



# The Effects of Using Fruit as a Substitute for Sugar on the Overall Quality of Cookies



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Section 3, Stations 5 & 6

# Diabetes

- Diabetes is a long-lasting health condition that affects how your body turns food into energy
  - The body can't make enough insulin OR the body cannot use insulin as easily
-  or no insulin =  blood glucose
- 3 main types: Type 1, Type 2, and gestational diabetes (GD)
- 34.2 million US adults have diabetes, which is the 7th leading cause of death in the United States (CDC.gov)
- Counting carbohydrates in foods and drinks is a vital tool for managing blood sugar levels
- Prevention:
  - Type 1: no prevention, just maintenance
  - Type 2: healthy diet low in sugar and saturated fat, and with regular exercise
  - GD: exercise before pregnancy, healthy diet (high fiber)

# Cookies

It is not only important for people with diabetes to control their blood sugar levels by being mindful of what they eat. Consuming adequate fiber is an often overlooked way to help keep blood sugar balanced.



1 tsp. sugar = 4 grams of carbohydrates, all of which are “added sugar.”

Sugar does **NOT** provide fiber.

Products with **less sugar** and **more fiber** may benefit people with diabetes.

# Granulated & Brown Sugar

Sugar not only leads to sweetness in baked items, it also influences color (browning), moisture, tenderness, volume, and nutritional value (added sugar, total carbohydrates, and overall calories).

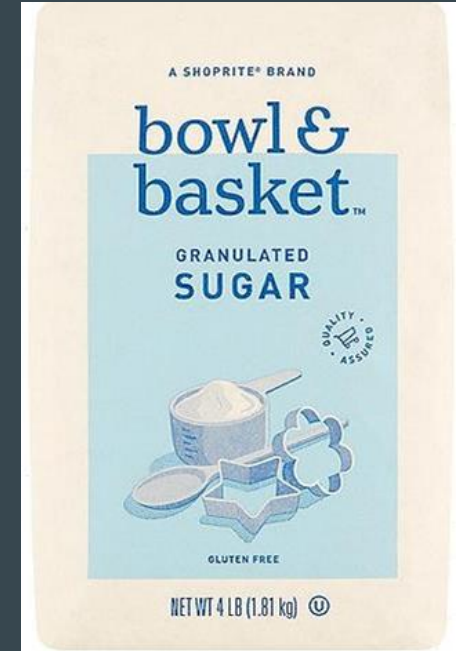


Nutrition Facts		
Serving Size: 1 full recipe		
Amount Per Serving		% Daily Value*
<b>Calories</b>	560.1 kcal	28 %
<b>Total Fat</b>	- g	- %
Saturated Fat	- g	- %
Trans Fat	- g	- %
<b>Cholesterol</b>	- mg	- %
<b>Sodium</b>	41.3 mg	2 %
<b>Total Carbohydrate</b>	144.6 g	48 %
Dietary Fiber	- g	- %
Sugars	143 g	
<b>Protein</b>	0.2 g	0 %
Vitamin A	- %	Vitamin C - %
Calcium	12 %	Iron 6 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Nutrition Facts		
Serving Size: 1 full recipe		
Amount Per Serving		% Daily Value*
<b>Calories</b>	387 kcal	19 %
<b>Total Fat</b>	- g	- %
Saturated Fat	- g	- %
Trans Fat	- g	- %
<b>Cholesterol</b>	- mg	- %
<b>Sodium</b>	1 mg	0 %
<b>Total Carbohydrate</b>	100 g	33 %
Dietary Fiber	- g	- %
Sugars	99.8 g	
<b>Protein</b>	- g	- %
Vitamin A	- %	Vitamin C - %
Calcium	0 %	Iron 0 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.



This recipe calls for  $\frac{2}{3}$  cup brown sugar (left) and  $\frac{1}{2}$  cup of granulated sugar (right).

# Substitute 1: Banana

Banana		
Nutrition Facts		
Serving Size: 1 full recipe		
Amount Per Serving	% Daily Value*	
<b>Calories</b>	105 kcal	5 %
<b>Total Fat</b>	0.4 g	1 %
Saturated Fat	0.1 g	1 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	1.2 mg	0 %
<b>Total Carbohydrate</b>	27 g	9 %
Dietary Fiber	3.1 g	12 %
Sugars	14.4 g	
<b>Protein</b>	1.3 g	3 %
Vitamin A	2 % • Vitamin C	17 %
Calcium	1 % • 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.



# Substitute 2: Applesauce

Mott's, Unsweetened Applesauce, Apple		
Nutrition Facts		
Serving Size 100g		
Amount Per Serving		% Daily Value*
Calories	40.7 kcal	2 %
<b>Total Fat</b>	0 g	0 %
Saturated Fat	0 g	0 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	0 mg	0 %
<b>Total Carbohydrate</b>	11.4 g	4 %
Dietary Fiber	0.8 g	3 %
Sugars	9.8 g	
<b>Protein</b>	0 g	0 %
Vitamin A	0 %	• Vitamin C 16 %
Calcium	0 %	• Iron 0 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.



