

BAKING DONUTS



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INTRODUCTION

Donuts are the most versatile bakery item. Not only is it eaten at breakfast, it's consumed at lunch, on a sandwich, and as a snack throughout the day. No matter if it is fried or baked, yeast-leavened, or chemical-leavened there's a donut for everyone! Donuts or doughnuts are round or ring-shaped fried or baked goods characterized by their sweet flavor and soft texture. They can be filled with jams or jelly, chocolate, pastry cream, or dulce de leche.

The donut market is constantly growing and it has a current market value of USD 12 billion, it's expected to grow at a Compound Annual Growth Rate (CAGR) of 7% from 2023 to 2031. Yeast-leavened donuts have a bigger market share than their chemically-leavened counterparts.¹

Fried donuts can usually be yeast-leavened baked goods or chemically leavened. Also known as cake donuts. Baked donuts are usually cake donuts. Both varieties have their lovers or detractors, and they both present their own individual processing and formulation challenges.



Donut Market Opportunities

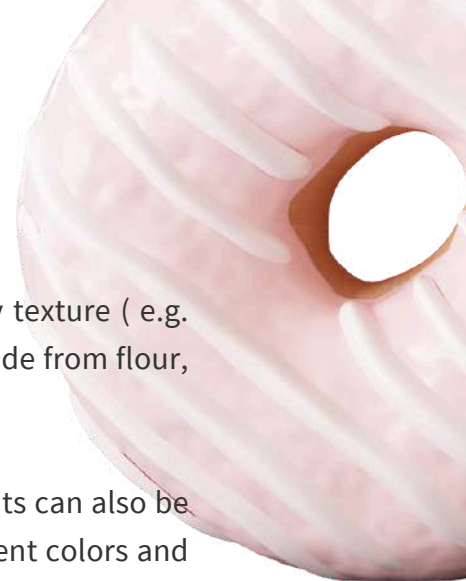
- ▶ The donut market is constantly growing and it has a current market value of **USD 12 billion by 2023**, it's expected to grow at a Compound Annual Growth Rate (**CAGR**) of **7% from 2023 to 2031**.
- ▶ Yeast-leavened donuts have a bigger market share than their chemically-leavened counterparts.
- ▶ Novel current trends are surging due to the consumer's interest in healthier baked goods.

1. Nisha Deore, Cognitive Market Research. "Doughnuts Market Size Was USD 12 Billion in 2023!" Cognitive Market Research, 18 May 2024, www.cognitivemarketresearch.com/doughnuts-market-report. Accessed 26 May 2024.

WHAT ARE DONUTS?

Donuts are ring-shaped bakery products characterized by their soft and airy texture (e.g. yeast-leavened) or by their cakey soft texture (e.g. cake donuts). They are made from flour, sugar, fat, and a leavening agent, either yeast or baking powder.²

They can be ring-shaped, round-shaped, and filled with jelly or creams. Donuts can also be topped with chocolate or traditional sugar glaze/icing and sprinkles of different colors and flavors.²



Types/Varieties

BY LEAVENING AGENTS

- **Yeast-leavened donuts:** they are made from a lean sweet dough and are leavened by yeast fermentation. This type of donut is characterized by its light airy texture and soft crumb. They are less sweet and less tender than cake donuts.³
- **Cake donuts:** they are made from a batter and chemically leavened by baking powder or baking soda. They are characterized by their dense cake-like texture and soft crumb.⁴

BY VARIETY

- Frosted
- Glazed
- Powdered
- Boston cream
- Filled
- Old- fashioned
- Bear claw
- Buttermilk

BY SHAPE

- Ring-shaped
- Bars
- Long Johns (rectangular shape)
- Twist
- Balls
- Donut hole



TYPES OF DONUTS



GLAZED



POWDERED



BEIGNETS



BOSTON CREAM



BEAR CLAW



OLD-FASHIONED



SPRINKLES



JAM FILLED



APPLE FRITTERS

INGREDIENTS

All-purpose flour

Flour serves as the backbone of donuts providing the structure and texture necessary for an airy texture. It contains gluten, a protein that, when hydrated and kneaded, forms a network that gives dough its elasticity and strength. In yeast-leavened donuts, flour provides the structure for gas retention and the overall texture of the product. In cake donuts, flour acts as a bulking agent to produce the cake-like texture of the product.²

Cake Flour

Cake flour is a finely milled flour that is typically made from soft spring wheat. It has a lower protein content than all-purpose flour (<10%), which makes it ideal for making cake donuts and other baked goods that require a light and tender crumb.²

