**Cranberry Orange Scones and Modifying Fat**

A Research Paper

Submitted to Cassondra Burgess, MS, RD and Jodie Seybold, MS, RD

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Abstract

Reduced fat bake goods do not have the same overall acceptability as traditional bake goods. Finding a fat substitute, that creates the same taste as a traditional bake good is extremely difficult to achieve. Previous research studies suggest, the functions of fats, affect the volume, flavor, texture of the baked product. The purpose of this experiment is to determine the effect of fat on the volume, tenderness, mouth feel, texture and flavor on cranberry orange scones. The research experiment was conducted for three weeks. The variations of recipes were judged subjectively by five sensory panelists. For the objective evaluation, a penetrometer was used for tenderness, and the v-caliper measured volume. Specific volume and density were also measured. All data was collected, and data analysis was analyzed using SPSS version 17.0.

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Chapter I

The Problem

Introduction

Imagine, always having those grueling morning hunger pains, and not able to have achieve satiety because you were restricted to consuming a low calorie reduced fat meal every day. This is the life of person with Prader Willi Syndrome. Prader Willi Syndrome (PWS) because is an inherited genetic disorders that relies heavily on nutrition intervention (Pereira, Schalk & Geraghty, 2009). The genetic defect, at a certain stage, makes people with PWS always feeling hungry, thus seeking food constantly (Pereira et al., 2009). Obesity is common in people with Prader Willi Syndrome, requiring them to consume fewer calories, and reduced fat foods than a normal person (Ekaitis, n.d.). In fact, PWS people have decreased mobility, increasing their risk for health complications, making diet modification extremely important (Sode-Carlsen & Farholt, 2009). Foods that are reduced fat, and/or fat-free have a different taste than foods with a high fat content. Baked goods, in particular; contain high amounts of fat, therefore making it extremely difficult to make a successful reduced-fat or fat free baked product. Making a reduced fat product often results in increased volume, with a decreased weight; resulting in an altered, undesirable texture (Wekwete & Navder, 2008). Modifications of fat in recipes, sometimes don’t work because of the extreme stickiness of the dough, or increase in viscosity, due to the low fat content (Wekwete & Navder 2008).

Although there is a lack of studies with fat modification, modifying fat to make a reduced fat bake good overall results in lack of acceptability from the person consuming the product. The purpose of this experiment is to determine the effect of fat on the volume, tenderness, mouth feel, texture and flavor on cranberry orange scones.

CHAPTER II

Research Questions

Research Questions

When manipulating the fat content of the (heavy cream) control recipe, with half and half, 2%, and fat free milk, questions relating to the manipulation of fat and its effect on volume, tenderness, mouth feel, texture, and flavor arose. In conducting this experiment, these research questions were the driving force of finding answers on the effect of cranberry orange scone when manipulating fat.

1. Will judges notice the difference in flavor in the half-and-half scone compared to the scone made with heavy cream?
2. When substituting whole milk for heavy cream, what occurs to the tenderness of the product?
3. Will judges prefer the mouth feel of the scone made with fat free milk or the scone made with heavy cream?
4. Will the judge prefer the texture of a scone made with heavy cream, or a scone made with whole milk?
5. When substituting heavy cream for Slim n Trim fat free milk, what occurs to the volume of the scone?

Chapter III

Review of the Literature

Introduction

Almost all baked goods today, are high in fat, which can aide in the prevention of obesity with people that have Prader-Willi syndrome. It is important to modify the fats of a baked good so they contain a lower fat content. Although, modifying the fat of a baked good is relatively easy, the challenge is finding a “fat replacement” which yields the same taste as a baked good high in fat. When fats modified in a baked good, studies show it has an effect on volume, flavor, color, texture, and tenderness of the overall product.

Prader-Willi Syndrome and Health

People with Prader-Willi syndrome need a special restricted diet. One part of the restricted diet with this genetic disorder is a reduced fat diet. The study Lindmark, Trygg, Giltvedt and Kolset (2010) found children 2 years of age (24% of energy from fat) , and 3-4 years of age (25% of energy from fat) with Prader-Willi syndrome consumed a lower amount of saturated and monounsaturated fats than the recommendations from the Nordic Nutrition Recommendations for the general population (Lindmark and Trygg, 2010).

One with prader-willi syndrome that is obese has a significant decrease in mobility, which can lead to increased health complications. Sode-Carlsen, Farholt, Rabben, Bollerslev,Sandahl Christiansen and Höybye (2009) studied the BMI of PWS patients, and their activity level. Sode-Carlsen and Farholt found a correlation in the reduction of physical activity performance (walking 10 m and rising in a chair) with patients that have a high BMI and body fat mass (Sode-Carlson and Farholt, 2009). Stressing the importance of a restricted diet, such as consuming low-fat food items so physical activity can be achieved will help decrease the chances of PWS patients to develop cardiovascular disease, diabetes and other health complications related to obesity and lack of physical activity.

Functions of Fats in Bake Goods

Fat plays many major roles in the outcome of a baked product (McWilliams, 2008).. Fat adds flavor to a product. Fat adds richness in terms of flavor, and many different fats add a distinct flavor such as butter and olive oil and lard (McWilliams, 2008).. Fat also has a huge influence on texture (McWilliams, 2008).. Depending on the type of product, fat plays a vital role in the overall texture, for butter pieces in a pastry, creates a flaky texture (McWilliams, 2008). Fried foods, which use oil, have a crisp texture due to the high temperature of cooking. Tenderness is one of the main functions of a fat in a product (McWilliams, 2008). Fat acts as an inhibitor of gluten development, acting as an effective tenderizing agent (McWilliams, 2008).

Fat and Flavor

The percentage of milk fat content added to a mixture has an effect on the flavor release of the final product (Roberts & Pollien, 2006). During the lipid phase, the lipid particles attract to aroma compounds, resulting in flavor release (Roberts & Pollien 2006). In the study of Roberts, Pollien, and Watzke (2006) they studied the effect of flavor release, and the size of the fatty acid chain in coconut oil, medium-chain triglycerides and hydrogenated palm fat compared to milk fat. Roberts, Pollien, and Watzke (2006) found at all lipids being 90% to 100% liquid, with the exception of hydrogenated palm fat at 30%t, it supported that there was no significant difference of absorption of aroma compounds between variables,which supports the concept that flavor release is not determined by the fatty acid chain length of the variables studied accordingly. Another study by Linforth, Cabannes, Hewson, Yang, and Taylor studied the Effect of Fat Content on Flavor Delivery during Consumption…” Using a triangle based study; participants of the study were to determine the odd sample that contained a high level of orange flavoring, from two samples that contained the same levels of orange flavoring. The results for the study concluded 12 of the 21 participants were able to detect the odd sample; signifying flavor intensity is significantly detectable with a mixture of the same fat content (Linforth & Cabannes, 2011). Linforth, Cabannes, Hewson, Yang, and Taylor also found in the study, with 40 participants, 26 were able to detect the similarity between the sample of 1% fat, with low concentration of orange flavoring, and the 10% fat sample with high concentrations of flavoring. This particular experiment in the study supports that a low-fat product produces the flavor similarity/acceptability to a high fat product when adjusting the amount of flavor concentration of a product (Linforth & Cabannes, 2011).

