Pastry & Pie Production

The pastry and pie sector has always been a staple of the baking industry, and a consumer favorite. In 2021, the global pastry and cake market was valued at 130 Billion USD and is expected to peak at 170 billion USD by 2027.[1] Worldwide, the cakes, pastries, and sweet pies market is projected to grow at approximately 4% CAGR.[2]

It is a common belief that pastries originated in Egypt, and different societies, such as Hebrew, adopted the baked good.[3] The pastry then traveled with merchants and travelers to Greece and the Roman empire in the form of Baklava, a type of phyllo dough.

Getting Started

Typically, pastry dough or pie crust is made using three primary ingredients: flour, water, and shortening. Sweet pastries additionally contain a high concentration of sugar or sweeteners. While the dough is simple, there's room for creativity when it comes to fillings and toppings. Fruits, creams, custards, glazes, toppings and crumbles are just a few combinations to make a product delicious and visually stand out.

Some common pastries include short-crust, puff, choux, flaky, phyllo, suet crust, rough puff, and hot water crust pastry. Pies typically fall into either fruit or cream filling categories.

Pastry

A highly popular and versatile kind is the Danish pastry. These products are multi-layered laminated viennoiserie pastries leavened with yeast and often topped with cream cheese or a fruit filling.

Large amounts of butter or margarine are applied between each thin layer of yeast dough and folded several times (like croissants). Layers of butter between fruit filling and pastry base reduce the moisture migration from filling to butter, maintaining the flaky nature of the pastry. High sugar content in the topping reduces the available water for migration.

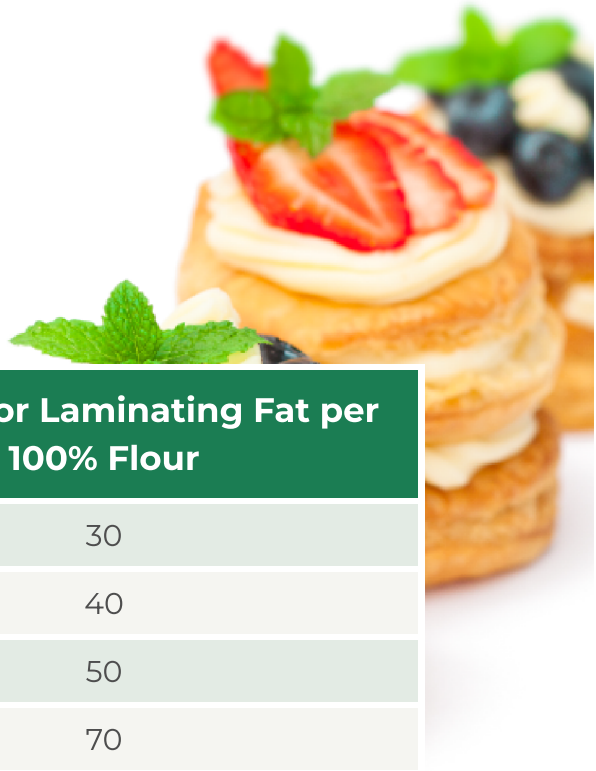
Using Pastry Shortening

A pastry shortening is a firm yet malleable specialty fat used in laminated bakery products. It is made of solid and liquid fat blends at a precise ratio or solid fat index (SFI). Unlike the all-purpose version, pastry shortening is typically stable and does not flow or deform with its own weight. So, it doesn't crack when stress is applied during dough sheeting and folding.

Formulating
Puff Pastry

Ingredient	Flour (dry flour weight %)
Flour	100
Salt	1
Water	44
Yeast (compressed)	8
Shortening	9.6
Sugar	9.2
Egg	12
Skimmed milk powder	5
Laminating margarine/butter	62-64

How much fat should you use?
Depends on the finished product.



Type of Pastry	% Roll-in or Laminating Fat per 100% Flour
Lean Dough	30
Medium-rich Dough	40
Rich Dough	50
Very Rich Dough	70

Manufacturing
Danish Pastry

Here are the steps for developing a Danish-type bakery product:[4,5,6]

- **Weigh** out the ingredients according to the respective formulation.
- **Mix** all the ingredients for 5 minutes and create a homogenous ingredients mixture. Gluten development should occur only during the lamination process.
- **Rest** the dough for an hour followed by sheeting to the desired thickness.
- **Laminate** the dough into 5-6 single folds: Two folds at a time, 30 minutes hold-time between each folding.
- **Sheet** the dough to 0.6-0.8 inches (approximately) to be baked after achieving the desired layers.
- **Cut** the dough and fill it if internal filling is desired. Apply a layer of shortening before filling to avoid a soggy product.
- **Brush** the product with an egg wash (or egg wash substitute), followed by baking.
- **After baking**, apply a layer of butter or margarine on the surface before putting a layer of cream cheese or fruit filling.

