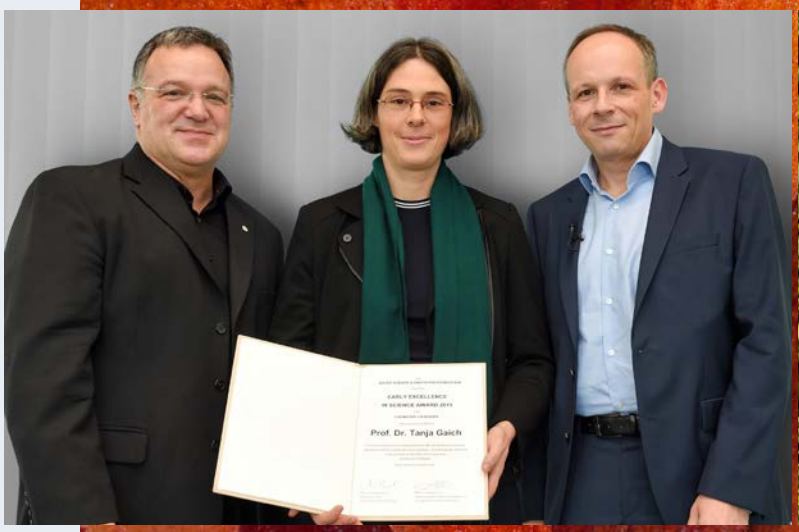
AWARD FOR AUSTRIAN CHEMIST

Natural healing power from the laboratory

Plants, fungi and other organisms are the source of important constituents of drug products. But because these substances often only occur in minimal quantities in nature, their potential remains largely undiscovered. Professor Tanja Gaich recreates these bioactive natural substances in the laboratory, an achievement for which she has been honored with the Early Excellence in Science Award 2015.



Professor Tanja Gaich (photo left) receives the award from Professor Andreas Busch (left), member of the Executive Committee of the Pharmaceuticals Division and head of Drug Discovery and Professor Michael Brands (right), head of Medicinal Chemistry Berlin at Drug Discovery. Gaich produces synthetic taxol derivatives. In nature, small quantities of taxol can be isolated from the bark (large photo) of the Pacific yew (photo right).

Sometimes Mother Nature guards her treasures jealously. Countless starting materials for new drug products can be found in plants, marine sponges and fungi. However, scientists would have to chop down entire forests, finance marine expeditions into remote areas or breed gigantic fungus cultures to be able to isolate the quantities that are needed for laboratory testing. Nonetheless, most of our antibiotics are based on rare natural substances, as are many cancer drugs.

Scientists are tracking down nature-based recipes

Many promising ideas would never be pursued if there were no scientists like Tanja Gaich. "We're working on manufacturing natural substances synthetically in the laboratory," explains Gaich, a professor at the University of Konstanz. In 2015, in recognition of her achievements in organic synthesis chemistry, she received the Early Excellence in Science Award endowed with EUR 10,000 from the Bayer Science & Education Foundation. "Professor Gaich is one of the world's best in her discipline and also trains outstanding chemists," praises Professor Michael Brands, head of Medicinal Chemistry Berlin at Bayer Drug Discovery, who nominated Gaich for the award.

At present, one of the topics that Gaich's working group is investigating is the synthesis of taxol derivatives. Taxol is derived naturally in very small quantities from the bark of the Pacific yew and is used as a cancer treatment. A 12-meter, 200-year-old tree yields approximately 350 milligrams of taxol – enough for just one dose for one patient. Around the turn of the millennium, scientists succeeded in extracting a related substance from the needles of the European yew, a tree that often grows in parks, and converting it into taxol. It is now also possible to produce the substance from yew cell cultures.

Gaich's team also experimented with sarpagin alkaloids. These substances derived from the roots of the medicinal plant Rauwolfia are effective against malaria and also as antibiotics. One kilogram of the plant yields only about 5 milligrams of sarpagin alkaloids.

To be able to synthesize a natural substance, scientists first have to analyze the structure of the molecule. They then break it down conceptually into components that can either be purchased commercially or manufactured with established chemistry. Next, these components have to be synthetically assembled in the laboratory to recreate the natural substance. The advantage is that the molecules that occur in nature are frequently not ideal for medicinal treatment, while substances created synthetically in the laboratory can be modified slightly to enhance their action.

"In many cases a lot of materials and numerous synthesis stages are required to manufacture a fraction of a milligram," explains Bayer chemist Brands. "For some classic natural substances that we synthesized it took 40 or more individual stages." Gaich plans to make these synthesis processes significantly more efficient and reduce the number of work stages. "To achieve that, we are searching for recurring structural motifs," says the 36-year-old.

Pursuing her goal with ambition and perseverance

She is therefore looking for an intersection in the molecular structure of various natural substances which will then be manufactured efficiently. "Once we've found an element like this, we will be able to press on with the synthesis of various natural substances from this point," says Gaich. The development of a synthesis method often takes more than 5 years. Time and time again, researchers find themselves at a dead end, or their ideas turn out to be not viable. For many scientists, the risk for their own career is too big and they therefore avoid this research area. Long-term research projects into natural substance synthesis are highly regarded worldwide, but are now seldom funded.

"The danger is that nowadays we don't train enough chemists with the ability to synthesize such complex molecules," warns Gaich. "But the life science industry needs people with these qualities." She herself remains unswayed by the occasional failure. "I'll keep on doing this research for as long as I can." ■

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