Volume Baked Goods

Smith and Johansson (2004) studied and used water-oil emulsion variables of 0% solid fat, 20% , 40% , 60% and 80% when baking bread. In the sample of 20% fat, volume was 1771 ml, and the sample of 60% solid fat was 1888 ml (Smith & Johansson, 2004). Also, the difference in volume of the 0% solid fat sample to the 80% solid fat loaf, there was a 30% increase difference (Smith & Johansson, 2004). They found that the greater amount of (saturated fat) solid fat there is in a loaf of bread, the greater the volume (Smith & Johansson, 2004). The study also concluded that as the volume increased, the weight of bread decreased (Smith & Johansson, 2004). They found a 10% or (2g) difference in the weight of the sample with 0% solid fat and 80% solid fat (Smith & Johansson, 2004). In the study Wekwete and Navder (2008), “the control cookie had decreased height after baking compared to the reduced fat cookies” *(*Wekwete & Navder 2008)*.* The fat replacer, avocado had the greatest height, which resulted in a more “cake-like” texture *(*Wekwete & Navder 2008)*.*

Dough Characteristics

Wekwete and Navder (2008) studied cookies, using 100% butter, and then replacing 50% of the butter with fat replacers avocado, and *Oatrium (*Wekwete & Navder 2008)*.* When using the avacodo and *Oatrium* the fat content was reduced by 35% and 39%, thus producing a reduced fat cookie *(*Wekwete & Navder 2008)*.* When mixing the dough, they noted a greater significance in dough stickiness with the reduced fat mixtures *(*Wekwete & Navder 2008)*.*

Conclusion

There has been limited research done with fat modification and bake goods, especially milk substitutes in bake goods. This experiments design contains a procedure, subjective and objective evaluations with different milk substitutes, in hopes that this study design t can be used for future research.

Chapter IV

Methods

Introduction

First, the recipes wss onverted from English to metric units, to ensure accuracy and precision with the recipes. Second, the ingredients were weighed out prior to lab to allow proper amount for all procedures. All four recipes control, half and half (variable 1), 2% milk (variable 2), fat free milk (variable 3) cranberry orange scone recipe were baked (Table 1). After the scones were baked, subject and objective evaluations took place. All subjective and objective evaluation data was collected as well as, the same procedure took place for three weeks to eliminate invalid data. Data analysis occurred after all three weeks.

Table 1. Identification key for all four recipes used in the experiment.

|  |  |  |  |
| --- | --- | --- | --- |
| Control | Variable 1 | Variable 2 | Variable 3 |
| MARTIN’S Heavy Cream | Martins Half and Half | Martins 2% Milk | Slim n Trim Fat Free Milk |

Procedure

Baker is dressed in proper lab attire. Proper lab attire is black or blue pants, white short-sleeve shirt, apron, with ball cap or hair net. Hands are clean, fingernails are groomed, with no nail polish or fake nails.

During the trial week, there were a few adjustments made to the recipe as well as the procedure. 190 grams of flour was added to the original recipe, as well as an additional 20 grams of all-purpose flour added for the cutting board surface when the dough is being rolled. The flour modifications were made because during the trial week, the control and variable recipes had substantially runny, sticky dough. The recipe, with theses flour modifications were cut in half for experiment weeks solely due to lowering the total cost of the experiment.

The orange glaze (orange juice + confectioner sugar) was not used during the experiment weeks. During the trail week, it was decided from other panelists, that it was difficult to judge flavor (acidic/sweet), one of my subjective measurements. The “sprinkle” of granulated sugar was also removed from this recipe for the same reason for the orange glaze. In addition, the egg wash (1 medium egg + water) was not used in the experiment weeks. Egg wash was not used during the experiment weeks because it had an effect on color, the other subjective measurement in the experiment.

Before preparing the baking ingredients for the cranberry orange scones, gather the following materials: one large mixing bowl, a wooden spoon, electronic grams scale, milliliter cylinder, oven, two oven mitts, cooling rack, parchment paper, timer, electric mixer with paddle attachment, micro plane (skin peeler for orange zest) 3 inch round cutter, rolling pin, cutting board, ruler, cookie sheet.

Now that the needed cooking equipment is gathered, gather the needed ingredients to make cranberry orange scones (Table 2). Refer to appendix B for the original cranberry orange scones recipe in English and metric prior to experiment recipe modifications.

Table 2: The control recipe and variable recipes used during the experiment.

|  |  |
| --- | --- |
| **Amount** | **Ingredient** |
| 330.63g | Generic All-Purpose Flour |
| 60.0g | General All-Purpose Flour for surface |
| 25g | Generic Granulated Sugar |
| 14g | Generic Baking Powder |
| 6g | Generic Kosher Salt |
| 170.10g | Generic Unsalted Butter Sticks |
| ***118.3ml*** | ***Heavy Cream\**** |
| 20g | Name brand Ocean Spray Dried Cranberries |
| 112g | Extra Large Eggs |
| 3g | Grated Orange Zest |
| **Variables (\* = control ingredient)** | |
| 118.3ml | Half and Half |
| 118.3ml | 2% Milk |
| 118.3ml | Fat free milk |

Note. The recipe used was halved from the original recipe in Appendix B. Ingredients from the original were also not used in the experiment recipe due to time and money constraints.

Measure out the 118.3 ml of the Martins heavy cream using the ml cylinder. Read the ml cylinder when placed on a flat surface at eye level. Read at eye level making sure the liquid read at the meniscus. Pour heavy cream into bowl. Rinse out ml cylinder with water. Dry out cylinder with paper towel. Gather microplane tool and two medium sized oranges, rub microplane up and down on outside of orange peel over small bowl for the orange zest. Spoon the grated orange zest into small bowl on electronic gram scale until it reads 3 grams. Set aside. Next, sift the flour using the sifter into one of the measuring bowls. ZERO the electronic scale, the screen will read 0.0 g. Spoon the sifted flour, onto the small bowl that is one the zeroed electronic grams scale until it reads 330.63 grams. Place flour in electric mixing bowl and set aside. Zero Scale with small bowl placed on scale. Electronic scale will read 0.0 g. Spoon Martins baking powder into small bowl until scale reads 14 g. Set aside. Place a new small bowl on scale and zero scale. Weigh out Martins salt until the scale reads 6 g. Set aside. Place a new small bowl on scale and zero scale (0.0 g). Carefully spoon Martins sugar into small bowl until it reads 25 grams. Set aside. Place a clean dry small bowl onto electronic scale and zero. Scale will read 0.0 g. Cut pieces of cold unsalted butter and place into small bowl until it reads 170.10 g. Set aside. Place a clean dry small bowl onto scale. Zero Scale (0.0 g). Crack 6 large eggs in small bowl. Wisk eggs together for 30 seconds in bowl. Place a clean dry bowl on scale. Zero Scale (0.0 g). Spoon whisked egg onto bowl on scale until it reads 112 grams of eggs. Place a new bowl onto electronic gram scale. Zero Scale (0.0 g). Spoon the grated orange zest into small bowl on electronic gram scale until it reads 6 grams. Set aside. Place a new bowl onto electronic grams scale. Zero scale (0.0 g). Spoon out Ocean spray cranberries until the scale reads 40 grams. Set aside.

Measure ingredients three more times, for a total of four varied recipes. Replace the control with half and half (variable 1), 2% MARTINS milk (variable 2), and fat free milk (variable 3) with each recipe. Refer to appendix G for pictures of the control, variable 1, variable 2, and variable 3 ingredients. Use the same measuring procedure as the control as described above.

According to Garten (2006),

Preheat oven to 400 degrees Fahrenheit. Combine in the electric mixing bowl, 330.63 Martins all-purpose flour, 25 g of Martins granulated sugar, 14 grams of baking powder, 6 grams salt, and 3 grams orange grated orange zest. Then add the 170.10 grams of unsalted butter. Attach paddle attachment to electric mixer. Attach bowl to electric mixer, and mix at speed 1 (the lowest speed possible). When butter gets to be pea sized, slowly add the 112 grams of eggs, and control (heavy cream) to the mixture (all-purpose flour, granulated sugar, salt, grated orange zest and unsalted butter, egg and the control (heavy cream). The mixture (dough) will be lumpy. Add the 20 grams of cranberries, and ¼-cup flour to the mixture, and mix on speed 1 until the cranberries and flour are blended.

