

Diabetic Oatmeal Raisin Cookies
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Abstract

This experiment was to design a diabetic dessert into an even more diabetic-friendly dessert that contained ingredients, which have been scientifically studied to help control blood sugars. The design of the study tested the palatability and acceptance of oatmeal raisin cookies made with coconut flour through subjective testing using the Hedonic Scale obtained from 25 random voluntary participants and two objective tests, which measured wettability and spreadability. Results from subjective testing indicated that there was a slight preference of the control and 50/50 (72% would eat again) over the extreme (68% would eat again). The wettability test for all three trials were the same, which indicated a slight increase of ten to eleven grams of water absorbed: control (61g/72g), 50/50 (50g/60g), and extreme (49g/60g). For the spreadability test, the size of the control and extreme came out to be a 5 and the 50/50 a 3. In conclusion, the control and 50/50 were preferred over the extreme, though the extreme was still highly accepted.

Introduction/Purpose

According to the ClevelandClinic health information on diabetes, on average, a diabetic is restricted to three to five carbohydrate choices per meal, which is about 45-65g carbs (clevelandclinic.org). This limits a diabetic on their selections if they decide to choose a dessert. Usually desserts are worth three carbohydrate sources, which is about 41-50g carbohydrate. While sugar-free diabetic desserts have been developed with the advancement of sugar substitutes, these desserts may have undesirable aftertastes and long-term side effects (McWilliams, 2012, p. 158-161). In an attempt to create an

alternative dessert with additional diabetic-specific health benefits, an oatmeal raisin cookie recipe adapted from the American Diabetic Association was altered to substitute coconut flour for all-purpose flour. The original recipe uses real sugar versus a sugar substitute, and whole-wheat flour and all-purpose flour. The nutritional value for the original recipe is one carbohydrate exchange (17g carb) for two cookies. The implied beneficial ingredients in the oatmeal raisin cookies are oats for increasing fiber and cinnamon for lowering blood sugars and hemoglobin A1C. The substitution of coconut flour adds additional fiber and manganese to utilize biotin and choline in the egg. Scientific studies examine how these would benefit people with diabetes.

Review of Literature

Oatmeal raisin cookies contains fiber due to the oat content. Quaker Oats claim that incorporating their oatmeal into one's diet may lower blood sugar levels for diabetics. One cup of Quaker Oats contains four grams of fiber (quakeroats.com). It has been studied that incorporating fiber in a diabetic diet may help stabilize blood sugars by providing bulk and delaying gastric emptying. According to the position paper from the Academy of Nutrition and Dietetics, dietary fiber's role in slowing digestion suggests that "the rate of glucose appearance in the blood is slowed and insulin secretion is subsequently reduced" (American Dietetic Association, 2008, p. 1723). This is ideal for a diabetic who is trying to manage and prevent spikes in blood sugar levels.

Dietary fiber may also be beneficial for those concerned with possible development of diabetes. A study conducted by Wannamethee, et al. found that dietary fiber has

preventive effects of lowering the risk of diabetes in males 60-79 years old (Wannamethee, Whincup, Thomas, & Sattar, 2009). They concluded that a high-fiber diet, with at least 20 grams of fiber per day may reduce the risk of diabetes.

Another study supports this conclusion and found that magnesium may also play a role in decreasing the risk of developing diabetes. The study published by Hopping, et al. examined the association of dietary fiber and magnesium and its influence in diabetes on a multi-ethnic cohort in Hawaii. Like the previous study, they found dietary fiber intake was inversely proportional related to diabetes risk (Hopping, Erber, Grandinetti, Verheus, Kolonel, & Maskarinec, 2010). The researchers speculate that this may be due to the high magnesium content in many fiber-rich foods. They cited other research which points at magnesium being protective against diabetes due to its role as “an essential cofactor for enzymes involved in glucose metabolism and its effect on insulin action and glucose homeostasis” (Wolk, 2007; Saris, 2000; Barbagallo, 2007). This led Hopping and her researchers to question the primary attributor in preventing diabetes, which could either be fiber itself or the magnesium present in fiber. Further studies must be done to distinguish the effects of fiber and magnesium on diabetes. If future studies prove that it is actually magnesium that plays a stronger role in preventing diabetes, our hypothesis that the fiber content of our cookies from the oatmeal may prevent diabetes would be invalid. This is because the type of rolled oats we used in our experiment was low in magnesium.

Another ingredient in oatmeal raisin cookies that may be beneficial for diabetics is

cinnamon. There have been numerous studies examining the effectiveness of cinnamon in lowering blood glucose and/or hemoglobin A1C (HbA1C) in diabetics. Hemoglobin A1C is a measurement of glucose bound to hemoglobin protein. It is an accurate measure for blood glucose levels over a longer, steady period of time (Nelms, Sucher, Lacey, & Roth, 2011, p. 492). A study published by Dr. Crawford designed a randomized controlled study following 109 subjects with type II diabetes. The results of the study found that a supplementation of one gram of cinnamon for a period of 90 days lowered HbA1C by 0.83% in subjects with poorly controlled diabetes (Crawford, 2008). In conclusion, Dr. Crawford recommends cinnamon as a safe method to assist in lowering HbA1C.

There is an additional study that confirms the effect of consuming cinnamon in lowering blood sugar levels. This study, published by Khan et. al, concluded that a small dose of cinnamon daily (one to six grams) was effective at lowering blood glucose levels in type II diabetic subjects (Khan, Safdar, Khan, Khattak, & Anderson, 2003). However, the physiological mechanism by which cinnamon acts on lowering blood sugar levels have not been clearly understood.

For this experiment, coconut flour was substituted for all-purpose flour. Ideally, the experiment would have called for a substitution of the entire flour content in the recipe with coconut flour. However, as scientific protocol, only one variable can be altered, which was the all-purpose flour. Coconut flour was the choice for substitution because of its relatively high fiber and low carbohydrate content compared to other flours. As previous studies concluded, a diet high in fiber and low in carbohydrate is ideal for a

diabetic. As indicated on the nutrition label of the coconut flour used, a mere two tablespoons of coconut flour contains five grams of fiber with only eight grams of carbohydrate. The emergence of coconut flour, along with other alternative wheat flours have allowed for experimentation in developing functional foods, such as the coconut flour oatmeal raisin cookies. Recent studies have begun to examine this possible beneficial relationship of coconut flour in improving symptoms in diabetes.

The Food and Nutrition Research Institute in the Philippines with lead researcher Trinidad et al., have published a few studies examining dietary coconut flour and its health benefits. One of his studies entitled *Glycaemic index of different coconut (Cocos nucifera)-flour products in normal and diabetic subjects* examined the effects of consuming coconut fiber in varying amounts from baked goods on blood sugar levels of normal and diabetic subjects. The design of the study was a randomized, cross-over with 10 normal and type II diabetic subjects. The subjects were required to fast overnight (10-12 hours), and were then fed white bread followed by a standardized glucose drink to determine the relative glycemic index of the bread. Normal subjects were then given various test foods, pan de sal, granola bar, cinnamon bread, multigrain loaf, chocolate chip cookies, hotcake, chocolate sprinkles, carrot cake, macaroons and brownies to eat throughout the day. All of these test foods had a control amount of 50 grams of carbs; however, they all had varying amount of coconut flour added. Their results illustrated that the supplementation of coconut-flour to foods was inversely proportional to the glycemic index of the subjects (Trinidad*, Valdez, Loyola, Mallillin, Askali, Castillo & Masa, 2003).

