



Pretzel Production & Formulation

A long time favorite snack, pretzels have been around for centuries. And thanks to recent health trends, many consumers perceive pretzels as a healthier snack compared to many available alternatives.⁷ Another factor contributing to the potential growth of the pretzel market is their clean label statuses, due to the use of commonly safe ingredients.

The pretzel market is expected to grow around 2.7 - 4% with a compound annual growth rate for the period between 2020-2026. This market shows a slow growth in alternative and novel varieties due to the characteristics of the conservative pretzel consumer.^{7,8}

Global pretzel consumption around the world shows that the biggest market for pretzels is the United States, followed by Europe. Among the available varieties, hard pretzels reign above soft pretzel due to their convenience and larger stable shelf life.^{1,7}



What are pretzels?

Pretzels are baked snack foods commonly shaped as symmetrical loops. They are manufactured from lean and stiff fermented doughs. A wide variety of shapes can be found as rods, sticks, and the traditional loop form.¹

A pretzel can be either a sweet or savory food, as they are commonly topped with coarse salt or cinnamon sugar. The two main types of pretzel are hard and soft pretzel, distinguished by their texture.²

Pretzel variations commonly consumed around the world are:

- Mini pretzels
- Regular thins
- Soft pretzels
- Bavarians
- Rods



History of Pretzels & Their Production

Initially introduced to the US by Austrian and German immigrants as bretzels, pretzels are thought to have originated in the 12th century, when a Christian monk started rewarding children for their proper prayers with this baked snack. Their characteristic form is thought to represent the folded hands of a prayer.¹

In the 1860s hard pretzels were introduced to the US market. Since the 1980s the baked product industry has made significant improvements in the automatization of its manufacturing process. Today, pretzels are one of the most loved and consumed snacks in the American market. Their consumption is significantly increasing due to their perception as a healthy alternative snack.³



Pretzel Formulation

Pretzel's most basic formulation is with flour, yeast, salt and water. However, the addition of malt and soybean oil is common to enhance other sensorial attributes of the product. Here are common ingredients used for pretzel manufacturing.^{1,2,3}

Ingredient	Type	Function
Flour	Bread flour (11-14.5%) for soft pretzels Low protein flour (7-9%) for hard pretzels	Provides structure through the formation of the gluten network and imparts color by providing substrate for Maillard's browning reaction
Water	-	Provides moisture for flour gelatinization
Yeast	Compressed yeast for soft pretzels Active dry yeast for hard pretzels	Provides leavening and aids in flavor and aroma
Malt	Non-diastatic malt for soft pretzels Diastatic malt for hard pretzels	Provides sweetness, a characteristic flavor and moisture, plus aids in crust browning and shelf-life stability
Sugar	White granulated	Provides sweetness and aids in crust browning
Chemical leavening	Baking soda or ammonium bicarbonate	Aids in leavening
Soybean oil	-	Provides a tender texture, moistness, mouthfeel and mild flavor
Shortening	Butter or shortening	Imparts tenderness and mouthfeel, lubricates dough and aids in air incorporation during creaming
Salt	Coarse	Provides flavor and interesting texture profile



Soft vs Hard Pretzels

A wide variety of pretzel variations exist, but most can be divided into two broad categories: soft or hard pretzels. Each is characterized by their composition and production process.^{1,2}

	Soft Pretzels	Hard Pretzels
Overall Quality	<p>Bread-like snack quality</p> <p>Freshly baked</p> <p>Short shelf life, just a couple of hours</p> <p>High moisture content, of around 18 - 23%</p>	<p>Hard crust and texture like snack</p> <p>Packaged</p> <p>Long shelf life stability, of around 6 months</p> <p>Low moisture content, around 2.0 - 2.7%</p>
Ingredients	<p>Bread flour (11-14.5%) for soft pretzels</p> <p>Non-diastatic malt</p> <p>Compressed yeast</p>	<p>Low protein flour (7-9%) for hard pretzels</p> <p>Diastatic malt for hard pretzels</p> <p>Active dry yeast</p>
Processing	<p>Proofing times of around 20-25 minutes.</p> <p>Partially baked, frozen and finished baked at location or convenience of the consumer.</p>	<p>Completely baked at the processing plant</p> <p>Proofing times of around 5 minutes on the proofing conveyor</p>
Baking	<p>Baking temperatures range from 260-315 °C (500-600 °F)</p> <p>Baking times of around 4-5 minutes in modular ovens</p>	<p>Baking temperatures range from 260-288 °C (500-550 °F)</p> <p>Baking times of around 2.5 minutes in modular ovens</p>