Spread 60 g of flour onto cutting board. Put dough from electric mixing bowl, onto well-floured surface. Knead the dough into a ball. Flour the rolling pin, and hands. Roll dough until ¾ inch thick. Confirm thickness with ruler. Small pieces of butter will show in dough. Be sure to keep the dough on a flour surface to prevent the dough from sticking. Flour a 2 inch round cutter. Cut into the dough using the 3 inch round flutter tool. Cut 15 scones. If needed, use the scrape of dough, and re-roll on the floured surface and rolling pin and cut using the flutter tool to make more scones. Place scones on parchment paper. When all the scones are cut into 3 inch round flutters, place on cookie baking sheet. Spread scones at least one inch apart. Place in oven, with oven mitt on your hand, the 15 scones for 23 minutes. Set timer for 23 minutes. After 23 minutes, pull scones out of the oven using an oven mitt. Allow scones to cool for 15 minutes.

Repeat baking steps three times. First, replace the control (heavy cream) with the MARTIN’s half and half (variable 1), second time with the MARTIN’S 2% milk (variable 2), and the third time with Slim n Trim fat free milk (variable 3). After the cranberry scones are baked, it is time perform the subjective and objective evaluation. Subjective evaluation consisted of mouth feel, texture and flavor, while objective evaluation consisted of tenderness, and volume (Appendix F).

Subjective Evaluation

For the subjective evaluation five petition boards were set up each containing the sample plate (Appendix E), one score card, a pencil, and judges will be advised prior to bring a glass of water at room temperature. The subjective data judged by the panelists were flavor, texture, and mouth feel based on a 1-5 scale (Fig. 1). Every variable was assigned a different three digit number to ensure that there was no bias.

Sensory Panel

The five same panelists evaluated the samples for the three weeks of experimentation. The panelists were students, in the Tuesday lab for Experimental Foods Class; FDNT 362. All panelists were females, and were between 19 to 22 years of age. Figure 1. Scorecard for Cranberry Orange Scones

The Scorecard for Cranberry Orange Scones

1. Review the characteristics being evaluated
2. Taste each one of the samples, and put the appropriate number in the box using the scale for each characteristic.
3. Fill out and review scorecard to the best of your ability.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Characteristic | Sample 214 | Sample 323 | Sample 619 | Sample 926 |
| Mouth feel |  |  |  |  |
| Flavor |  |  |  |  |
| Texture |  |  |  |  |

**Mouth Feel:**

Circle the number that applies:

Smooth 1 2 3 4 5 Gritty

**Flavor:**

Circle the number that applies:

Sweet 1 2 3 4 5 Acidic

**Texture:**

Circle the number that applies:

Moist 1 2 3 4 5 Dry

(Ms. Seybold, 2010, Sensory Evaluation Sheet)

Figure 1. The scorecard given to the sensory panelists. They were asked to score using the 1-5 scale accordingly for mouth feel, flavor, and texture.

Objective Evaluation

Objective measures in this study include volume, and tenderness (Appendix X). The penetrometer was used to measure tenderness, while the v-caliper was used to measure volume. With the volume measurement and mass of the scone density of the scone, and specific volume were also measured.

To perform the V-Caliper test:

First weigh in grams the four samples individually. Prior to measuring, be sure the screw is loosened, making the scale easily adjustable. When the scale moves up or down a “stiff-bar” gets longer/shorter in length. Also, be sure the scale reads 0 before starting. Stick the “stiff-bar” on the left side of the scone until the end of the v-caliper is touching slightly touching the top of the scone. How to read the measured value:

1. “Read the centimeter mark on the fixed scale to the left of the 0-mark on the vernier scale. (10mm on the fixed caliper)” (Tresna, 2008).
2. “ Find the millimeter mark on the fixed scale that is just to the left of the 0-mark on the vernier scale. (6mm on the fixed caliper)” (Tresna, 2008).
3. “ Look along the ten marks on the vernier scale and the millimeter marks on the adjacent fixed scale, until you find the two that most nearly line up. (0.25mm on the vernier scale)” (Tresna, 2008).
4. “To get the correct reading, simply add this found digit to your previous reading. (10mm + 6mm + 0.25mm= 16.25 mm)” (Tresna, 2008).

Repeat this step for the right side of the scone. To get the volume of each sample, total together the left and right side measurements, and divide by two. Repeat for every sample.

To perform the penetrometer test:

Cut the scone in half. Throw top half away in the trashcan and use the bottom half of the scone. “With instruction, ensure the needle begins at zero. After the sample is placed underneath, squeeze and hold the lever for one minute then release. Tap the needle pad lightly until it stops moving. Record the reading...” (Seybold, 2010). Repeat for every sample

Specific volume and density were measured using the standard formulas (Table 3) The numbers calculated for specific volume and density of each of the variables (control, half and half, 2% and fat free) was added together and divided by the total number of samples (3) to get an average of each variables specific volume and density.

Table 3: The formulas used for each scone to find specific volume and density of a scone.

|  |  |
| --- | --- |
| **To Measure:** | *Formula* |
| Specific Volume | *Average volume of the scone/Mass of the sample* |
| Density | *Mass of scone in grams/average volume of the sample* |

Data Analysis

After the subjecting and objective results were gathered from all three experiment weeks, the program SPPSS was used for data analysis. Test of with-in subject effects, measured the consistency of making the recipes, as well as judging. Testing of between subject effects, measured the significance in the difference of the control, and recipe variable s 1, 2, and 3. T-tests were then ran to determine the significance between recipes with texture, flavor and mouth

feel. When looking at the SPSS data sheets, the frequency table concluded that the data was within all normal ranges, allowing for further data analysis tests (with-in subject effects, between subject effects) to be interpreted. After all scones were baked, subjective and objective evaluation occurred, and SPSS data analysis testing occurred, the results from all three experiment weeks were interpreted. In addition, USDA handbook 8 was used for nutrient analysis of the control, and three variable recipes.

Chapter V

Results

Table 4. The mean and standard deviation of the three sensory evaluations mouth feel, flavor, and texture for the control, half and half (variable 1), 2% milk (variable 2), and fat free milk recipes (variable 3) for all three experiment weeks.

|  |  |  |  |
| --- | --- | --- | --- |
| Dependent Variable | Condition | Mean | Standard Deviation |
| Mouthfeel | Control- Heavy Cream | 2.93 | 1.116 |
| Half and Half | 2.4 | 0.894 |
| 2% Milk | 2 | 0.471 |
| Fat Free Milk | 2.87 | 0.803 |
| Flavor | Control- Heavy Cream | 3.33 | 0.624 |
| Half and Half | 2.93 | 0.641 |
| 2% Milk | 2.73 | 0.435 |
| Fat Free Milk | 2.6 | 0.548 |
| Texture | Control- Heavy Cream | 3.33 | 0.816 |
| Half and Half | 2.53 | 0.298 |
| 2% Milk | 1.8 | 0.38 |
| Fat Free Milk | 2.73 | 0.279 |

Consistency

After running SPSS 17.0 Statistical Output “with-in subject effects” tests, there was not a significant difference (p-value >.05) between judging from the sensory panelists, as well as making the recipes. With a p-value of .108, this concludes that there was consistency of judging, as well as making the recipes for all three experiment weeks (Table 5). Data was valid for consistency, therefore, it was appropriate to continue running data analysis.

