



# Flour Substitution for Heart Healthy Alternatives

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## Abstract

- The effects of highly processed foods contained within the average American diet has dramatically impacted, individual health can be observed with the increased incidence of cardiovascular and heart disease, elevated percentages of total daily fat consumption, and unhealthy high cholesterol levels.
- Researchers attempted to create a chocolate muffin with increased nutritional benefit with reduced sugar and carbohydrate count for those with cardiovascular disease and satisfy needs of heart healthy diet.
- Four comparison trials were conducted which matched a control, buckwheat flour, and almond flour substitute against one another with manipulation of flour additives for palpability and overall acceptability.
- Further research for improving texture and appearance would be beneficial. Additional consideration for fat substitutions to manipulate texture using applesauce or yogurt versus vegetable oil has been shown to help.

## Introduction

- The amount of snacking and overall consumption of high fat, processed, and convenience foods have grown in frequency and number.
- An estimated 95% of American adults and children do not consume the recommended amount of dietary fiber. A 2009-2010 National Health and Nutrition Survey calculated a mean daily fiber intake of 16.2 grams. Total dietary fiber should be 25-30 grams from food.
- An elevated low-density lipoprotein (LDL) is a major cause of heart disease and atherosclerosis. Total cholesterol of 125-200mg/dL, LDL less than 100mg/dL, and HDL 40mg/dL or higher is recommended for men and women age 20 years of age or older.
- The best option is to choose a flour that provides additional nutrition, such as increased fiber. The benefits of increased fiber consumption appear to lower the risk for developing coronary heart disease, stroke, and hypertension.
- Since all-purpose flour is most commonly used for baked goods, finding a muffin recipe with an alternative flour that still produces an acceptable muffin, without sacrificing the other functions that all-purpose flour serves in baking, can be challenging.
- Our goal is to develop a low-carbohydrate and low-sugar chocolate muffin that can match the taste of a traditional muffin for heart healthy consumers.

## Methods and Materials

### Materials:

2 large mixing bowls, dry/wet mixing cups, measuring spoons, 12 slot baking pans, oven, knife, cutting board, small cups – 3oz, small paper plates, paper towels – napkins, forks/spoons, water, data sheets – evaluation forms with pens provided

### Subjects and Setting:

First trial contained 11 participants, second trial contained 12 participants, third trial contained 14 participants, & fourth trial contained 13 participants.

The product was tested five times by 12 adult male and female participants approximately 20-65 years of age (10 women; 2 men; median age of 39). Each participant was randomly and conveniently selected (Fontbonne students, co-workers, family- friends) to two or three sample categories of varied muffin substitution recipes. The setting was a class located in the university foods lab which included a conventional oven, multiple sinks, countertop space, a large pantry and cooking equipment. Each variation was tested five times, with a different ratio of the selected substitution in each trial.

### Objective Evaluation:

- The volume of one control and one experimental muffin from each trial formulation was measured in height, by using centimeters on a standard ruler.
- The evaluation used the average height of three muffins within each trial to measure volume.
- The height was measured by slicing muffin in half and taking measurement from base to peak.
- The control muffin recorded an average height of 2.2". The almond flour recorded an average height of 2". The measurements remained constant throughout testing.

### Subjective Evaluation:

- For all four of the trials, the researchers gave their participants score cards to evaluate the products. Appearance, Texture, Flavor, Smell and Overall Rating were the five categories that the muffins were evaluated on by the participants.
- The evaluation scores for each category were based on a five-point Likert Scale, with 3 being an optimal score in categories and to 5 being an optimal score in overall rating.

### Nutrition Analysis:

- MyFitness Pal

## Results

Trial 1: Combination of ½ All-purpose flour and ½ Buckwheat flour. High density and moisture absorbance from Buckwheat flour resulted in poor subjective analysis with poor flavor and increased product dryness.

Trial 2: Combination of ½ All-purpose flour and ½ Buckwheat flour with manipulation of ingredients to increase the moisture content. Following poor results from subjective analysis decision was made to switch flour substitute for Almond flour in attempt to improve taste and moisture acceptability.

