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A sweet sensor

By Kai-Jye Lou, Staff Writer

Researchers at the **University of Illinois at Urbana-Champaign** have developed DNA sensors that can be used with commercially available personal glucose meters to detect and quantify compounds other than glucose.[1] The researchers are now working to simplify the approach and think the sensors could have use in diagnosing diseases or identifying environmental contaminants.

"Despite tremendous efforts in developing quantitative devices for sensing applications, few sensors are being used widely by the public, with the notable exception of personal glucose meters," said Yi Lu, professor of chemistry at UIUC.

Personal glucose meters are small, portable devices that typically cost less than $20. Because of their low price, ease of use and widespread deployment, Lu and Yu Xiang, a postdoctoral researcher in the Department of Chemistry at UIUC, decided the meters would be a good platform for detecting and quantifying a variety of compounds beyond glucose in liquid samples.

The researchers repurposed the meter to indirectly measure compounds of interest by implementing an intermediate step that would translate the detected levels of a compound into a glucose readout.

To do this, the researchers designed a series of sensors that consisted of magnetic beads attached to a complex of invertase and a DNA enzyme or DNA aptamer that specifically interacts with the target molecule. In the compound's presence, the DNA component releases invertase, a yeast-derived enzyme that catalyzes the hydrolysis of sucrose into glucose, which in turn is detected by the meter.

In proof-of-concept studies, the sensors enabled the detection and quantification of cocaine, adenosine, interferon-γ (IFNG; IFN-γ) and uranium with micromolar to nanomolar sensitivity.

The researchers used the Accu-Chek Aviva blood glucose meter from the Roche Diagnostics unit of **Roche** throughout the study, which was published in *Nature Chemistry*. For the cocaine sensors, the group also tested the Freestyle Lite and Ascensia Contour meters from **Abbott Laboratories** and **Bayer AG**, respectively, and found signal enhancement trends that were similar to those seen with the Aviva meter.

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> ***—Yi Lu, University of Illinois at Urbana-Champaign***

Easy access

Now that they have proof-of-concept data, the UIUC group plans to develop sensor kits to generate samples that could be analyzed with commercial glucose meters.

Lu envisions three areas in which the technology could be applied: in diabetic patients who want to measure additional markers in blood to help better monitor their disease and aid doctors with treatment decisions; for early detection of infectious diseases and cancer; and for indicating the presence of environmental contaminants such as heavy metals, toxins and pathogens.

He expects the shelf life of the DNA sensors will be about six months and said the kits would be especially useful in resource-limited settings, such as in remote areas with few medical facilities.

"Few existing quantitative assay systems could match our method using glucose meters in terms of wide availability to the public, portability, low cost and ease of use," Lu told *SciBX*. "While most existing assays using laboratory-based instruments are efficient and sensitive, they are very difficult for the public to use because of limited access to the instruments and high cost."

His group is now trying to expand the range of compounds that can be quantified with the approach and also is working to simplify the process and make it more user friendly.

"Our current methodology does not require any complicated device or operation, but it still has several steps including sample addition, magnetic separation and liquid transfer," he said. "Our ultimate goal is to develop an integrated design to make all the steps automatic and have comparable simplicity to a typical personal glucose meter test."

UIUC has filed patent applications covering the approach. Lu said he is in licensing discussions with multiple parties.

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Contact: Yi Lu, University of Illinois at Urbana-Champaign, Urbana, Ill.
e-mail: yi-lu@illinois.edu

COMPANIES AND INSTITUTIONS MENTIONED

Abbott Laboratories (NYSE:ABT), Abbott Park, Ill.
Bayer AG (Xetra:BAY), Leverkusen, Germany
Roche (SIX:ROG; OTCQX:RHHBY), Basel, Switzerland
University of Illinois at Urbana-Champaign, Urbana, Ill.