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For issue on or after: 13 March 2017

AS GCE APPLIED SCIENCE

G623/01/INSERT Cells and Molecules

PLAN FOR AN INVESTIGATION

INSERT



INFORMATION FOR CANDIDATES

- The abstract on pages 2–3 of this insert is to give you some background that you might find helpful in planning for the task that follows. Not all the information included will be directly relevant and you are expected to select the information that is relevant to the task.
- This document consists of 4 pages. Any blank pages are indicated.

‘SOURDOUGH TECHNOLOGY’

Bread making is one of the oldest technologies known to mankind. Findings suggest that people in Babylon, Egypt, Greece and Rome used bread as part of their diet long before the Common Era.

The traditional sourdough process as a means of leavening dough is one of the oldest cereal fermentations, resulting in a more gaseous dough and so a more aerated bread. The use of sourdough in wheat breads has gained popularity as a means to improve the quality and flavour of wheat breads. A vast array of products rely on the use of sourdough fermentation such as *Panettone*, focaccias, German rye breads, French breads, soda crackers and San Francisco sourdough.

The characteristics of leavened wheat bread are high volume, soft and elastic crumb structure, good shelf life and microbiological safety. However, fresh bread made from wheat flour is a product with a short shelf life and during the staling process, it loses its freshness and crispness, while crumb firmness and rigidity increase. Research has shown that adding sourdough to wheat breads delayed firmness and staling and increased resistance to microbial spoilage. These benefits are attributed to the wild yeasts and spores of the lactic acid fermenting bacteria [LAB] which occur naturally in the flour.



Fig. 1 Sourdough starter culture

The preparation of sourdough begins with a starter culture made from flour and water. This is used to cultivate the wild yeasts and *Lactobacilli*, which are present in flour. The purpose of the starter is to produce a vigorous leaven and to develop the flavour of the bread. In practice there can be several kinds of starters, based on the types of flour used, for example whole wheat, rye, or rice flour, and the ratio of flour to water in the starter. A day or two after adding the initial flour and water, bubbles will start to form in the starter, indicating that the wild yeasts and LAB are becoming active and multiplying. The starter is ‘fed’ with fresh flour and water over several days until it is ready to use.

When wheat flour comes into contact with water, the naturally occurring enzyme amylase breaks down starch into glucose, sucrose, galactose and raffinose, which sourdough’s wild yeasts can metabolise. However, amylase also breaks down starch to maltose, which the yeasts are unable to metabolise. Lactic acid bacteria ferment the maltose using a series of complex biochemical pathways to produce lactic acid, ethanoic acid and/or ethanol, which contribute to the characteristic flavour associated with the dough. These by-products are metabolised by the yeasts to produce carbon dioxide gas, thus causing the dough to rise.

Sourdough can vary in consistency. The proportion between flour and water used in the starter culture is called the dough yield. This is defined as

$$\text{Dough yield} = \frac{(\text{mass of flour} + \text{mass of water}) \times 100}{\text{mass of flour}}$$

Temperature is an important factor since it influences the microbial composition of the sourdough. Optimum temperatures for the growth of *Lactobacilli* are 30 °C to 40 °C depending on the strain, and for yeasts 25 °C to 27 °C.

Obtaining a satisfactory rise from sourdough takes longer than a dough leavened with baker's yeast because the microbes in a sourdough are less vigorous. However there are many benefits of sourdough and sourdough bread. The acidic environment of sourdough bread has the advantage of reducing the loss of vitamin B1 due to heat. Sourdough bread has a better digestibility than yeast-fermented and non-fermented breads and it is more resistant to microbial spoilage and staling.

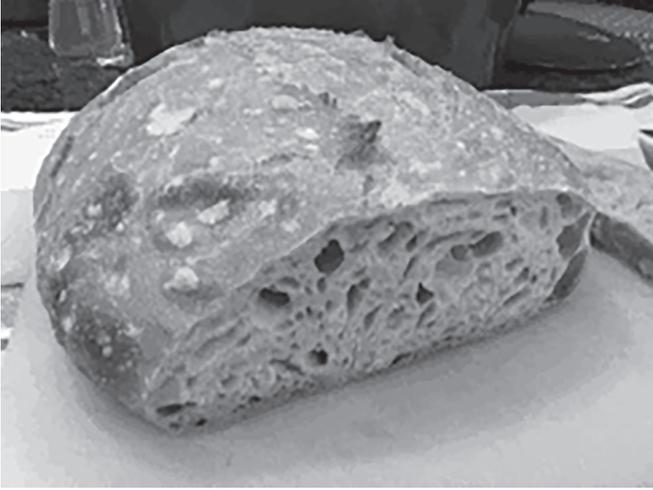


Fig. 2 Sourdough bread

The bakery industry has known a revolution over the past 150 years. Many of the small artisan bakeries, which were present in every village, were replaced by a high technological bakery industry. Industrial mono-production took over from the high variety bakeries, as bread could be produced in a more efficient way. Productivity became the key to success. Different baking technologies were developed to meet new market demands. The main consequence of this evolution was a decreased interest for bread flavour through long fermentation processes. However, in recent years, demand for tastier bread has resulted in an increase in products from artisan bakeries and for speciality breads from all over the world. A new business has been created through that demand for companies specialised in the production of stabilised sourdough products.

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