In a later study, Trinidad et al. uses the results from the previous study to determine the effectiveness of coconut flour as a functional food. The study is conducted in the Philippines, which is the world's second largest coconut producer. If coconut flour proved to be beneficial in managing chronic diseases, this could promote utilization of coconut flour as a means to decrease health complications. Possible chronic diseases it could prevent, such as the risk for cancer, cardiovascular disease, and diabetes mellitus. The researchers provided industrial background on the production process of coconut flour, which, in summary, is inexpensive and easy to produce. When analyzing the composition of the fiber composition of coconut flour, researchers found that coconut flour had a higher fiber content than oats and flaxseed. Based on the premise that fiber in oats may attribute to lowering cholesterol and in promoting heart health, the same applies for coconut flour, which may in fact be even more effective since it contains more fiber. This study found that consumption of coconut flour supplemented foods decreased serum cholesterol, LDL and triglycerides levels. Also, the results reaffirmed once again that consumption of coconut flour supplemented foods decreases the glycemic index (Trinidad, Mallillin, Valdez, Loyola, Askali-Mercado, Castillo, Encabo, Masa, Maglaya, & Chua, 2004).

Additional benefits to coconut flour beyond its high fiber content, is its manganese content. This mineral is important in the absorption of choline and biotin found in eggs. These B-vitamins rely on manganese as a cofactor for activation (Null, 1986). Therefore, the manganese in the coconut flour will aid in the absorption of choline and biotin in the

egg. According to the United Kingdom Diabetic community-led and resource support website, manganese deficiency is common in diabetics and may be believed to attribute to diabetes (Diabetes.co.uk). However, more research must be done to prove this hypothesis.

Method/Design

The control oatmeal raisin cookie recipe was taken from the American Diabetes Association. This recipe required the following ingredients: 1-1/2 cups of old-fashioned (not quick cooking) oats, 1/2 cup all-purpose flour, 1/2 cup whole wheat flour, 2 teaspoons ground cinnamon, 1/2 teaspoon baking soda, 1/4 teaspoon salt, 1/3 cup 67% vegetable oil butter-flavored spread, 1/4 cup granulated sugar, 1/2 cup dark brown sugar, 1 large egg, 1 teaspoon vanilla extract, and 1/4 raisins. There were a few modifications done to the control before beginning on the rest of the experiment. The recipe asked to use a margarine spread with 67% vegetable oil, but a 79% vegetable oil was used. Also, golden brown sugar, one teaspoon of ground cinnamon, and half a cup of raisins were used instead of what the recipe had asked for. These were the simple modifications that had taken place before the start of the experiment.

For the 50/50 recipe, coconut flour was used in replacement of all-purpose flour.

Coconut flour cannot replace all-purpose flour in a 1:1 ratio due to the increased absorbability properties of coconut flour. One cup of all-purpose flour is equivalent to about 1/4 or 1/3 cup of coconut flour (www.nourishedkitchen.com). The experiment was done using 1/4 cup of coconut flour, due to ease of calculation. In this recipe, 1/4 cup of all-

purpose flour and one tablespoon of coconut flour was used to replace the other $\frac{1}{4}$ cup of all-purpose flour.

For the extreme recipe, the all-purpose flour was completely omitted from the recipe with coconut flour replacing it. The entire $\frac{1}{2}$ cup of all-purpose flour was replaced with two tablespoons of coconut flour.

The preparation process for each of the recipes above was as followed. The dry ingredients, such as oats, whole wheat flour, all-purpose/coconut flour, baking soda, cinnamon, and salt, were put together, mixed, and set aside. The wet ingredients, such as the butter, granulated sugar and brown sugar was mixed together until it was smooth. Once all the butter and both sugars were mixed well, the egg and vanilla extract was added in and mixed. Then the dry and wet ingredients were mixed together until the appearance looked sticky and then the raisins were mixed in. All ingredients were mixed manually by hand. A $\frac{1}{4}$ sized measuring cup was used as a mold for the cookies. As each $\frac{1}{4}$ cup of cookie was placed on the baking sheet, it was pressed together and slightly flattened to make sure that the cookie held together while baking. Then the cookies were placed in a pre-heated oven at 350°F, with top and bottom heating. For each experimental procedure, the same oven and baking sheets were used to decrease the amount of extraneous variables.

The two objective tests done were wettability and spreadability tests. Wettability tested the moisture of the oatmeal raisin cookies. This test was done after the cookie had been

baked and cooled. Once the cookie cooled, it was weighed on a scale to determine the weight. Then it was placed in a bowl filled with a ½ cup of water for ten seconds and quickly taken out and placed back on the scale to weigh. This test was done to see how much water the cookie can absorb. The size of the oatmeal raisin cookies was tested using the spreadability test. This was also done after the cookie had been baked and cooled. The spreadability tested to see the size of the cookie after baking.

To determine the different characteristics of the oatmeal raisin cookies, the hedonic scale of 1-7 was used for the trial run and was changed to 1-5 during the random voluntary participants sample trials. This was changed to be simpler for the participants to rate and the evaluators to calculate. The different characteristics that were measured were appearance, moisture, flavor, and overall acceptability.

Results and Discussions

The most extreme case was highly acceptable with a 68% of participants stating that they would try the product again, but it was not as acceptable as the control and 50/50 with a 72% overall acceptability. There are a total of twelve tables with corresponding graphs.

Figures 1 to 4 are the appearance, moisture, flavor, and overall acceptability rating of the control recipe, figures 5 to 8 are the rating scale for the 50/50 recipe and figures 9 to 12 for the extreme recipe.

The acceptability of the appearance of the control oatmeal raisin cookies had a rating of 80%. This meant that the participants liked the appearance of the control. The moisture

rating was 36%, which meant that the control was not moist to most taste buds. The flavor rating for the control was 60%. This meant that the control was very sweet to most tasters. The overall acceptability of the control oatmeal raisin cookies was 72%, meaning that the participants are willing to try this product again.

Control

Table 1.
Appearance Rating

not appetizing at all (1)	0%
somewhat not appetizing (2)	14%
no preference (3)	6%
somewhat appetizing (4)	20%
extremely appetizing (5)	60%

Table 2.
Moisture Rating

not moist (1)	0%
somewhat moist (2)	40%
just right (3)	24%
somewhat too moist (4)	16%
too moist (5)	20%

Table 3. Flavor Rating

not sweet enough (1)	0%
not nearly sweet enough (2)	12%
just right (3)	28%
somewhat too sweet (4)	28%
too sweet (5)	32%

Table 4. Overall Acceptability Rating

definitely would not eat again (1)	0%
would not eat again (2)	8%
no preference (3)	20%
would eat again (4)	30%
definitely would eat again (5)	42%

