Accelerators of Vital Processes

Author — Angel Gonzalo

Our body needs enzymes to function properly. We need them for all metabolic processes. Without enzymes, we would not be able to live. They also play a crucial role in our oral health. This is why Swiss Dental Company CURADEN has been investing for years in basic research into enzymatic applications.

Dr Michel-Angelo Sciotti is an innovation researcher and project manager for Life Sciences at the University of Applied Sciences Northwestern Switzerland in Muttenz. A molecular biologist, he has extensive experience in the application of enzymes. He has been working on the use of enzymes in toothpastes for CURADEN since 2013. The backstory is that CURADEN's owner Ueli Breitschmid initiated a meeting with Sciotti and on the spur of the moment exclaimed: "Enzymes are a great thing!" And indeed they are: our genes are essentially a 'construction manual' for enzymes and other proteins. "To put it simply," says Sciotti, who took Breitschmid's opening gambit with good humour, "genes are basically the code text, and enzymes are able to read this code, interpret it and process it further." Looked at like this, enzymes form the basis of life. "Of course that's great…" Sciotti jokes. Enzymes are a main category of proteins that are regarded as 'little chemists' because they control the chemical processes in our cells. Composed of amino acids, they are highly complex molecules that act as biocatalysts. This means that they have the ability to accelerate the reaction rate of biochemical processes. There are around 5,000 reactions that can be accelerated by enzymes. Each enzyme is responsible for one function.

Enzymes enable metabolism

Molecular biologists such as Sciotti know that it is primarily enzymes that enable cells and thus organisms to function and make life possible in the first place. They are required for all chemical reactions that take place in the human body. These include, for example, the regeneration of cells or tissue and the removal of waste products and toxins, as well as supporting the immune system. Enzymes are the driving force in our body and are therefore responsible for all the functions of every single organ in our body.

Enzymes make it possible to metabolize and use energy from food. They help the body to digest food and absorb nutrients from proteins, carbohydrates, fats and plant fibres. But we also need them to see, hear, smell, taste, breathe and move.

Receptors are molecules on the cell surface that respond to a chemical signal from outside the cell and trigger mechanisms that generally lead to the function of certain genes that influence cell function. Interestingly, almost all receptors are also enzymes or exert their effect through the activation of an enzyme. Simply put: enzymes really get our organism going!

Enzymes in saliva

Like other bodily fluids, saliva is hardly a tasteful conversation topic. But this secretion deserves our appreciation, not only because it lubricates our mouths and enables us to swallow food. Salivary glands are found in many animal species and have evolved in animals over millions of years for all sorts of purposes. Snakes use them to produce venom, fly larvae use them to produce silk and mosquitoes use them to inject chemicals to prevent blood from clotting as they suck our blood. Some birds even use their saliva as 'glue' to build their nests. For humans, saliva and the enzymes and other substances it contains are vital in a different way. Our taste buds need a liquid medium so that the molecules we perceive as flavours can reach them. This is what allows us to distinguish between different flavours in our food. Saliva has evolved for precisely this function.

Saliva is also responsible for initial 'digestion' in the mouth: It contains enzymes that break down food, including amylase, which converts starch into sugar. Its work continues on the food residue between the teeth. A little attention is all it takes to notice its effect: the more we chew a piece of bread, the sweeter it tastes. This is why babies love to suck on a piece of bread.

Calcium and fluoride not only in toothpaste

If dentists are so keen to insist that we eat less sugar, it is because among the 700 types of bacteria in the mouth, there are some that feed on these sweet substances and produce acids that attack our tooth enamel and cause tooth decay. Fortunately, saliva constantly washes away bacteria and restores the neutral pH of the mouth. Most drinks are a little acidic, including orange and apple juice – and even milk. They taste sweet because they contain sugar. Cola drinks typically have a pH of 2.5. By way of explanation, the lower the value on a scale of 0 to 14, the higher the acidity, with pure water being the benchmark for a neutral pH of 7. Saliva is not only the first barrier against bacteria, but also contains calcium, phosphate and fluoride. These elements adhere to tooth enamel and repair it. Proteins stored in saliva coat the enamel and protect it from acids. Bacterial colonies, for their part, form 'protective shields' after eating. If calcium is then added with the saliva, tartar forms.

Toothpaste containing enzymes

This makes saliva a special 'juice' with a variety of functions for dental and oral health: it cleans, protects and regenerates the teeth. How important it is often doesn't become clear until it is lacking. This is because a reduced saliva flow, as well as an altered composition, significantly increases the risk of tooth decay, tooth erosion and periodontitis. An enzymatic toothpaste intensifies the protective functions of saliva, uses and activates the natural defence systems and activates new ones inspired by other biological systems. CURADEN's 'Be you' toothpaste, for example, mimics the enzymatic antibacterial protection of, among others, honey. And these defence systems are urgently needed. When combating tooth decay, the aim is to reduce the population of certain bacteria and the protective plaque they form (e.g. Streptococcus mutans), but without eradicating them completely. Streptococcus mutans is a typical 'pioneer' of oral flora: it stimulates the colonization of other bacteria and – if our oral hygiene is out of balance – it may cause the acidification that is responsible for caries formation. But basically, these bacteria are our 'table guests' and cannot simply be regarded as bad guys, especially as they prevent opportunistic infections caused by other germs and are important for a healthy, rich oral flora. But only as long as proper oral hygiene is practised. Opportunistic pathogens, i.e. fungi and bacteria that are not part of our oral flora, are often responsible for inflammation and clinical conditions. The approach adopted by innovation researcher and molecular biologist Michel-Angelo Sciotti: "We add enzymes to the toothpaste, i.e. we strengthen a naturally existing system by adding enzymes obtained from the black mould Aspergillus Niger." The better the enzymatic reaction works, the better it supports the natural system of our oral flora. And this is precisely at the core of Sciotti's research work for CURADEN, which has already been successfully applied in toothpastes such as 'Be you'. "The principal aim of our next development in enzyme application," Sciotti says, "is to find specific enzymes in the databases that can break down or render harmless unfavourable and/or harmful substances such as plaque, caries or periodontal disease-promoting components – or, on the contrary, to produce positively acting substances that reduce the bacterial population and plaque formation."

It is primarily enzymes that enable cells and thus organisms to function and make life possible in the first place.