60 mL Vegetable Oil 57 g. Egg 17 g. Egg Yolk 5 mL Vanilla 150 g. Sucralose (Splenda) 88 g. All Purpose Flour 85 g. Bittersweet Chocolate	17 g. Dutch-processed Cocoa 30 mL Boiling Water 28 g. Unsweetened Chocolate 29 g. Melted Butter 60 mL Vegetable Oil 57 g. Egg 17 g. Egg Yolk 5 mL Vanilla 150 g. Xylitol (XyloSweet) 88 g. All Purpose Flour 85 g. Bittersweet Chocolate	17 g. Dutch-processed Cocoa 30 mL Boiling Water 28 g. Unsweetened Chocolate 29 g. Melted Butter 60 mL Vegetable Oil 57 g. Egg 17 g. Egg Yolk 5 mL Vanilla 175 g. Fructose 88 g. All Purpose Flour 85 g. Bittersweet Chocolate

Procedure (Same for all variations):

1. Adjust oven rack to lowest position and heat oven to 350˚F. Grease 8 x 8 inch baking pan.
2. Whisk cocoa and boiling water together in large bowl until smooth. Add unsweetened chocolate and whisk until chocolate is melted. Whisk in melted butter and oil. Add eggs, yolks, and vanilla and continue to whisk until smooth and homogenous. Whisk in sucralose/xylitol/fructose until fully incorporated. Add flour and salt and mix with rubber spatula until combined. Fold in bittersweet chocolate pieces.
3. Scrape batter into prepared pan and bake until toothpick inserted halfway between edge and center comes out with just a few moist crumbs attached, 30-35 minutes. Transfer pan to wire rack and cool 1 ½ hours.
4. After completely cool, cut into 2-inch squares and serve. Serves 8.

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