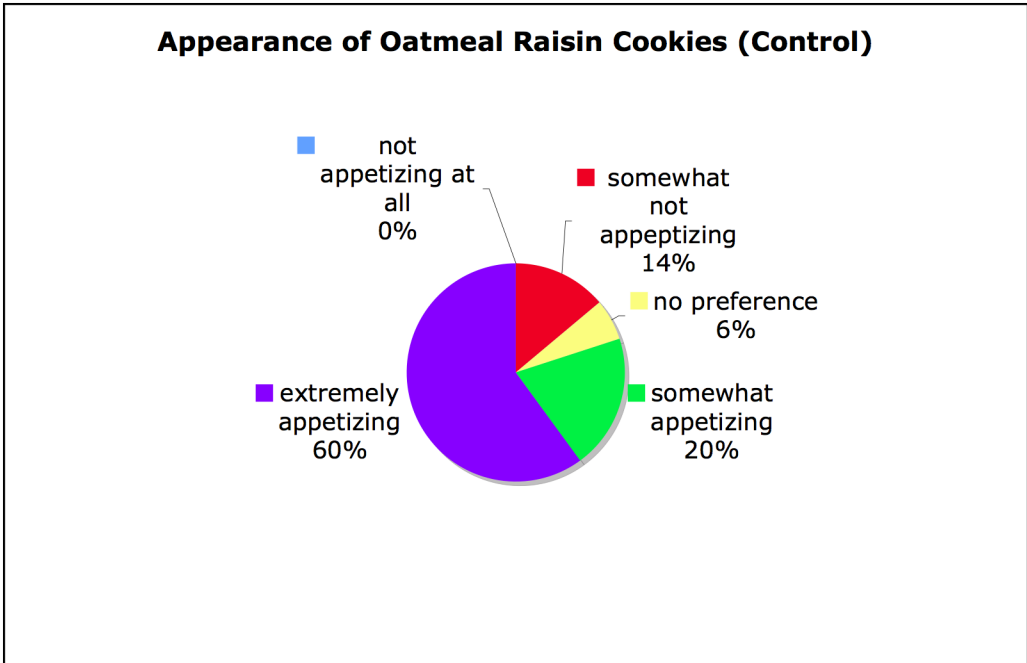


Figure 1. This shows the control recipe percentage of overall appearance with 80% of participants, who had a positive look on the cookie. The appearance of the cookie was appetizing to the sample evaluators.

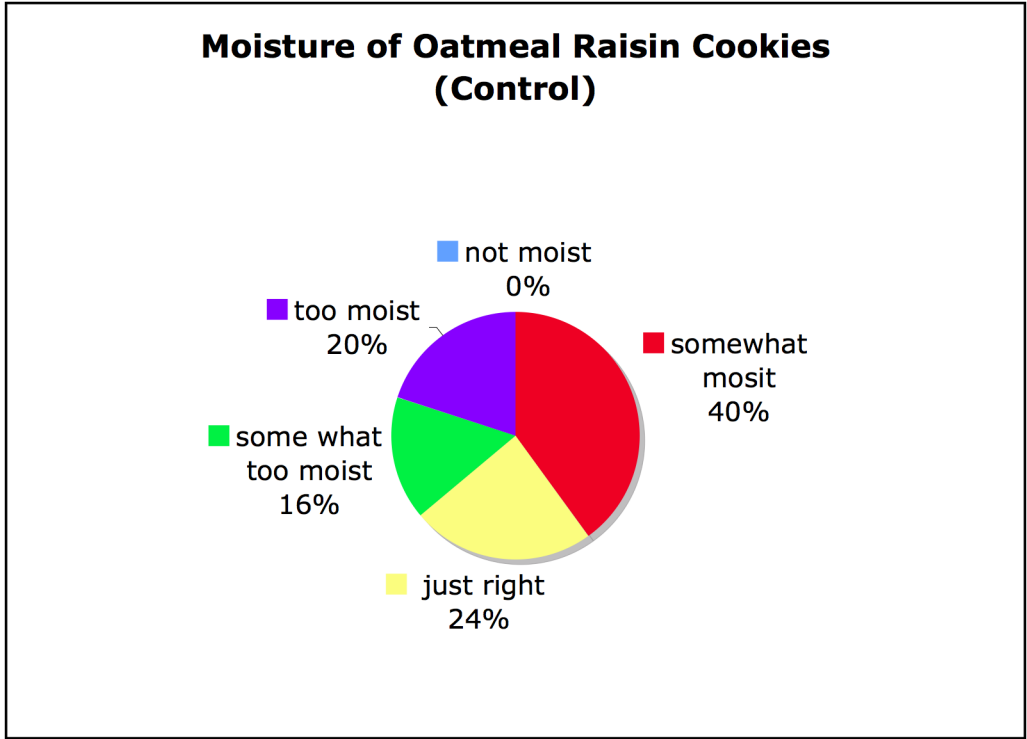


Figure 2. This shows the control recipe percentage of overall moisture with 36% of sampling population, who thought the cookies were too moist. This value should be low

because cookies should not be too moist. 24% of the sample population thought the moisture was just right.

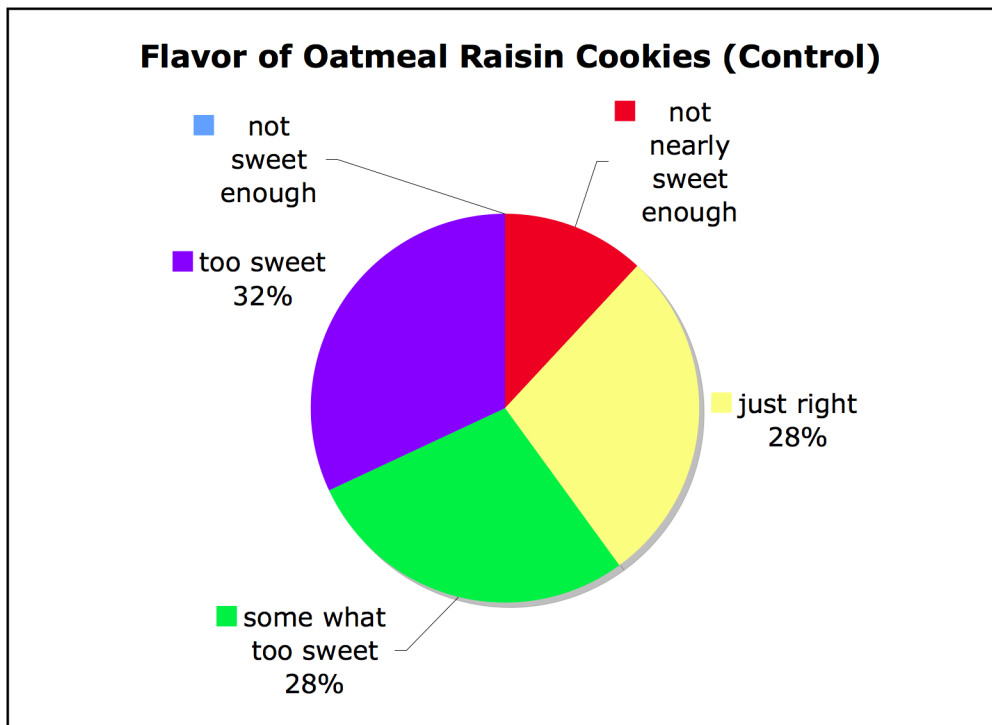


Figure 3. This shows the control recipe percentage of overall flavor with 60% of the sampling population, who thought that the cookie was too sweet. This value should be low because oatmeal raisin cookies should not be too sweet. 28% of the sample population thought the sweetness was just right.