Table 5: Data for level of significance for consistency of judging and making recipes during all three trial weeks.

|  |  |
| --- | --- |
| Tests of with-in subject effects: | P- Value |
| Consistency of judging and making recipes | .108 |

Note. P-value >.05 was not significant\*

Differences between Recipes

The test of between subject effects; determined the level of significance in terms of differences between the control; variable 1, variable 2, and variable 3. There was a significant difference (p-value <.05) between all four recipes. With a p-value of .000, it concludes there are variable s between the recipes (See Table 6). Running independent t-tests of data determined the difference of recipes in terms of flavor, texture and mouth feel. There is a significant difference (p value of .009) in texture between the half-and-half (variable 1) and 2% milk (variable 2) (Table 7). There is a significant difference (p value of .002) in texture between the 2% milk (variable 2) and fat free milk (variable 3) (Table 8). There were no significant differences (p-value>.05) in mouth feel and flavor between all four recipes.

Table 6. After running SPSS- test of between subject effects, results showed significant differences between all four recipes.

|  |  |
| --- | --- |
| Test of between subject effects: | P-Value: |
| Variable between Recipes (control, variable 1, variable 2, variable 2) | .000 |

Note. p–value >.05 was not significant\*

Table 7. After running SPSS- independent sample t-tests, results showed there was significant differences in texture with the half and half recipe and 2% milk.

|  |  |
| --- | --- |
| Independent Sample T-Tests: TEXTURE | P-Value |
| Recipes: Half and Half (Variable 1) and 2% Milk (Variable 2) | .009 |

Note. p-value <.05 is significant\*

Table 8. After running SPSS- independent sample t-tests, results showed there was significant difference in texture with the 2% milk and fat free milk.

|  |  |
| --- | --- |
| Independent Sample T-Test: TEXTURE | P-Value |
| Recipes: 2% Milk (Variable 2) and Fat Free Milk (Variable 3) | .002 |

Note. p-value <.05 is significant\*

Specific Volume and Density

There was a difference in terms of average density, between the control recipe and fat free milk. The control recipe had a greater density than the fat free milk (variable 3). There was minimum difference in density with half and half (variable 1) and 2% milk (variable 2) (Table 9). Average specific volume of the recipe variables did not yield conclusive results, concluding that specific volume results are not as applicable as the results for average density (Table 10). In appendix I, it is evident in the picture, that the control recipe, and half-and-half variable had a more structured cone.

Table 9. The average scone density for the control, half and half, 2% and fat free mil recipes.

|  |  |
| --- | --- |
| Condition | Mean Density |
| Control | 20.8 |
| Half and Half | 17.868 |
| 2% | 17.81 |
| Fat Free Milk | 15.97 |

Table 10. The average scone density for the control, half and half, 2%, and fat free milk recipes.

|  |  |
| --- | --- |
| Condition | Mean Specific Volume |
| Heavy Cream (Control) | .052 |
| Half and Half (Variable 1) | .174 |
| 2% Milk | .0537 |
| Fat Free Milk | .158 |

Chapter VI

Conclusion

Significant testing, showed that the dependent variables; flavor and mouth feel between all four recipes were similar. The dependent variable; texture. showed differences between recipes.

The results support that when manipulating fat, there is no difference in the detection of flavor in the product as supported by the study Linforth and Cabennes (2011). Flavor between recipes went undetectable, probably due to the overpowering sweetness of the cranberries, and the acidity of the orange zest added to the scones.

With regards to texture, cranberry orange scones made with half and half were moister than cranberry orange scones made with 2% milk, due to the higher fat content of the half and half. Cranberry orange scones made with 2% milk were textural different than the fat free milk; probably due to the absence of fat in the fat free recipe.

In conclusion to this experiment, cranberry orange scones made with half and half instead of heavy cream produce a similar product in terms of mouth feel, texture, and flavor, and contains almost a third less saturated fat than the heavy cream, therefore making it a successful fat substitute for scones. See appendix A for nutrient analysis of control, and the three variable recipes. Although 2%, and fat free milk would be the more preferred substitute because it contains only 2% and 0% fat, it had significant differences in texture, therefore making it an acceptable fat substitute from the panelists.

Discussion

Chapter VII

Strengths

All five panelists used proper judging when scoring samples, because they were all classmates that were taught and trained in FDNT 263 experimental foods on how to be a sensory panelists, resulting in consistent judging of the cranberry orange scones. One experimenter performed all procedures for all three experiment weeks, resulting in consistency of all four varied recipes. Bias was eliminated due to the samples being assigned different numbers each week so panelists could not identify the recipe with the sample while judging. Variables used had a wide range of percentage of fat, allowing for comparison of subject and objective evaluation between recipes.

Results of Recipe Modifications

There was one recipe modification that did not work prior to baking. The fat free milk (variable 3) recipe had extreme dough stickiness, making it extremely difficult to mold a scone . Appendix H shows the characteristics of the fat free milk variable (variation 3) dough and the 2% milk variable and how it differed from the control, and the half and half recipe. As supported from the study conducted by Wekwete and Navder (2008), the reduced fat modifications were significantly stickier. Heavy cream and half and half contain cream, while the 2% and fat free milk contain no cream and have significantly lower amounts of fat, attributing to the characteristics of the sticky dough. After baking, all variations were edible and physically appealing. In appendix I, it is evident when looking at the picture, that the control recipe, and half-and-half variable had a more structured cone, making it more physically appealing to the eye.

Limitations

One limitation of this study was the lack of space and equipment limitation while doing the experiment. The lack of space forced experimenters to share space, resulting in an extremely messy and unorganized experimental environment. Originally, the instrument, planimeter was to be used instead of the v-caliper. The equipment replacement was due to the weak logistics of the planimeter. Another limitation of the study was the fact that all the judges were in the same age range of 19-22 years old. If there was a wider age range, results may have varied; for example, if children were part of the sensory panelists, they may have more sensitivity to fat modification in terms of flavor, texture and mouth feel than an adult. For objective evaluation, validity of the results for tenderness is not valid due to equipment failure of the penetrometer during the third week of experiments. Tenderness was accounted for in results, due to equipment failure.

Recommendations

For future research on cranberry orange scones and fat modification, consider the following recommendations:

* Increasing the number of experiment weeks to create more precise results.
* Add a fourth variation (e.g. whole milk) to compare with the control recipe, in hopes of finding additional acceptable fat substitutes.
* Identify every sensory panelist for in-depth analysis of comparing judges scores.
* Be prepared for equipment failure, with back up equipment

