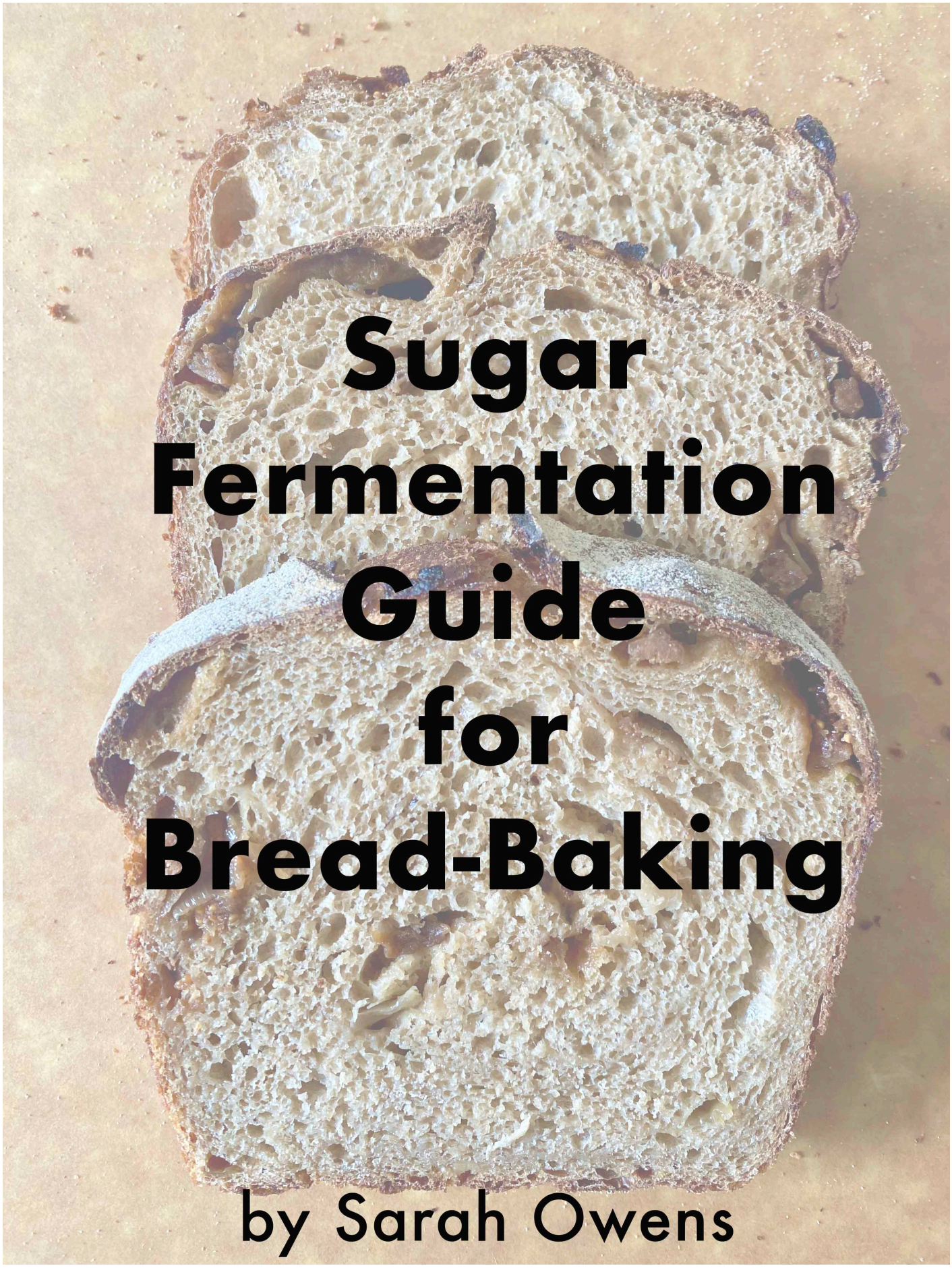

Sugar Fermentation Guide for Bread-Baking

by Sarah Owens

There are many types of sweeteners that can be used in sourdough baking to enhance dough fermentation rate and the flavor and appearance of bread. Besides affecting crust color development, sweeteners also provide a nutrient source for yeast to feed upon. If you want to add genuine appeal to your existing crust or are creating a new formula, the proper selection of sugar type can play an important role in the way your doughs perform, and how your baked goods are perceived.