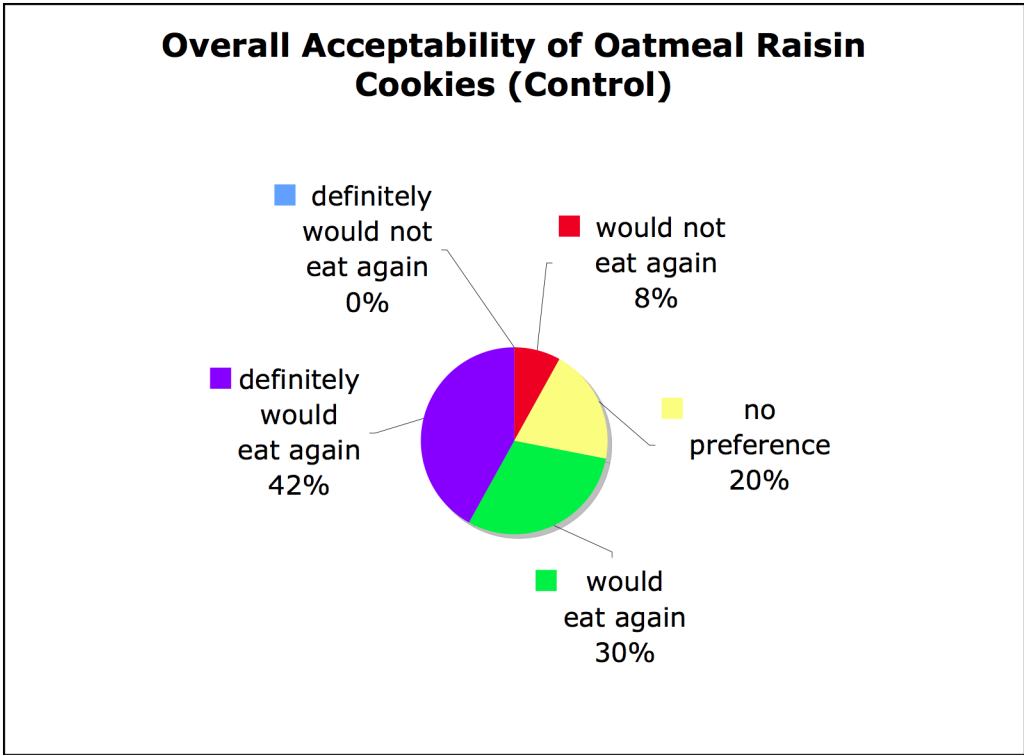


Figure 4. This shows the control recipe percentage of overall acceptability of 72% from participants. The sample evaluators rated the likelihood of trying this product again. This value should be high to show how acceptable this product is to the public.

For the 50/50 oatmeal raisin cookies, the appearance acceptability was rated at 80%.

This meant that the appearance of the oatmeal raisin cookies was very appealing. The moisture rating was 32%, meaning that the cookies were too moist. The flavor rating was 60%. This meant that the cookie was too sweet for most taste buds. The overall acceptability of the 50/50 recipe was 72%, meaning that people are willing to try this product again.

not appetizing at all (1)	0%
somewhat not appetizing	4%

Table 5. Appearance Rating

not moist (1)	4%
somewhat moist (2)	32%

Table 6. Moisture Rating

not sweet enough (1)	0%
not nearly sweet enough	0%

Table 7. Flavor Rating

definitely would not eat again (1)	0%
would not eat again (2)	0%

Table 8. Overall Acceptability

somewhat not appetizing (2)	4%	somewhat moist (2)	32%	not nearly sweet enough (2)	0%	would not eat again (2)	0%
no preference (3)	16%	just right (3)	32%	just right (3)	40%	no preference (3)	28%
somewhat appetizing (4)	28%	somewhat too moist (4)	16%	somewhat too sweet (4)	28%	would eat again (4)	36%
extremely						definitely	

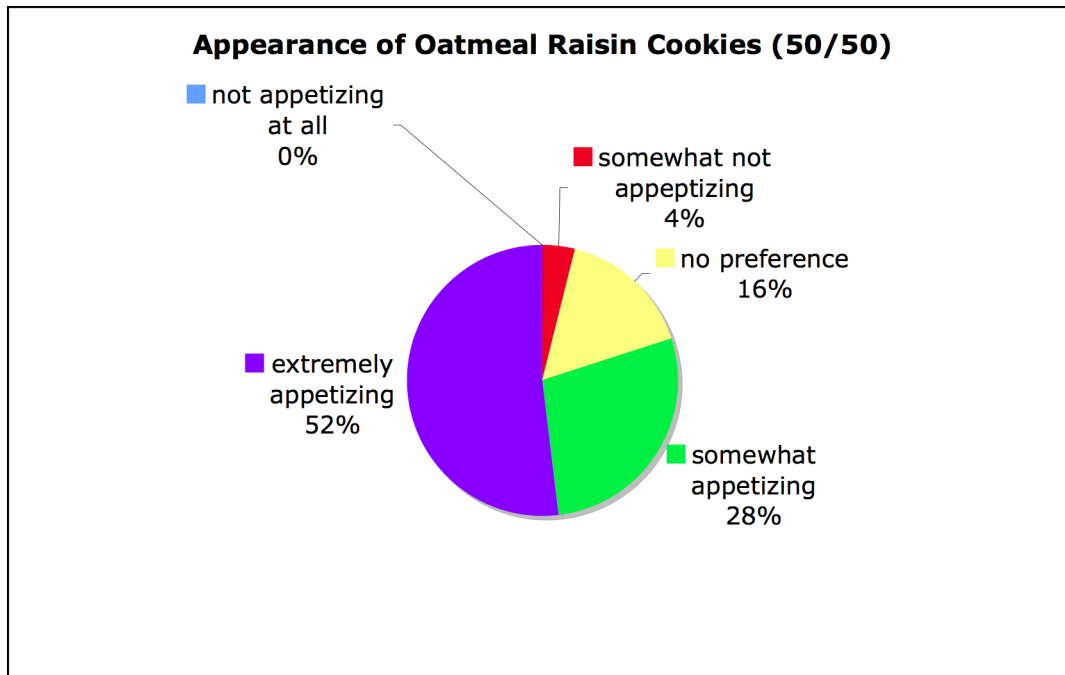


Figure 5. This shows the 50/50 recipe percentage of overall appearance with 80% of population, who thought the look of the cookie was appetizing. The appearance of the cookie was appetizing to the sample evaluators.