Cake flour is often chlorinated, a process that involves treating flour with small doses of chlorine gas. This oxidizes some of the starch and protein molecules in the flour, which increases the acidity of the flour and increases its water absorption capacity. Cake flour treated by chlorination results in baked goods with a finer crumb structure. Chlorination can also help to increase the cake's volume and improve its shelf life.²

Sugar

Sugar is an essential ingredient in donut making. It provides sweetness and helps create a moist and tender texture. It also aids in browning by providing a substrate for the Maillard reaction. Sugar provides the final product with a tender structure by decreasing starch gelatinization and water activity.²

Fat

Fat plays an important role in donut production. The most commonly used are vegetable oils, margarine, butter, or palm shortening. The main function of fat in donuts is as a tenderizer by coating flour particles and restricting the formation of a gluten network. They also aid in moisturizing, flavor, and leavening in combination with sugar and color.²

Yeast

Yeast is a single-celled microorganism crucial for yeast-leavened donuts. It provides the gasses required for leavening, contributing to the volume and texture of the finished product. When yeast is in the presence of water and a substrate (e.g. damaged starch or sugars), fermentation occurs. This produces acids, aromas, and carbon dioxide. Resulting in a porous crumb that provides the characteristic aromatic, light, and airy texture.²

Chemical leavening

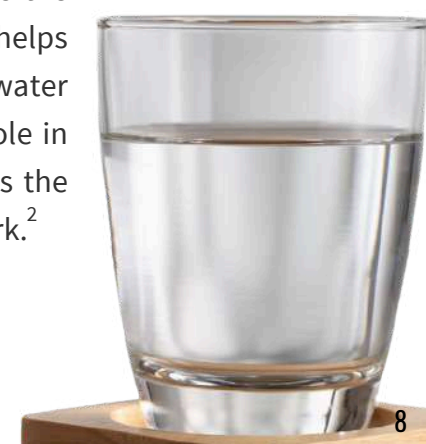
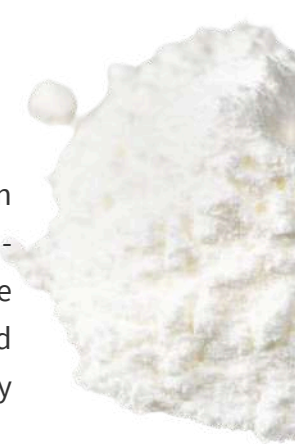
Chemical leavening agents like sodium bicarbonate and leavening acids are often used in cake donuts to produce carbon dioxide. Chemical leavening systems are the key to high-quality products. The volume, density, cell structure, and texture of the baked goods are determined by the gas produced from the leavening system used in the formula. The speed of the reaction, or how fast the leavening system produces gas in the batter, is affected by factors like acid type, temperature, water activity, and the type or ratio used.²

Eggs

Eggs provide the foaming ability and structure of the donuts. They act as gelling and binding agents, helping to set during baking. They also provide moisture which contributes to the softness and tenderness of the final product. Finally, eggs contribute towards the Maillard browning reaction, resulting in that custard aroma.²

Water

Water is a crucial ingredient in baking, serving as a hydration agent that binds the other ingredients together and facilitates gluten development. In donuts, water helps create a cohesive dough and keeps the consistency of the batter. Additionally, water contributes to the texture and tenderness of the final product, playing a key role in achieving the desired mouthfeel. It should be noted that excess water hydrates the proteins in the flour, developing them further and creating a more elastic network.²



Frosting/Icing

The most popular topping on donuts is icing or glaze. This serves two main functions: adding a novel flavor and texture to the donut and as a form of decoration.

Due to the nature of frostings and icings as emulsions, the appropriate combination of ingredients as well as the right processing conditions and procedures must be taken into account to obtain a quality final product. In some cases, the use of icing stabilizers may be required for the final product's optimum quality.

Icing stabilizers are ingredients that provide foam or emulsion stability, elasticity, and anti-sticking or setting properties. They are commonly produced from hydrocolloids, gums, polyglycerol esters, fatty acids, sorbates, and other emulsifiers. Some of the most commonly used ones are agar, guar gum, locust bean gum, carrageenan, or gum arabic.

