Researchers use a synthetic 'tongue' to sort out whiskies

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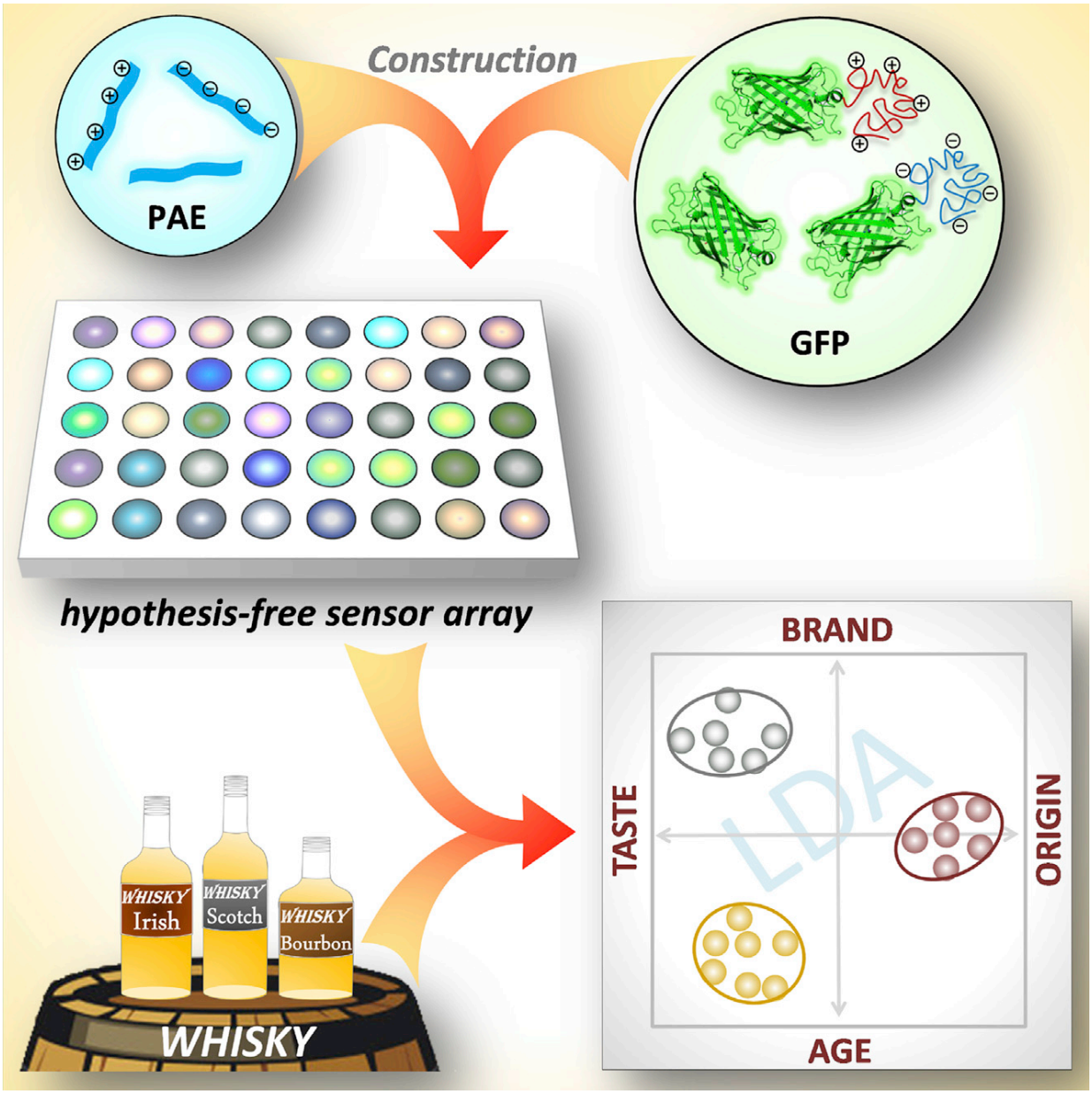