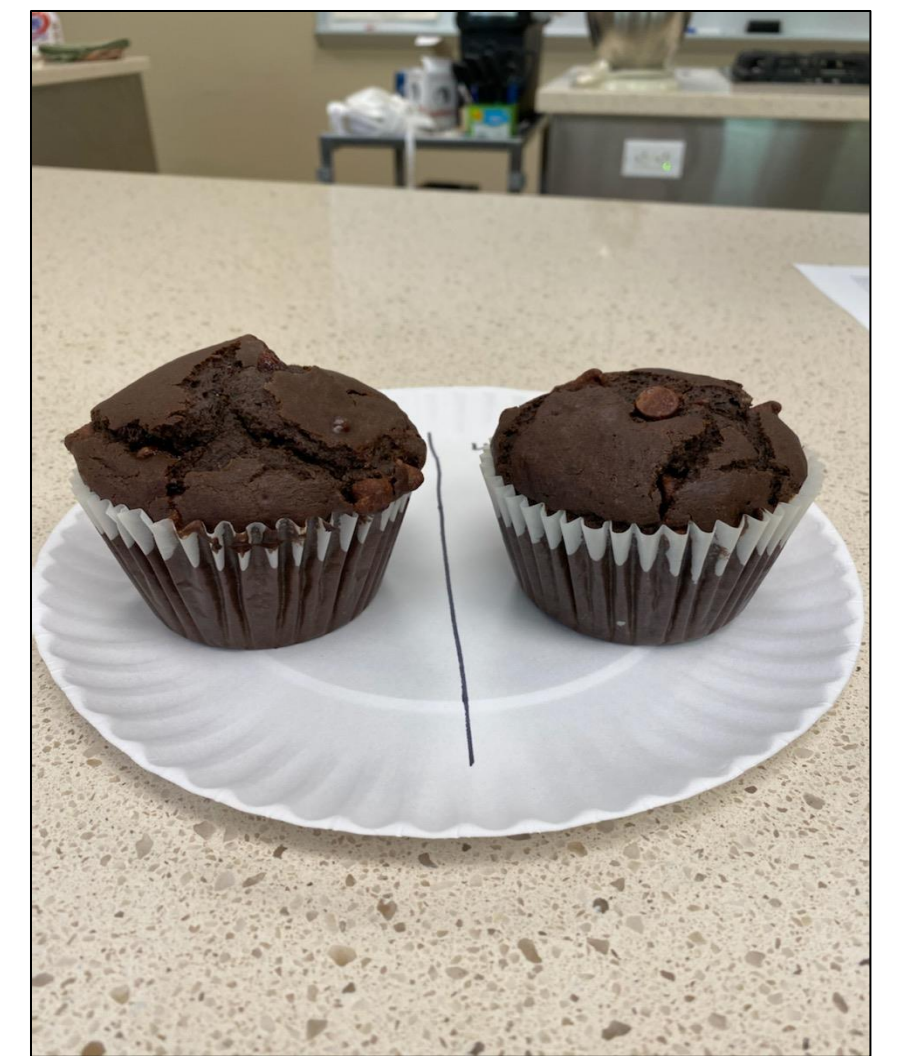
Trial 3: Combination of ½ All-purpose flour and ½ Almond flour received an increase in subjective review. Addition of Almond flour added subtle sweetness and texture producing a softer and moister product.

Trial 4: Most successful trial with Almond flour substitution of All-purpose flour for 1:1 ratio. Increased Almond flour created a sweeter and moister product. The Almond flour also created a desirable aroma. The higher fat content in Almond flour also aided in desired texture and taste.