# Substitute 3: Dates

<b>Nutrition Facts</b>	
10 servings per container	
<b>Serving Size</b>	<b>2 Dates (40g)</b>
<b>Amount per serving</b>	
<b>Calories</b>	<b>110</b>
<b>% Daily Value*</b>	
<b>Total Fat</b> 0g	<b>0%</b>
Saturated Fat 0g	<b>0%</b>
Trans Fat 0g	
<b>Cholesterol</b> 0mg	<b>0%</b>
<b>Sodium</b> 0mg	<b>0%</b>
<b>Total Carbohydrate</b> 30g	<b>11%</b>
Dietary Fiber 3g	<b>11%</b>
Total Sugars 25g	
Includes 0g Added Sugars	<b>0%</b>
<b>Protein</b> 1g	
Vit. D 0mcg 0% • Calcium 20mg 2%	
Iron 0.4mg 2% • Potas. 260mg 6%	
Magnesium 20mg 4% • Biotin 3mcg 8%	
<small>* The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.</small>	

Ingredients: Organic Medjool Dates



# Hypotheses

1. Fruit sweetened cookies will have fewer grams of sugar compared to the sugar sweetened cookies, which is beneficial for diabetics.
2. Fruit sweetened cookies will be statistically significantly different in baking time compared to the sugar sweetened cookies, with the fruit sweetened cookies having a longer total baking time.
3. The taste of the fruit sweetened cookies will be statistically significantly different when compared to the sugar sweetened cookies, the sugar sweetened cookies being rated more sweet.
4. The overall liking of the fruit sweetened cookies will be statistically significantly different than the sugar sweetened cookies, with the sugar sweetened cookies having a higher overall liking.



# Experimental Design - Recipe

Recipe	Ingredients	Methods/Changes
Added Sugars - 519 (Control)	$\frac{2}{3}$ cup vegan butter, $\frac{1}{3}$ cup brown sugar, $\frac{1}{2}$ cup granulated sugar. $\frac{1}{3}$ cup applesauce, 1 tbsp ground flaxseeds, 2 tsp cinnamon, 1 tsp vanilla extract, 1 tsp baking powder, 1 tsp baking soda, $\frac{1}{2}$ tsp salt, 2 cups all-purpose flour, 2 cups rolled oats, $1+\frac{1}{2}$ cup coconut flakes, $\frac{3}{4}$ cup vegan chocolate chips	Preheat oven to 350 degrees Fahrenheit. Add the butter, brown & granulated sugars to a large bowl and cream together. Add the applesauce, flaxseed, cinnamon, vanilla, baking powder, baking soda, and salt. Mix until well combined. Add flour, oats, and coconut flakes. Fold them in gently. Add the chocolate chips. Stir again. Using a small scoop, drop dough onto a parchment-lined baking tray. Bake for 12-14 minutes, or until lightly golden brown. Let the cookies rest for 5 minutes, then move to wire rack. Enjoy!
Banana - 305 (Substitution 1)	Swap out brown & granulated sugars. Add 1 mashed banana.	Mash one ripe banana, mix together with butter.
Applesauce - 128 (Substitution 2)	Swap out brown & granulated sugars. Add 1 cup unsweetened applesauce.	Add 1 cup of applesauce to butter and mix.
Dates - 475 (Substitution 3)	Swap out brown & granulated sugars. Add 1 cup soaked and chopped dates.	Soak 1 cup of pitted dates in hot water for at least 30 minutes. Drain the dates and dice them small. Add the dates to the butter and mix.

# Experimental Design - Evaluations

## Sensory Measures

- ❖ 5 panelists
- ❖ 7 attributes:
  - Appearance:
    - Exterior - Golden Brown
    - Interior - Dense
  - Texture:
    - Chewy
    - Moist
  - Taste: Sweet
  - Flavor: Fruity
  - Overall Liking



Julia measuring the diameter of the cookies, using the digital caliper.

## Objective Measures

- ❖ Height in millimeters
- ❖ Diameter in millimeters
- ❖ Baking Time



Sensory evaluation presentation.

# Results



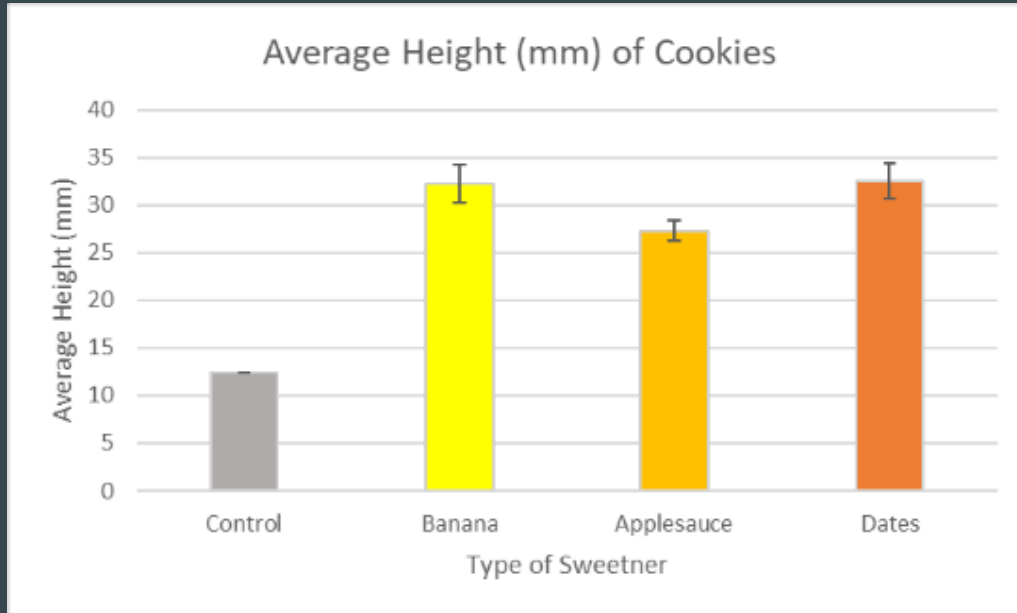
Kathleen (left) and Julia (right) with their fruit and sugar sweetened cookies.