This visual abstract shows a three-element sensor array system that can discriminate age, blend status, country of origin, and elements of taste in whiskies. Credit: Jinsong Han et al./*Chem* 2017

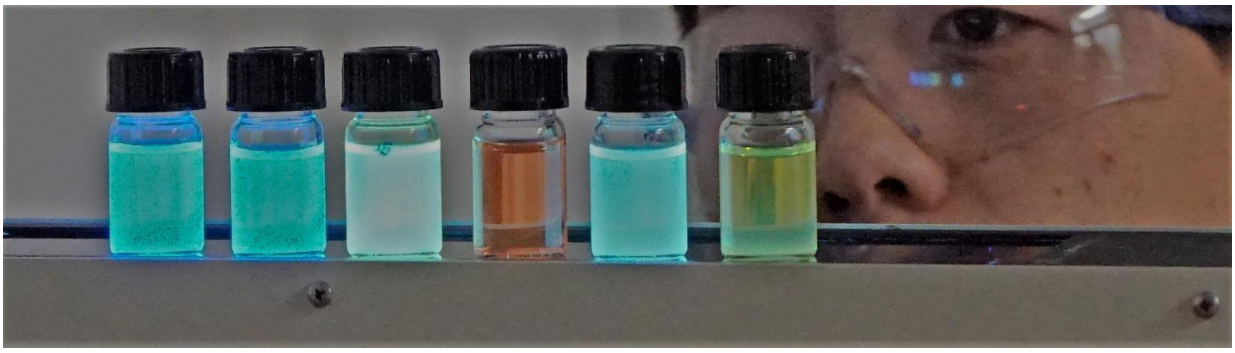
Whiskies may differ in taste and smell, but they are so similar in chemical composition that most analyses can't tell two closely related brews apart. In the journal *Chem* on June 8, researchers introduce an artificial sensor array or "tongue" that can detect whether two nearly identical whisky samples are a match. The sensor arrays can also identify some of the whiskies' key qualities, such as malt status, age, and country of origin.

A master whisky distiller can tell these spirits apart, but at the chemical level, whisky brands contain many of the same molecules. Their complexity also makes it difficult to tease them apart given that plant matter, such as malts and trace flavors such as citrus, contains so many different elements. "One of the things I was interested in was 'how closely related can two analytes be so that you still can tell them apart?' and for that, whiskies are absolutely fantastic," says senior co-author Uwe Bunz, an organic chemist at Heidelberg University.

Each sensor array is made up of a series of solutions each containing a unique glowing sophisticated dye. When the researchers add a droplet of whisky into the solutions, the whisky causes a slight change in the brightness of each chemical's glow. When Bunz and his colleagues use a machine called a plate reader to measure the subtle changes in fluorescence, they can find a signature pattern for each whisky.

"If you have 3, 4, or 5 elements on the tongue, you get 3, 4, or 5 different intensity changes, and these intensity changes form a pattern. And the pattern is unique," he says. "Each single polymer's response to

the whisky would not be very useful, but if you combine them, they form a really unique pattern."

