Bagels and Chemistry: Exploring the Power of Yeast

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Cite as: Barron, Lila, Grace Norris, Henry Su, Graham Whitney, and Marjan Alaghmand. 2025. "Bagels and Chemistry: Exploring the Power of Yeast". Food-Fueled, 2, e00012. https://doi.org/10.57912/28908032.

Web address: https://edspace.american.edu/foodfueled/issues/volume-2/bagels-and-chemistry-exploring-the-power-of-yeast/

Introduction

Humans have made leavened bread for millennia, but the first true bagels were likely originated by 13th century Jewish communities in what is now known as Poland. At the time, antisemitic laws segregated Jews from Christians, creating insular Jewish enclaves throughout the region. It was in these neighborhoods where bakers invented a smaller version of the boiled, ring-shaped Polish bread known as *obwarzanek*. These became known as *beygals* in Yiddish and took on great cultural significance in the communities. They were given to new mothers to protect newborn children and became part of mourning rituals. During the 19th century, bagels came to the United States with European Jewish immigrants and would become a staple food in the following decades.

Our group chose to make a bagel to examine four things: how yeast works in baked goods, how gluten works in baked goods, why bagels are boiled, and why the Maillard Reaction occurs when baking bagels. We documented the process of making bagels and did additional research to investigate these topics.

Recipe

Nutrition Facts (1 bagel) (Nutritional Database)

- ¼ cup of water
- ½ teaspoon active dry yeast
- ½ teaspoon sugar
- ½ cup flour
- 1 tablespoon oil
- 1 large egg
- 2 tablespoons everything bagel seasoning

Serving Size:
1 medium bagel (105g)
Everything Bagel

Amount Per Serving

Calories	**277**
	% Daily Value*
Total Fat 1.4g	**2%**
Saturated Fat 0.4g	**2%**
Trans Fat 0g	
Polyunsaturated Fat 0.6g	
Monounsaturated Fat 0.4g	
Cholesterol 0mg	**0%**
Sodium 443mg	**19%**
Total Carbohydrates 55g	**20%**
Dietary Fiber 1.7g	**6%**
Sugars 8.9g	
Protein 11g	
Vitamin D 0mcg	**0%**
Calcium 230mg	**18%**
Iron 3.7mg	**21%**
Potassium 112.4mg	**2%**
Caffeine 0mg	

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2000 calories a day is used for general nutrition advice.

Instructions

1. Warm water in the microwave for 15 sec. Add yeast and sugar.
2. Mix. Wait for yeast to get foamy.
3. Add flour and mix.
4. Flour surface and knead dough for 10 min (until not sticky).
5. Pour oil in a bowl, add dough in a ball.
6. Cover and let rise for approx. 1 hour or until doubled in size.
7. Shape into bagels and place on parchment paper.
8. Boil each bagel for 1 min on each side in sugar water.

9. Add egg wash and seasoning immediately after boiling.
10. Bake at 425° F for 15-25 minutes.
11. Enjoy!

Photo Gallery

Science Behind the Dish

How Yeast Works

Yeasts are single-celled organisms that break down simple sugars into carbon dioxide, ethanol, flavor molecules, and energy in a process called fermentation (Lawandi 2015). In a bagel, yeast is responsible for bread rise, fermentation, and developing gluten. Carbon dioxide, ethanol, and gluten are the three major components related to yeast that help bread rise. Yeast organisms expel carbon dioxide as they feed off sugars, causing the dough to rise (Lawandi 2015). Ethanol is formed during fermentation, and the evaporation of ethanol while the bagel is in the oven leaves room for gas bubbles, causing the bread to rise (Lawandi 2015). Yeast also helps to develop gluten. As the bagel dough rises, enzymes in the flour slowly break down the gluten proteins into smaller pieces, which can more easily assemble into a network and form gluten; this traps the gas bubbles that cause the bread to rise in the oven (Lawandi 2015).

Why Bagels are Boiled

Boiling bagels inactivates some of the yeast in the dough. This prevents the bagels from expanding further in the oven, and leads to a firmer product, and the signature shape of the bagel. According to *NPR*, "[bagels] are poached or boiled in

a solution of water and malt barley for anywhere from 30 seconds to 3 minutes. This pre-gelatinizes the starch in the dough, locking the liquid inside of it and expanding the interior. As the video puts it, it's like flash-frying a steak before grilling it to seal in the juices. The boiling also thickens the crust and it is essential to produce a 'chewier' bagel" (Godoy 2015).

How Gluten Works

Gluten is a protein found in wheat flour. It plays a crucial role in a bagel's texture. When flour is mixed with water, and then kneaded, the gluten proteins form strands. The process of kneading combines two proteins naturally found in wheat and some other grains. These proteins, known as glutenin and gliadin, combine with water to form gluten, a strong and stretchy protein fiber whose long strands create the "framework" of dough. Gluten makes the dough more elastic to give it a light, chewy texture. It also helps the dough rise, to create an airy center to contrast the crusty outside.

Why the Maillard Reaction Occurs

In 1912, French chemist Louis-Camille Maillard discovered how sugars reacting with amino acids can link together to form proteins. When heated to temperatures above 120ºC, this reaction gives food a brown color, a crispy texture, and a roasted taste. In the case of bagels, the sugars in the dough react with the proteins in the egg wash to get a browning reaction in the oven. The reaction can be enhanced by coating the bagels with lye wash instead of egg wash because lye is extremely basic (Extance 2018).

Conclusion

Our exploration of bagel-making provided valuable insights into the science behind the dish. Through the process, we observed the role of yeast in fermentation and bread rise, the structural importance of gluten in creating a

chewy texture, and the impact of boiling on the bagel's signature density and crust. Finally, we saw how the Maillard reaction transforms the dough during baking, giving bagels their appealing golden-brown color and rich flavor.

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