The oral microbiome and **overall health**

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Dr Michel Angelo Sciotti seems to be living the dream of any person interested in science. Michel is not only a Swiss biologist employed at the University of Applied Sciences and Arts Northwestern Switzerland. He's also been an innovation scientist since 2004, who is dedicated to creating new products in the fields of molecular biology and bioanalytics. Whenever a company approaches him with a new idea, he'll find a way to make it happen. For his doctoral thesis, he looked at oral streptococcal antigens.

What does he like about dentistry? "Certainly the interaction," says Michel, standing in the middle of his laboratory on a warm July afternoon. "Biologists understand the wider scope of a biochemical reaction while dentists have the practical experience and data. If a new toothpaste with an enzymatic system such as lactoperoxidase is supposed to rebalance the oral microbiome, dentists need to understand and recognise this mechanism." Enzymes? Lactoperoxidase? Well, let's start at the beginning.

For decades, even centuries, dental and medical professionals have regarded all bacteria as the enemy and something to be removed from the human body. However, dentistry has started changing this view. Modern research and technology have helped reveal that the human microbiome is an intricate and complex system consisting of over 1,000 different bacteria that need to exist in a symbiotic balance with our bodies—for that reason, not all bacteria should be eliminated. "The perception of bacteria has changed: bacteria are a part of our lives, they exist on our skin and are needed to protect us from opportunistic pathogens," says Michel. "An aseptic mouth could have devastating effects on microbiome. At the same time, certain bacteria remain unknown, as do their interactions," he explains.

Light in the oral cavity

In the oral cavity alone, there are several different and distinct bacterial species present in the various ecosystems on the surfaces of the mucosal membranes, tongue, palate and other areas. Some of these bacteria are beneficial to our health, some are detrimental, but they nevertheless have co-existed for thousands, if not millions, of years. "Nature does not think in concepts of bad or good bacte-

Dr Michel Angelo Sciotti

ria. It was probably not the sense of evolution that we've had healthy teeth for a hundred years. However, it was the sense of nature to keep people away from diseases through a balanced microbiome," says Michel. People now need to keep the natural oral microbiome intact if they want to keep their teeth as long as they live and, a huge part of doing that, involves a healthy diet with low sugar consumption.

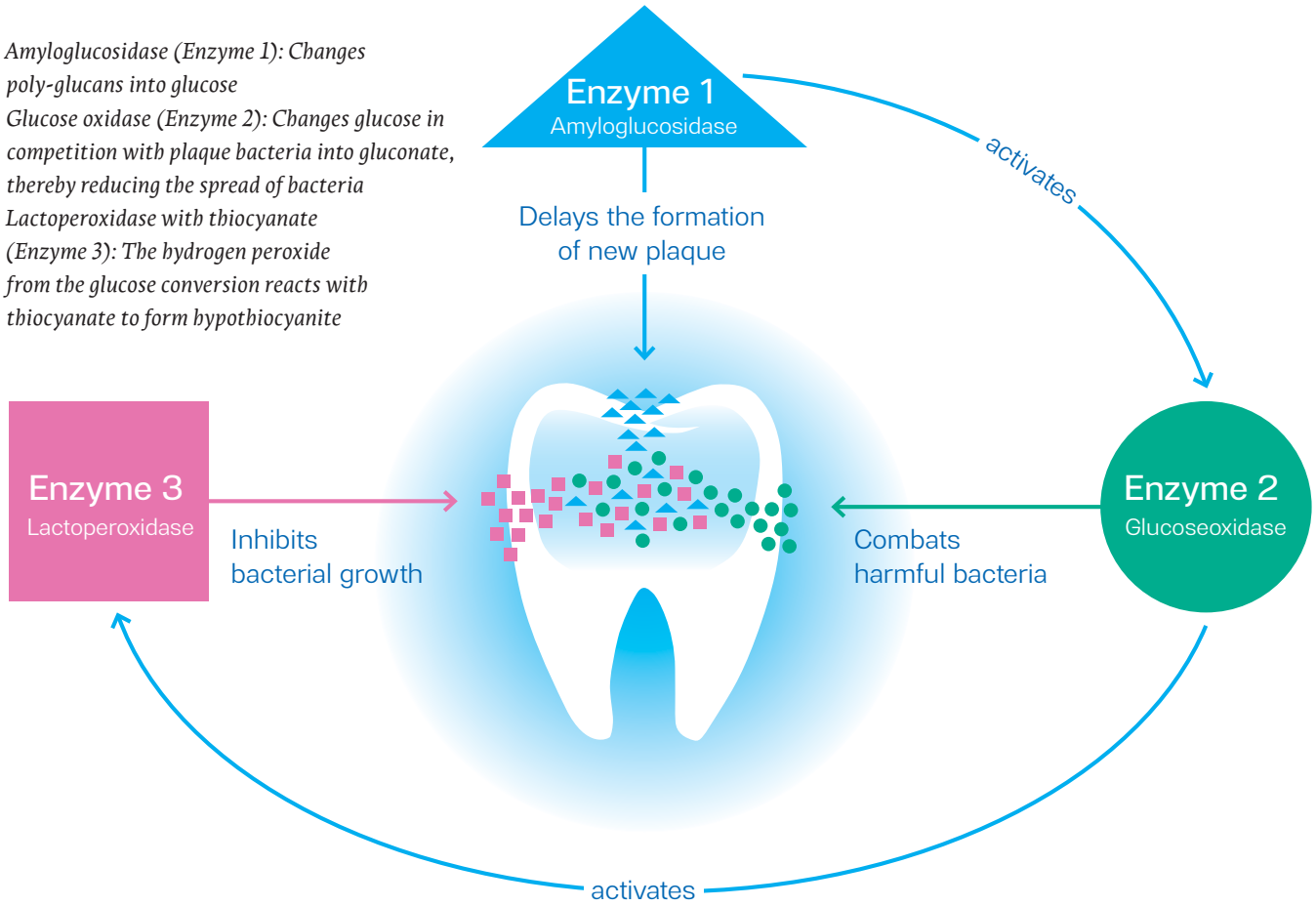
This understanding of the oral microbiome has brought to light an appreciation of its importance in regulating our systemic health. Only a balanced microbiome can reduce inflammation, help regulate the cardiovascular system, assist in metabolic functioning and provide many other benefits to overall health. An oral microbiome that is not in equilibrium—i.e. dysbiosis—allows disease-producing bacteria to proliferate and can lead to oral diseases. If these oral diseases are left untreated, they can in turn have adverse effects on systemic health. It becomes clear then that maintaining a balanced oral microbiome has a positive effect, not only on oral health, but also on the overall health of the entire body.