The cookies baked with granulated and brown sugars fell flat compared to the previous week, when they were first tested, which influenced the objective evaluations.



Brown and granulated sugar sweetened cookies versus fruit sweetened cookies (519, 305, 128, 475 respectively).

# Objective Results - Height (mm)



**Banana:**  $p$ -value 0.00

**Applesauce:**  $p$ -value 0.00

**Dates:**  $p$ -value 0.00

The **bananas**, **applesauce**, and **dates** had  $p$ -values  $< 0.05$ , which indicates there is a significant difference in the height (mm) of cookies using the alternative sweeteners compared to the control.

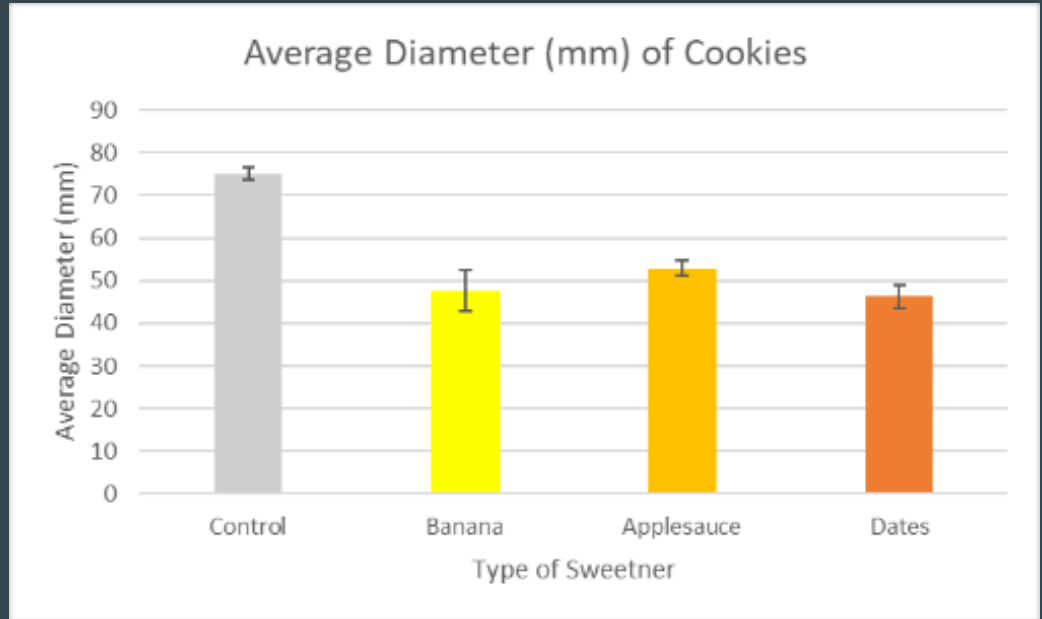
# Objective Results - Diameter (mm)

**Banana:**  $p$ -value 0.00

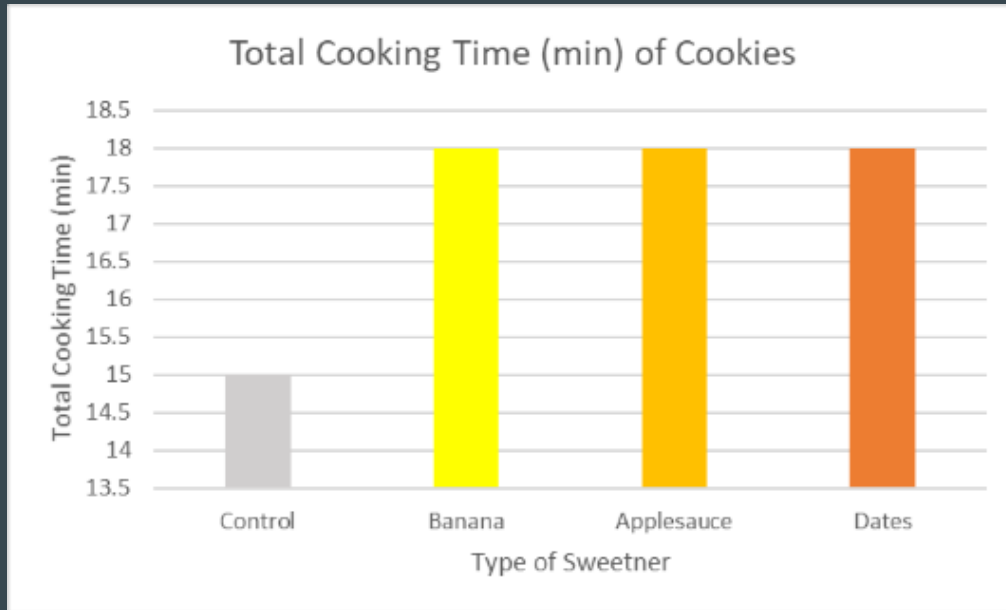
**Applesauce:**  $p$ -value 0.00

**Dates:**  $p$ -value 0.00

The **bananas**, **applesauce**, and **dates** had  $p$ -values  $< 0.05$ , which indicates there is a significant difference in the diameter (mm) of cookies using the alternative sweeteners compared to the control.



