

In Practice Article

TITLE

Donuts

ABSTRACT

A doughnut or donut is a type of fried dough confectionery or dessert food. The doughnut is popular in many countries and prepared in various forms as a sweet snack that can be homemade or purchased in bakeries, supermarkets, food stalls, and franchised specialty outlets.

INTRODUCTION

Doughnuts are usually deep fried from a flour dough, and typically either ring-shaped or without a hole, and often filled. Other types of batters can also be used, and various toppings and flavorings are used for different types, such as sugar, chocolate, or maple glazing. Doughnuts may also include water, leavening, eggs, milk, sugar, oil, shortening, and natural or artificial flavors. (Pritchard, 1992).

Shapes

Ring doughnuts are formed by one of two methods: by joining the ends of a long, skinny piece of dough into a ring, or by using a doughnut cutter, which simultaneously cuts the outside and inside shape, leaving a doughnut-shaped piece of dough and a doughnut hole (from the dough removed from the center). This smaller piece of dough can be cooked and served as a "doughnut hole" or added back to the batch to make more doughnuts. A disk-shaped doughnut can also be stretched and pinched into a torus until the center breaks to form a hole.

Alternatively, a doughnut depositor can be used to place a circle of liquid dough (batter) directly into the fryer (Miller, 1997).

Topping

After frying, ring doughnuts are often topped. *Raised doughnuts* are generally covered with a glaze (icing). *Cake doughnuts* can also be glazed, or powdered with sugar or covered with cinnamon and granulated sugar. (Roth et al., 2016) They are also often topped with cake frosting (top-side only) and sometimes sprinkled with coconut, chopped peanuts, or sprinkles (also called jimmies).

METHOD

Participants

Originally, most varieties of doughnut holes were derivatives of their ring doughnut (yeast-based dough or cake batter) counterparts. However, doughnut holes can also be made by dropping a small ball of dough into hot oil from a specially shaped nozzle or cutter.

Procedure

Hanson Gregory, an American, claimed to have invented the ring-shaped doughnut in 1847 aboard a lime-trading ship when he was 16 years old. (Moser, 1999) Gregory was dissatisfied with the greasiness of doughnuts twisted into various shapes and with the raw center of regular doughnuts. He claimed to have punched a hole in the center of dough with the ship's tin pepper box, and to have later taught the technique to his mother.

Smithsonian Magazine states that his mother, Elizabeth Gregory, "made a wicked deep-fried dough that cleverly used her son's spice cargo of nutmeg and cinnamon, along with lemon rind," and "put hazelnuts or walnuts in the center, where the dough might not cook through", and called the food 'doughnuts'.

RESULTS

Yeast doughnuts and cake doughnuts contain most of the same ingredients, however, their structural differences arise from the type of flour and leavening agent used. In cake doughnuts, cake flour is used, and the resulting doughnut is denser because cake flour has a relatively low gluten content of about 7 to 8 percent. (Baumann, 2007) In yeast doughnuts, a flour with a higher protein content of about 9 to 12 percent is used, resulting in a doughnut that is lighter and more airy. In addition, yeast doughnuts utilize yeast as a leavening agent. Specifically, "Yeast cells are thoroughly distributed throughout the dough and begin to feed on the sugar that is present... carbon dioxide gas is generated, which raises the dough, making it light and porous." Whereas this process is biological, the leavening process in cake doughnuts is chemical. In cake doughnuts, the most common leavening agent is baking powder. Baking powder is essentially "baking soda with acid added. This neutralizes the base and produces more CO₂ according to the following equation: $\text{NaHCO}_3 + \text{H}^+ \rightarrow \text{Na}^+ + \text{H}_2\text{O} + \text{CO}_2$."

The physical structure of the doughnut is created by the combination of flour, leavening agent, sugar, eggs, salt, water, shortening, milk solids, and additional components. The most important ingredients for creating the dough network are the flour and eggs. The main protein in flour is gluten, which is overall responsible for creating elastic dough because this protein acts as "coiled springs." The gluten network is composed of two separate molecules named glutenin and gliadin. Specifically, "the backbone of the gluten network likely consists of the largest glutenin molecules, or subunits, aligned and tightly linked to one another. These tightly linked glutenin subunits associate more loosely, along with gliadin, into larger gluten aggregates." The gluten strands then tangle and interact with other strands and other molecules, resulting in networks that

provide the elasticity of the dough. In mixing, the gluten is developed when the force of the mixer draws the gluten from the wheat endosperm, allowing the gluten matrix to trap the gas cells.

DISCUSSION

Water is a necessary ingredient in the production of doughnuts because it activates the other ingredients, allowing them to perform their functions in building the doughnut's structure. For example, sugar and salt crystals must be dissolved in order for them to act in the dough, whereas larger molecules, such as the starches or proteins, must be hydrated in order for them to absorb moisture. Another important consideration of water is its degree of hardness, which measures the amount of impurities in the water source. Pure water consists of two parts hydrogen and one part oxygen, but water used in baking often is not pure. Baker's salt (NaCl) is usually used as an ingredient due to its high purity, whereas the salts in water are derived from varying minerals. As an ingredient, "salt is added to enhance the flavour of cakes and breads and to 'toughen up' the soft mixture of fat and sugar." If relatively soft water is being used, more salt should be added in order to strengthen the gluten network of the dough, but if not enough salt is added during the baking process, the flavor of the bread will not be appealing to consumers. (Pritchard & Ashwood, 2008).