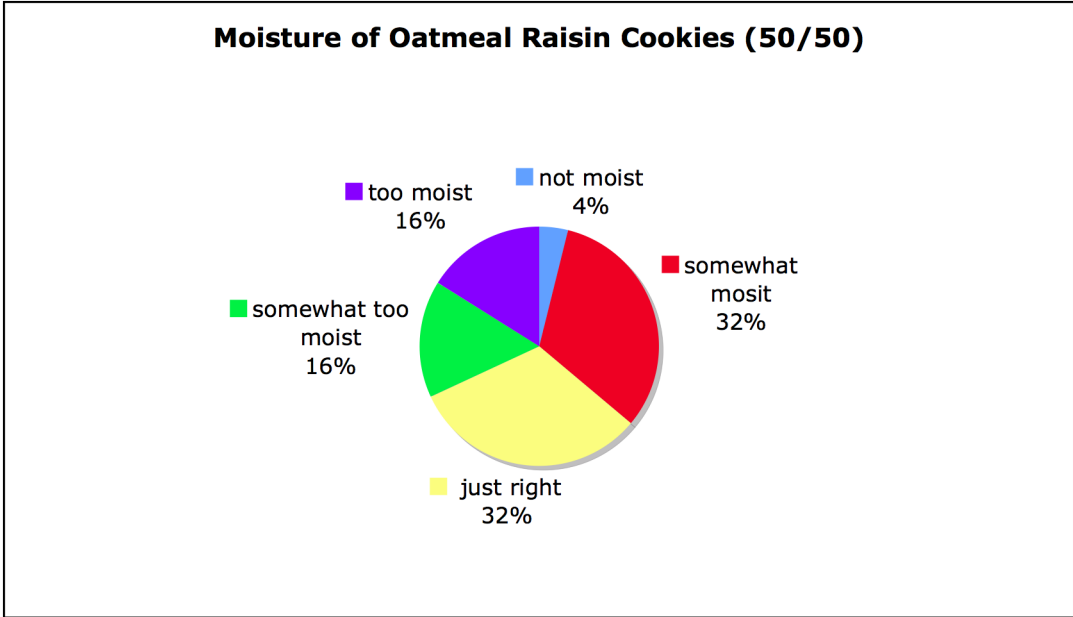


Figure 6. This shows the 50/50 recipe percentage of overall moisture with 48% of participants, who thought the cookies were too moist. This value should be lower because cookies should not be too moist. 32% of the participants thought the moisture content was just right.

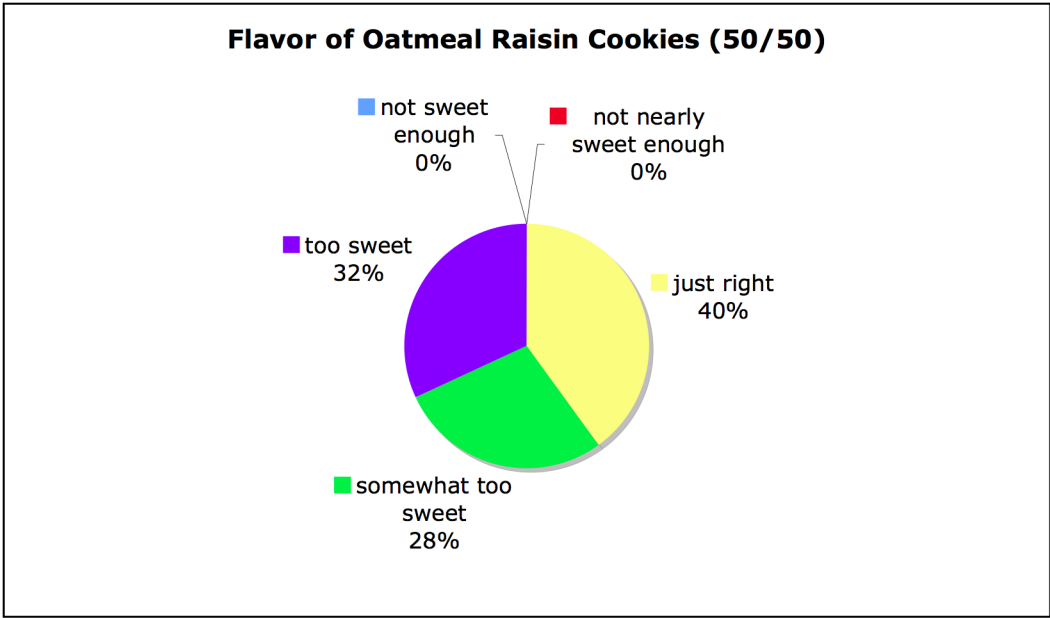


Figure 7. This shows the 50/50 recipe percentage of overall flavor with 60% of participants, who thought the cookies were too sweet. This value should not be too high, as the decreased amount of sugar that was used to make this cookie more diabetic friendly. 40% of the sampling population thought the sweetness of this recipe was just right.

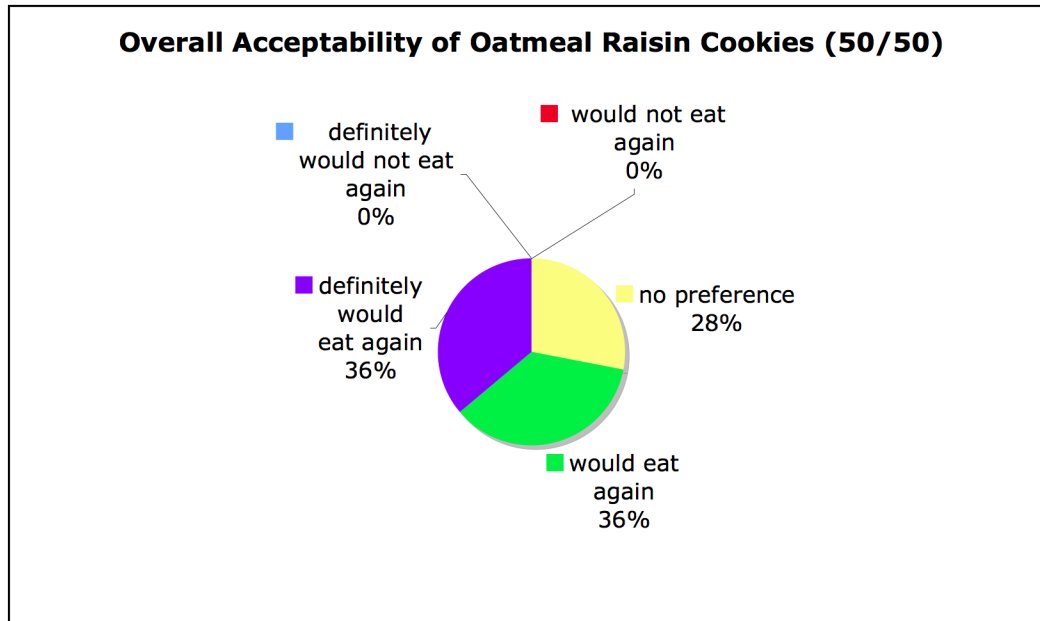


Figure 8. This shows the 50/50 recipe percentage of overall acceptability with 72% of the sampling population, who agreed to try this product again.

For the extreme oatmeal raisin cookies, the appearance acceptability was 84%. This means that the cookie was appealing to a majority of the participants. The moisture rating was 24%, meaning that the cookie was too moist. The flavor rating was 48%. This meant that a little less than half of the participants thought the product was too sweet. The overall acceptability of the extreme recipe was 68%, meaning that the participants would try this product again.

no preference (3)	16%	just right (3)	32%	just right (3)	40%	no preference (3)	28%
somewhat appetizing (4)	28%	somewhat too moist (4)	16%	somewhat too sweet (4)	28%	would eat again (4)	36%
extremely appetizing (5)	52%	too moist (5)	16%	too sweet (5)	32%	definitely would eat again (5)	36%

Figure 5. This shows the 50/50 recipe percentage of overall appearance with 80% of population, who thought the look of the cookie was appetizing. The appearance of the cookie was appetizing to the sample evaluators.