# Objective Results - Total Cooking Time (min)



The control took the shortest time to cook: 15 minutes

The cookies made with **bananas**, **applesauce**, and **dates** took the longest time to cook: 18 minutes

**Note:** We were not able to determine the significant difference between the total cooking time due to only one set of data conducted.

# Appearance - Golden Brown

Compared to the control:

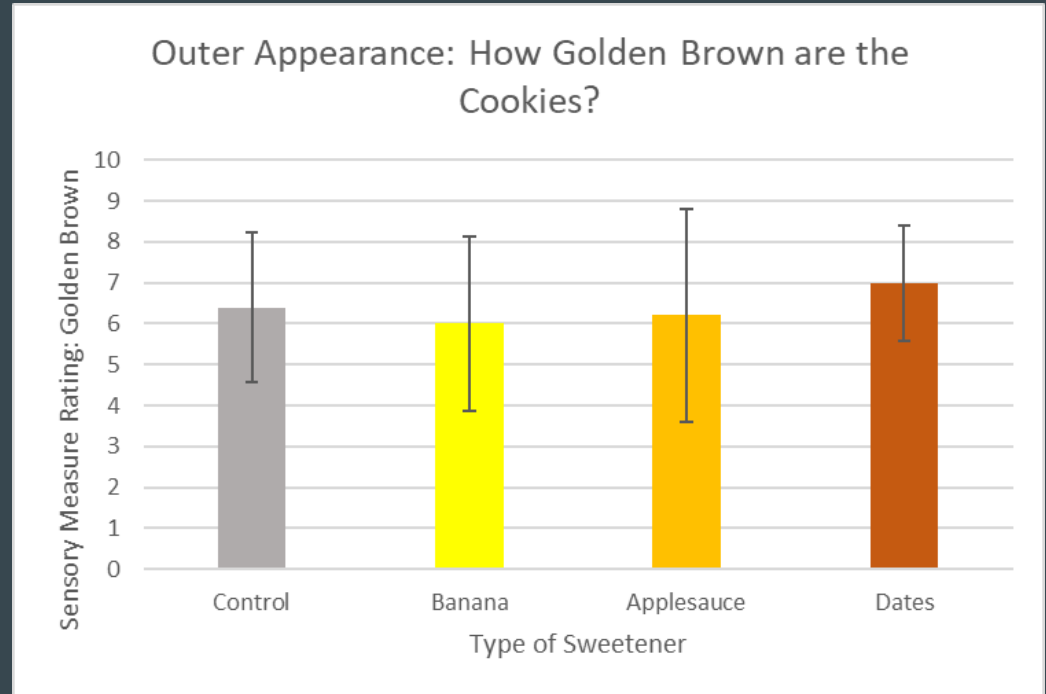
**Banana:**  $p$ -value 0.37

**Applesauce:**  $p$ -value 0.70

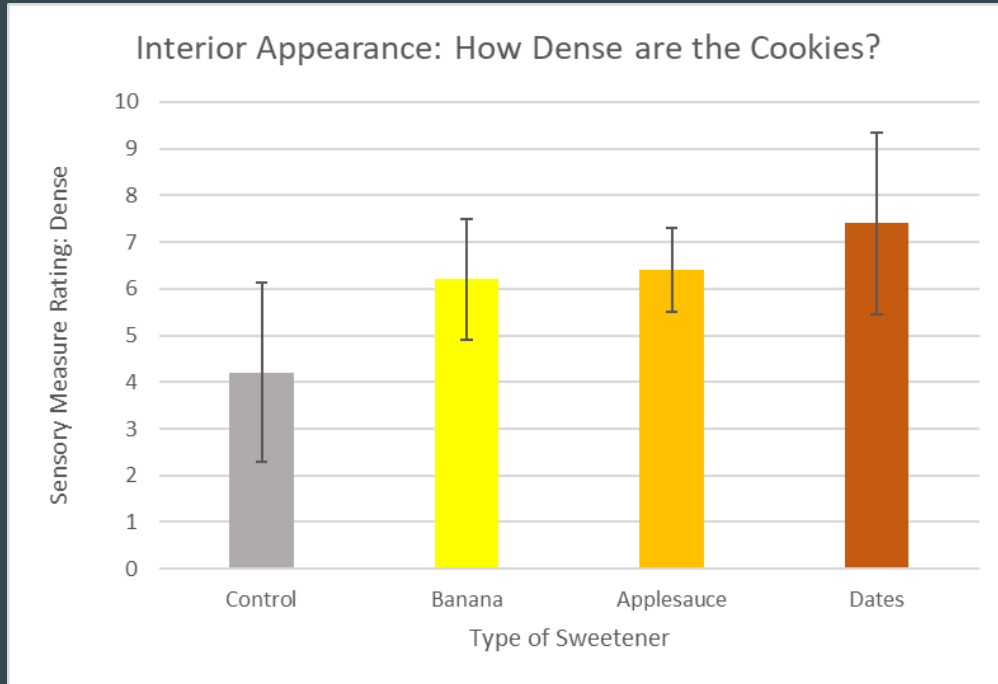
**Dates:**  $p$ -value 0.30

T-tests for **bananas**, **applesauce**, and **dates** versus the control resulted in  $p$ -values greater than 0.05, which means that there were NO statistically significant differences.

