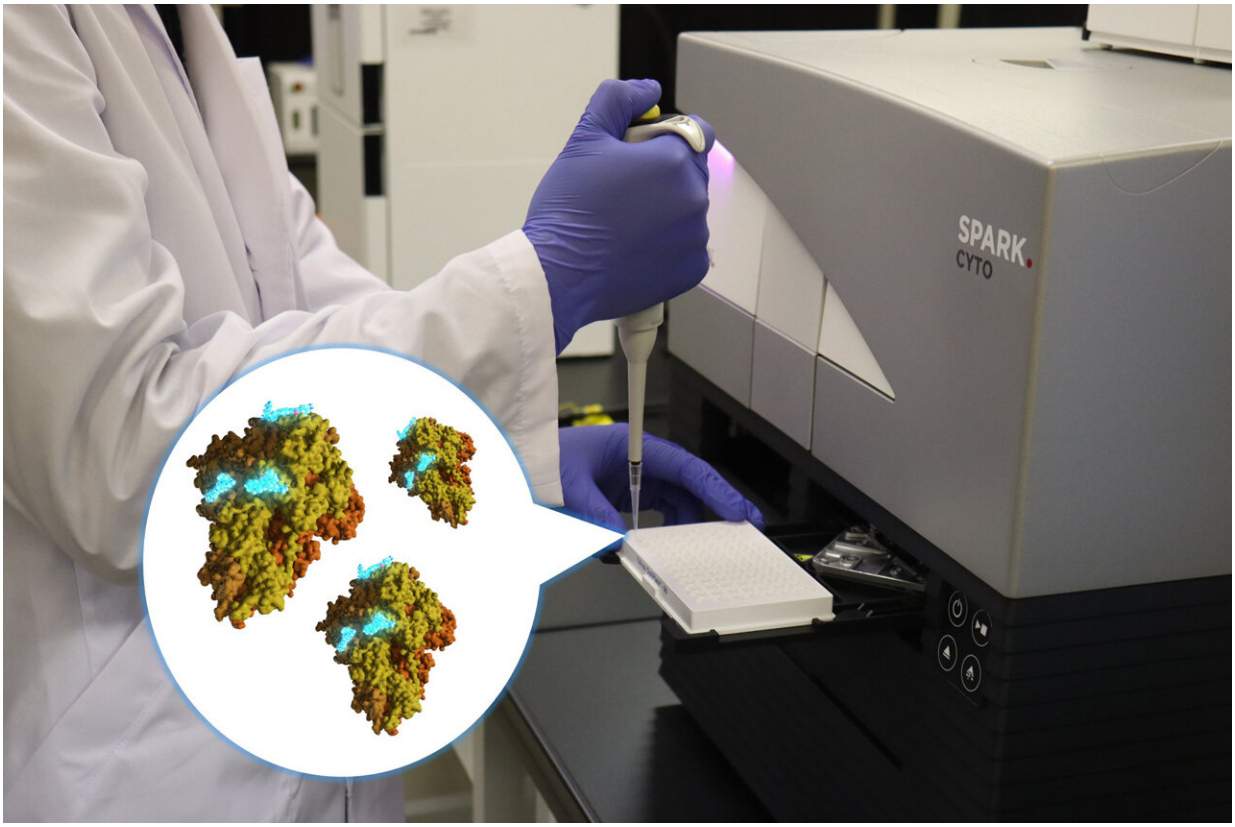
Glowing COVID-19 diagnostic test prototype produces results in one minute

January 17 2024



Using a bioluminescent substrate that reacts with SARS-CoV-2 spike protein (shown in the insert), researchers have devised a potential one-minute COVID-19 test. Credit: Ryo Nishihara

Cold, flu and COVID-19 season brings that now-familiar ritual: swab,

wait, look at the result. But what if, instead of taking 15 minutes or more, a test could quickly determine whether you have COVID-19 with a glowing chemical? Now, in ACS Central Science, researchers describe a potential COVID-19 test inspired by bioluminescence. Using a molecule found in crustaceans, they have developed a rapid approach that detects SARS-CoV-2 protein comparably to one used in vaccine research.

From fireflies to lanternfish, many animals possess the chemical tools to produce light. Typically, this reaction requires the substrate luciferin and the enzyme luciferase. However, a class of less discriminating luciferins, known as imidazopyrazinone-type (IPT) compounds, can glow when encountering other proteins, including ones that aren't considered enzymes.

Previous research suggests that IPT luciferins could serve as the basis for a new type of medical test that uses luminescence to announce the presence of a target protein in a specimen. Ryo Nishihara, Ryoji Kurita and colleagues suspected that an IPT luciferin could react with the SARS-CoV-2 spike protein, which allows the virus particles to invade cells and cause COVID-19—and open the door to develop a glowing test.

The team first investigated 36 different IPT luciferins' abilities to react with a single unit of spike protein. Only one molecule, which came from tiny crustaceans from the genus Cypridina, emitted light. The researchers then tested the luciferin's activity with the spike protein in its natural state, as three units folded together.

They found that, over the course of 10 minutes, an adequate amount of light could be detected. A commercially available luminescence reading device was required; the light could not be seen by the naked eye. Additional experiments indicated that the IPT luciferin was selective because it did not glow when exposed to six proteins that occur in saliva.

They define this specific luminescence reaction by non-luciferase biomolecules as "biomolecule-catalyzing chemiluminescence (BCL)".

Finally, they found that the luciferin could detect the amount of the spike protein in saliva with the same accuracy as a technique currently used in vaccine development. However, the luciferin system delivered results in one minute—significantly faster than the current rapid point-of-care tests.

This BCL-based approach could serve as the basis for a simple "mix and read" test in which the IPT luciferin is added to untreated saliva from someone suspected of having COVID-19, according to the researchers. They note that a similar approach could be adapted to detect other viruses that possess spike-like proteins, such as influenza, MERS-CoV and other coronaviruses.

More information: Pseudo-Luciferase Activity of the SARS-CoV-2 Spike Protein for Cypridina Luciferin, *ACS Central Science* (2024). DOI: 10.1021/acscentsci.3c00887

Provided by American Chemical Society