

How enzymes are revolutionising the food industry & reducing waste

Enzymes are not new to the food and beverage industry. We make cheese, yoghurt, and lactose-free milk with the help of enzymes, naturally occurring catalysts that accelerate chemical reactions, but we are still making breakthroughs in how they can be manipulated for use in industrial processing and waste management.

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Harnessing the power of enzymes is far from straightforward. Enzymes denature in conditions dissimilar to those in living cells, meaning they do not fit seamlessly into industrial processes.

An under-explored area is how enzymes might have an impact in tackling food waste, which has a huge cost in food manufacturing and creates a wasteful burden for producers. The Food and Agriculture Organisation (FAO) estimates that one-third of food produced for human consumption goes to waste; some of this occurs during the production and supply chain.

To meet this goal, improving efficiency and finding solutions to reduce waste in processing is vital. Enzymes are the key with which Tetra Pak and EnginZyme are opening new doors. But how does EnginZyme's technology work, and how is Tetra Pak adapting it to the advantage of the food and dairy industry?

Innovative enzyme solutions improves production technology

If enzymes could be adapted and controlled for industrial processes, they could make the perfect processing partner: they are naturally occurring and do not introduce any toxic chemicals or by-products. Consider the food we eat, which comes from natural products, and the enzymes in our mouth and gut

designed to breakdown and refine these nutritional molecules that is inside a food product.

Today, food manufacturers use enzymes to enhance flavour, texture and ripening processes – but they need to be in an easily handled form, such as powder.

Further, the quantity of enzymes must be controlled to ensure there is no impact on the end product quality or shelf-life stability.

Currently, the enzymes added during food and beverage processing are rarely removed from the final product, which may influence taste and texture, especially if the enzymatic activity is not controlled or stopped.

EnginZyme's technology comes with a solution that can fix enzymes onto a solid support material which can be designed for specific functionalities – such as different raw ingredients, equipment, and process conditions. This 'immobilisation process' is proprietary patent-protected in 23 countries.

It means that enzymes are transformed into a solid material which is easier to handle than enzymes added directly. By binding the enzyme to a particle material, while maintaining its activity, it can be efficiently used in food industry, as the food product 'indirectly' can pass the fixed enzymes (without the enzymes ending up inside the food product).

The technology fixes the enzymes in the solid support material which again is located in a reactor, and the food product then passes into the reactor and stays there until enough enzymatic reactions have happened. This can be a batch or continuous process. It comes with all the flexibility in size and capacity as long as the fixed enzymes can do the intended reaction to the product that is fed to the reactor.

As the enzymes are fixed and it is the product that goes in and out of the reactor, the enzymes can be reused – preventing them from ending up in the end product, and giving manufacturers better control of the production process and running conditions like time, pH, and temperature.



Improving efficiency and scale

EnginZyme and Tetra Pak are working together on solutions for using enzymes in immobilised form.

EnginZyme wants to discover enzymatic solutions that ensure the wanted process happens inside the reactor as their technology is agnostic to enzyme type, making it a smarter, transferable solution for the food industry.

The collaboration also taps into Tetra Pak's knowledge and expertise in food processing, such as design and development of the reactors, integration of the technology into food line solutions, which includes automation, hygienic design, run time, processing parameters, all of which have an impact on Total Cost of Ownership, Performance Guarantees and finally Return of Investment by having better product quality and long shelf-life stability.

Combining Tetra Pak's food processing expertise and EnginZyme's biomanufacturing innovation, the two companies are investigating how enzymes could be stabilised and engineered to better serve the food industry.

Given the focus on reducing waste, the companies are currently working on ways to recover and re-use any by-products from food processing. Take Greek yoghurt production. Typically, for every 3-4 ounces of milk, you produce one ounce of yoghurt – the rest is acid whey.

Acid whey by-product is a thin, watery substance that still contains

valuable lactose sugar molecules. There can be damaging effects when it seeps into waterways: sugars deplete oxygen from the water when it is decomposed, and this results in taking oxygen away from fish and marine life, as well as creating blooming of algae which consumes the sugars. As more algae grows, the more light is prohibited from entering the water – which has a damaging effect on the water ecosystem if the pollution is not controlled.

For that reason, the partnership is working to solve how to convert acid whey produced from fresh cheese and yoghurt – around 22,500m litres annually – into an added value ingredient such as prebiotic fibre. Alternatively, it could be reused in yoghurt production to improve the nutritional yoghurt quality.

The companies will also explore how enzymes can improve the quality of a range of other products such as vegan alternatives and prebiotic dairy products.

Tetra Pak is working to integrate EnginZyme's biotechnology into direct product or waste-stream line solutions, meaning the process solution could be easily scaled to any existing or new processing lines.

Enzymes exist in natural processes and bringing that into the food industry as a 'controllable' solution is a fantastic opportunity. It is just a matter of cracking the code to maximise the use of raw ingredients, reduce industry waste, and improve efficiencies in production. ■