Dried Figs + Fermentation

Dried and rehydrated figs and fig concentrates are all-natural sweeteners that add more than just sugar to a dough. Fig concentrate is derived from figs and water. The product is a pure concentrated extract of dried figs, derived by leaching the dried figs with water and concentrating the resulting extract to a minimum of 70° Brix (70% fruit soluble solids).
In addition to naturally occurring sugars, it is also high in citric acid. Fig concentrate can add a tangy, mild sweetness to bread doughs and a rich, mahogany crust to baked breads.

Determining the Effects of Figs on the Rate of Fermentation

When evaluating the effects of using dried or rehydrated figs or fig concentrate in sourdough formulas, it is important to consider a few variables inherent in sourdough baking. These include the unique microbial fingerprint of the starter, the types of sugar that each microbe prefers, and how enzyme activity and fermentation is regulated throughout the bread-making process. Each of these variables will influence the effects of figs on the rate of fermentation and the overall qualities of the baked bread.

Starter

Each sourdough culture is a unique reflection of the flour it is fed, where and how it is kept, and by whom it is maintained. Because of these variables, research studies on the effects of sweeteners in sourdough formulas have been limited to a few isolated strains of bacteria that work closely with wild yeasts. The sugar profile of figs is enriched in glucose and the overall profile is more like honey than sucrose (table sugar). This can further our understanding of fig concentrate based upon similar studies of using honey to feed isolated strains of lactobacilli

bacterium (LAB) found in sourdough starters. The following guide combines scientific studies with observational, sensory information in a home or professional bakery setting. This guide will allow you to understand the effects of sugar on dough, gauge how much dried figs or fig concentrate to use in sourdough breads, and what to expect in return.

The Role of Enzymes in Fermentation

Creating delicious breads, regardless of the flour or sweetener used, is a combination of both biochemical and microbial activity. Enzyme activation is a subtle yet complex biochemical component of fermentation and is one of the most important aspects of learning how sourdough microbes have access to the sugars that they need to feed. The biproducts of microbial sugar consumption, namely carbon dioxide gas, lactic and acetic acids, ethanol, and glycol (among others), are responsible for both leavening and flavoring the dough. Although there are many different types of enzymes with important functions, we will simplify the definition and role of just a few in the baking context.

Enzymes are complex proteins that catalyze biochemical reactions, namely breaking down larger molecules into smaller ones. This is an important component of converting flour starches into fermentable sugars. Various enzymes are present in raw ingredients like flour and interestingly, in yeast as well. These enzymes fit like a lock and key with starches and proteins to liberate energy and nutrients. Enzymes are also present in our bodies, primarily in our saliva and stomachs and are what begins the process of digestion. There are many enzymes that warrant our focus in baking.

Types of Enzymes

There are many different types of sugar, including glucose, fructose, maltose, lactose, dextrose, and so on. Specific enzymes break down complex starch molecules to unlock specific sugars. For example, maltase breaks down maltose into glucose. Invertase breaks down sucrose into glucose and fructose. LAB that are present in a sourdough starter, including the many different species and subspecies, prefer and will metabolize glucose before turning to other sugars. The result of LAB fermentation is acid production that minimizes other microbes, particularly ones considered

pathogens in food spoilage. The lack of competition with these spoilage microbes also allows certain yeasts to thrive. In some cases, however, certain species of LAB will be inhibited by particular sugars in high concentrations (such as sucrose). Leavening sourdough breads is a beautiful give-and-take dance and is dependent upon a healthy, active starter that will change as it feeds upon what is available.

Enzymes and how they work are an important part of dough fermentation and the flavor and appearance of bread. Two primary enzymes that we manage in the bread baking process are amylase and protease. Amylase works to break down the complex starch amylose into simpler, fermentable sugars while protease breaks down even more complex proteins by severing peptide bonds between amino acids. These processes influence fermentation, dough structure, and the resulting bread in several key ways.

When properly controlled, enzymes unlock sugars that speed along fermentation but ideally, not so fast that we don't have time to develop dough extensibility and strength. It is also sometimes desirable to control enzyme activity enough that some sugar is left in the dough before baking. This allows us to taste it on our palates, balance other flavor compounds like acidity, and adds to caramelization of the crust. Combined with flavor compounds that are the bi-products of microbial fermentation, the resulting bread can be a wondrous representation of more than the sum of its humble parts. Flour, water, and salt mean nothing without managing the enzymes and microbes that do the work!