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Appendix A

**Nutrient Content of Experimental Recipes**

**Cranberry Orange Scones– Heavy Cream (Control)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Heavy Cream** | **All Purpose Flour** | **Sugar- Granulated** | **Baking Powder** | **Kosher Salt** | **Grated-Orange Zest** | **Unsalted Butter** | **Extra Large Eggs** | **Dried**  **Cranberries** | **Total** | **Total/Serving** |
| Amount needed | **118.3 ml** | **390.63 g** | **25 g** | **14 g** | **6 g** | **3 g** | **170.10 g** | **112 g** | **20 g** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Energy (kcal) | 68.79 | 45.6 | 97 | 7 | 0 | 3 | 30.52 | 85.29 | 62 | **399.2 kcal** | **57.03 kcal** |
| Protein | 2.44 | 40.35 | 0 | 0 | 0 | .04 | 1.45 | 14.07 | .01 | **58.36 g** | **8.34 g** |
| Total lipid | 44.10 | 3.83 | 0 | 0 | 0 | ,01 | 137.97 | 10.65 | .27 | **197.82 g** | **28.26 g** |
| Saturated fat | 27.454 | .605 | 0 | 0 | 0 | .001 | 87.377 | 3.501 | .021 | **118.959 g** | **16.994 g** |
| Monounsaturated fat | 12.738 | .340 | 0 | 0 | 0 | .001 | 35.757 | 4.097 | .040 | **52.973 g** | **15.135 g** |
| Polyunsaturated fat | 1.638 | 1.613 | 0 | 0 | 0 | .001 | 5.176 | 2.140 | .132 | **10.7 g** | **1.529 g** |
| CHO by difference | 3.33 | 298.09 | 25.0 | 3.88 | 0 | .75 | .10 | .81 | 16.47 | **348.43 g** | **49.78 g** |
| Fiber | 0.0 | 10.5 | 0 | 0.0 | 0 | .3 | 0 | 0 | 1.1 | **11.9 g** | **1.7 g** |
| Sugars, total | .13 | 1.05 | 24.95 | 0.00 | 0 | 0 | .10 | .008 | 13.0 | **39.238 g** | **5.605 g** |
| Sucrose | 0 | 0 | 24.95 | 0 | 0 | 0 | 0 | O | 0 | **0 g** | **0.0 g** |
| Glucose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | .008 | 0 | **0.008 g** | **0.001 g** |
| Fructose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Lactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Maltose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Galactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Starch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Calcium | 77 | 59 | 0 | 823 | 0 | 5 | 41 | 63 | 2 | **1070 mg** | **152.86 mg** |
| Iron | .04 | 18.13 | .01 | 1.54 | 0 | .02 | .03 | 1.96 | .11 | **21.84 mg** | **3.12 mg** |
| Magnesium | 8 | 86 | 0 | 4 | 0 | 1 | 3 | 13 | 1 | **116 mg** | **16.57 mg** |
| Phosphorus | 74 | 422 | 0 | 307 | 0 | 1 | 41 | 222 | 2 | **1069 mg** | **152.71 mg** |
| Potassium | 89 | 418 | 0 | 3 | 0 | 6 | 41 | 155 | 8 | **720 mg** | **102.86 mg** |
| Sodium | 45 | 8 | 0 | 1484 | 0 | 0 | 19 | 159 | 1 | **1716 mg** | **245.14 mg** |
| Zinc | .27 | 2.73 | 0 | 0.00 | 0 | .01 | .15 | 1.44 | .02 | **4.62 mg** | **0.66 mg** |
| Copper | .007 | .563 | .002 | 0.001 | 0 | .003 | .027 | .081 | .016 | **0.7 mg** | **0.1 mg** |
| Manganese | .001 | 2.664 | .001 | .002 | 0 | 0 | .007 | .031 | .053 | **2.759 mg** | **0.394 mg** |
| Selenium | .6 | 132.4 | .1 | 0.0 | 0 | 0 | 1.7 | 34.4 | .1 | **169.3 mcg** | **24.19 mcg** |
| Vitamin C | .7 | 0.0 | 0 | 0.0 | 0 | 4.1 | 0.0 | 0.0 | 0.0 | **4.8 mg** | **0.69 mg** |
| Thiamin | .026 | 3.066 | 0 | 0.0 | 0 | .004 | .009 | .045 | .001 | **3.151 mg** | **0.45 mg** |
| Riboflavin | .131 | 1.930 | .005 | 0.0 | 0 | .003 | .058 | .512 | .003 | **2.642 mg** | **0.377 mg** |
| Niacin | .046 | 23.063 | 0.000 | 0.0 | 0 | .027 | .071 | .084 | .198 | **23.489 mg** | **3.356 mg** |
| Pantothenic acid | .304 | 1.711 | 0.000 | 0.0 | 0 | .015 | .187 | 1.717 | .043 | **3.977 mg** | **0.568 mg** |
| Vitamin B-6 | .031 | .172 | 0 | 0.0 | 0 | .005 | .005 | .190 | .008 | **0.411 mg** | **0.059 mg** |
| Folate, total | 5 | 715 | 0 | 0 | 0 | 1 | 5 | 53 | 0 | **779 mcg** | **111.29 mcg** |
| Vitamin B-12 | .21 | 0 | 0 | 0 | 0 | 0.00 | .29 | 1.00 | 0 | **1.5 mcg** | **0.21 mcg** |
| Vitamin A, IU | 1752 | o | 0 | 0 | 0 | 13 | 4251 | 605 | 0 | **4869 IU** | **695.57 IU** |
| Vitamin E (alpha-tocopherol) | 1.26 | .23 | 0 | 0 | 0 | .01 | 3.95 | 1.18 | .21 | **6.84 mg** | **0.98 mg** |
| Vitamin D | 32 | o | 0 | 0 | 0 | 0 | 102 | 92 | 0 | **194 IU** | **27.71 IU** |
| Vitamin K | 3.8 | 1.2 | 0 | 0 | 0 | 0 | 11.9 | .3 | .8 | **18 mcg** | **2.57 mcg** |

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**Nutrient Content of Experimental Recipes**

