

Introduction

- School snack bars and vending machines must comply with regulations by U.S. Department of Agriculture's Food and Nutrition Service (USDA/FNS).
- A "smart snack" must contain 50% or more whole grains by weight, have the first ingredient as a fruit, vegetable, dairy product, or protein, or be a combination food with at least ¼ cup of fruit and/or vegetable.
- For a "smart snack" the requirements are: total calories (≤ 200), sodium ($\leq 200\text{mg}$), total fat ($\leq 35\%$ of calories), saturated fat ($< 10\%$ of calories), 0g trans fat, and sugar ($\leq 35\%$ by weight).

Objective

- The objective of this study was to develop a "smart snack" geared towards kids and/or teens to be sold within schools.

Materials & Methods

- Dunkin' Pumpkins is a smart snack that consists of pumpkin whole grain oat cookies (gluten-free) and a vanilla yogurt dip (Table 1, Table 2, and Figure 2).
- Processing of Whole Grain Oat Pumpkin Cookie:
 - After formulation, mix all wet ingredients together. Gradually stir in dry ingredients and mix well. Roll dough and shape. Bake at 350°F for 10 minutes. Allow product to cool before packaging, storage, and distribution (Figure 1).
- Whole Grain Oat Pumpkin Cookie Functional Ingredients:
 - Xanthan gum: Bound water and improved texture in the cookie because of the lack of a gluten matrix (Palaniraj and Jayaraman 2011).
- Processing of Vanilla Yogurt Dip:
 - Formulate ingredients before mixing. Package and refrigerate product immediately for storage and distribution (Figure 1).
- Vanilla Yogurt Dip Functional Ingredients:
 - Gelatin: A gelling agent that thickened the yogurt dip in this product by using a small amount in the formulation.
- To characterize Dunkin' Pumpkins, size, color, texture, and water activity measurements (Table 3) were evaluated from three batches by sampling three cookies per batch (n=9).
- A sensory panel of children ≤ 16 years (n=20) and adults ≥ 18 years (n=20) was conducted.
- A hedonic scale of 1=dislike extremely to 9=like extremely was used to rate appearance, taste, texture, and overall acceptability of Dunkin' Pumpkins when tasted separately and as dipped into the yogurt (Table 4).

Table 1: Pumpkin Cookie Formulation

Ingredient	Mass (grams)	Nutrition Facts
Pumpkin	122	1 servings per container Serving size About 3 cookies (30g) Amount per serving Calories 60 % Daily Value* Total Fat 1.5g 2% Saturated Fat 0g 0% Trans Fat 0g Cholesterol 0mg 0% Sodium 10mg 0% Total Carbohydrate 12g 4% Dietary Fiber 2g 7% Total Sugars 2g Includes 2g Added Sugars 4% Protein 2g Vitamin D 0mcg 0% Calcium 15mg 2% Iron 1mg 6% Potassium 46mg 0% *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. Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4
Whole Grain Oat Flour	92	
Honey	12	
Vanilla Extract	5	
Cinnamon	3	
Xanthan Gum	2.5	

Table 2: Yogurt Dip Formulation

Ingredient	Mass (grams)	Nutrition Facts
Nonfat Vanilla Yogurt	140	1 servings per container Serving size 2 Tbsp (35g) Amount per serving Calories 40 % Daily Value* Total Fat 0g 0% Saturated Fat 0g 0% Trans Fat 0g Cholesterol 0mg 0% Sodium 10mg 0% Total Carbohydrate 8g 3% Dietary Fiber 0g 0% Total Sugars 7g Includes 4g Added Sugars 8% Protein 2g Vitamin D 0mcg 0% Calcium 32mg 2% Iron 0mg 0% Potassium 32mg 0% *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. Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4
Brown Sugar	12	
Honey	7	
Vanilla Extract	5	
Gelatin	1.8	

Table 3: Quantitative Measurements (n=9)

Cookie Attributes	
Diameter	41.8 ± 0.6 mm
Thickness	9.2 ± 0.3 mm
Surface Color	L* 44.1 ± 1.4 a* 14.5 ± 0.3 b* 36.8 ± 2.3
Hardness	805.8 ± 56.7 g
Fracturability	723.4 ± 83.2 g*sec
Water Activity	0.96 ± 0.05
Yogurt Dip Attributes	
Water Activity	0.98 ± 0.03

- The cookie contains 51% pumpkin and 39% whole grain oats. The product overall is 100 calories, has 20 mg sodium, total fat of 5.0% by weight, no saturated or trans fat, and 13.8% total sugars. Therefore, each component meets the USDA/FNS standards for a "smart snack."
- For cookies dipped in yogurt, children rated overall acceptability and taste as 7.3 ± 1.78 and 7.3 ± 1.71, whereas adults rated overall acceptability and taste as 6.2 ± 1.70 and 6.6 ± 1.61 (Table 4).