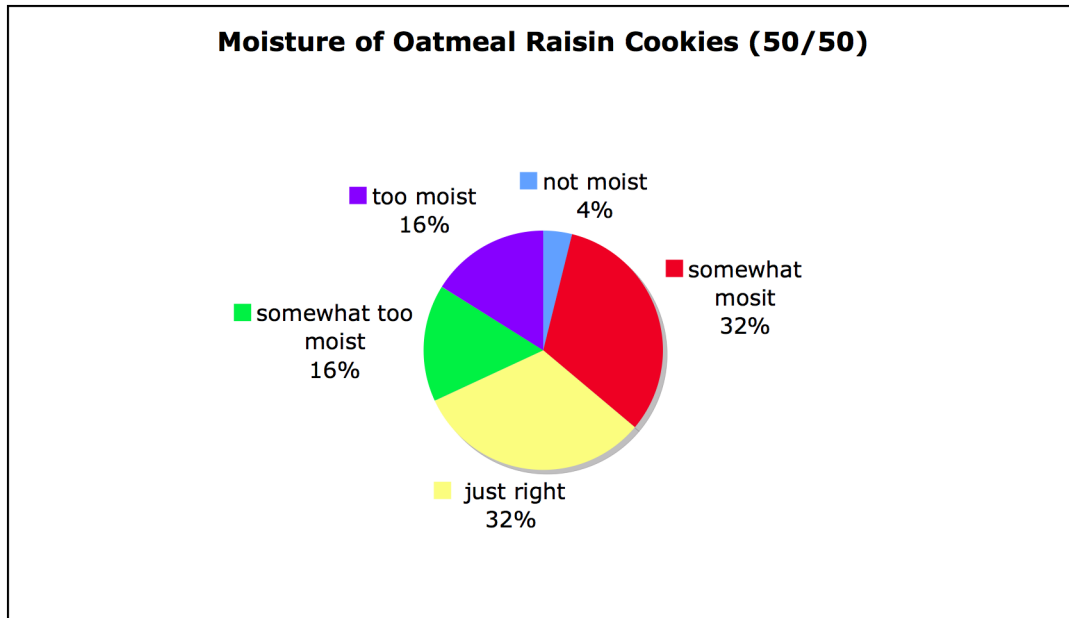


Figure 6. This shows the 50/50 recipe percentage of overall moisture with 48% of participants, who thought the cookies were too moist. This value should be lower because cookies should not be too moist. 32% of the participants thought the moisture content was just right.

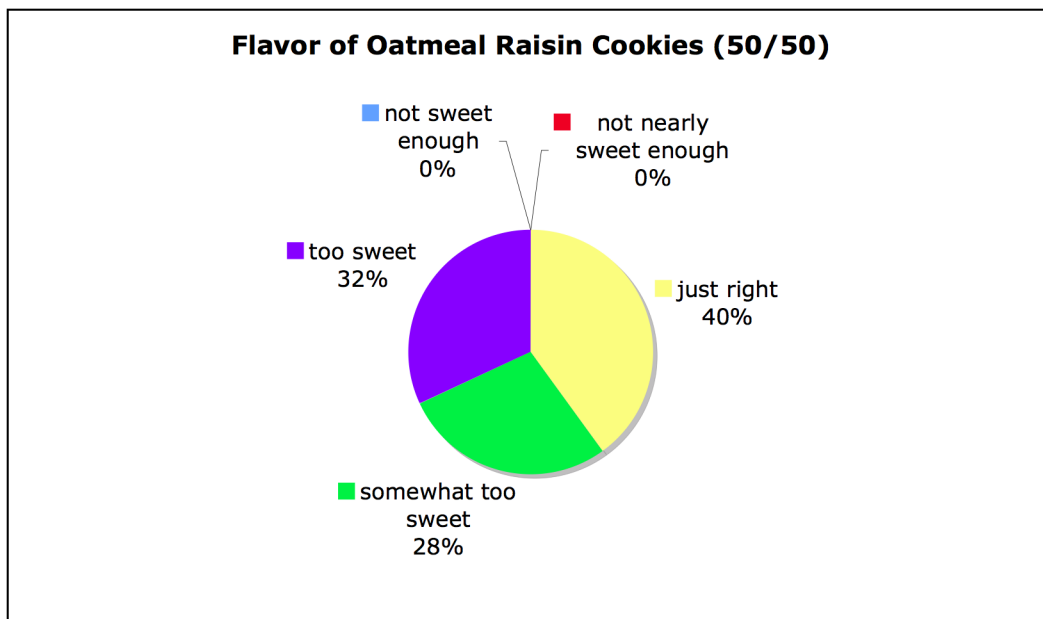


Figure 7. This shows the 50/50 recipe percentage of overall flavor with 60% of participants, who thought the cookies were too sweet. This value should not be too high, as the decreased amount of sugar that was used to make this cookie more diabetic

friendly. 40% of the sampling population thought the sweetness of this recipe was just right.

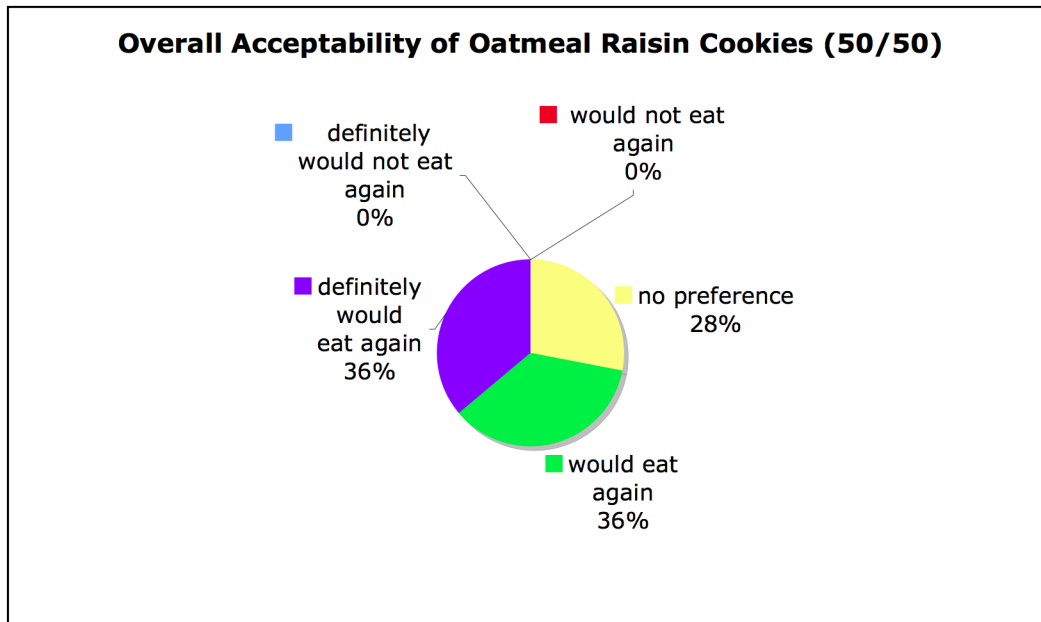


Figure 8. This shows the 50/50 recipe percentage of overall acceptability with 72% of the sampling population, who agreed to try this product again.

