# Biotechnology as a tool for the production of food

**Biotechnology opens up numerous opportunities for the food industry. The targeted use of biotechnological methods can, amongst other things, help reduce the quantity and number of unhealthy ingredients in foods as well as degrade allergenic substances. Genomic research and targeted breeding also greatly facilitate progress in agriculture. Food biotechnology therefore contributes significantly to saving resources, optimising harvest yields and producing better foods.**

Biotechnology has become an integral part of the cheesemaking process.



The world's growing population and the increasing demand for healthy food represent highly challenging issues for the food industry. Biotechnology can contribute enormously to the production of nutritious food and already has a long tradition in the food sector. People have used the catalytic properties of microorganisms and their enzymes in food production more or less consciously for thousands of years. The economic importance of food biotechnology becomes particularly evident when one looks at food products produced with biotechnological methods: more than two billion litres of wine, 10 billion litres of beer and two billion kilogrammes of cheese are consumed in Germany every year. These figures clearly show that biotechnology has become a major actor in the food processing industry.

Food biotechnology employs state-of-the-art methods that make a significant contribution to making food safer, more tolerable and palatable. Biotechnology plays a particularly important role in the degradation of allergens in food. The enzymatic cleavage of plant proteins in wheat or soy with peptidases is increasingly replacing a method involving hot hydrochloric acid. The use of hot hydrochloric acid is associated with the formation of carcinogens and its production put a great deal of strain on both workers and machinery. In contrast, the biotechnological method has no such negative effects. Further examples are the enzymatic degradation of lactose in dairy products or acrylamide precursers in bread and potato crisps, which results in a significant reduction of potentially carcinogenic acrylamide in the final product.

## Wider use means less waste

New methods also generate new ways to conserve resources. On the one hand, the addition of specific enzymes that stop biological degradation processes in food can prolong the shelf-life of food, which decreases sales losses as well as the quantity of waste. In addition, biotechnological methods that are able to break up nutrient-rich compounds such as woody plant constituents have the potential to make such compounds part of human and animal diets. Enzymatic predigestion can help break down complex structures and remove unwanted compounds; this is similar to lactic fermentation, a classical method for producing sauerkraut. The development of new food sources has the potential to optimise the way agricultural raw materials are used.

## “Smart” breeding using genome analyses

Molecular genetic analyses considerably facilitate the breeding of crop plants.



However, biotechnology was used long before it was applied in the industrial production and processing of food. In addition, green technology has long become an integral part of agriculture. In particular, the study of plant genomes provides increasing insights that can be used for developing and breeding new plant varieties. The goal is not to alter the plant genome, but rather to specifically select and propagate suitable plants, as farmers have done for many thousands of years.

The "classical" method still relied on external plant features and plant breeders had to use a time-consuming process to determine purely empirically whether a cross had the desired phenotype or not. Nowadays, knowledge of the molecular properties and the genetic basis of phenotypic features can help plant breeders save a lot of time and money. Genetic markers associated with a desired property can help breeders identify appropriate and inappropriate plants very early in the breeding process. Such markers can obviate the need for breeders to grow countless plant descendants in order to find out whether they have the sought-after properties (see article entitled "Genetic fingerprinting - a useful method in fruit production"). This marker-assisted selection is now widely used in agriculture; breeding that involves this particular method is referred to as "smart breeding".

## Strict controls for GM-free crops

In addition to biotechnological methods that help optimise "classical" plant cultivation, there is an increasing number of approaches that enable the specific alteration of the genetic makeup of plants in order to improve the plants' resistance to pathogens or increase the content of specific compounds. These genetically modified organisms (GMO) are primarily grown in North and South America as well as China and India. They are hardly ever grown in Europe. A GM maize variety that was originally authorised for sale in the EU is now banned in Germany and many other European countries, so that currently there is no commercial cultivation of genetically modified plants in Germany. Seeds are globally traded and adventitious GM material must be prevented from being unintentionally introduced to and spread in Germany. Seed batches traded on the international market and imported into Germany must therefore be evaluated and checked for the presence of GMO (see article entitled "International procedures for the detection and identification of GM seeds"). If the proportion of GM material is above the technical detection limit of 0.1 percent, the entire seed batch must be destroyed.

## Improved production through made-to-measure enzymes

However, the possibilities for the use of GMOs in the food sector go far beyond their direct use as food. Genetically modified organisms are primarily used for the production of enzymes that are more efficient and safer than their natural counterparts. Recombinant rennin, also known as chymosin, has been used for many years in the production of cheese and other fermented dairy products. Recombinant chymosin has a high degree of purity and cheese produced with recombinant chymosin is fit for consumption by vegetarians and certain religious groups. Recombinant chymosin therefore replaces natural rennin produced from calf stomach and has a market share of around 75% in Germany.

Food biotechnologists (here: from the University of Hohenheim) are developing new food production methods.


Biochemical and molecular biological methods such as transcriptome, proteome and metabolome analyses will in the future provide new knowledge relevant to food production processes. These methods can help optimise existing products and production methods as well as enable the production of completely new products and methods. Agricultural raw materials can thus be used optimally and processed into safe, high quality food.

**Dossier**

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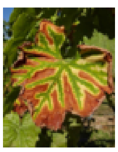

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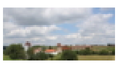

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