**Dates** were rated the most golden brown, while **bananas** were the least.



# Appearance - Density



Compared to the control:

**Banana:**  $p$ -value 0.20

**Applesauce:**  $p$ -value 0.09

**Dates:**  $p$ -value 0.09

T-tests for **bananas**, **applesauce**, and **dates** versus the control resulted in  $p$ -values greater than 0.05, which means that there were NO statistically significant differences.

**Dates** were rated the most dense, while the control was the least.



# Texture - Chewy

Compared to the control:

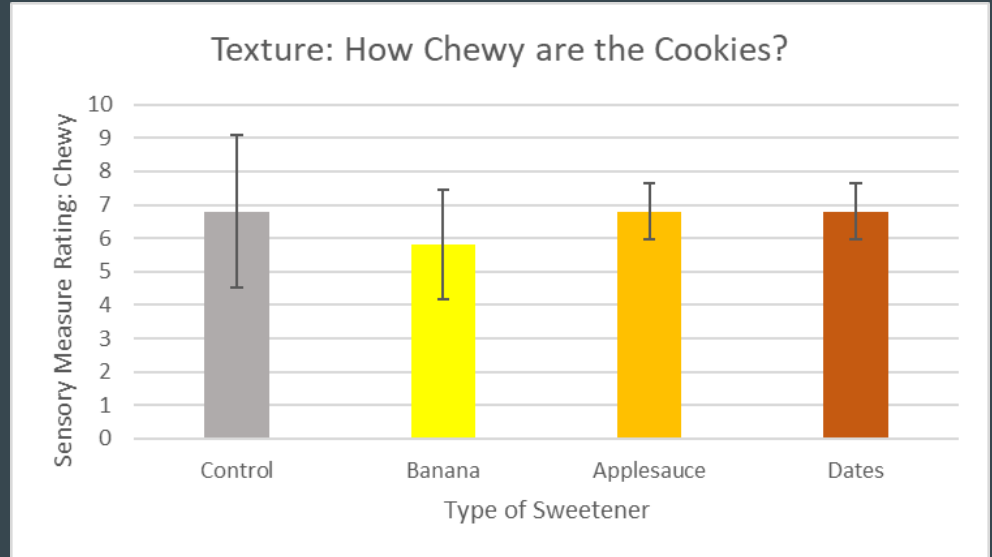
**Banana:**  $p$ -value 0.59

**Applesauce:**  $p$ -value 1

**Dates:**  $p$ -value 1

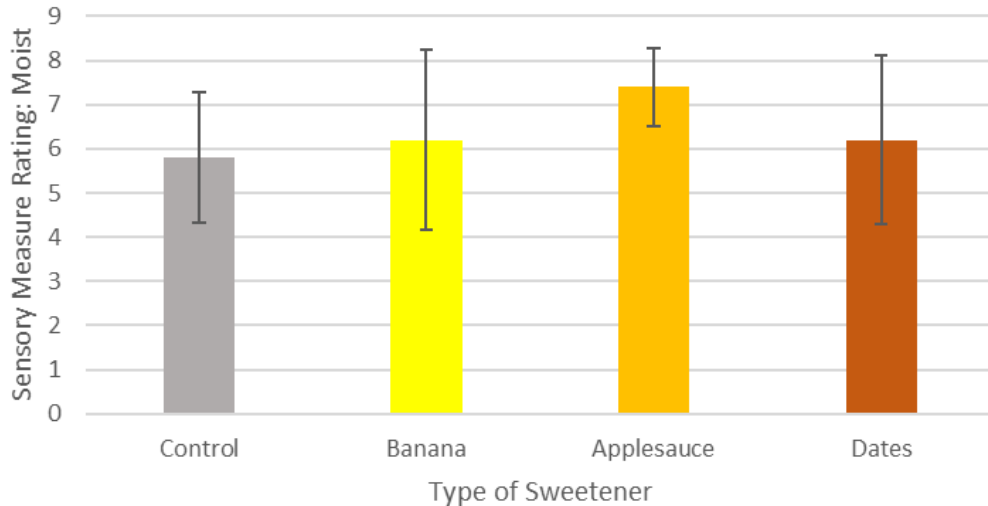
The t-tests for **bananas**, **applesauce**, and **dates** versus the control resulted in  $p$ -values greater than 0.05, which means that there were NO statistically significant differences.

**Dates**, **applesauce**, and the control were rated as chewy as one another, all more chewy than **banana**.



# Texture - Moist

Texture: How Moist are the Cookies?



Compared to the control:

**Banana:**  $p$ -value 0.78

**Applesauce:**  $p$ -value 0.18

**Dates:**  $p$ -value 0.79

T-tests for **bananas**, **applesauce**, and **dates** versus the control resulted in  $p$ -values greater than 0.05, which means that there were NO statistically significant differences.

**Applesauce** was rated the most moist, while the control was the least. **Banana** and **dates** were tied in the middle.