An important property of the dough that affects the final product is the dough's rheology. This property measures the ability of the dough to flow. It can be represented by the power law equation: $\tau = k \cdot D^n$ where τ is the tangential stress, k is the viscosity coefficient, D is the shear rate, and n is the flow index. Many factors affect dough rheology including the type of

ingredients, the amount of the ingredients, or the force applied during mixing. Dough is usually described as a viscoelastic material, meaning that its rheology depends on both the viscosity and the elasticity. The viscosity coefficient and the flow index are unique to the type of dough being analyzed, while the tangential stress and the shear rate are measurements obtained depending on the type of force being applied to the dough. (Reis & Roth, 2016)

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Figure 1. Contingency Graph for % of attempts to remove space

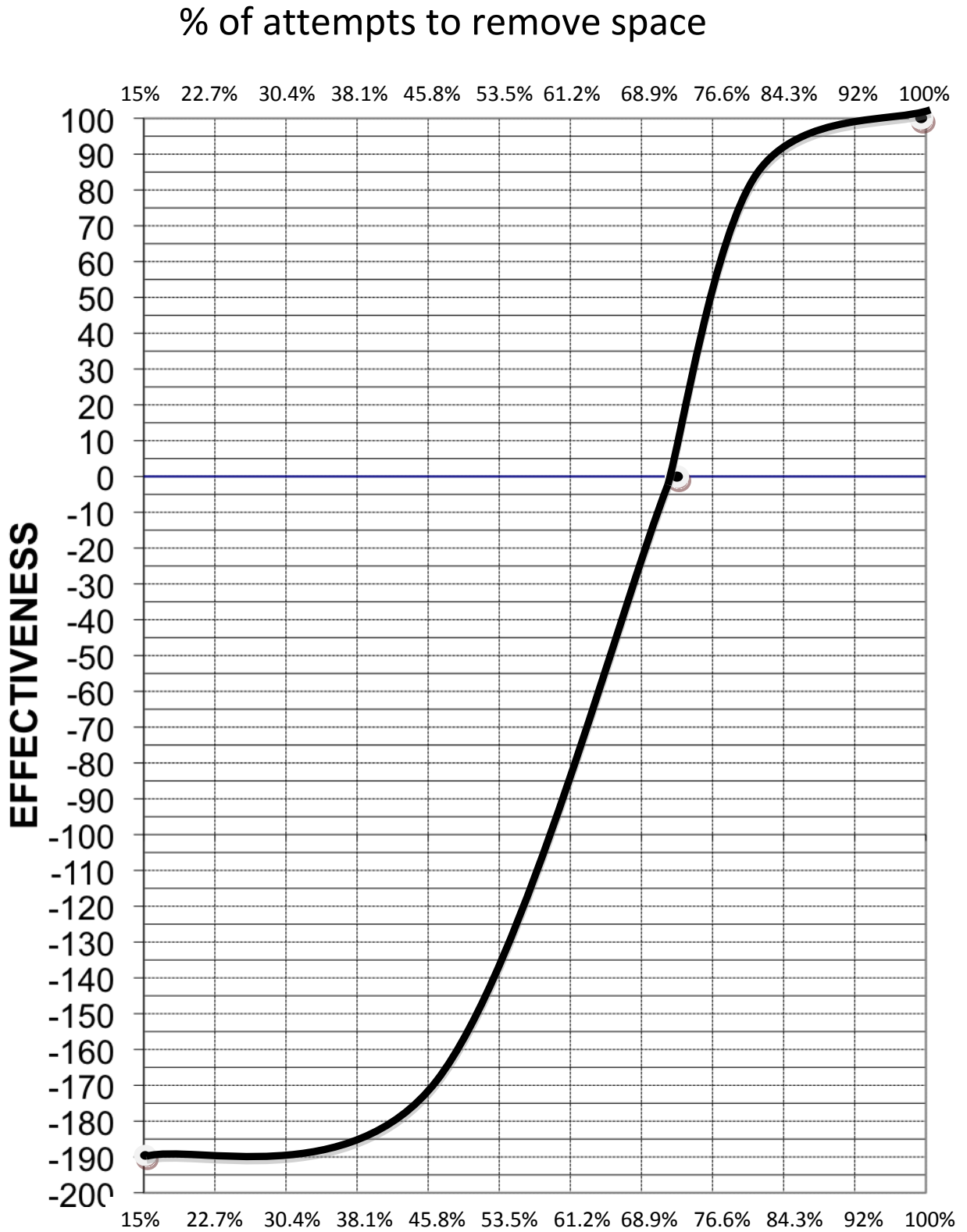


Table 1. Donut ProMES system

Objective Class 1 – Defense

Objective 1: Improve Positioning

| Indicator | Maximum Level | Minimum Level | Expected Level | Rank of Maximum | Effect Maximum | Rank of Minimum | Effect Minimum |
|--|---------------|---------------|----------------|-----------------|----------------|-----------------|----------------|
| % of possessions of 5 people in a stance | 80% | 5% | 35% | H | 85 | M | -75 |
| % of possessions 5 people on ball side | 90% | 25% | 55% | M | 88 | M | -100 |
| % of possessions all 5 people are covered after a scramble | 30% | 0% | 15% | H | 90 | H | -184 |

Note. L = Low importance, M = Moderate importance, H = High importance

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