**Cranberry Orange Scones– Half and Half (Variable 1)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Half and Half** | **All Purpose Flour** | **Sugar- Granulated** | **Baking Powder** | **Kosher Salt** | **Grated-Orange Zest** | **Unsalted Butter** | **Extra Large Eggs** | **Dried**  **Cranberries** | **Total** | **Total/Serving** |
| Amount needed | **118.3 ml** | **390.63 g** | **25 g** | **14 g** | **6 g** | **3 g** | **170.10 g** | **112 g** | **20 g** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Energy (kcal) | 157 | 45.6 | 97 | 7 | 0 | 3 | 30.52 | 85.29 | 62 | **487.41 kcal** | **69.63 kcal** |
| Protein | 3.58 | 40.35 | 0 | 0 | 0 | .04 | 1.45 | 14.07 | .01 | **59.5 g** | **8.5 g** |
| Total lipid | 13.89 | 3.83 | 0 | 0 | 0 | ,01 | 137.97 | 10.65 | .27 | **167.61 g** | **23.94 g** |
| Saturated fat | 8.647 | .605 | 0 | 0 | 0 | .001 | 87.377 | 3.501 | .021 | **100.152 g** | **14.307 g** |
| Monounsaturated fat | 4.012 | .340 | 0 | 0 | 0 | .001 | 35.757 | 4.097 | .040 | **44.247 g** | **12.642 g** |
| Polyunsaturated fat | .516 | 1.613 | 0 | 0 | 0 | .001 | 5.176 | 2.140 | .132 | **9.578 g** | **1.368 g** |
| CHO by difference | 5.19 | 298.09 | 25.0 | 3.88 | 0 | .75 | .10 | .81 | 16.47 | **350.29 g** | **50.04 g** |
| Fiber | 0.0 | 10.5 | 0 | 0.0 | 0 | .3 | 0 | 0 | 1.1 | **11.9 g** | **1.7 g** |
| Sugars, total | .19 | 1.05 | 24.95 | 0.00 | 0 | 0 | .10 | .008 | 13.0 | **39.298 g** | **5.614 g** |
| Sucrose | 0 | 0 | 24.95 | 0 | 0 | 0 | 0 | O | 0 | **0 g** | **0.0 g** |
| Glucose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | .008 | 0 | **0.008 g** | **0.001 g** |
| Fructose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Lactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Maltose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Galactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Starch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Calcium | 77 | 59 | 0 | 823 | 0 | 5 | 41 | 63 | 2 | **1070 mg** | **152.86 mg** |
| Iron | .08 | 18.13 | .01 | 1.54 | 0 | .02 | .03 | 1.96 | .11 | **21.88 mg** | **3.13 mg** |
| Magnesium | 12 | 86 | 0 | 4 | 0 | 1 | 3 | 13 | 1 | **120 mg** | **17.14 mg** |
| Phosphorus | 115 | 422 | 0 | 307 | 0 | 1 | 41 | 222 | 2 | **1110 mg** | **158.57 mg** |
| Potassium | 157 | 418 | 0 | 3 | 0 | 6 | 41 | 155 | 8 | **788 mg** | **112.57 mg** |
| Sodium | 50 | 8 | 0 | 1484 | 0 | 0 | 19 | 159 | 1 | **1721 mg** | **245.86 mg** |
| Zinc | .62 | 2.73 | 0 | 0.00 | 0 | .01 | .15 | 1.44 | .02 | **4.97 mg** | **0.71 mg** |
| Copper | .012 | .563 | .002 | 0.001 | 0 | .003 | .027 | .081 | .016 | **0.705 mg** | **0.101 mg** |
| Manganese | .001 | 2.664 | .001 | .002 | 0 | 0 | .007 | .031 | .053 | **2.759 mg** | **0.394 mg** |
| Selenium | 2.2 | 132.4 | .1 | 0.0 | 0 | 0 | 1.7 | 34.4 | .1 | **170.9 mcg** | **24.41 mcg** |
| Vitamin C | 1.1 | 0.0 | 0 | 0.0 | 0 | 4.1 | 0.0 | 0.0 | 0.0 | **5.2 mg** | **0.74 mg** |
| Thiamin | .042 | 3.066 | 0 | 0.0 | 0 | .004 | .009 | .045 | .001 | **3.167 mg** | **0.452 mg** |
| Riboflavin | .180 | 1.930 | .005 | 0.0 | 0 | .003 | .058 | .512 | .003 | **2.691 mg** | **0.384 mg** |
| Niacin | .094 | 23.063 | 0.000 | 0.0 | 0 | .027 | .071 | .084 | .198 | **23.537 mg** | **3.362 mg** |
| Pantothenic acid | .349 | 1.711 | 0.000 | 0.0 | 0 | .015 | .187 | 1.717 | .043 | **4.022 mg** | **0.575 mg** |
| Vitamin B-6 | .047 | .172 | 0 | 0.0 | 0 | .005 | .005 | .190 | .008 | **0.427 mg** | **0.061 mg** |
| Folate, total | 4 | 715 | 0 | 0 | 0 | 1 | 5 | 53 | 0 | **778 mcg** | **111.14 mcg** |
| Vitamin B-12 | .40 | 0 | 0 | 0 | 0 | 0.00 | .29 | 1.00 | 0 | **1.69 mcg** | **0.24 mcg** |
| Vitamin A, IU | 428 | o | 0 | 0 | 0 | 13 | 4251 | 605 | 0 | **4869 IU** | **695.57 IU** |
| Vitamin E (alpha-tocopherol) | .40 | .23 | 0 | 0 | 0 | .01 | 3.95 | 1.18 | .21 | **5.98 mg** | **0.85 mg** |
| Vitamin D | 10 | o | 0 | 0 | 0 | 0 | 102 | 92 | 0 | **194 IU** | **27.71 IU** |
| Vitamin K | 1.6 | 1.2 | 0 | 0 | 0 | 0 | 11.9 | .3 | .8 | **15.8 mcg** | **2.26 mcg** |

**Nutrient Content of Experimental Recipes**

**Cranberry Orange Scones– 2% Milk (Variable 2)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2% Milk** | **All Purpose Flour** | **Sugar- Granulated** | **Baking Powder** | **Kosher Salt** | **Grated-Orange Zest** | **Unsalted Butter** | **Extra Large Eggs** | **Dried**  **Cranberries** | **Total** | **Total/Serving** |
| Amount needed | **118.3 ml** | **390.63 g** | **25 g** | **14 g** | **6 g** | **3 g** | **170.10 g** | **112 g** | **20 g** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Energy (kcal) | 6 | 45.6 | 97 | 7 | 0 | 3 | 30.52 | 85.29 | 62 | **336.41 kcal** | **48.06 kcal** |
| Protein | .40 | 40.35 | 0 | 0 | 0 | .04 | 1.45 | 14.07 | .01 | **56.32 g** | **8.05 g** |
| Total lipid | .24 | 3.83 | 0 | 0 | 0 | ,01 | 137.97 | 10.65 | .27 | **153.96 g** | **21.99 g** |
| Saturated fat | .153 | .605 | 0 | 0 | 0 | .001 | 87.377 | 3.501 | .021 | **91.658 g** | **13.094 g** |
| Monounsaturated fat | .068 | .340 | 0 | 0 | 0 | .001 | 35.757 | 4.097 | .040 | **40.303 g** | **11.515 g** |
| Polyunsaturated fat | .009 | 1.613 | 0 | 0 | 0 | .001 | 5.176 | 2.140 | .132 | **9.071 g** | **1.296 g** |
| CHO by difference | .59 | 298.09 | 25.0 | 3.88 | 0 | .75 | .10 | .81 | 16.47 | **345.69 g** | **49.38 g** |
| Fiber | 0.0 | 10.5 | 0 | 0.0 | 0 | .3 | 0 | 0 | 1.1 | **11.9 g** | **1.7 g** |
| Sugars, total | .62 | 1.05 | 24.95 | 0.00 | 0 | 0 | .10 | .008 | 13.0 | **39.728 g** | **5.675 g** |
| Sucrose | 0 | 0 | 24.95 | 0 | 0 | 0 | 0 | O | 0 | **0 g** | **0.0 g** |
| Glucose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | .008 | 0 | **0.008 g** | **0.001 g** |
| Fructose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Lactose | .61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0.61 g** | **0.09 g** |
| Maltose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Galactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Starch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Calcium | 15 | 59 | 0 | 823 | 0 | 5 | 41 | 63 | 2 | **1008 mg** | **144 mg** |
| Iron | 0.0 | 18.13 | .01 | 1.54 | 0 | .02 | .03 | 1.96 | .11 | **21.8 mg** | **3.11 mg** |
| Magnesium | 1 | 86 | 0 | 4 | 0 | 1 | 3 | 13 | 1 | **109 mg** | **15.57 mg** |
| Phosphorus | 11 | 422 | 0 | 307 | 0 | 1 | 41 | 222 | 2 | **1006 mg** | **143.71 mg** |
| Potassium | 17 | 418 | 0 | 3 | 0 | 6 | 41 | 155 | 8 | **648 mg** | **92.57 mg** |
| Sodium | 6 | 8 | 0 | 1484 | 0 | 0 | 19 | 159 | 1 | **1677 mg** | **239.57 mg** |
| Zinc | .06 | 2.73 | 0 | 0.00 | 0 | .01 | .15 | 1.44 | .02 | **4.41 mg** | **0.63 mg** |
| Copper | .001 | .563 | .002 | 0.001 | 0 | .003 | .027 | .081 | .016 | **0.694 mg** | **0.099 mg** |
| Manganese | .002 | 2.664 | .001 | .002 | 0 | 0 | .007 | .031 | .053 | **2.76 mg** | **0.394 mg** |
| Selenium | .3 | 132.4 | .1 | 0.0 | 0 | 0 | 1.7 | 34.4 | .1 | **169 mcg** | **24.14 mcg** |
| Vitamin C | 0.0 | 0.0 | 0 | 0.0 | 0 | 4.1 | 0.0 | 0.0 | 0.0 | **4.1 mg** | **0.59 mg** |
| Thiamin | .005 | 3.066 | 0 | 0.0 | 0 | .004 | .009 | .045 | .001 | **3.167 mg** | **0.45 mg** |
| Riboflavin | .023 | 1.930 | .005 | 0.0 | 0 | .003 | .058 | .512 | .003 | **2.534 mg** | **0.362 mg** |
| Niacin | .011 | 23.063 | 0.000 | 0.0 | 0 | .027 | .071 | .084 | .198 | **23.454 mg** | **3.351 mg** |
| Pantothenic acid | .043 | 1.711 | 0.000 | 0.0 | 0 | .015 | .187 | 1.717 | .043 | **3.716 mg** | **0.531 mg** |
| Vitamin B-6 | .005 | .172 | 0 | 0.0 | 0 | .005 | .005 | .190 | .008 | **0.385 mg** | **0.055 mg** |
| Folate, total | 1 | 715 | 0 | 0 | 0 | 1 | 5 | 53 | 0 | **775 mcg** | **110.71 mcg** |
| Vitamin B-12 | .06 | 0 | 0 | 0 | 0 | 0.00 | .29 | 1.00 | 0 | **1.35 mcg** | **0.19 mcg** |
| Vitamin A, IU | 23 | o | 0 | 0 | 0 | 13 | 4251 | 605 | 0 | **4869 IU** | **695.57 IU** |
| Vitamin E (alpha-tocopherol) | 0.0 | .23 | 0 | 0 | 0 | .01 | 3.95 | 1.18 | .21 | **5.58 mg** | **0.8 mg** |
| Vitamin D | 6 | o | 0 | 0 | 0 | 0 | 102 | 92 | 0 | **194 IU** | **27.71 IU** |
| Vitamin K | 0.0 | 1.2 | 0 | 0 | 0 | 0 | 11.9 | .3 | .8 | **14.2 mcg** | **2.03 mcg** |

