

Alex Goodman

STAT-365

4/11/2023

Dr. Robinson

Project Protocol: Muffin Study



Research Question:

Does the level of rack in the oven (top or bottom) and brand of muffin have a significant effect on muffin bake height?

Motivation/Background:

I decided to undertake this study because I like muffins. I want to know if the rack we put them on to bake has an effect on bake height.

Research Design:

This study has a 2x2 factorial treatment structure with 4 treatments, which are nominal. The response variable measured is the height of each muffin (measured by sticking a toothpick

marked with measurements down the center of each muffin.) This is measured in millimeters. The explanatory variables are the level of rack (bottom rack or top rack), and the type of muffin mix used (Betty Crocker and Krusteaz, both Chocolate Chip). To deviate which brand is which, two different colored muffin liners will be used, one to indicate each brand respectively. These can be any two colors, but they need to be consistent, and one must take note of which brand is associated with which color.

The muffins will be randomly assigned to one of two 3x4 baking pans, each able to hold 12 muffins. Each pan will have a mix of both brands of muffins. Each rack that gets baked will get baked by *itself*. There will be four trials of this experiment, (twice with the top rack, and twice with the bottom), for a total of 48 muffins. There are links attached below for the recipes/mixes, will use the same general recipe for both, as they both involve preheating oven to 400°F and baking for the same amount of time (20 minutes, to keep things nice and even.) I will measure out the exact same amount of mix in each liner, to account for the amount of mix being an extraneous source of variation.

Materials and tools:

- Betty Crocker Chocolate Chip Muffin Mix (4 packets)
 - 1 cup of water or milk
- Krusteaz Chocolate Chunk Muffin Mix (2 boxes)
 - 1 cup of water
 - 1 cup of vegetable oil
 - 6 eggs
- 2 3x4 cupcake/muffin pans
- 48 cupcake/muffin liners (at least 2 different colors)
- Medium mixing bowl
- Mixing spoon
- Measuring cup

- Oven w/ multiple racks
- Toothpick w/mm markings to measure height of muffins

Chronology of Steps:

- 1.) Before beginning to bake, make sure to randomize muffin assignments. Look online for a randomizer, and randomly assign 48 muffins (24 from each brand) into 4 separate 3x4 muffin pans. Designate which muffin brand will use which color of liner.
- 2.) Gather all required materials.
- 3.) Follow all instructions listed on the muffin mix for each brand, carefully assigning the correct mix into each slot/pan.
- 4.) Bake the first batch on either the top or bottom rack (randomize this, but make sure you have a total of 2 trials on the top, 2 on the bottom). Continue to adhere to given muffin recipe instructions listed on the package. However, to find a common bake time, bake for 20 minutes.
- 5.) Measure the height of each muffin after baking by sticking the marked toothpick directly in the center of each muffin. Be sure to carefully record the height at eye level. Be aware of how you demarcated your toothpick. Record your data in a spreadsheet or other applicable data collection software.
- 6.) Repeat Steps 3, 4, and 5 for the second, third, and fourth trials.
- 7.) Run analyses and continue the project.

Notes:

- Listed below are the two brands of muffin mix used in the study, which contain pictures of the recipes used to bake the muffins.

[Betty Crocker Chocolate Chip Muffin Mix](#)

[Krusteaz Chocolate Chunk Muffin Mix](#)