For the extreme oatmeal raisin cookies, the appearance acceptability was 84%. This means that the cookie was appealing to a majority of the participants. The moisture rating was 24%, meaning that the cookie was too moist. The flavor rating was 48%. This meant that a little less than half of the participants thought the product was too sweet. The overall acceptability of the extreme recipe was 68%, meaning that the participants would try this product again.

Extreme

Table 9.

Appearance Rating	
not appetizing at all (1)	0%

Table 10. Moisture Rating

not moist (1)	12%
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Table 11. Flavor Rating

not sweet enough (1)	0%
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Table 12. Overall Acceptability

definitely would not eat again (1)	0%
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somewhat not appetizing (2)	8%
no preference (3)	8%
somewhat appetizing (4)	36%
extremely appetizing (5)	48%

somewhat moist (2)	40%
just right (3)	24%
somewhat too moist (4)	8%
too moist (5)	16%

not nearly sweet enough (2)	8%
just right (3)	44%
somewhat too sweet (4)	28%
too sweet (5)	20%

would not eat again (2)	12%
no preference (3)	20%
would eat again (4)	42%
definitely would eat again (5)	26%

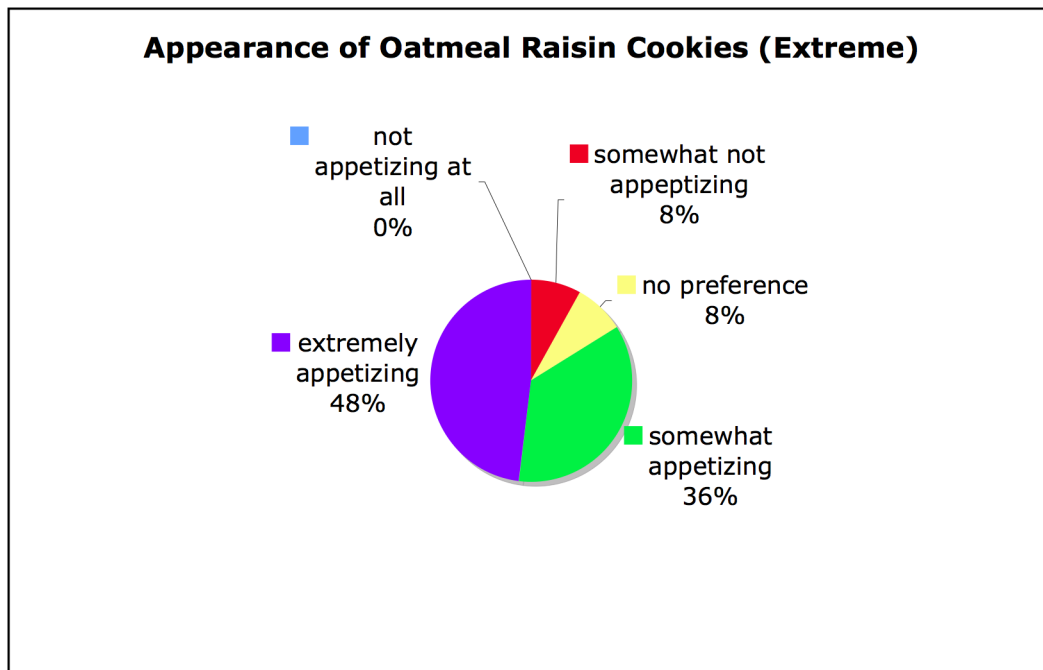


Figure 9. This shows the extreme recipe percentage of overall appearance with 84% of participants, who thought the cookie looked appealing. This value should be high, so the product can be more acceptable.

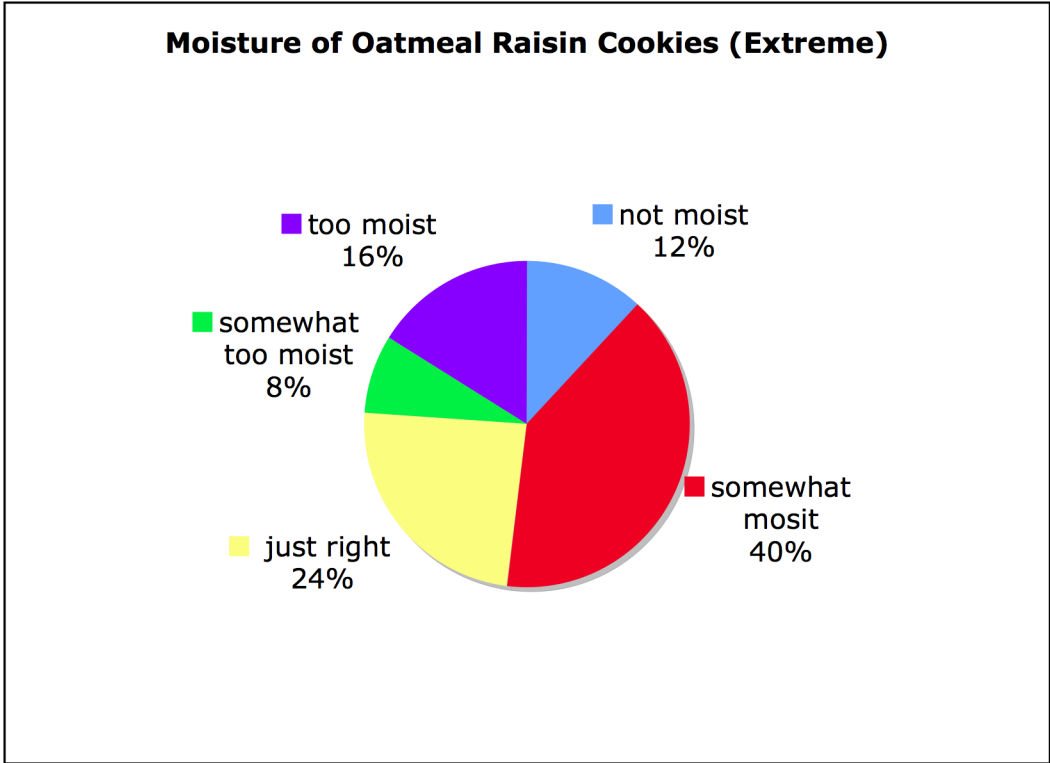


Figure 10. This shows the extreme recipe percentage of overall moisture with 24% of participants, who thought the cookie was too moist. 24% of the sample population thought the moisture was just right. The other 52% did not think the cookies had any moisture.