# Taste - Sweet

Compared to the control:

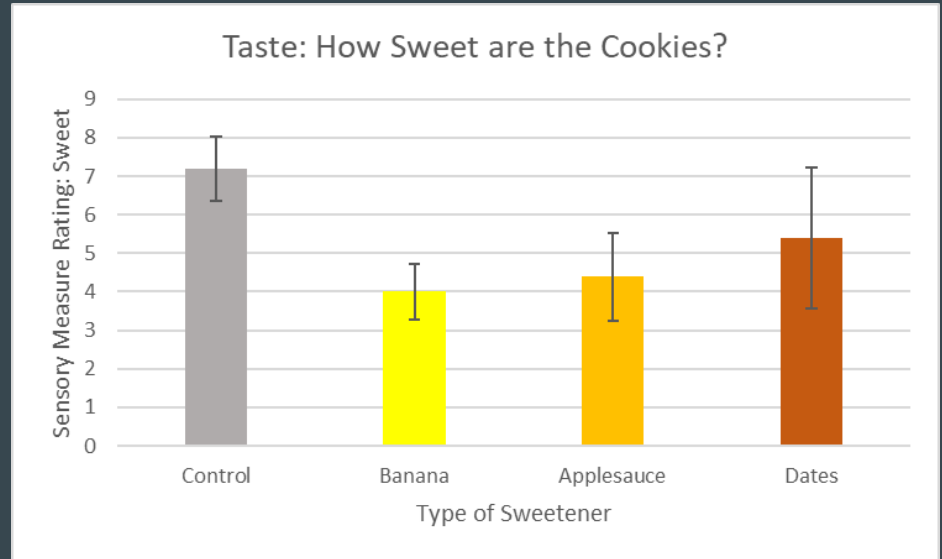
**Banana:**  $p$ -value 0.003

**Applesauce:**  $p$ -value 0.025

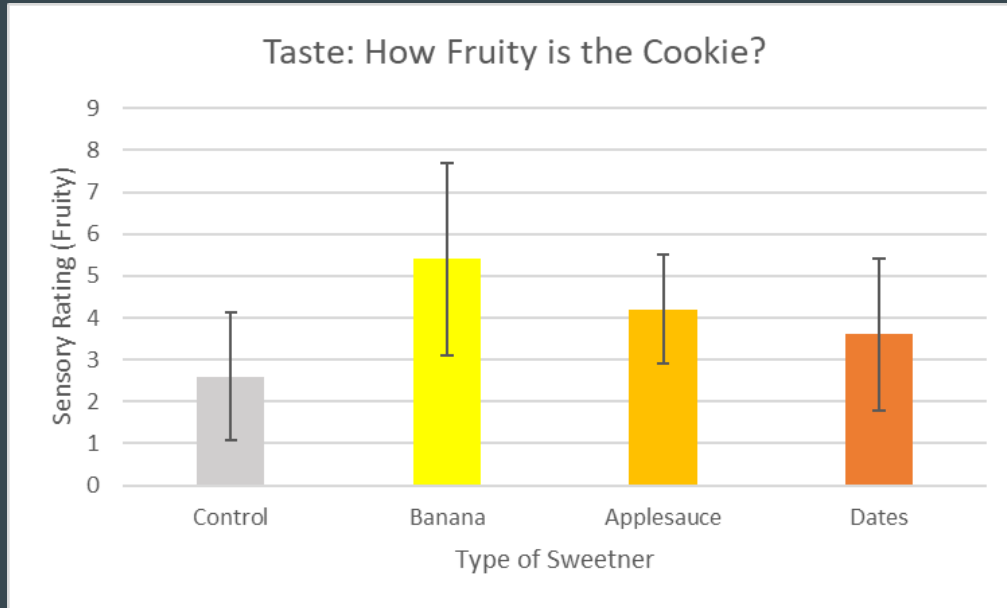
**Dates:**  $p$ -value 0.121

The t-tests for **bananas** and **applesauce** versus the control resulted in  $p$ -values less than 0.05, which means that there were statistically significant differences. The t-test for **dates** versus the control was greater than 0.05; NO statistically significant difference.

The control was rated the most sweet, while **banana** was the least.



# Flavor - Fruity



**Banana:**  $p$ -value 0.11

**Applesauce:**  $p$ -value 0.03

**Dates:**  $p$ -value 0.27

The **applesauce** had a  $p$ -value  $< 0.05$ , which indicates there is a significant difference in how fruity the flavor of the **applesauce** cookies were in comparison to the original.

The **banana** cookies were rated the most fruity.

