Expert interview

Fighting diseases with plant-derived active compounds

Herbal medicines have a long tradition in Germany. According to the Federal Institute for Drugs and Medical Devices, 1,320 phytopharmaceuticals have, as of July 2016, been granted marketing authorisation. In an interview with Dr. Ariane Pott from BIOPRO Baden-Württemberg GmbH, Professor Dr. Michael Wink, Director of the Institute of Pharmacy and Molecular Biotechnology at the University of Heidelberg, highlighted that plants produce compounds that are effective against microorganisms and that can also be put to good use in the treatment of human diseases.

How would you define herbal medicines?

Many people believe that all medicines that are made from plants are what are generally classified as herbal medicines. This is, however, not the case. In Germany, the Medicinal Products Act (Drug Law, AMG) determines what falls under the term herbal medicine and distinguishes between several categories of active substances. The AMG regards compounds that can be isolated in pure form from plants as chemically defined compounds. Plant-derived cardiac glycosides and morphine are therefore treated in the same way as their chemically synthesised counterparts. Then there are plant extracts, preparations that contain a mix of compounds rather than single pure compounds. It is these preparations that the AMG classifies as herbal medicines (phytopharmaceuticals). There is a third category of plant-derived medicines that are used in homoeopathy and anthroposophy. The AMG considers these medicines as homoeopathic and anthroposophic medicines rather than phytotherapeutic

Prof. Dr. Michael Wink, Director of the Institute of Pharmacy and Molecular Biotechnology at the University of Heidelberg
© Wink

agents.

What is the function of compounds we use for disease treatment in the plants from which they are derived?

All plants produce chemical compounds as part of their normal metabolic activities and we have studied them intensely, also in evolutionary terms. Plants cannot run away, but there is a large number of organisms that feed on them. They have, therefore, developed a chemical defence system in order to protect themselves. This is also the reason why many plants are poisonous. However, the chemical defence system does not always work effectively as the organisms which feed on the plants tend to co-develop counterstrategies that enable them to break down plant-derived compounds in the liver or eliminate them from cells.

Can you give an example and highlight the effect of such a plant extract?

Standardised extracts are made from hawthorn (Crataegus monogyna) berries, leaves and flowers.
© Wink

Plants can also become infected with microorgansims, i.e. fungi, bacteria and viruses, and become sick, just like humans. In contrast to humans and animals, plants do not have an immune system that protects them against pathogens, and therefore use secondary metabolites to protect themselves against pathogen attacks. This means that many plant-derived metabolites have an antimicrobial effect. Plants usually use one molecule for several functions. Flowering plants, for example, attract pollinators with secondary metabolites that also fend off herbivores. This is because these compounds (both odours and pigments) prevent insects from feeding on the plant. They are attracted to the flower, but are not supposed to eat it. This is why plants produce nectar which they use to reward pollinating insects for not eating them. Secondary fruit metabolites have similar functions. Ripe fruits are very attractive to frugivores, i.e. insects and animals that have fruits as their preferred food type and as a consequence disperse the seeds. Unripe fruits, which have not yet produced seeds, must not be eaten, which is why these are often bitter and poisonous. The toxin gradually degrades as fruits mature, like in tomatoes. While green tomatoes are toxic and can cause intestinal problems, red tomatoes are safe to eat because the toxic steroid alkaloids have been broken down.

Plants produce active ingredients that protect plants against being eaten or destroyed by infections. Plants often produce dozens or even hundreds of metabolites with different effects and different targets. As a result, plants always have a mix of secondary metabolites available to fight off attackers, rather than just one specific compound. This mix is less specific, but has the advantage that the plant can protect itself against a broad range of different enemies and that the enemies have a harder time developing resistance. It is usually rather difficult to identify a compound with the greatest effect in such a mix. This is why the AMG regards plant extracts that are used in phytotherapy as active pharmaceutical ingredients.

Hawthorn is a medicinal plant that is used for the treatment of heart conditions. The secondary

hawthorn metabolites belong to a group of polyphenols, i.e. catechol derivatives, which can have many different targets, including targets that play a role in congestive heart failure. Polyphenols interact with proteins through covalent and non-covalent bonds. In addition to polyphenols, hawthorn extract also contains saponins, which are compounds that improve the absorption of polar phenols. The extract is therefore more effective than the use of a specific polyphenol alone.

How do you find new active pharmaceutical ingredients?

The main thrust of drug discovery is on a single-target focus, i.e. a specific receptor or enzyme in which active pharmaceutical ingredients match their target perfectly, either as agonist or antagonist. Researchers have recently found plants that produce neurotoxins that target specific receptors. For example, plants from the genus Atropa (of which the deadly nightshade is the best known due to its poisonous effect) produce a tropane alkaloid called hyoscyamine (the racemate is called atropine) that is highly poisonous due to its ability to block the binding of acetylcholine to its receptor. What is often overlooked is the ability of Atropa plants to produce many other compounds. These protect them against microorganisms, against which atropine is ineffective. This means that Atropa extracts have much broader effects than isolated hyoscyamine.

However, there are also many examples of plants that do not contain such highly active compounds. Rather than one particular powerful active ingredient, these plants have a mix of less poisonous or even non-toxic saponins, terpenes and polyphenols. It is thought that 70 percent of all plants do not produce a specific poisonous compound, but rather a sophisticated mix of compounds that have a synergistic protective effect.

Read more about it:

The great untapped potential of herbal medicines

Baden-Württemberg is home to a large number of companies that produce herbal medicines, i.e. preparations made from plant extracts rather than pure compounds. In an interview with Dr. Ariane Pott from BIOPRO Baden-Württemberg, Professor Dr. Michael Wink, Director of the Institute of Pharmacy and Molecular Biotechnology at the University of Heidelberg, explains how these special extracts are placed on the market and how they differ from medicines made from pure compounds.

Article

14-Nov-2016
Dr. Ariane Pott

Further information

Prof. Dr. Michael Wink
Room 401
Im Neuenheimer Feld 364
69120 Heidelberg
Tel.: + 49 (0)6221 544880
Fax: + 49 (0)6221 544884
E-mail: Wink(at)uni-heidelberg.de

- Institute of Pharmacy and Molecular Biotechnology (IPMB), University of Heidelberg

---

The article is part of the following dossiers

Phytopharmaceuticals – fighting disease with natural substances

Associated expert interview

The great untapped potential of herbal medicines

Baden-Württemberg is home to a large number of companies that produce herbal medicines, i.e. preparations made from plant extracts rather than pure compounds. In an interview with Dr. Ariane Pott from BIOPRO Baden-Württemberg, Professor Dr. Michael Wink, Director of the Institute of Pharmacy and Molecular Biotechnology at the University of Heidelberg, explains how these special extracts are placed on the market and how they differ from medicines made from pure compounds.

plant | active pharmaceutical ingredient | phytopharmaceuticals