We are enzymes

No human would be alive without enzymes. Enzymes are biological catalysts—they naturally accelerate the speed at which chemical reactions occur in the body without being used up. "We are made of enzymes. We are made by enzymes. Enzymes translate the genetic code and produce more enzymes and proteins that will perform all activities and functions that happen in and between the cells. It is likely that most biological problems may have an enzymatic-based solution," argues Michel. Made up mostly of proteins, enzymes are essential to the human body's proper functioning. Without them, almost all of the processes that occur in our bodies would happen at a rate that would be too slow for us to exist. From the absorption of oxygen and the production of energy to the reduction of systemic inflammation, the plethora of biological activities in our cells would be unable to continue effectively without enzymes.

It makes sense then that enzymes are important for maintaining good oral health. When we eat, our food needs to be broken down so that the nutrients can be released and absorbed. Digestive enzymes facilitate this by reducing food

Amyloglucosidase (Enzyme 1): Changes poly-glucans into glucose
Glucose oxidase (Enzyme 2): Changes glucose in competition with plaque bacteria into gluconate, thereby reducing the spread of bacteria
Lactoperoxidase with thiocyanate (Enzyme 3): The hydrogen peroxide from the glucose conversion reacts with thiocyanate to form hypothiocyanite



to its constituents like amino acids (from proteins), sugars (from carbohydrates), cholesterol and fatty acids (from fats) and an assortment of vitamins, minerals and other compounds. Though found in the pancreas and small intestine, the first digestive enzymes that are produced when eating are actually present in the saliva where they act as a lubricant and initiator of the digestive process. As they also possess antibacterial properties, these enzymes that are naturally present in saliva, protect and maintain oral health by reducing plaque build-up and promoting natural remineralisation. By doing so, they keep the immune system in balance and improve systemic health.

Enzymes for oral health

Dr Christoph Fiolka, on the other hand, seems to be living the dream of any person interested in transforming science into solutions. A chemist from the Cologne area, he is head of product development of Curaden AG, where he also oversees the Swiss company's range of toothpastes, all of which contain a certain enzymatic system. "We use three types of enzymes: amyloglucosidase, glucose oxidase and lactoperoxidase," starts Christoph. "Amyloglucosidase, otherwise known as glucoamylase or AMG, works by breaking down the starches in food to glucose. This is why foods rich in starch, like potatoes, may begin to have a slightly sweet taste when chewed—the AMG enzymes in saliva are already breaking the starch down into sugar at this point."

The artificial adding of glucose oxidase helps with digestion by catalysing the breakdown of glucose into antimicrobial hydrogen peroxide and gluconolactone. When amyloglucosidase and glucose oxidase are combined with lactoperoxidase, a natural, yet potent, method of antibacterial protection is created in the enamel pellicle, destroying the bacteria, inhibiting dental plaque acid production and reducing oxidative stress.

The lactoperoxidase enzyme belongs to an antimicrobial system that relies on the lactoperoxidase-mediated oxidation of thiocyanate into hypothiocyanite. Hypothiocyanite is known

Dr Christoph Fiolka

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for its active antibacterial effects on cariogenic bacteria and certain periodontal pathogens. In fact, hypothiocyanite is part of the endogenous defence system and is present in all mucous membranes of the human organism, as well as in saliva. Researchers at University of Greifswald, Germany have been working on the lactoperoxidase system to help patients with limited oral hygiene.

A balanced oral microbiome

Christoph raves over the university's recent findings. "We both agree that we need to maintain an effective endogenous antimicrobial defence system for the prevention of caries and periodontal diseases. Such a system could be the lactoperoxidase-thiocyanate-hydrogen peroxide-system (LPO-system). In their quantitative suspension test, raising the thiocyanate and hydrogen peroxide concentration over the physiological level alone showed a relatively low antimicrobial effect. However, the antimicrobial efficacy of the LPO-system was very high after adding lactoperoxidase. In other words, the LPO-system reduced cariogenic bacteria within 15 minutes, effectively," he explains. Thus, the LPO-system can help regulate the necessary balance in the oral microbiome.

Michel and Christoph agree that if these enzymes are present in toothpaste as well, their protective effect can be intensified, reducing the build-up of plaque and tartar and encouraging remineralisation. "A higher concentration of peroxides helps with the natural antibacterial effect of saliva. We know that epithelial cells provide a physical barrier against pathogenic microbes and they produce peroxide at low doses.

Dr Michel Angelo Sciotti and Dr Christoph Fiolka wonder what else enzymes can do in terms of their antibacterial activity. How can they contribute to improving colds, influenza and a myriad of other illnesses and conditions? How effective are they for the prevention of xerostomia, halitosis and oral cancer—all of which have been suggested by previous studies. "We are only at the beginning," both say simultaneously. ■