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**Nutrient Content of Experimental Recipes**

**Cranberry Orange Scones– Fat Free Milk (Variable 3)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Fat free Milk** | **All Purpose Flour** | **Sugar- Granulated** | **Baking Powder** | **Kosher Salt** | **Grated-Orange Zest** | **Unsalted Butter** | **Extra Large Eggs** | **Dried**  **Cranberries** | **Total** | **Total/Serving** |
| Amount needed | **118.3 ml** | **390.63 g** | **25 g** | **14 g** | **6 g** | **3 g** | **170.10 g** | **112 g** | **20 g** |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Energy (kcal) | 42 | 45.6 | 97 | 7 | 0 | 3 | 30.52 | 85.29 | 62 | **372.41 kcal** | **53.2 kcal** |
| Protein | 4.12 | 40.35 | 0 | 0 | 0 | .04 | 1.45 | 14.07 | .01 | **60.04 g** | **8.58 g** |
| Total lipid | .10 | 3.83 | 0 | 0 | 0 | ,01 | 137.97 | 10.65 | .27 | **153.82 g** | **21.97 g** |
| Saturated fat | .062 | .605 | 0 | 0 | 0 | .001 | 87.377 | 3.501 | .021 | **91.567 g** | **13.081 g** |
| Monounsaturated fat | .026 | .340 | 0 | 0 | 0 | .001 | 35.757 | 4.097 | .040 | **40.261 g** | **11.503 g** |
| Polyunsaturated fat | .004 | 1.613 | 0 | 0 | 0 | .001 | 5.176 | 2.140 | .132 | **9.066 g** | **1.295 g** |
| CHO by difference | 6.07 | 298.09 | 25.0 | 3.88 | 0 | .75 | .10 | .81 | 16.47 | **351.17 g** | **50.17 g** |
| Fiber | 0.0 | 10.5 | 0 | 0.0 | 0 | .3 | 0 | 0 | 1.1 | **11.9 g** | **1.7 g** |
| Sugars, total | 6.23 | 1.05 | 24.95 | 0.00 | 0 | 0 | .10 | .008 | 13.0 | **45.338 g** | **6.477 g** |
| Sucrose | 0 | 0 | 24.95 | 0 | 0 | 0 | 0 | O | 0 | **0 g** | **0.0 g** |
| Glucose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | .008 | 0 | **0.008 g** | **0.001 g** |
| Fructose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Lactose | 6.23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **6.23 g** | **0.89 g** |
| Maltose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Galactose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Starch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0 g** | **0.0 g** |
| Calcium | 149 | 59 | 0 | 823 | 0 | 5 | 41 | 63 | 2 | **1142 mg** | **163.14 mg** |
| Iron | 0.04 | 18.13 | .01 | 1.54 | 0 | .02 | .03 | 1.96 | .11 | **21.84 mg** | **3.12 mg** |
| Magnesium | 13 | 86 | 0 | 4 | 0 | 1 | 3 | 13 | 1 | **121 mg** | **17.29 mg** |
| Phosphorus | 124 | 422 | 0 | 307 | 0 | 1 | 41 | 222 | 2 | **1119 mg** | **159.86 mg** |
| Potassium | 191 | 418 | 0 | 3 | 0 | 6 | 41 | 155 | 8 | **822 mg** | **117.43 mg** |
| Sodium | 61 | 8 | 0 | 1484 | 0 | 0 | 19 | 159 | 1 | **1732 mg** | **247.43 mg** |
| Zinc | .51 | 2.73 | 0 | 0.00 | 0 | .01 | .15 | 1.44 | .02 | **4.86 mg** | **0.69 mg** |
| Copper | .016 | .563 | .002 | 0.001 | 0 | .003 | .027 | .081 | .016 | **0.709 mg** | **0.101 mg** |
| Manganese | .004 | 2.664 | .001 | .002 | 0 | 0 | .007 | .031 | .053 | **2.762 mg** | **0.395 mg** |
| Selenium | 3.8 | 132.4 | .1 | 0.0 | 0 | 0 | 1.7 | 34.4 | .1 | **172.5 mcg** | **24.64 mcg** |
| Vitamin C | 0.0 | 0.0 | 0 | 0.0 | 0 | 4.1 | 0.0 | 0.0 | 0.0 | **4.1 mg** | **0.59 mg** |
| Thiamin | .005 | 3.066 | 0 | 0.0 | 0 | .004 | .009 | .045 | .001 | **3.13 mg** | **0.447 mg** |
| Riboflavin | .223 | 1.930 | .005 | 0.0 | 0 | .003 | .058 | .512 | .003 | **2.734 mg** | **0.391 mg** |
| Niacin | .115 | 23.063 | 0.000 | 0.0 | 0 | .027 | .071 | .084 | .198 | **23.558 mg** | **3.365 mg** |
| Pantothenic acid | .437 | 1.711 | 0.000 | 0.0 | 0 | .015 | .187 | 1.717 | .043 | **4.11 mg** | **0.587 mg** |
| Vitamin B-6 | .045 | .172 | 0 | 0.0 | 0 | .005 | .005 | .190 | .008 | **0.425 mg** | **0.061 mg** |
| Folate, total | 1 | 715 | 0 | 0 | 0 | 1 | 5 | 53 | 0 | **775 mcg** | **110.71 mcg** |
| Vitamin B-12 | .61 | 0 | 0 | 0 | 0 | 0.00 | .29 | 1.00 | 0 | **1.9 mcg** | **0.27 mcg** |
| Vitamin A, IU | 18 | o | 0 | 0 | 0 | 13 | 4251 | 605 | 0 | **4869 IU** | **695.57 IU** |
| Vitamin E (alpha-tocopherol) | 0.01 | .23 | 0 | 0 | 0 | .01 | 3.95 | 1.18 | .21 | **5.59 mg** | **0.8 mg** |
| Vitamin D | 0 | o | 0 | 0 | 0 | 0 | 102 | 92 | 0 | **194 IU** | **27.71 IU** |
| Vitamin K | 0.0 | 1.2 | 0 | 0 | 0 | 0 | 11.9 | .3 | .8 | **14.2 mcg** | **2.03 mcg** |