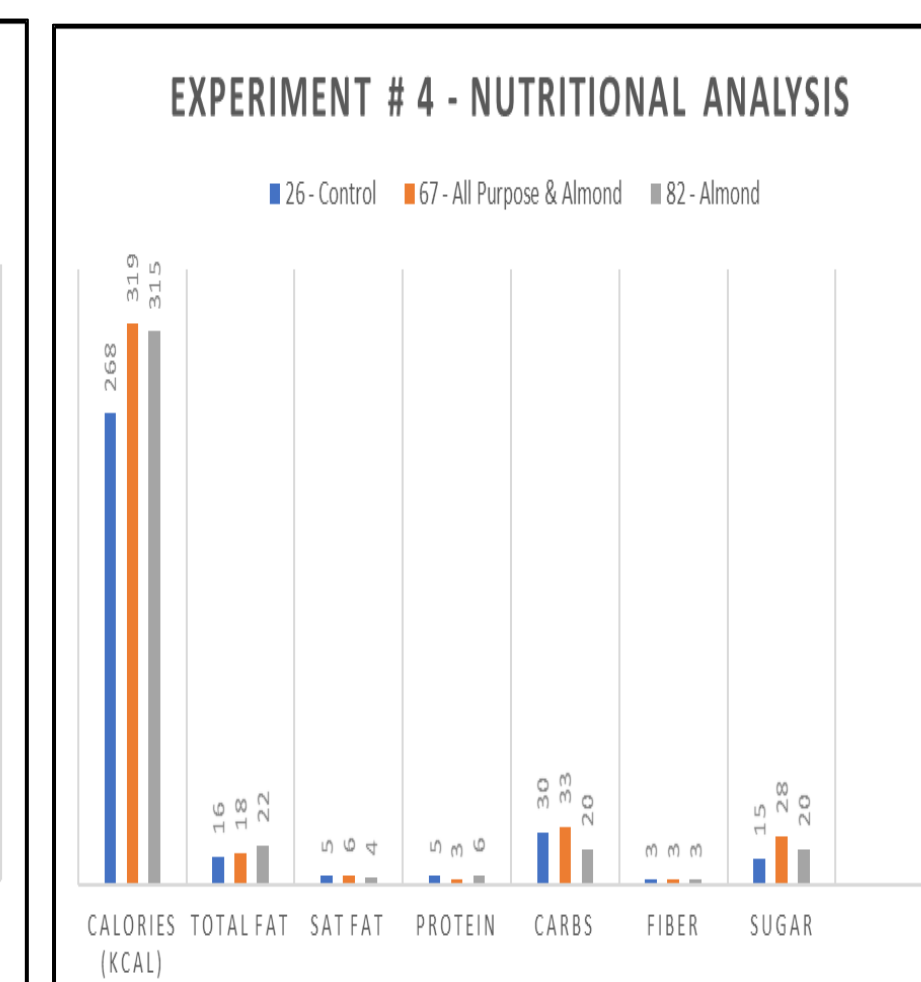
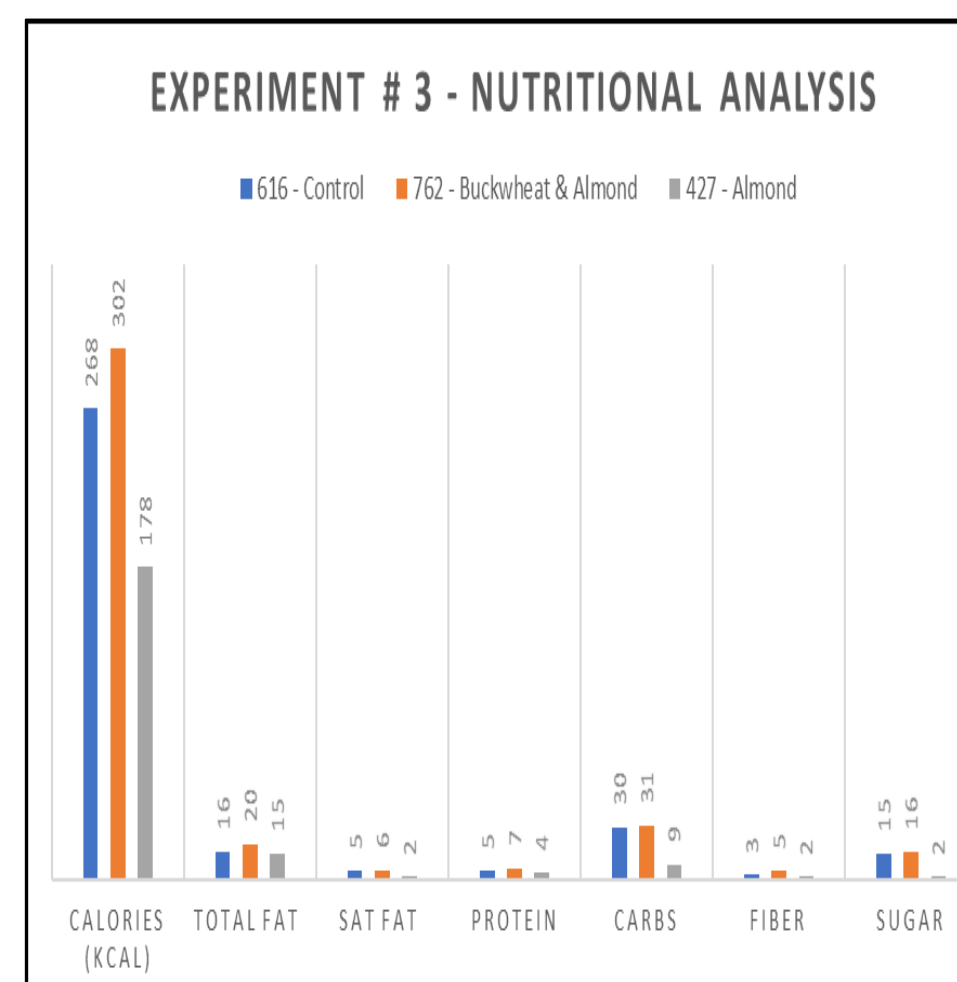
