



Doughnut Worry, They're Gluten-Free: An Experimental Study on the Acceptability of Gluten-Free Flours When Baking Mini-Doughnuts

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Abstract

- Celiac Disease is an autoimmune disorder where the body attacks the lining of the small intestine after the ingestion of gluten.
- A gluten-free diet is the most effective form of treatment for those with Celiac Disease, gluten-allergy, or gluten sensitivity.
- Gluten is a protein found in wheat, barley, and rye.
- The goal of this study was to determine what gluten-free flour was most acceptable when baking mini-doughnuts.
- Researcher performed four different trials comparing all-purpose gluten containing flour to an all-purpose gluten-free flour, buckwheat flour, chickpea flour, and cassava flour.
- Results of the four trials indicated that the all-purpose gluten-free flour was the most acceptable when baking mini-doughnuts, followed by chickpea flour.

Introduction

- One percent of Americans suffer from Celiac Disease.
- For those diagnosed with Celiac Disease, experiencing any allergy, or sensitivity to gluten, a gluten-free diet has been the most effective form of treatment.
- As recent as 2020, the gluten-free market is estimated to be valued at 7.59 billion dollars. Although this diet has gained popularity in recent years, a 2014 study found dissatisfaction among consumers regarding the variety, availability, and affordability of gluten-free products
- The gluten in wheat flour has very unique properties that are essential in baking as it contributes to structure and texture. If gluten is removed from baked items, it could potentially risk an unsuccessful outcome.
- The purpose of this study is to determine which gluten-free flour is most comparable to wheat containing, all-purpose flour in regards to flavor, texture, appearance, and overall acceptability in baked doughnuts.
- The researchers predict that the gluten-free all-purpose blend flour will be the most comparable in terms of similarities and overall acceptability when compared to a traditional, all-purpose gluten containing cake doughnuts.

Methods and Materials

Materials: Stove Top, Conventional Oven, Saucepan, Mixing Bowls, Wooden Spoons, Whisks, Measuring Cups, Measuring Spoons, Mini-Doughnut Mold (12-count), Cooling Rack, Plastic Ziplock Bags, Scissors, Toothpicks

Subjects and Setting: Each of the four trials included 7 participants.

- The participants consisted of (5) females, (2) males, and (1) instructor.
- No participants were adhering to a gluten-free diet.
- The product was developed in Fontbonne University's food lab. The food lab consisted of gas stoves, conventional ovens, and cooking utensils to prepare the product.
- Trial 1: All-purpose flour vs. All-purpose gluten-free flour
- Trial 2: Buckwheat vs. Chickpea vs. Cassava flours
- Trial 3: Gluten-free flour vs. Chickpea flour
- Trial 4: All-purpose flour vs. All-purpose gluten-free flour

Objective Evaluation:

- For all four of the trials, the researchers gave their participants score cards to evaluate the products. Texture, color, moisture, flavor and overall acceptability were the five categories that the donuts were evaluated on by the participants.
- Using a 5-point hedonic scale, the following characteristics were critiqued: texture, color, moisture, and flavor, where 1 = much too "crumbly/light/moist, soggy/not sweet enough" to 5 = much too "coarse, chewy/dark/dry/sweet" and 3 demonstrated ideal qualities "light, fluffy, easy to chew/pleasingly golden brown/moist, tender crumb/pleasingly sweet."
- The last category was overall acceptance where 1=dislike very much to 5=like very much.

Nutrition Analysis

- Chronometer

Results

- In Trial 1, All-Purpose Gluten-free flour performed better in color and flavor. All-Purpose flour scored higher in moisture. Both flours produced equal results in texture. When comparing the two recipes for overall acceptability, the All-Purpose Gluten-free flour was preferred.
- In Trial 2, three different gluten-free flours were tested: buckwheat, chickpea, and cassava. Of the three flours tested, chickpea flour performed better in all categories and an overall acceptability of 4.4, followed by buckwheat and cassava flour.
- Chickpea flour was then compared to the All-Purpose Gluten-free flour for Trial 3. Results indicated that the All-Purpose Gluten-free flour was preferred in texture whereas the chickpea flour was preferred in color and moisture. Both recipes produced equal results in flavor. Results showed that the All-Purpose Gluten-free flour blend recipe was preferred over the chickpea flour.
- In Trial 4, researchers compared the preferred All-Purpose Gluten-free flour to the original control recipe, All-Purpose flour. Results of Trial 4 indicated that the All-Purpose Gluten-free flour was preferred in color and flavor whereas All-Purpose flour was preferred in moisture. Both recipes produced equal results in texture. All-Purpose Gluten-free flour was preferred over the All-Purpose flour.

