

# Facilitating diagnosis with a new type of biosensor

14 September 2018



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Scientists from the Max Planck Institute and EPFL have developed a new type of biosensor able to precisely quantify metabolites using a single drop of blood. The accuracy and simplicity of the procedure could make it a tool of choice for diagnosing and monitoring several diseases.

Diseases or injuries can result in dramatic changes in the [blood](#) levels of metabolites, which are chemical compounds produced by the body's metabolism. For example, an increase in the level of the amino acid [phenylalanine](#) in the blood is characteristic of the genetic disorder phenylketonuria (PKU). Phenylalanine levels in infants suffering from PKU need to be controlled through diet to avoid irreversible brain damage. It is therefore essential to be able to regularly monitor phenylalanine levels in the blood.

However, such monitoring currently requires blood samples to be sent to laboratories, and the results take several days to reach the patient. This delay often complicates disease management for PKU patients and their physicians. The treatment of numerous diseases could be improved if the blood concentration of disease-relevant metabolites were

monitored at the point of care – ideally by the patient.

To address this problem, a team of scientists led by Professor Kai Johnsson of the Max Planck Institute for Medical Research (MPIMR) in Heidelberg and EPFL's Laboratory of Protein Engineering has developed a way to measure metabolite concentrations in small blood samples within minutes. The approach was validated with patients from the Heidelberg and Lausanne University Hospitals. The research was published today in *Science*.

## Molecular engineering

"We introduce a fundamentally new mechanism to measure metabolites through blood analysis," says Qiuliyang Yu, the first author of the paper and a scientist at the Department of Chemical Biology at the MPIMR. "Instead of miniaturizing available technologies, we developed a new molecular tool." The tool is a light-emitting protein that changes color in the presence of the reduced cofactor nicotinamide adenine dinucleotide, known to biochemists by its acronym NADPH. This molecule can be produced in an enzyme-catalyzed reaction specific to the metabolite of interest, which means that the [metabolite](#) concentration can be determined by analyzing the color of the emitted light. Using different enzyme-catalyzed reactions, the same sensor can carry out quantitative assays of various metabolites, such as phenylalanine, glutamate and glucose.

## Fast and accurate

In practice, the procedure is quite simple. In the case of phenylalanine, a drop of blood is taken from the patient through a painless finger prick. A fraction of the blood sample is then added to a reaction buffer and applied to paper containing the [biosensor](#). When phenylalanine is consumed and NADPH is produced, the light emitted by the sensor

changes color from blue to red – a change that can be detected by an everyday digital camera or smartphone. The change in color is then used to calculate the phenylalanine concentration.

The whole procedure takes only 10 to 15 minutes and can be done at the point of care. It is so easy and accurate that patients should eventually be able to test themselves, which is something the scientists are working on. "We are now looking for ways to further automate and simplify the test," concludes Qiuliyang Yu.

**More information:** Qiuliyang Yu et al.

Semisynthetic sensor proteins enable metabolic assays at the point of care, *Science* (2018). [DOI: 10.1126/science.aat7992](https://doi.org/10.1126/science.aat7992)

Provided by Ecole Polytechnique Federale de Lausanne

APA citation: Facilitating diagnosis with a new type of biosensor (2018, September 14) retrieved 19 September 2018 from <https://medicalxpress.com/news/2018-09-diagnosis-biosensor.html>

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