0

Appendix B:

Garten 2006,

|  |  |  |
| --- | --- | --- |
| **Metric** | **English** | **Ingredient** |
| 531.25 g | 4cups plus ¼ cup | Generic All-Purpose Flour |
| 54.2 g | 1/4 cup plus additional for sprinkling | Generic Granulated Sugar |
| 27.6 g | 2 tablespoons | Generic Baking Powder |
| 12 g | 2 teaspoons | Generic Kosher Salt |
| 340.194 g | ¾ pound | Generic Unsalted Butter Sticks |
| 236.6 ml | 1 cup | Heavy Cream |
| 40 g | 1 cup | Dried Cranberries |
| 224 g | 4 | Extra Large Eggs |
| 6 g | 1 tablespoon | Grated Orange Zest |
| X | 1 | Egg beaten with 2 tablespoons water or milk, for egg wash |
| 2 | 4 teaspoons | Freshly squeezed orange juice. |
| 62.5 g | ½ cup | Confectioners sugar, plus 2 tablespoons |

Directions: Preheat the oven to 400 degrees F.

In the bowl of an electric mixer fitted with a paddle attachment, mix 4 cups of flour, 1/4 cup sugar, the baking powder, salt and orange zest. Add the cold butter and mix at the lowest speed until the butter is the size of peas. Combine the eggs and heavy cream and, with the mixer on low speed, slowly pour into the flour and butter mixture. Mix until just blended. The dough will look lumpy! Combine the dried cranberries and 1/4 cup of flour, add to the dough, and mix on low speed until blended.

Dump the dough onto a well-floured surface and knead it into a ball. Flour your hands and a rolling pin and roll the dough 3/4-inch thick. You should see small bits of butter in the dough. Keep moving the dough on the floured board so it doesn't stick. Flour a 3-inch round plain or fluted cutter and cut circles of dough. Place the scones on a baking pan lined with parchment paper. Collect the scraps neatly, roll them out, and cut more circles.

Brush the tops of the scones with egg wash, sprinkle with sugar, and bake for 20 to 25 minutes, until the tops are browned and the insides are fully baked. The scones will be firm to the touch. Allow the scones to cool for 15 minutes and then whisk together the confectioners' sugar and orange juice, and drizzle over the scones

Appendix C

**Rachel Knepp’s Market Order**

**Recipe: Cranberry Orange Scones (Yield 7)**

|  |  |
| --- | --- |
| **Amount** | **Ingredient** |
| 390.63 | Generic All-Purpose Flour |
| 25g | Generic Granulated Sugar |
| 14g | Generic Baking Powder |
| 6g | Generic Kosher Salt |
| 170.10g | Generic Unsalted Butter Sticks |
| ***118.3ml*** | ***Heavy Cream\**** |
| 20g | Name brand Ocean Spray Dried Cranberries |
| 112g | Extra Large Eggs |
| 3g | Grated Orange Zest |
| **Variables (\* = control ingredient)** | |
| 118.3ml | Half and Half |
| 118.3ml | 2% Milk |
| 118.3ml | Skim Milk |

**Market Order Sheet**

|  |  |
| --- | --- |
| **Ingredient** | **Amount Needed** |
| **Produce** | |
| Generic Orange | 2 medium-sized oranges |
| Name brand Ocean Spray dried Cranberries | 80g |
| **Cold/ Dairy/ Bread** |  |
| ***Generic Heavy whipping cream\**** | ***118.3ml*** |
| Generic Half and Half (variable 1) | 118.3ml |
| Generic 2% Milk (variable 2) | 118.3ml |
| Generic Skim Milk (variable 3) | 118.3ml |
| Generic Extra Large Eggs | 448g |
| Generic Butter, Unsalted Sticks | 682g |
| **Baking/Canned** |  |
| Generic Kosher Salt | 24g |
| Generic Granulated Sugar | 100g |
| Generic All-Purpose Flour | 1562.6g |
| Generic Baking Powder | 56g |

Appendix D:

Table 4. The mean and standard deviation of the three sensory evaluations mouth feel, flavor, and texture for the control, half and half (variable 1), 2% milk (variable 2), and fat free milk recipes (variable 3) for all three experiment weeks.

|  |  |  |  |
| --- | --- | --- | --- |
| Dependent Variable | Condition | Mean | Standard Deviation |
| Mouthfeel | Control- Heavy Cream | 2.93 | 1.116 |
| Half and Half | 2.4 | 0.894 |
| 2% Milk | 2 | 0.471 |
| Fat Free Milk | 2.87 | 0.803 |
| Flavor | Control- Heavy Cream | 3.33 | 0.624 |
| Half and Half | 2.93 | 0.641 |
| 2% Milk | 2.73 | 0.435 |
| Fat Free Milk | 2.6 | 0.548 |
| Texture | Control- Heavy Cream | 3.33 | 0.816 |
| Half and Half | 2.53 | 0.298 |
| 2% Milk | 1.8 | 0.38 |
| Fat Free Milk | 2.73 | 0.279 |

Table 6. After running SPSS- test of between subject effects, results showed significant differences between all four recipes.

|  |  |
| --- | --- |
| Test of between subject effects: | P-Value: |
| Variable between Recipes (control, variable 1, variable 2, variable 2) | .000 |

Note. p–value >.05 was not significant\*

Table 7. After running SPSS- independent sample t-tests, results showed there was significant differences in texture with the half and half recipe and 2% milk.

|  |  |
| --- | --- |
| Independent Sample T-Tests: TEXTURE | P-Value |
| Recipes: Half and Half (Variable 1) and 2% Milk (Variable 2) | .009 |

Note. p-value <.05 is significant\*

Table 8. After running SPSS- independent sample t-tests, results showed there was significant difference in texture with the 2% milk and fat free milk.

|  |  |
| --- | --- |
| Independent Sample T-Test: TEXTURE | P-Value |
| Recipes: 2% Milk (Variable 2) and Fat Free Milk (Variable 3) | .002 |

Note. p-value <.05 is significant\*

Table 9. The average scone density for the control, half and half, 2% and fat free mil recipes.

|  |  |
| --- | --- |
| Condition | Mean Density |
| Control | 20.8 |
| Half and Half | 17.868 |
| 2% | 17.81 |
| Fat Free Milk | 15.97 |

Table 10. The average scone density for the control, half and half, 2%, and fat free milk recipes.

|  |  |
| --- | --- |
| Condition | Mean Specific Volume |
| Heavy Cream (Control) | .052 |
| Half and Half (Variable 1) | .174 |
| 2% Milk | .0537 |
| Fat Free Milk | .158 |

Appendix E

Note. The plate format used that was given to the judge that contained the samples:

049

073

092

061

Appendix F

Concept Map of Dependent Variables:

Appendix G



Heavy Whipping Cream used in the control recipe.



Galiker’s Half and Half used for Variable 1.



Galikers 2% Reduced Fat Milk was used as Variable 2.



http://www.zeer.com/Food-Products/Giant-Vitamin-A--D-Fat-Free-Milk/000092681

Fat Free Milk used for variable 3

Appendix H



Note. Dough characteristics for each condition.

Appendix I



Note. O73: Half and Half 092: Control 061: 2% milk 049: Fat Free milk.

The half-and-half, and control recipes had the greatest physical appeal due to a conformed scone shape.