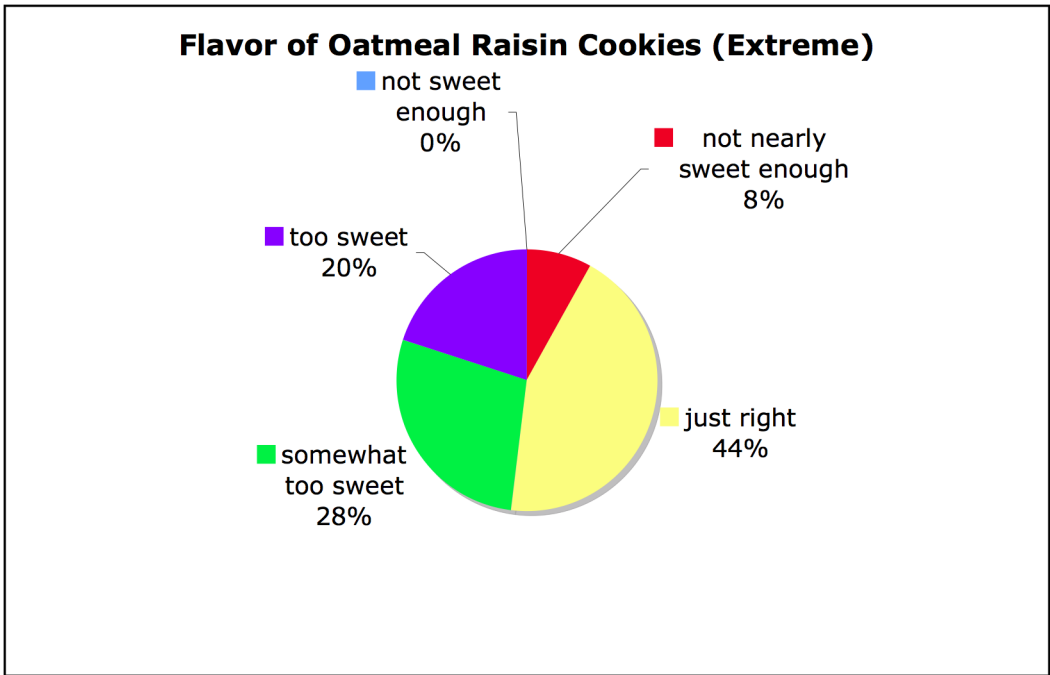


Figure 11. This shows the extreme recipe percentage of overall flavor with 48% of participants, who thought the cookies were too sweet. 44% of the sample population thought the cookies had the right amount of sweetness.

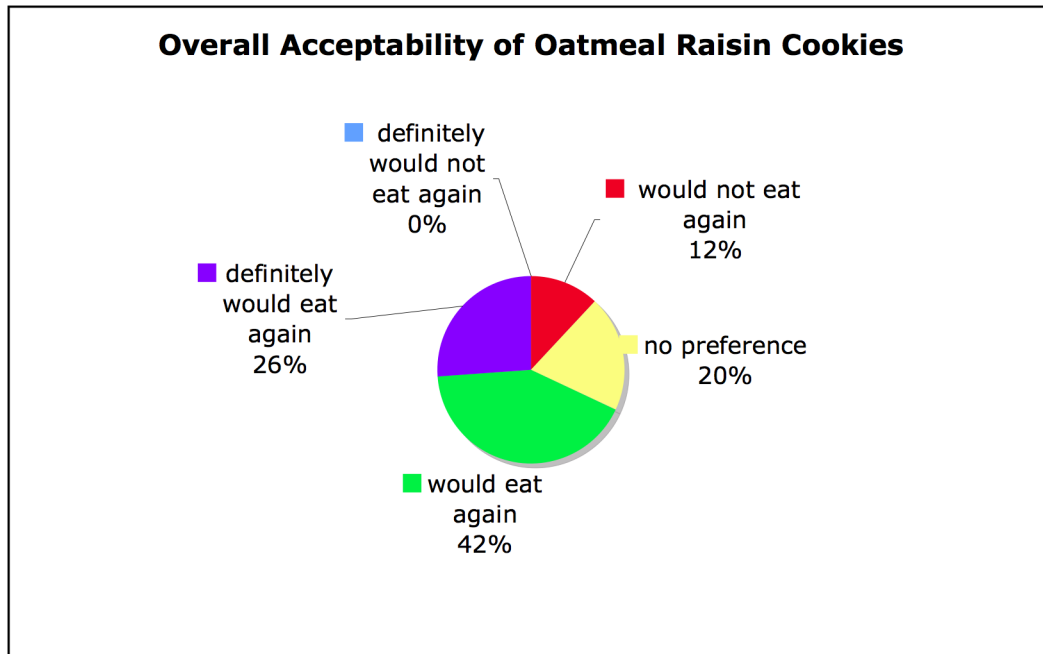


Figure 12. This shows the extreme recipe percentage of overall acceptability with 68% of participants, who were willing to try the product again. 12% of the sample population stated that they would not try this product again.

When the cookies for the objective tests were made, sea salt had been used instead of regular salt. This could have had an effect on the wettability and spreadability of the cookies. Using the wettability test, the control cookie weighed 61g before and after weighed 72g. The 50/50 cookie weighed 50g before and 60g after. For the extreme cookie, it weighed 49g before and 60g after. The spreadability of the control, 50/50, and extreme was 5, 3, and 5, respectively.

During the trial run, some of the cookies were rolled up into a ball. This caused the cookie to not flatten out and bake thoroughly through. For that reason, the cookie was

packed and flattened to make sure it held up when baking. During the objective trials, the amounts of cookies that each experiment made were: control made 11.5 cookies, 50/50 made 12 cookies, and the extreme made 11 cookies. For the public sample trial, the amount of cookies made from the control was 13 cookies and the 50/50 and extreme made 12 cookies. The difference in amount of cookies made could be due to using different measuring techniques such as measuring spoons/cups, packing, and leveling off. The baking times for the objective testing were fourteen minutes for both the control and extreme and fifteen minutes for the 50/50 experiments. For the public sampling, the baking time was fifteen minutes for all three experiments.

The overall acceptability of the control, 50/50, and extreme experiments were 72%, 72%, and 68%, respectively. All three experiments had a high turnover of participant likeliness and were willing to purchase/taste these products again. The extreme had a high overall acceptability percentage and falls short of the acceptability of the control and 50/50. This could be due to the low moisture content of the extreme formulated cookie. The addition of extra liquid needed to be added with the replacement of the all-purpose flour for coconut flour (www.redmill.com). During the experiment, extra liquid that needed to be accounted for was not added. This could be a contributed factor to the moisture scale, where less than a quarter of the participants said it was at the right amount of moisture, when the percentage should have been higher. The extreme experiment was considered to be the least moist of the three.

Conclusions

While our oatmeal raisin cookies contained ingredients that may be beneficial for persons with diabetes, it is questionable whether or not the amount of the ingredients in the cookies is high enough to have an effect. For instance, the fiber present in the original oatmeal raisin cookies is a mere one-gram per serving. A recommendation of at least 20 grams of fiber daily is shown to have beneficial health implications. According to some studies, the effects of cinnamon were shown when one to six grams were consumed per day. The amount of cinnamon in the entire recipe is one teaspoon, which is approximately 2.6 grams. When distributed evenly among all cookies (average yield of cookies is 12), this turns out to be 0.22 grams of cinnamon per cookie for a total of 0.44 grams per serving.

Due to equipment and financial limitations, we were unable to run a nutrition analysis to compare the two recipes. Our experimental design of coconut flour oatmeal raisin cookies served as a base for further studies to test the potential health benefits of replacing all-purpose flour with coconut flour. Our results have established that the majority of our test consumers accepted our experimental cookies. This is a first step in the right direction of finding a solution to producing a more diabetic-friendly dessert that everyone can enjoy. We conclude that as part of a healthy diet, incorporating coconut flour oatmeal raisin cookies, in moderation, is a recommended alternative to traditional desserts. Further research needs to be done to establish the quality of using coconut flour as a substituted ingredient and the next step would be to see what the effects of replacing the entire flour content with coconut flour.