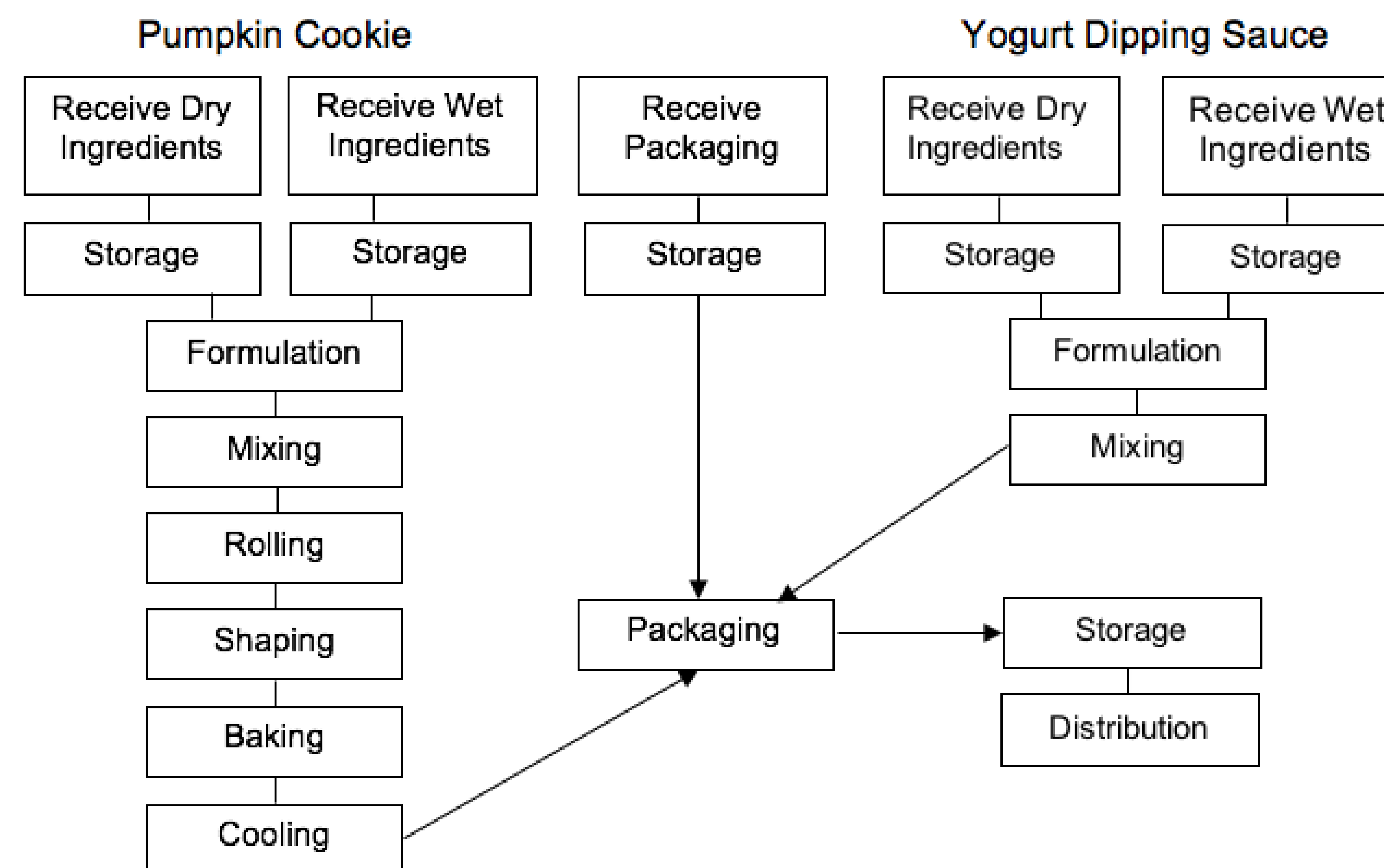


Figure 1: Process Flow Diagram

Table 4: Sensory Panel Means and Standard Deviations (Children: n=20 and Adults: n=20)

	Cookie		Yogurt Dip		Cookie and Yogurt Dip	
	Children	Adults	Children	Adults	Children	Adults
Appearance	7.0 ±1.57	6.4 ±1.60	7.6 ±1.36	7.3 ±1.26	-	-
Taste	6.2 ±1.91	4.6 ±1.85	8.2 ±0.95	7.9 ±1.37	7.3 ±1.71	6.6 ±1.61
Texture	6.4 ±1.87	4.3 ±2.23	7.9 ±1.41	7.5 ±1.67	-	-
Overall	6.7 ±2.01	4.6 ±1.88	8.4 ±0.75	7.8 ±1.45	7.3 ±1.78	6.2 ±1.70

*Scores range from 1=Dislike Extremely to 9=Like Extremely



Figure 2: Whole Grain Oat Pumpkin Cookie and Vanilla Yogurt Dip

Conclusions

- Adult panelists stated they would purchase this product for \$1-2 for their child at a school snack bar, but suggested the cookie could be sweeter and crispier.
- Panelists suggest amount of spices and honey could increase to yield a sweeter flavor in the cookies and the texture could be improved by being crispier.
- Overall, Dunkin' Pumpkins was found to be appealing to children especially when consumed with the yogurt dip.

References

Palaniraj A, Jayaraman V . (2011). Production, recovery and applications of xanthan gum by *Xanthomonas campestris*. *Journal of Food Engineering*, 106:1–12, doi: 10.1016/j.jfoodeng.2011.03.035

USDA FSN (2016). A Guide to Smart Snacks in School: Help Make the Healthy Choice the Easy Choice for Kids at School. Available from: <https://fns-prod.azureedge.net/sites/default/files/tn/USDSmartSnacks.pdf>. Accessed 2 February, 2018.