Trial 1



Trial 2



Trial 4



All-Purpose Flour

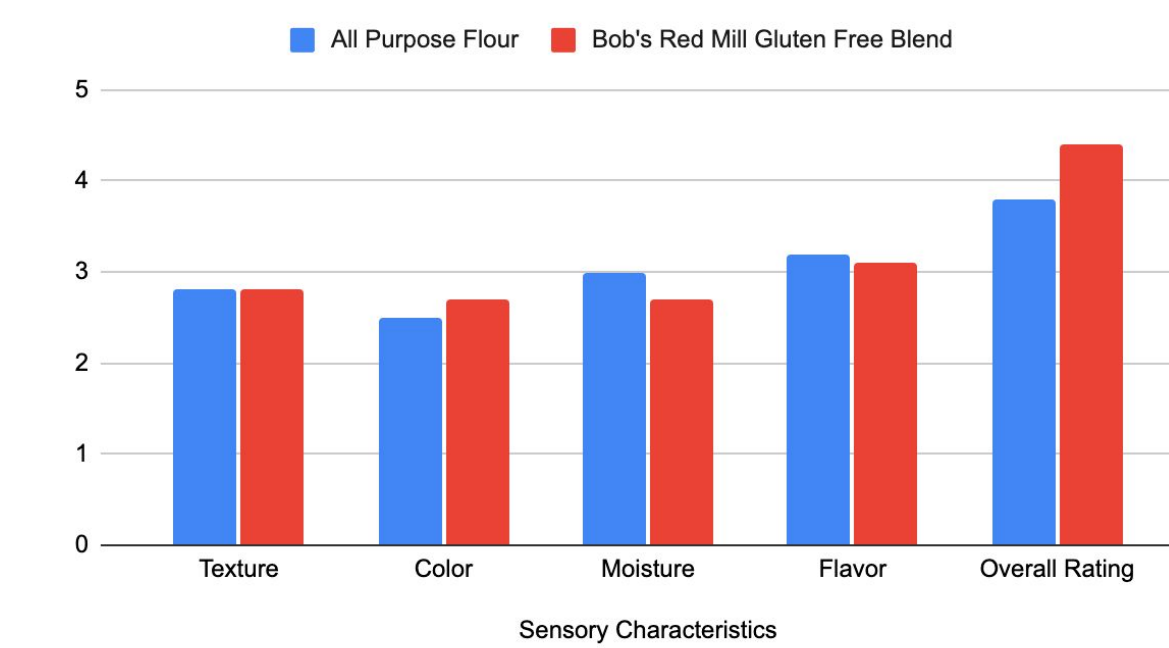
All-Purpose Flour Doughnuts	
Nutrition Facts	
Serving Size: 1 Mini donut	
Amount Per Serving	% Daily Value*
Calories	89.8 kcal 4 %
Total Fat	3.2 g 5 %
Saturated Fat	1.9 g 9 %
Trans Fat	0.1 g
Cholesterol	17 mg 6 %
Sodium	53.7 mg 2 %
Total Carbohydrate	14.3 g 5 %
Dietary Fiber	0.2 g 1 %
Sugars	9.3 g
Protein	1.2 g 2 %
Vitamin A	2 % • Vitamin C 0 %
Calcium	2 % • Iron 2 %
* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.	
Full Info at cronometer.com </>	

