

Enzymes - Improving Lives and Enhancing Sustainability Around the World

What are Enzymes?

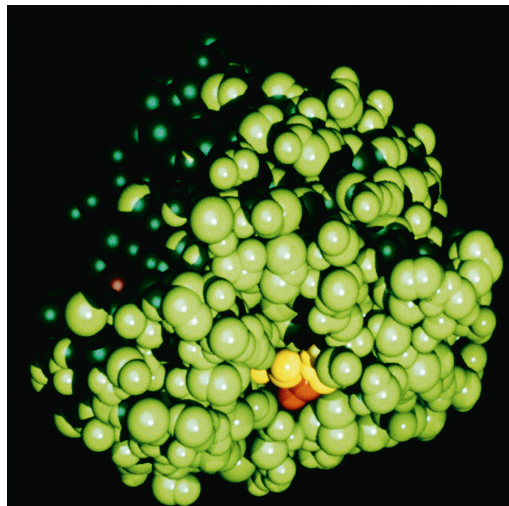
Enzymes are non-living protein molecules that are present inside all living things – people, animals, plants, you name it. They are nature's own tools, cutting and pasting different kinds of biological material and speeding up chemical reactions. And each enzyme has its own specialty. Human digestion is one of the many different processes helped along by enzymes in our saliva and stomach. They help to break down food so that your body can absorb all the nutrients. But enzymes can do much more than just help to digest food. They are currently used by more than 40 industries to improve manufacturing processes and product performance.

As a world leader in bioinnovation, Novozymes develops enzyme solutions to improve industrial performance and reduce consumption of raw materials, water and energy. In fact, Novozymes has secured more than 6,000 patents while developing more than 700 products through the company's intensive research and development efforts.

The Production Process

By copying nature, Novozymes engineers microorganisms such as fungi and bacteria to produce enzymes with desired traits. Microorganisms grow by simple cell division, making exact copies of themselves, and producing enzymes as they grow. By managing the type of microorganism being grown, Novozymes can also control the type of enzymes being produced.

Growing microorganisms in closed containers is called fermentation. In large fermentation tanks microorganism growth can be monitored and controlled, allowing for rapid growth. When a fermentation tank is full, the liquid mixture of microorganisms and enzymes is filtered, separating the enzymes from the rest of the biomass. The enzymes are then formulated, packaged and shipped to customers around the world, while the remaining waste material is neutralized and used as agricultural fertilizer.



Real-world Applications

Enzymes have the potential to help solve some of the world's most pressing challenges, including the economic and environmental challenges of reducing CO₂ emissions and overcoming resource scarcity. By lowering energy consumption in beer-making, turning waste products into advanced biofuels, or producing detergents that can clean in cold water, Novozymes products can contribute significantly to reducing the world's energy use.

Further, enzymes have minimal environmental impact because they are naturally biodegradable. Estimates show that our customers save an average of 100 kilograms of CO₂ emissions for each kilogram of enzymes they use in their manufacturing process.

In 2009, the use of Novozymes' technologies in our customer industries resulted in the reduction of CO₂ emissions totaling more than 27 million tons – the equivalent of taking seven million cars off the road.

Some of the ways our enzymes are improving lives and sustainability around the world include:

- **Detergents** – Traditional detergents can clean your clothes in hot water, but using our enzymes in laundry and dishwashing detergents can get the same job done in cold water, resulting in significant savings in energy and water consumption. Using enzymes can also reduce the need for some chemicals in detergents, reducing chemical releases to the environment through wastewater and improving water quality.
- **Biofuels** - Novozymes produces enzymes that convert the starch and cellulose in various feedstocks into simple sugars, which in turn can be fermented into biofuels. Every day, Novozymes gets closer to developing technologies that will enable more types of agricultural and urban waste to be converted into commercially-viable advanced biofuels that can reduce greenhouse gas emissions by up to 90 percent when compared to gasoline.
- **Food and beverage** – Enzymes are used to enhance the quality, nutritional profile and production efficiency of products such as bread, juice, cheese, pasta and beer. For example, enzymes convert trans-fatty acids into healthy fats in cooking oils. Enzymes can also help keep bread fresher longer.
- **Animal feed** – Adding enzymes to livestock feed and pet food increases its nutritional value and improves phosphorus absorption in animals. This leads to faster animal growth, improved health and reduced environmental impact since less phosphorus is released into the environment in animal waste.
- **Clothing** – Enzymes can significantly reduce the amount of water used in textile processing, reduce pilling on fabrics, and even give denim the “stonewashed” look.

