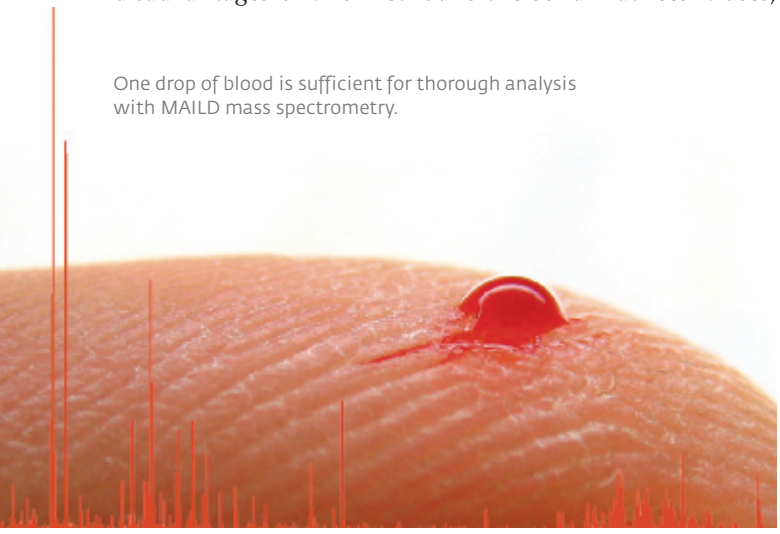
What's in a Drop of Blood? The Full Diagnosis

Mass spectrometry is used to identify chemical compounds. In the MALDI (Matrix-Assisted Laser Desorption/Ionization) process, for instance, proteins are crystallized with the matrix and broken down into small protein ions with laser beams. These are then traced and analyzed. One of the disadvantages of this method is the solid matrices it uses, because, in addition to the ions produced by the laser light from the mix of substances being analyzed, ions with masses of less than 500 daltons also emerge from the matrix. As a result, the many small molecules that play a part in the metabolism of living beings cannot be detected. "The ions from traditional matrices are the haystack in which we are looking for some important needles," explains Aleš Svatoš, who heads the research group at the Max Planck Institute for Chemical Ecology in Jena.



One drop of blood is sufficient for thorough analysis with MAILD mass spectrometry.

Together with colleagues from the Czech Academy of Science, his team has now modified the matrices so that they no longer produce disruptive ions. The new method, called matrix-assisted ionization/laser desorption (MAILD), has helped the researchers reliably and quickly identify in excess of 100 different molecules. They also use clinical samples: it is possible to detect a whole range of organic acids that are specific to blood in a single droplet – less than a millionth of a liter. The methods used for these analyses in medical practice are complex and unwieldy. If it were possible not only to determine the presence of the metabolites, but also to quantify them, MAILD might advance to become a method for rapid analysis in biomedicine. As it holds such great potential for diagnostic applications, this process has now been patented.

Made-to-Measure Sugar Chains

Carbohydrates not only satisfy hunger, they are also used as a basis for new vaccines. It is now much easier to manufacture substances and test their effectiveness as vaccines, thanks to an automatic synthesizer developed by scientists at the Max Planck Institute of Colloids and Interfaces. The new device can produce any carbohydrate from individual sugar molecules. Carbohydrates located on the shells of pathogens offer the immune system a point of attack and are suitable as vaccines in that they train the immune system to deal with the microbes. The researchers have already identified almost a dozen candidates for vaccines, including one acting against the malaria pathogen, and produced them with the new apparatus.

The right mixture for carbohydrates: Peter Seeberger and his team have developed a fully automatic carbohydrate synthesizer that facilitates the search for new vaccines.

"Our automatic synthesizing system currently offers an unbeatably fast method of manufacturing complex carbohydrates," says Peter Seeberger, Director at the Max Planck Institute in Potsdam. "As there used to be no efficient way of doing this, biologists and doctors tended to have a problem with carbohydrates." In many cases, they even had to give up their work because there was no equipment they could buy that would produce the substances. Finding the situation profoundly irritating, Seeberger decided to do something about it.

He presented his synthesizing device for carbohydrates at the 237th Meeting of the American Chemical Society in Salt Lake City – and received the Claude S. Hudson Prize in Carbohydrate Chemistry from the Society. The device can make complex molecules from linked sugar molecules in just a few hours. The technology that is commonly used now takes months or even years.

Photos: MPI of Colloids and Interfaces (bottom), MPI for Chemical Ecology, Aleš Svatoš (top)