All-Purpose Gluten-free Flour

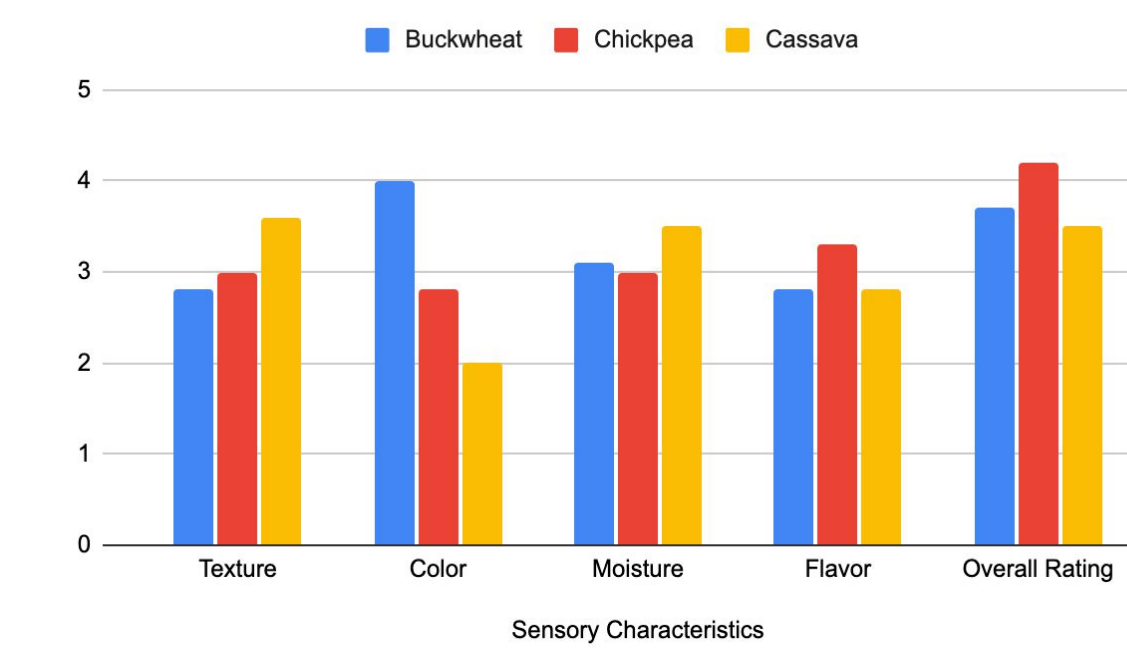
Gluten Free All-Purpose Blend Doughnuts	
Nutrition Facts	
Serving Size: 1 Mini donut	
Amount Per Serving	% Daily Value*
Calories	87.5 kcal 4 %
Total Fat	3.2 g 5 %
Saturated Fat	1.9 g 9 %
Trans Fat	0.1 g
Cholesterol	17 mg 6 %
Sodium	53.6 mg 2 %
Total Carbohydrate	14 g 5 %
Dietary Fiber	0.5 g 2 %
Sugars	9.4 g
Protein	1.1 g 2 %
Vitamin A	2 % • Vitamin C 0 %
Calcium	3 % • Iron 1 %
* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.	
Full Info at cronometer.com </>	

