# BREAKING DOWN THE FUTURE OF BREAD

CONSUMERS ARE RESISTANT TO HEALTHIER BREAD OPTIONS, SUCH AS WHOLE GRAIN BREAD, DUE TO THEIR TEXTURE AND TASTE. DEVELOPMENTS IN ENZYMES HAVE THE POTENTIAL OF ENHANCING DOUGH QUALITY WITHOUT THESE COMPROMISES.

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**THE** baking industry is one of the world's largest sectors involved in daily food production, and one of the most important aspects of it is the production of bread. There are huge regional differences and preferences for the appearance, structure and taste of bread, which has resulted in an enormous variety of products.

While in Northern European countries, tin bread, with the focus on crumb softness, is the first choice option, in Southern European countries, crusty breads with crusts that are crisp are preferred. In today's bread industry, improving product quality with a focus on health and innovation is of the highest priority.

Currently, industrial bakeries add enzymes to the dough to increase stability and rising power, resulting in a higher quality bread in terms of crumb structure, volume and the prevention of staling. The enzymes used are mainly amylases and xylanases that degrade starch and fibres respectively. Xylanases in particular, play a key role in determining dough quality.

## ROLE OF XYLANASES

The main constituents of wheat flour are starch and protein (gluten), which are derived from the inner part of grain kernels, also called the endosperm.

Other minor components in the flour include lipids, ash and non-starch polysaccharides, which are mainly derived from bran. These latter components have a large effect on the properties of the dough and bread. Flour may also contain endogenous xylanases, but in general, only low amounts of xylanase activity have been measured in flours.

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The largest group of non-starch polysaccharides present in flour is arabinoxylan, which can be roughly divided into water soluble and insoluble ones. Both xylan types have a large water holding capacity, but in the case of insoluble arabinoxylans, this capacity is two times higher than soluble ones.

On the other hand, water soluble arabinoxylans provide high viscosity solutions. This high viscosity is thought to be the biggest effect of the arabinoxylans on bread quality. During the rising of the dough, the yeast produces gas that will be retained in gas cells, which are surrounded by proteins and water.

Addition of soluble arabinoxylans to the dough will increase the viscosity of the water between the protein molecules and the gas cells, resulting in better retention of the gas and stability of the foam, and leading to a fine bread crumb and larger loaf volumes.

The size of the arabinoxylan molecules is of importance for this: the longer the

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molecules, the higher the viscosity. The molecules should stay soluble, otherwise, they do not have an effect on the viscosity. Insoluble arabinoxylans increase viscosity. In fact, they may even have a negative effect on loaf volume, texture and bread crumb.

The quality of the dough can be improved with the addition of xylanases that degrade the insoluble xylans in such a way that they become more soluble, which results in a higher viscosity of the dough.

A second effect is that the water holding capacity will be reduced due to the lower capacity of the soluble arabinoxylan compared to the insoluble ones. This results in redistribution of the water among the other components in the dough, thereby increasing it extensibility.

These effects result in improved loaf volume, fine soft crumb and increased shelf life. Xylanases that are only able to degrade water soluble xylans to smaller parts are less suitable for use in bread making since small xylan molecules result in slackening and softening of the dough.

Overdosing of xylanases can also result in the same negative effects, which is due to degradation of both water soluble and insoluble xylans.

## HEALTH PROMOTING EFFECTS

Besides the quality effect xylanases have on dough and bread properties, they are also needed in bread making as health promoting agents. They increase the level of natural prebiotics and recent works have shown that

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Fermentors for enzyme production.

by modifying the natural fibre components of the flour, the arabinoxylans, they can potentially increase xylan-based prebiotics that help to support healthy intestinal bacteria.

This health promoting effect is further enhanced in whole grain breads where the content of fibre arabinoxylans is significantly higher.

Whole grain breads are not only higher in fibre content, the grains also contain other valuable compounds. As mentioned earlier, the inner part of the grain kernel, the endosperm, has starch and protein as its main components and does not contain many other valuable compounds.

On the contrary, the surroundings of the kernel, the bran and the germ, contain high levels of fibre and other bioactive compounds such as vitamins, minerals, a range of antioxidants and other beneficial phytochemicals. All these compounds in the bran and germ have been shown to have a positive effect on human health.

