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Sourdough bread

An early example of biotechnology

Bread-making is one of the earliest examples of biotechnology. Mural paintings and other records from ancient times indicate that it was carried out in Egypt about 4 000 years ago.

Yeast cultures became available commercially in the mid-nineteenth century; before this, bakers saved a portion of the raw dough (or 'leaven') from each batch. This was then used to inoculate the next lot of dough. The leaven contained both yeasts and lactobacilli, allowing the bread to rise while imparting a distinctive flavour (often a sour taste) while helping to preserve the finished product. 'Sourdough' bread varies greatly according to the starter culture used and the exact recipe followed. Dark Russian rye breads and traditionally-made French bagettes are both examples of 'sourdough' bread.

Modern bread production, however, uses almost exclusively baker's yeast, *Saccharomyces cerevisae*. This yeast is more reliable than the older 'leaven', is easier to use and speeds up production. Significantly, baker's yeast can also be dried for storage and distribution, while a leaven must be actively maintained. For convenience of commercial manufacture, some modern 'sourdough' bread is made using *Saccharomyces*, with the addition of lactobacilli or acids and flavourings. Genuine sourdough bread is increasingly hard to obtain.

Recently there has been renewed interest in sourdough breads, especially from craft bakers, often using unusual flours (such as spelt, *Triticum spelta*) that are supposed to bring health or environmental benefits.

The practical method described here is essentially a recipe which can be extended to form a scientific investigation. Because of the lengthy procedure however, it is better-suited to practical investigations by individuals working at home than by large groups.

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Aim

To produce genuine sourdough bread.

Equipment and materials

Needed by each person or group

Revitalising dried sourdough cultures

- Dried sourdough culture
- Strong white flour (*e.g.*, bread-making flour)
- Water
- 1 litre glass container with lid, for preparing starter culture
- Incubator set at 25 ℃ or a warm cupboard

Basic bread recipe (sufficient for 2 loaves)

- Culture from first proof, 900 ml
- Butter, 2 tablespoons
- Milk, 225 ml
- Salt, 2 teaspoons
- Sugar, 2 tablespoons
- Strong white flour, 840 g
- Plastic film
- Spatula for mixing
- Large kitchen bowl
- 500 g loaf tins, 2

Procedure

A To revitalise the culture

1 The first step is to revitalise the dried culture. Put the dried culture in a clean 1 litre container. Add 140 g of flour and 165 ml of warm water, then mix well.

2 Seal the container loosely, so that gas can escape. Leave to prove at 25 ℃ for 24 hours. Stir vigorously several times during this period.

3 After 24 hours, stir in another 140 g of flour to the culture and sufficient water to maintain the consistency of the mixture.

Fig. 1 Fig. 2 Fig. 3

4 Repeat at 6-hourly intervals, until the culture forms a thick frothy layer of bubbles some 50–90 mm deep. At this stage, the culture may be used immediately or refrigerated for later use.

To make the bread

B Prepare the first proof

5 Mix 450 ml of the revitalised culture with 450 ml of warm water and 420 g of flour in a large bowl.

6 Cover with plastic film and leave at 25 °C for 12 hours until the mixture has doubled in volume and has the consistency of thin porridge and is full of bubbles. Save some of this culture in a clean container for future use. The culture can be kept for up to 6 months without 'feeding' in a refrigerator. With care to avoid contamination and periodic revitalisation, a culture can be maintained for a lifetime.

Fig. 4 Fig. 5 Fig. 6

C Second proof and baking

7 Add 900 ml of the culture from the first proof to a large mixing bowl.

8 Melt the butter and add the milk to it. Warm the liquid gently to 25 °C.

9 Add the sugar and salt and stir to dissolve.

10 Pour this liquid into the culture and mix well.

11 Add the flour gradually, mixing thoroughly after each addition.

12 Knead the dough until it is smooth.

13 Divide the dough into two, shape each portion into a loaf and place in a loaf tin.

14 Cover the tins with a damp cloth and leave the dough to prove at 25 °C for 1.5–3 hours. When the dough has risen 3–6 cm above the rim of the tins, it is ready to bake.

15 Preheat the oven to 190 °C. Bake the bread for 10 minutes, then reduce the oven temperature to 180 °C and continue baking for 45 minutes.

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

Fig. 15

Safety

Although sterile conditions are not needed, scrupulous hygiene is important to prevent contamination of the sourdough culture. Bread intended for consumption should only be prepared in a kitchen, not in a laboratory. Incubators used for growing other cultures should not be used.

Timing

The manufacture of traditional sourdough bread is a very slow process. Careful planning is therefore essential.

- Revitalisation of culture: 48 hours
- First proving: 12 hours
- Second proving: 1.5 –3 hours
- Baking: 55 minutes

Further investigations

1 The acidic nature of sourdough breads is thought to enhance their storage properties. Devise an investigation to compare the mould-free shelf-life of breads made using conventional bakers' yeast (*Saccharomyces cerevisiae*) and sourdough starters.

2 Dried sourdough cultures typically have a lower bacterial content than fresh starter cultures. It is thought that a reduction in storage temperatures might help to maintain the balance of lactobacilli to yeasts in such dried cultures. Devise an investigation to find out whether storage at room temperature (21 ℃), in a domestic fridge (4 ℃) or in a freezer (-20 ℃) is best for dried sourdough cultures.

3 Monitor the development of sourdoughs produced at different incubation temperatures and/or using different flours by measuring a) the consistency of the dough and; b) the amount of acid produced.

Note: Dough consistencies are expressed as dough yield, DY (DY = dough mass x 100 divided by flour mass). Firm doughs are characterised by low DY (*e.g.*, 160) and soft doughs by high DY (*e.g.*, 250).

The amount of acid produced by a sourdough is usually measured as total titratable acidity (TTA = ml 0.1 M NaOH required to neutralise 10 g of sourdough). The TTA differs in relation to DY. There is not a direct correlation between TTA and pH, as the pH is also affected by the buffering activity of the flour and the type of acids present — lactic and ethanoic (acetic) acids.

4 When sourdough breads are (first) proved for more than 12 hours, lactobacilli in the dough can generate more acid. Investigate the effect of proving time on the final acidity of the bread.

Preparation of a dried sourdough culture

Cultures prepared in this way can be stored for several months in a freezer

- Place a strip of waxed paper, about 1 metre long, waxed side uppermost, on a work surface.
- Pour about 225 ml of freshly-revitalised culture along the centre of waxed paper and spread it out evenly using a clean spatula, so that it covers the entire surface of the paper in a thin layer.
- Leave the culture overnight or until completely dry.
- Roll up the paper and crumble the dried culture from it into a mortar. Grind to a fine powder.
- Store the dried culture in a clean releasable plastic bag. Label and store in a freezer until needed.

Suppliers

Sourdough International (http://www.sourdo.com/) supplies a range of sourdough cultures from around the world, as well as publications.

Further reading

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Web sites

Sourdough FAQs

http://www.nyx.net/~dgreenw/sourdoughfaqs.html