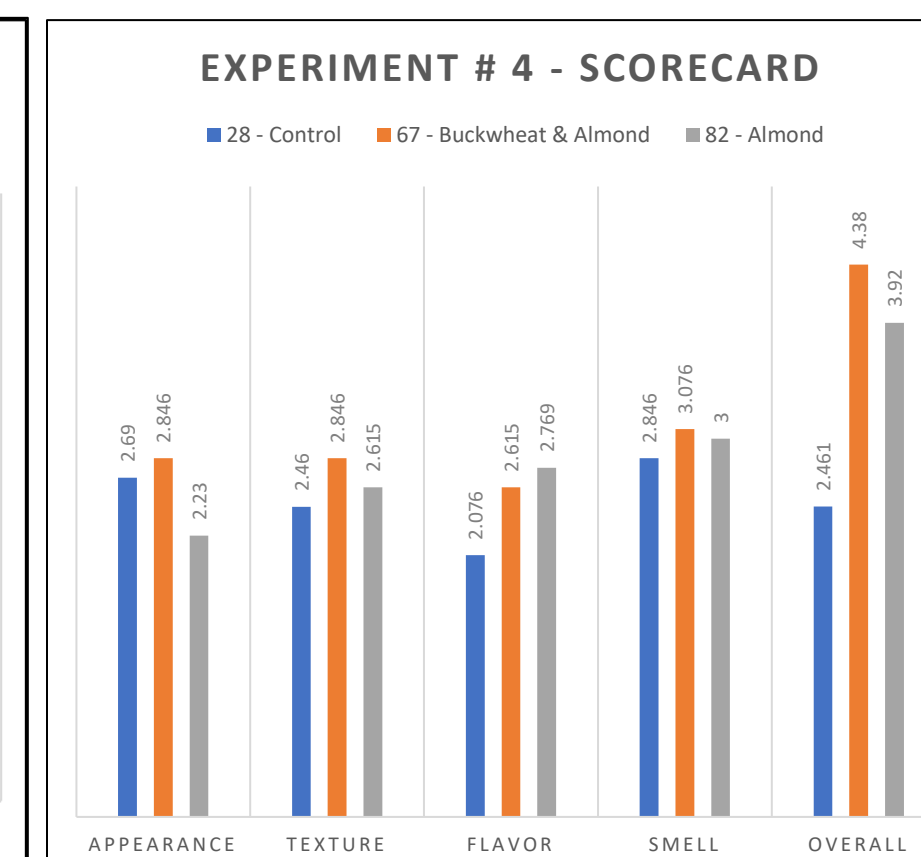
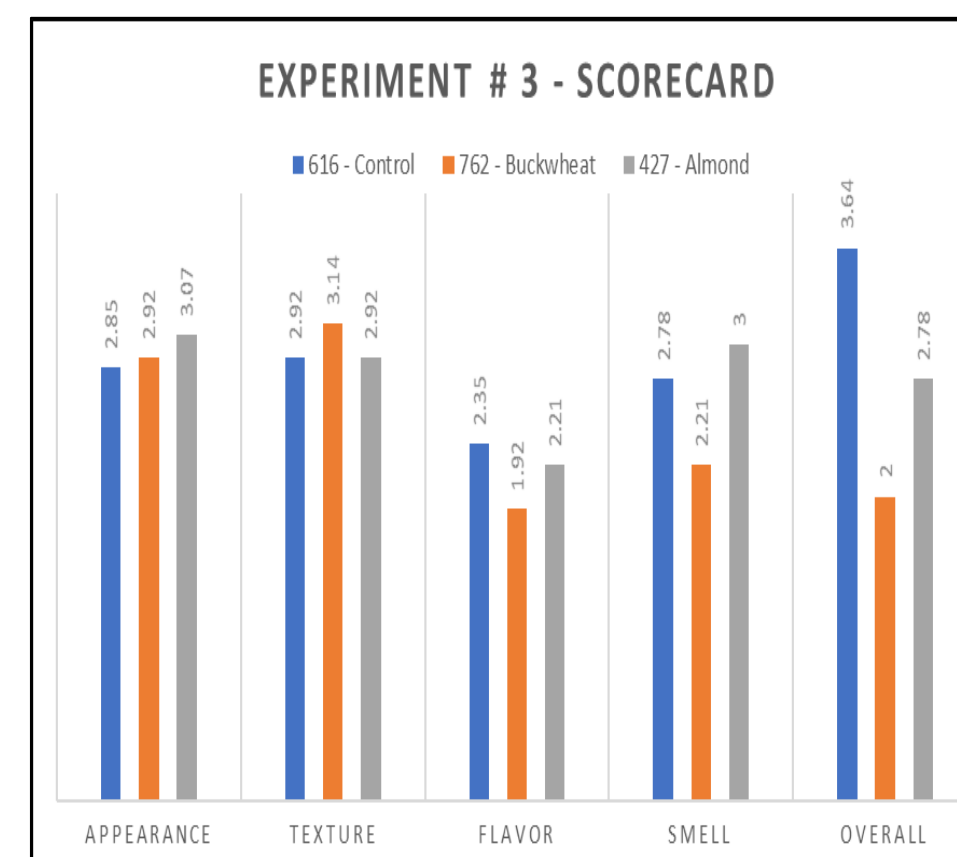
## Experimental Test 3