Controlling Enzyme Activity

The baked result of any recipe or formula has as much to do with the ingredients as it does with the way the dough is managed during fermentation. So how do we control enzyme activity and strive for balance in our doughs? Enzymes are not living organisms but like the microbes in our starters, can be affected by time, temperature, and pH. Starch enzymes are activated by hydration or increased temperature, catalyzing the conversion of starches into fermentable sugars. This takes time in the case of traditional doughs made with sifted white flour. Slowing down fermentation of doughs made with refined flour allows enzymes to unlock flavor development before leavening is completed by yeast, whether it is wild or cultivated.

Combining just flour and water allows enzymes to begin unlocking flavor compounds but also encouraging greater dough extensibility before the onset of fermentation. Delaying fermentation also allows the bran to soften that may otherwise compromise the structural integrity of the dough. This is particularly important in formulas or recipes that contain high amounts of whole grain flour.

As we learned above, too much of a good thing can lead to problems in our dough. It is important once enzymes begin doing their work, to regulate them as fermentation is introduced and proceeds. One of the easiest ways to do this is through adding acidic ingredients, and thankfully our sourdough starters are low enough in pH to be effective regulators. Using acidifying ingredients like fig concentrate can also contribute to regulation. The citric acid naturally present in fig concentrate can also be harnessed as a natural preservative, not only adding tanginess to the bread but also extending its shelf-life. It is important to note that while citric acid can inhibit the growth of *Saccharomyces cerevisiae* (existing as wild or cultivated yeast) in mediums with high pH values, the low pH of sourdough breads may counteract this. Salt and cold temperatures regulate not only enzyme activity but also yeast and bacterial activity. Generally speaking, the longer sourdough breads are held under cold temperatures, or the more whole grain is present in the formula, the greater the acidic profile. This can also be regulated by how much leaven is used and how the starter is maintained.

Flavor Considerations

Although we may not be able to taste the simple sugars locked up in a starch, once starch is broken down by enzymes, we can detect and recognize the presence of sweetness. These sugars initiate and speed along fermentation and may or may not be exhausted before the bread is baked, particularly if other sweeteners are added. Sugars also contribute to caramelization and crust color of baked goods, particularly when excess sugar is present in a dough that has not been metabolized by microbial fermentation.

In addition to the glucose profile of fig concentrate, the citric acid that is naturally present in figs may also influence the flavor of baked goods that use it. In some products, the acidity of fig concentrate may not be an issue, but in others, the flavor might compete with other ingredients in

that formula. This is something to consider when determining if fig concentrate might be right for your product or application.

When adding additional sugar to dough, the fermentation, flavor, and appearance will be affected by the source and type. Because figs are high in glucose that is favored by sourdough starters, they will enhance the fermentation speed of the dough. Because sourdough is already high in acidity however, consideration for flavor balance is important. There is a wide range of flavor desirability in sourdough breads, from mild, creamy, and lactic to strongly sour. For most people it is preferable to have enough tartness to know a bread is made with sourdough without overpowering the other flavors the bread accompanies.

For this reason, it is advised to experiment with the following suggestions when testing new recipes or formulas.

- When adding dried or rehydrated figs to a bread dough, aim for about 20 to 25% of the total flour weight.
- When adding fig concentrate to a dough, using 5 to 10% will enhance the flavor and caramelization of the dough without adding too much acidity.
- A small amount of added sweetener in the form of fig concentrate will boost the yeast activity of the dough and speed its fermentation.
- Doughs that contain residual sugars will brown more quickly and may need to be baked at lower temperatures than usual.
- Managing dough acidity through lowering the percentage of leavening or shortening extended cold fermentation may be desirable when adding sweeteners like fig concentrate.

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Sarah Owens is a California-based cookbook author, baker, professional gardener, and culinary instructor. She was awarded a James Beard for her first book Sourdough and released her second in August 2017 titled Toast & Jam with Roost Books. Her third and much anticipated title Heirloom: Time Honored Techniques, Nourishing Traditions, and Modern Recipes was published September 2019. Sarah curates private dining events, cooks for public pop-up dinners, and teaches baking and preservation workshops globally. Sarah believes strongly in the power of food to unite and heal and has been instrumental in developing a bakery located in Tripoli, Lebanon working with Syrian refugees. Her wholesale, mail order, and workshop space relocated from NYC's Rockaway Beach to California in spring of 2020, and will resume in-person experiences in late 2021.