The main functions of these stabilizers are:

- Prevents sugar crystallization
- Prevents syneresis or moisture in the package
- Improves icing structure, rheology, or setting
- Enhances gelling properties
- Emulsifies icing ingredients
- Enhances glaze surface



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DONUT PROCESSING



Yeast-leavened Donut

Yeast-leavened donuts can be made by the sponge-dough method, or by the straight dough method. The general method for yeast-leavened donuts is as follows:³

1. **Ingredient scaling/metering.**
2. **Dough mixing.** Mixing time will be a function of flour strength, mixer speed, batch size, and delayed sugar/fat/salt addition. Final dough temperature should be between 26–28°C (78–82°F).
3. **Bulk fermentation.** Dough ferments for 1–3 hours at ambient conditions until it doubles in size. Fermentation time is controlled by dough temperature, water absorption, pH, osmotic pressure, yeast food, and yeast level. In some straight-dough processes, this step is skipped in favor of a longer final fermentation. Do note that bulk fermentation provides rest and relaxation for the dough, resulting in fewer dough conditioners required for the makeup step.
4. **Makeup.** Dividing of bulk dough into dough blocks. Blocks are then sheeted and cut into appropriate shapes or by extruding with a low-pressure extruder.
5. **Final proofing.** Dough pieces are proofed at 35–43 °C (90–110 ° F); 40–70% RH for 30–40 min. An indentation test can be done to check the final point.
6. **Frying.** By partial immersion in oil at a temperature of 190–196°C (375–385°F). Dough floats on top of hot oil. This is due to its low density caused by gas expansion and water evaporation during the frying process.
7. **Glazing.** Is applied on top of the donut exiting the fryer. Sometimes it is hand-sprayed. In high-speed processes, this is applied through high-pressure or rotary nozzles.
8. **Cooling.** Donuts should be cooled to an internal to an internal temperature of 35–40°C (95–105°F) before packaging. As with cake donuts, yeast-raised donuts are allowed to cool before icings are applied.
9. **Icing.** Provides the ability to be creative with different flavors and textures. Mostly applied by hand, it provides the base for toppings.
10. **Dusting/coating.** Is achieved through pulverized dextrose and confectioner's sugar. Dextrose is less sweet than sucrose and its structure creates a cooling sensation in the mouth.
11. **Packaging.** For a longer shelf life, or for frozen distribution, donuts are usually packaged immediately after it is decorated. This retains its moisture and improves its shelf life.



Cake Donut

Cake donuts are made following a similar process to cake making. Its processing time is much shorter than yeast-raised donuts. The general process for cake donut production is as follows:⁴



1. **Ingredient scaling/metering.**
2. **Blending the ingredients.**
3. **Scaling / metering of water and other ingredients.**
4. **Mixing.** Mix for 1–2 minutes at low speed and 2 minutes at second speed to evenly incorporate and hydrate ingredients, at second speed to hydrate ingredients and aerate the batter. The final batter temperature should be between 21–24°C (70–75°F). This is to maintain the stability of the batter. A lower temperature would prevent excess gas production and moisture loss.
5. **Cutting/depositing.** Some batters go through a homogenizer before it is deposited into the hot oil.
6. **Frying.** By partial immersion in oil at a temperature of 190–195°C (375–385°F) for 45–60 seconds per side. Avoid frying at lower temperatures to reduce oil absorption and development of under-processing defects.
7. **Glazing.**
8. **Cooling.** To an internal temperature of 32–35°C (90–95°F) before packaging.
9. **Icing, coating, or enrobing.**



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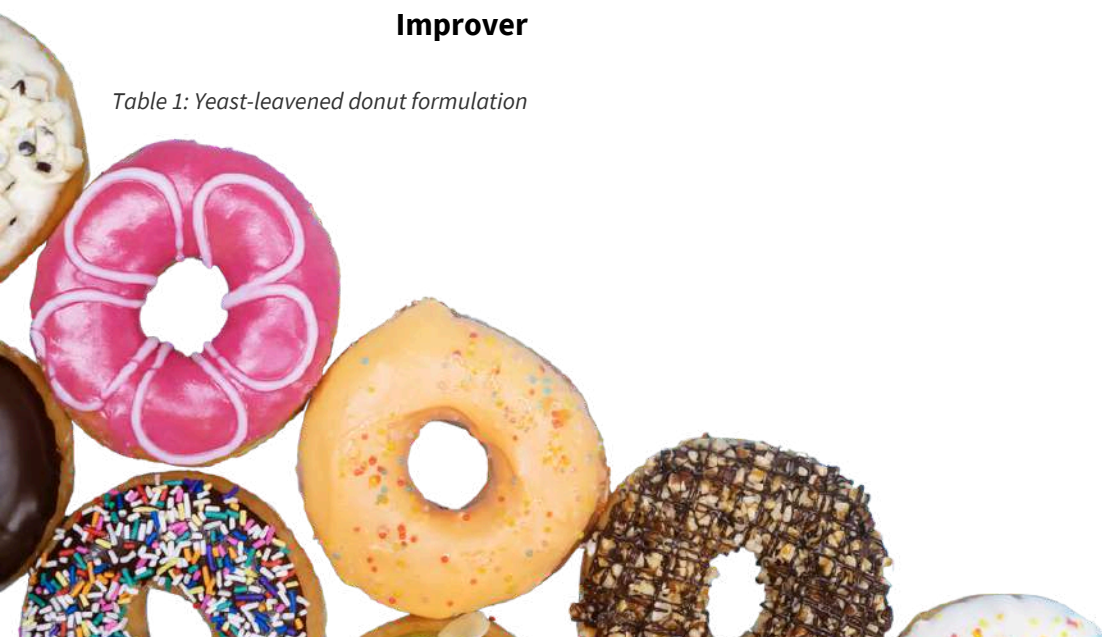
DONUT FORMULATION