Average Scores

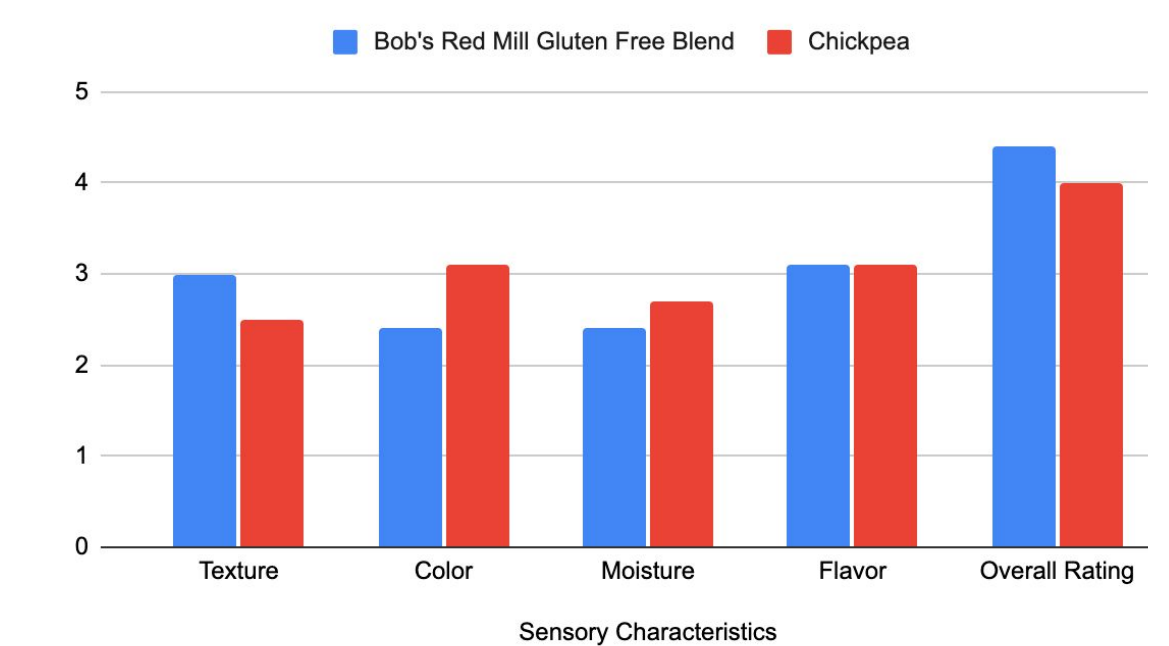
Trial #1



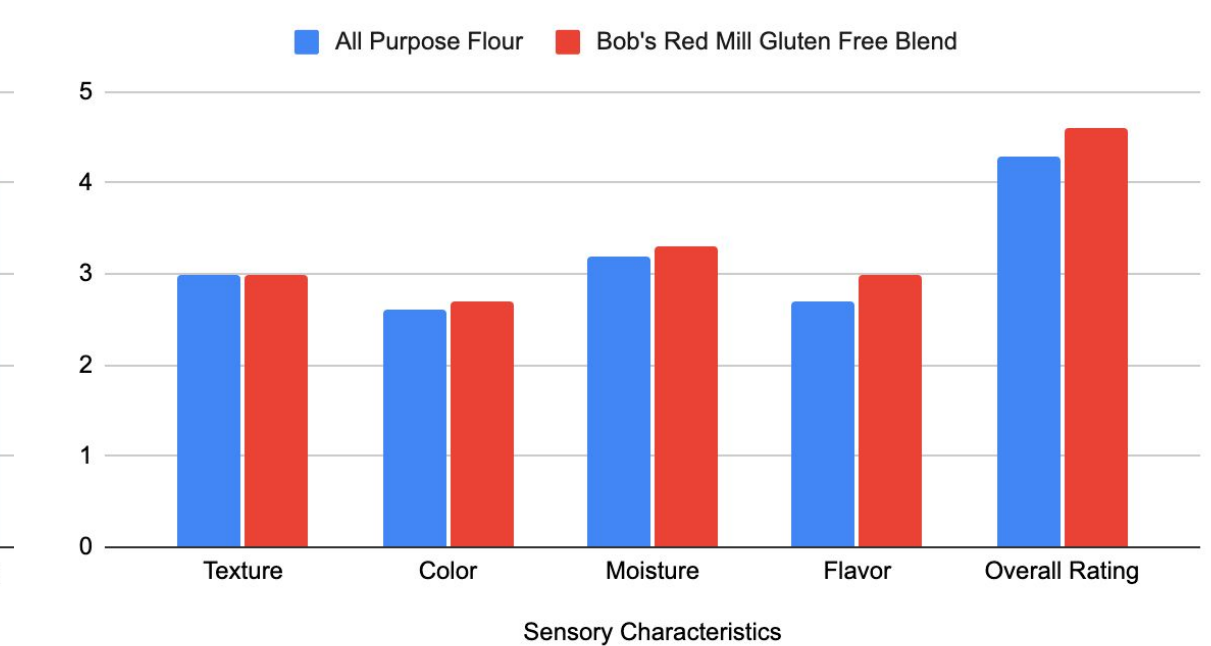
Trial # 2



Trial #3



Trial #4



Discussion

- The four trials in this study proved that All-Purpose Gluten-free flour provides a more cohesive mix of components to affect the baking properties and overall acceptability.
- Chickpea flour was also seen to be successful in terms of baking due to the quality to hold a high volume and soft crumb
- Limitations of this study include small sample size, no participants with a known gluten allergy, researchers included in sample size, and no comparable gluten-free mini-doughnuts within the consumer market.

Conclusions

- The results indicated that All-Purpose Gluten-Free flour is an acceptable alternative to All-Purpose flour when baking mini-doughnuts.
- Chickpea flour is also an acceptable alternative flour as it produced desirable results in all 5 categories: texture, color, moisture, flavor, and overall acceptability.
- Future research is needed to determine if Gluten-free flours acceptable when testing standard doughnut sizes and traditional frying methods.

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