Industrial Production of Soft Pretzels^{1,2}

Mixing: dry and liquid ingredients are combined and mixed to form stiff dough for around four minutes. They are commonly mixed in batch mixers to accomplish the level of energy required for this dough.

Proofing: the bulk dough is placed in a proof box set at 28°C (83°F) and 85% relative humidity for the appropriate amount depending on the product formulation.

Final proofing: tie bow doughs are placed in the proof box for 20–30 minutes.

Extrusion: the dough is passed through an extruder with several holes. The resulting strands are knit together to form the pretzel shape.

Cooking or lye bathing: pretzel dough pieces are completely submerged for 10 to 25 seconds in a 1.25% NaOH (12.5 g/L) bath previously heated to 90-93°C (194-200°F). Once removed from the bath, wait until the lye residual has been drained.

Salting: pretzels are placed on a perforated conveyor and then topped with coarse salt.

Baking: pretzels enter the baking chamber where they are baked at three different temperatures. The temperatures range depend on the type of pretzel produced.

Drying: baked pretzels enter the dry kiln wire-mesh for around 6-45 minutes at temperatures ranging from 240-270°C (115-132 °F).

Cooling: pretzels are cooled for 15 minutes at room temperature.

Packaging: due to their texture and low moisture content, pretzels must be packaged in laminated or co-extruded bags that have a good barrier against air humidity.



Operational parameters^{1,2}

Dipping or cooking temperature: the appropriate alkaline solution temperature is 70-93°C (158 - 200°F) to allow starch gelatinization and caramelization of the sugars.

Alkaline solution concentration: the sodium hydroxide solution used is typically 0.5-2.5% so the appropriate acid to alkaline ratio is maintained.

Baking temperature: ovens must be able to match the heat process profile required for each type of pretzel. Control of this parameter is crucial for optimal results. If the temperature is increased too quickly, blisters may form on the surface due to the drying of the surface before the internal moisture is removed.

Drying time: it can range from 6 - 45 minutes, depending on the desired final moisture.

THE IMPORTANCE OF THE LYE PROCESS

Pretzels are commonly cooked in a hot alkaline solution of lye or in its defect baking soda. This alkaline solution contributes to several characteristics of pretzels:^{1,2}

- The alkaline surface and the acidic interior produces the characteristic pretzel flavor contrast. The alkaline environment contributes to the Maillard browning reaction that produces other aromatic flavor compounds.
- Starch is gelatinized by the alkaline solution producing the hard and smooth surface.
- Surface sugars are caramelized due to the bath's high temperature, and this creates the lustrous below surface of the pretzel. The alkaline environment also contributes to the increasing rate of the Maillard browning reaction.



“ When baking soft pretzels, how do I keep the dough smooth and easy to manage?

When rolling out a batch, cover the rest of the dough with plastic wrap and refrigerate until use. This will slow down fermentation that can cause the extension of the dough and further collapse of the gluten network. The roughness of the surface may be caused by the drying of the dough at room temperature.⁵

“ Are there alternatives to baking soda for pretzel browning?

Molasses or other sugars can be added to the formulation to provide the characteristic brown color without the lye or baking soda hot bath. However, this may cause a change in the flavor profile and final texture.^{1,2} Dissolved non-diastatic malt powder can also be brushed before baking to produce a similar color.⁶

“ How can I avoid crystallization due to extrusion?

When pretzel dough is exposed to high pressures during extrusion, an off-color dough may result. This dough produces a product that doesn't rise in the oven and has an undesirable texture. This can be prevented by increasing the water content of the formulation, increasing the final dough temperature or reducing the proportion of yeast of the mix.²



References

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