PRE-MADE DOUGH

Puff pastry dough is commercially available as a ready-made dough mixture, chilled or frozen. Commercially, large-scale pastry dough manufacturing can be made in batches or using continuous production lines. The pastry sheet containing the fat is rolled out, and by transversal unfolding, it is reloaded from one belt to another of lower speed. A sheet of up to 128 layers of dough can be obtained which is then cut, filled, shaped and brushed prior to packaging.

Fillings & Toppings

A danish product can easily be prepared by filling the dough with fillings such as fruit, chocolate, or cream cheese. A simple but classic approach for topping is spreading a glaze made from powdered sugar over the baked product.

PIE PRODUCTION

The pie market is seeing exciting innovations, including new ideas for baked products from international markets. Increased health-conscious demands have resulted in a growing interest in organic raw cane sugar. Products like custard pie, lemon meringue, chocolate cream pie, or banana cream pie can leverage organic raw cane sugars. For products with sugar toppings, brown sugar can add rich, complex flavors. Seasonal pies, like pumpkin, sweet potato or pecan can be topped with a crumble or pie icing that uses brown sugar powder or crystals with cinnamon.

Quality Parameters

Quality is a crucial parameter for success of any pie and pastry production. Puff pastry must have a crispy and flaky texture. During baking, this texture is caused by the vapor generated from the dough and further entrapment by the fat layers. The other factors that need to be considered in manufacturing are: [6]

Sheetability: Avoid overstressing the dough. Proteases and/or reducing agents can be added in the mixing step to improve sheetability. [4]

Lamination thickness: Uniform thickness of layers ensures an even rise during baking and prevents the product from collapsing.

Manufacturing temperature: Dough development must be done at a low temperature (10–20°C) to prevent the roll-in fat from melting. Simultaneously, very low temperatures make fats too hard to sheet well.

Melting point: The butter or fat must always have an adequately high melting point and plasticity to ensure smooth running of the line. To increase the dough's plasticity and to avoid melting, mix the. dough with roll-in butter and put in the refrigerator prior to lamination.

Baking: Producing a crisp and flaky final product requires baking in a convection oven at 176°C for various durations depending on the product.

Quality Parameters (cont.)

SUGAR

Sugar is crucial in pies and sweet pastries, giving key structure to the product. In products such as pie and pastry fillings, sugar is responsible for the sensory properties such as texture and mouthfeel.

Baker's Sugar provides a finer granulation size than typical granulated sugar. This allows it to blend, mix and melt more evenly in baking applications. This makes it ideal for various bakery products and novel products such as cream pies, lemon meringue, and custard pies.

SHELF LIFE

The shelf life of any bakery product depends on the available free water in the product. Sugar binds with water, reducing the free water available for microbial growth. Therefore, sweet pastries have a longer shelf life than their meat-based counterparts. Adding sweet fillings increases sugar concentration in the product, resulting in water migration, followed by water binding. Meat-containing pastries have a shelf life of a few days, whereas sweet pastries can have a shelf life of a few weeks.

I want to make pastries in larger quantities. What natural preservatives would be best?

An increase in water-binding ingredients in pastries increases the shelf life. Hence, sweeter, higher-sugared pastries have a longer shelf life. In addition to this, you can use natural gums and stabilizers that reduce the water activity of the product, improving shelf life naturally. It is also important to let the product cool down to room temperature before packaging. Otherwise, the moisture is trapped in the packaging and results in a soggy product with a higher microbial load.

If I wanted to add a touch of sugar to my puff pastry, what percentage would you recommend?

Sugar can be added in two different ways: as a part of the formulation or as a part of filling/topping. Using 5-12% (flour bases) gives the optimum pastry quality. Higher concentration might inhibit the yeast activity and pastry lift. Studies show that 18% sugar content results in distorted shaped products and an osmotic resistant strain yeast would need to be used.[8]

I'm trying to reduce the water activity in my bake stable filling. What ingredients can help?

Any hydrocolloids or modified starches can help reduce water activity. In addition, using high-methylated or HM pectin coupled with high-sugar concentration and a calcium source helps in binding water and giving a structure to the fillings. In principle, this is a similar process as developing a jam and works flawlessly for fruit fillings. For cocoa based fillings, increasing the volume of cocoa powder can help bind more water.

What humidity should I set my oven for to bake pies and tarts?

There shouldn't be any humidity at all during the baking cycle. This is to ensure that the mass transfer of water from the pie happens as quickly as possible. The oven should be vented as much as possible to get rid of excess moisture. This would ensure a crispy pie crust.

On the other hand, the situation would be different for an egg custard tart or a key lime pie which has a high amount of egg in its filling. This would require a high humidity. Sometimes over 80% RH is needed to ensure that the egg filling doesn't crack. This is achieved by setting the pie in a water bath. A low temperature/high humidity setting is required for such delicate pies or tarts.

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