A diet rich in whole grain is expected to contribute to normal laxation and protect against the development of cardiovascular disease, type 2 diabetes and obesity, as indicated by recent nutrition research. An intake of just three slices of wholegrain bread can show significant beneficial effects.

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## TASTE PREFERENCES

Unfortunately, the actual intake of whole grain is far below recommendations. Most of the bread consumed in Europe is not whole grain (made with whole grain flour), but white and made with refined flours, which mainly consist of endosperm.

The preference for white bread is mainly due to tradition, technological problems in making wholegrain breads and taste preferences. The baking of good tasting whole grain bread is more complicated than baking white bread.

The somewhat bitter taste and brownish colour of wholegrain bread, disliked by white bread consumers, is caused by the outer bran layer, the pericarp. The inner bran layer, the aleurone, is hardly coloured and contains no bitter components. It is high in vitamins, minerals and other phytochemicals, and has low amounts of undesirable substances, which are mainly concentrated in the outer layer.

However, the addition of just aleurone to bread has a negative impact on bread volume and texture that is greater than for complete

bran in whole grain bread.

Addition of enzymes, such as xylanases, is expected to increase the quality of the whole grain breads. The xylanases will also help in the degradation of the fibres, resulting in more prebiotics, and the liberation of other healthy compounds.

This latter effect increases the bio-availability of vitamins, antioxidants and phytochemicals, and the uptake of these compounds by humans. Xylanases are not the only compounds that can be used to open bran structure and release the valuable compounds into the bread, other enzymes such as glucanases (degrading the fibre and opening the bran structure), feruloyl esterases (release of ferulic acid, which has been demonstrated to have a positive effect on human health) and phytases (better uptake of phosphorous from the grain) can be used as well.

An additional advantage of the enzyme action is improved mouthfeel of whole grain breads due to the degradation of the bran fibre to such an extent that it is no longer noticeable.

Information on nutrition and health is raising consumer interest in healthy eating and healthy bread. When expectations regarding taste can be met, consumers all over Europe would generally prefer healthier products. Therefore, a challenge of great interest for bakers is to focus on the wealth of bioactives present in wholegrain wheat, while also trying to solve the conflicting problems of taste and texture versus nutritional/health benefits.

## HEALTH INITIATIVE

To support this trend, a European collaboration project named HealthBread, was launched recently. The objective of this initiative is to develop and release new, nutritionally enriched white and whole grain breads.

As an opportunity to link science, innovation and craftsmanship, the project will develop and market new nutritionally

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improved bread products. Under this initiative, eight bakeries (from Austria, Germany, Italy and the Netherlands) and two research organisations, TNO (the Netherlands) and VTT (Finland), will join forces with professionals from the industry, business sector and research institutions.

Through innovative ingredients, bakeries under this project will deliver both 'good tasting' and nutritionally enriched breads. Special wheat compounds will be used to create breads that are higher in beneficial nutrients, such as dietary fibre, B vitamins, minerals, ferulic acid and antioxidants.

Dedicated fermentation processes and the use of enzymes, such as enzymes degrading the fibre (xylanases and glucanases), and enzymes that release healthy compounds (feruloyl esterases and phytases), will improve the availability of these nutrients for uptake in the digestive tract.

## ENZYME APPLICATIONS

As mentioned earlier, the enzymes currently used in the baking industry, apart from amylases, are mainly xylanases. However, new insights have opened opportunities for the development of new enzymes in the form of specific ones used for dough making and dough quality.

Efforts have been put in to develop enzymes with oxidative power, which can replace chemical oxidising agents in dough and breads. For example, enzyme mixtures have been produced using proprietary myceliophthora thermophila C1 technology, which served both as a source of enzymatic activities and as a production platform.

High enzyme production levels using this platform have been achieved, both for tailor-made enzyme mixtures and individual, so-called mono-component enzymes, allowing dedicated enzymes without unwanted or unneeded side activities.

Because of their ability to degrade or modify plant materials, enzymes such as xylanases and glucanases can be used in a number of other industrially relevant processes.

For example, when added to the starch-gluten separation process, xylanases will degrade the arabinoxylans present and can therefore lower the viscosity of the batter, resulting in higher starch and gluten yields.

In feed production, xylanases and glucanases are used to degrade the fibres in order to get a better feed conversion ratio. In paper and pulp applications, the xylanases can degrade the arabinoxylan and bleach the paper in a way that less chemical bleaching is required or becomes unnecessary entirely.

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