# Overall Liking of the Cookies

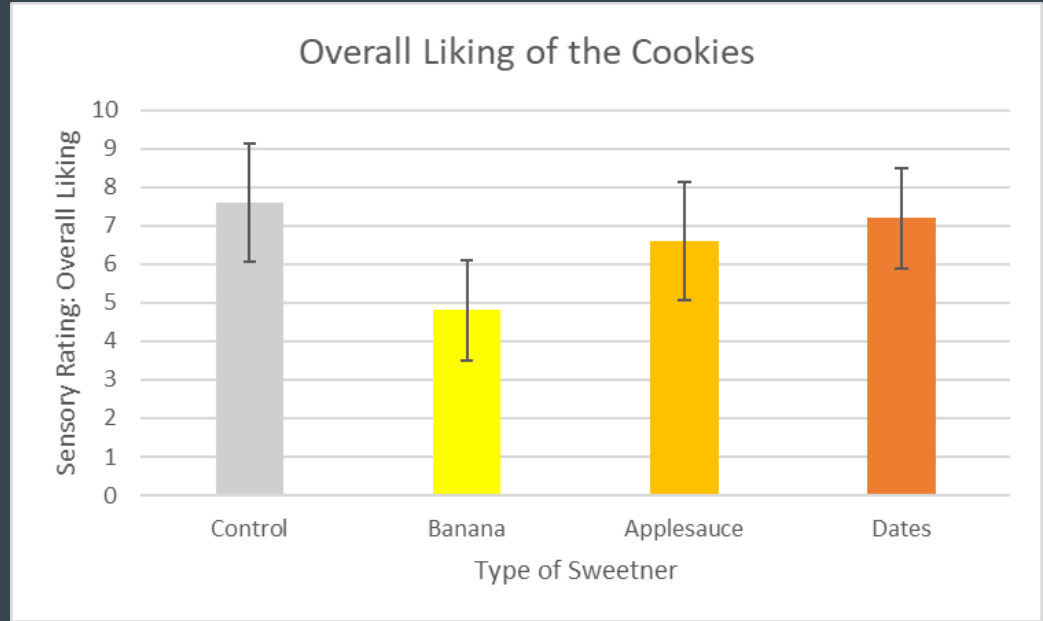
**Banana:**  $p$ -value 0.05

**Applesauce:**  $p$ -value 0.47

**Dates:**  $p$ -value 0.37

The **bananas** had a  $p$ -value equal to 0.05, which indicates there is a significant difference in the overall liking of the **banana** cookies in comparison to the original.

The control cookies were rated the highest as far as overall liking.



# Nutrition Facts Labels

## Nutrition Facts

Serving Size: 1 Serving

Amount Per Serving		% Daily Value*
<b>Calories</b>	709.7 kcal	35 %
<b>Total Fat</b>	34.5 g	53 %
Saturated Fat	25.4 g	127 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	505.6 mg	21 %
<b>Total Carbohydrate</b>	94.8 g	32 %
Dietary Fiber	7.9 g	32 %
Sugars	47.1 g	
<b>Protein</b>	9.3 g	19 %
Vitamin A	0 %	Vitamin C 4 %
Calcium	12 %	Iron 22 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Granulated & Brown Sugar

Banana

## Nutrition Facts

Serving Size: 1 Serving

Amount Per Serving		% Daily Value*
<b>Calories</b>	561.8 kcal	28 %
<b>Total Fat</b>	34.3 g	53 %
Saturated Fat	24.7 g	123 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	646.7 mg	27 %
<b>Total Carbohydrate</b>	63.6 g	21 %
Dietary Fiber	10 g	40 %
Sugars	12.7 g	
<b>Protein</b>	9.5 g	19 %
Vitamin A	0 %	Vitamin C 7 %
Calcium	7 %	Iron 36 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

## Nutrition Facts

Serving Size: 1 Serving

Amount Per Serving		% Daily Value*
<b>Calories</b>	561.5 kcal	28 %
<b>Total Fat</b>	34.3 g	53 %
Saturated Fat	24.6 g	123 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	647.2 mg	27 %
<b>Total Carbohydrate</b>	63.7 g	21 %
Dietary Fiber	9.9 g	40 %
Sugars	13.9 g	
<b>Protein</b>	9.4 g	19 %
Vitamin A	0 %	Vitamin C 16 %
Calcium	7 %	Iron 36 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Unsweetened Applesauce

Dates

## Nutrition Facts

Serving Size: 1 Serving

Amount Per Serving		% Daily Value*
<b>Calories</b>	608.5 kcal	30 %
<b>Total Fat</b>	34.5 g	53 %
Saturated Fat	25.4 g	127 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	501.4 mg	21 %
<b>Total Carbohydrate</b>	68.9 g	23 %
Dietary Fiber	8.3 g	33 %
Sugars	21 g	
<b>Protein</b>	9.6 g	19 %
Vitamin A	0 %	Vitamin C 10 %
Calcium	11 %	Iron 21 %

\* 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](http://cronometer.com)

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1 serving = 3 cookies, full recipe = 22 cookies

# Discussion - Objective Attributes

## Hypotheses Supported

- The objective attributes that were measured (height in mm, diameter in mm, and total cooking time) supported our hypothesis
- In regards to the  $p$ -values
  - Height(mm): all 3 variables had  $p$ -values  $< 0.05$
  - Diameter(mm): all 3 variables had  $p$ -values  $< 0.05$
  - Time(min): Hypothesis was supported, but unable to perform a t-test

## Any Surprises?

- The control cookies fell flat during the second week compared to the first week



## Done Differently?

- Being able to perform a t-test for the total baking time of the cookies to generate a  $p$ -value and find the statistical significance

# Discussion - Sensory Attributes

- ❖ The control cookies were rated the most sweet and had the highest overall liking, they were also rated the least dense and the least moist.
- ❖ **Banana** cookies were the most fruity, but the least sweet, least golden brown, and the least chewy.
- ❖ **Applesauce** cookies were the most moist, but otherwise fell somewhere in the middle of the ratings.
- ❖ Almost all graphs showed large error bars, meaning the results varied.
- ❖ **Date** cookies were the most golden brown, the most dense, and tied for most chewy; they were the second most moist and sweet. **Dates** also ranked the second for overall liking.
- ❖ 4 out of 5 panelists ranked **dates** and the control evenly for overall liking.
- ❖ Providing less total sugar and more fiber, **dates** could be a good replacement for added sugar in cookies, especially for people with diabetes. More tests would be needed for more reliable data (smaller error bars).