A wide variety of donut formulations exist, the two most commonly manufactured are cake donuts and yeast-leavened donuts.

Yeast-leavened Donut

Ingredients	Baker's Percentage (%)
Flour	100
Yeast	8.9
Salt	0.8
Water	46.4
Fat	8.9
Milk Powder	3.1
Sugar	10.7
Whole Egg	8
Improver	1.0-2.0

Table 1: Yeast-leavened donut formulation



Cake Donut



Ingredients	Baker's Percentage (%)
Flour	25
Cake Flour	75
Sugar	39.3
Whole Egg	31.3
Salt	1.7
Shortening	10.7
Skimmed-milk powder	12.5
Baking Powder	4.1
Vanilla	0.2
Water	14.4

Table 2: Cake donut formulation

ICING STABILIZERS FOR FROSTING/GLAZES

Product Name	Function
<u>Stabligel Plus</u>	Concentrated stabilizer solution formulated specifically for snack cakes, honey buns, or other baked/fried applications
<u>Stabilite Icing Stabilizer</u>	Effective stabilizer solution formulated specifically for freeze/thaw glazes and icings
<u>Perma-Frost™</u>	Super concentrated powdered stabilizer solution formulated specifically for donut and honey bun applications to prevent cracking separation and weeping.
<u>RTU Stabilizer</u>	Excellent stabilizer solution formulated specifically for ready-to-use icings and glazes to prevent cracking, separation, and weeping under reheated conditions.

Table 3: Icing stabilizers options from Vantage® Food

TROUBLESHOOTING DONUTS



How can I avoid the shrinking or collapse of round donuts?

Donuts go through a foam-to-sponge transition during frying, this transition is characterized by the settling of the structure interconnections and subsequent escape of the gasses from the inside of the baked good. Before the transition occurs the pressure of the gas bubbles is greater than that of the surrounding environment and thus the product inflates. Once the transition occurs, both inner pressure and surrounding pressure equalize and a small shrinkage may occur. Some ingredients such as sucrose can delay the foam-to-sponge transition by delaying starch gelatinization, this can produce shrinkage due to the absence of a full foam-to-sponge transition. Reducing sugar content, or slightly reducing the ability of the dough to retain gas, helps reduce this problem. If there is a need to maintain the sweetness level of the product, look into increasing the strength of the dough through dough improvers, or by adding more gluten or egg to the formula.⁵



How can I reduce the oil uptake of yeast-leavened donuts?

As mentioned above donuts go through a foam-to-sponge transition process, once this process is finished the inner pressure of the product is smaller than the one from the surrounding environment, and thus oil uptake may take place. For small-scale bakeries, tapping or banging donut trays may work out to reduce oil uptake; however, there are better solutions than this for high-speed bakeries. In high-speed bakeries, oil uptake or absorption can be reduced by adding a cellulose-based material such as Carboxymethyl Cellulose (CMC) or Hydroxymethyl Cellulose (HPMC) up to 0.3% flour weight. Another solution is to monitor the temperature of the oil to prevent it from dropping below 180 °C (360 °F), lower temperatures increase the cooking time and thus increase the potential time for oil penetration.⁵



SUMMARY

Donuts are a versatile and popular treat enjoyed throughout the day in various forms such as breakfast items, snacks, and even sandwiches. They can be fried or baked, yeast-leavened or chemically-leavened, and come in many shapes including rings, bars, and twists. Filled options and different toppings like frosting or icing add to their appeal. The basic ingredients include flour, sugar, fats, leavening agents, eggs, and water.

Making yeast-leavened donuts involves processes like mixing, fermentation, shaping, proofing, frying, and cooling, while cake donuts have a similar but quicker process. Production challenges, such as shrinking or oil absorption, can be addressed by adjusting ingredients and controlling temperatures. Overall, donuts offer a wide range of textures and flavors, making them a beloved choice for many different tastes and occasions.

If you need additional technical support in donut formulation or an improvement in your donut production efficiencies, contact us.

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