

# 10 Bread spoilage and staling

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## Introduction

Bread is the most important staple food in the Western world and it is recognized as a perishable commodity, which is at its best when consumed 'fresh'. Unfortunately, bread remains 'fresh' for only a few hours after it leaves the oven. During storage it is subjected to a number of changes which lead to the loss of its organoleptic freshness. The factors that govern the rate of freshness loss in bread during storage are mainly divided into two groups; those attributed to microbial attack, and those that are result of a series of slow chemical or physical changes which lead to the progressive firming up of the crumb, commonly referred to as 'staling'.

## Microbiological spoilage of bread

The most common source of microbial spoilage of bread is mould growth. Less common, but still causing problems in warm weather, is the bacterial spoilage condition known as 'rope' caused by growth of *Bacillus* species. Least common of all types of microbial spoilage in bread is that caused by certain types of yeast.

### *Mould spoilage*

Mould spoilage of bread is due to post-processing contamination. Bread loaves fresh out of the oven are free of moulds or mould spores due to their thermal inactivation during the baking process (Ponte and Tsen, 1978). Bread becomes contaminated after baking from the mould spores present in the atmosphere surrounding loaves during cooling, slicing, packaging and storage.

The environment inside a bakery is not sterile because dry ingredients, especially flour, contain mould spores, and flour dust spreads easily through the air. It has been estimated that 1 g of flour contains as many as 8000 mould spores. In some bakeries a similar number of spores settle on 1 m<sup>2</sup> of surface every hour (Doerry, 1990). Production operations such as weighing and mixing of ingredients increase the mould count in the air. In larger bakeries where segregation is possible, the flour handling areas are separated from the cooling and packaging area of the finished bread.

Bread crust is rather dry and if the relative humidity of the atmosphere is below 90%, moulds will not grow on it. Also, moulds are relatively slow to develop, so that in dry climates the surface of a slice of bread may dry before mould growth is sufficient to be visible. In a humid atmosphere, however, and especially on a loaf inside a wrapper, moulds will grow rapidly. This is true especially if the bread is wrapped hot from the oven so that droplets of water condense on the inside surface of the wrapper. When bread is cut, the inner, more susceptible surfaces are exposed to mould infection. Sliced, wrapped bread is more at risk, because the moist, cut surfaces are an ideal substrate for moulds to grow on and the packaging prevents the moisture loss.

The rate of mould growth in various breads depends on the recipe and the processing method (Seiler, 1992). Brown and wholemeal (wholewheat) breads appear to become mouldy rather earlier than white breads because mould growth is more clearly visible on the darker surfaces. Cultured breads, such as rye bread (Chapter 13), tend to have a slightly longer shelf life because of their increased acidity and lower pH. The processing method has also been shown to have an effect on the rate of mould growth. For example, bread made from no-time dough, i.e. CBP and ADD, has a slightly shorter shelf life than bulk-fermented bread. This difference is considered to be largely due to the higher alcohol content in fermented breads.

The most common bread spoilage moulds are *Penicillium* spp., although *Aspergillus* spp. may be of greater significance in tropical countries (Legan, 1993). In wheat breads a wide range of spoilage moulds including *Penicillium*, *Aspergillus*, *Cladosporium*, *Mucorales* and *Neurospora* have been observed (Table 10.1).

*Rhizopus (nigricans) stolonifer* is the common black bread mould. It has very fluffy appearance of white cottony mycelium and black sporangia. *Neurospora*

**Table 10.1** Characteristics of bread moulds

Mould	Colony colour	Colony appearance	Comments
<i>Penicillium</i> spp	Blue/green	Flat, spreads rather slowly	The most common type of bread mould
<i>Aspergillus niger</i>	Black	Fluffy, spreading	Frequently present
<i>Aspergillus flavus</i>	Olive green	with spore heads	
<i>Aspergillus candidus</i>	Cream	often clearly visible	
<i>Aspergillus glaucus</i>	Pale green		
<i>Cladosporium</i> spp	Dark olive green	Flat, spreads slowly	Often present on damp bakery walls, commonly encountered
<i>Neurospora sitophila</i>	Salmon pink	Very fluffy and fast spreading	Will grow very rapidly on moist bread
<i>Rhizopus nigricans</i>	Grey/black	Very fluffy and fast spreading	Will grow very rapidly on moist bread
<i>Mucor</i> spp	Grey		

Source Seiler, 1992