# Nutrition App Differences

My Fitness Pal

Control Cookie

Nutrition Facts	
Servings 22.0	
Amount Per Serving	
calories 218	
% Daily Value *	
<b>Total Fat</b> 11 g	17 %
Saturated Fat 4 g	18 %
Monounsaturated Fat 4 g	
Polysaturated Fat 2 g	
Trans Fat 0 g	
<b>Cholesterol</b> 0 mg	0 %
<b>Sodium</b> 633 mg ←	26 %
<b>Potassium</b> 34 mg	1 %
<b>Total Carbohydrate</b> 30 g	10 %
Dietary Fiber 5 g ←	20 %
<b>Sugars</b> 12 g ←	
<b>Protein</b> 3 g	6 %
Vitamin A	5 %
Vitamin C	3 %
Calcium →	278 %
Iron	5 %

Banana Cookie

Nutrition Facts	
Servings 22.0	
Amount Per Serving	
calories 185	
% Daily Value *	
<b>Total Fat</b> 11 g	18 %
Saturated Fat 4 g	18 %
Monounsaturated Fat 4 g	
Polysaturated Fat 2 g	
Trans Fat 0 g	
<b>Cholesterol</b> 0 mg	0 %
<b>Sodium</b> 631 mg ←	26 %
<b>Potassium</b> 64 mg	2 %
<b>Total Carbohydrate</b> 21 g	7 %
Dietary Fiber 5 g ←	21 %
<b>Sugars</b> 2 g ←	
<b>Protein</b> 3 g	6 %
Vitamin A	5 %
Vitamin C	4 %
Calcium →	273 %
Iron	5 %

Cronometer

Control Cookie

Nutrition Facts		
Serving Size: 1 Serving		
Amount Per Serving	% Daily Value*	
<b>Calories</b>	228.1 kcal	11 %
<b>Total Fat</b>	11.5 g	18 %
Saturated Fat	→ 8.5 g	42 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	168.1 mg	7 %
<b>Total Carbohydrate</b>	29.4 g	10 %
Dietary Fiber	2.6 g	11 %
Sugars	→ 13.5 g	
<b>Protein</b>	3.1 g	6 %
Vitamin A	0 % • Vitamin C	1 %
Calcium	4 % • Iron	7 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Banana Cookie

Nutrition Facts		
Serving Size: 1 Serving		
Amount Per Serving	% Daily Value*	
<b>Calories</b>	198.5 kcal	10 %
<b>Total Fat</b>	11.5 g	18 %
Saturated Fat	→ 8.5 g	42 %
Trans Fat	0 g	
<b>Cholesterol</b>	0 mg	0 %
<b>Sodium</b>	166.8 mg	7 %
<b>Total Carbohydrate</b>	21.7 g	7 %
Dietary Fiber	2.8 g	11 %
Sugars	→ 5.3 g	
<b>Protein</b>	3.2 g	6 %
Vitamin A	0 % • Vitamin C	2 %
Calcium	3 % • Iron	7 %

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

# References

“Cowboy Cookies.” Pick Up Limes. <https://www.pickuplimes.com/recipe/one-bowl-vegan-cowboy-cookies-41>. Accessed 9 September 2021.

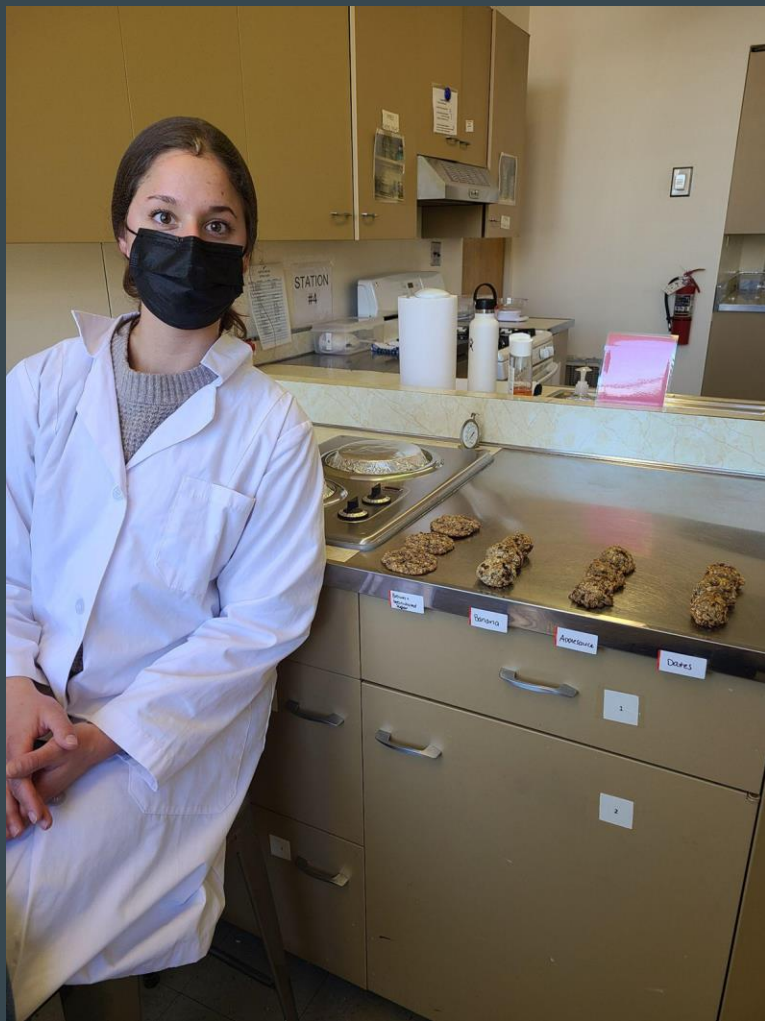
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Thank you!



Questions?