## Experimental Test 4



## Scorecard & Nutritional Analysis



## Discussion

- The first two trials used a large tin with cups measuring 4" x 2 1/2". The third and fourth trials used a normal tin with cups measuring 2" x 1 1/4". The large tin created difficulty in obtaining consistent cooking duration.
- Oven temperature variations and mechanical issues additionally affected consistency with cooking.
- Limited sample size for accurate portrayal of flour alternative acceptability

## Conclusions

- This study shows that it is possible to use an Almond flour substitute to create an acceptable product, which provides more beneficial nutrients, low sugar and low carbohydrate levels for those with cardiovascular disease or maintaining a heart healthy diet.
- Almond flour reduces the amount of sugar by 8 grams per serving
- Almond flour reduces carbohydrates by 13 grams per serving.
- Overall acceptability of Almond flour was greater than that of control containing all-purpose flour.

## References

- Conforti, F. D., & Strait, M. J. (1999). The Effects of Liquid Honey as a Partial Substitute for Sugar on the Physical and Sensory Qualities of a Fat-Reduced Muffin. *Journal of Consumer Studies & Home Economics*. 23(4), 231–237. <https://doi.org/10.1046/j.1365-2737.1999.00113.x>
- De La Hera, E., Oliete, B., & Gómez, M. (2013). Batter Characteristics and Quality of Cakes Made with Wheat-Oats Flour Blends. *Journal of Food Quality*. 36(2), 146–153. <https://doi.org/10.1111/jfq.12020>
- Estellar, M. S., Amaral, R. L., & Lannes, S. C. D. S. (2004). Effect of Sugar and Fat Replacers on the Texture of Baked Goods. *Journal of Texture Studies*. 35(4), 383–393. <https://doi.org/10.1111/j.1745-4603.2004.tb00602.x>
- Jakobsen MU, Dethlefsen C, Joensen AM, Stegger J, Tjønneland A, Schmidt EB, Overvad K. (2010). Intake of carbohydrates compared with intake of saturated fatty acids and risk of myocardial infarction: Importance of the Glycemic Index. *American Journal Clinical Nutrition*, 91(6), 1764-8.
- Yildiz, E., Gocmen, D. (2020). Use of almond flour and stevia in rice-based gluten-free cookie production. *Journal of Food Science Technology*. <https://doi.org/10.1007/s13197-020-04608-x>