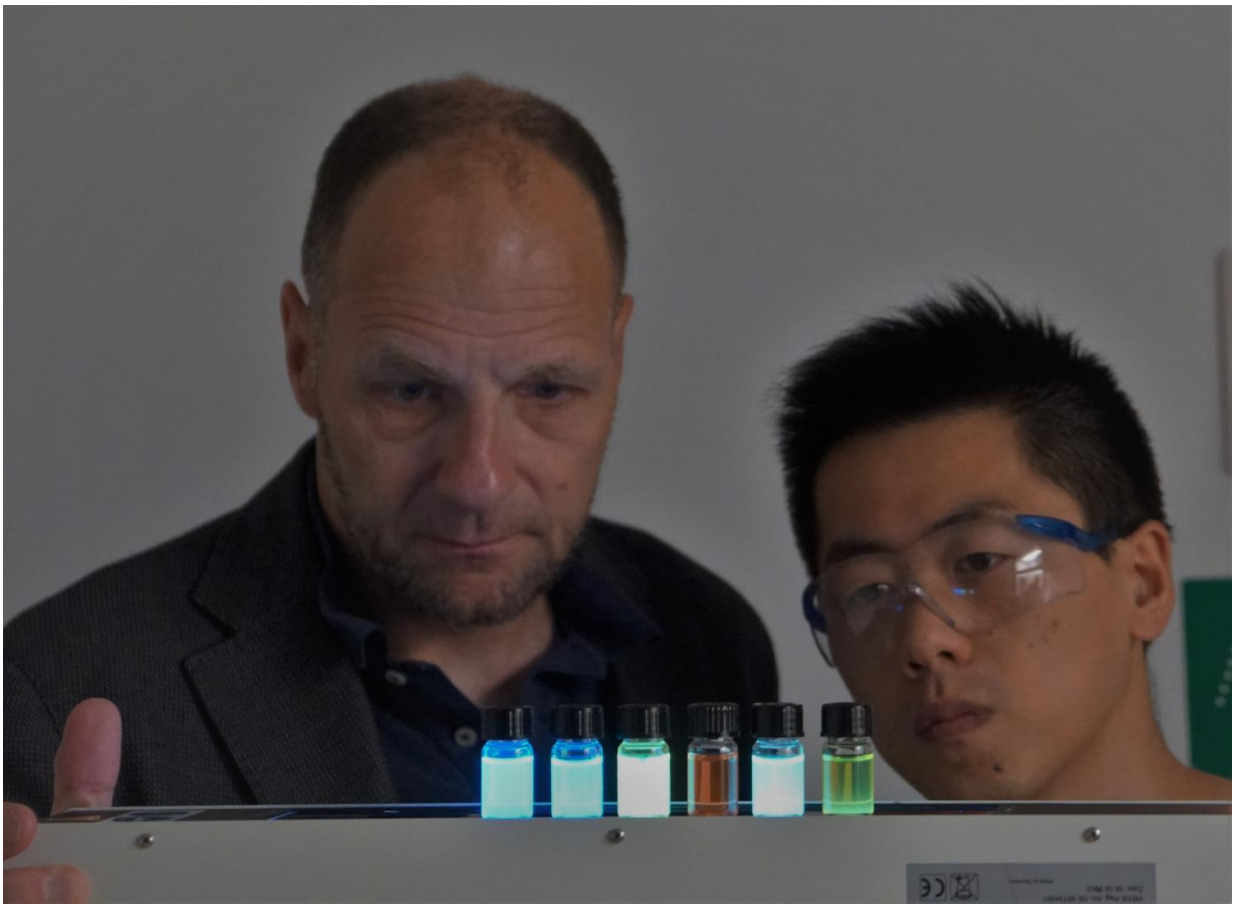


A row of the glowing polymer dyes that make up the sensor array lined up in a row. Doctoral student Jinsong Han is behind them. Credit: Uwe Bunz

The sensor array looks nothing like a traditional tongue, but it operates on some of the same principles, Bunz argues. "Our human tongue consists of 6 or 7 different receptors—sweet, salty, bitter, sour, umami, and hotness—and they're able to identify food by differential reactions of those elements," he says. "The combination of differential receptors gives you an overall taste impression of what you eat."

Unlike traditional chemical techniques such as mass spectrometry, which break down a mixture into the individual chemicals that make it up, these synthetic "tongues" respond to the overall mixture. "If someone put in a small amount of poison or something, you could not discriminate that," says Bunz. They don't know exactly which components of the whisky are reacting with the various glowing polymers, but they've noticed patterns that seem to correlate with whisky age, malt status (single or double), and country of origin.

These synthetic "tongues" can highlight similarities between whiskies, but they can't identify an unknown whisky from scratch, he says. "You start with a sample that you know is the real McCoy. Then you look at another sample, and you can say whether it's the same sample or it's not." In other words, these tongues would be great for spotting counterfeits of expensive luxury whiskies.



Uwe Bunz (left) and doctoral student Jinsong Han looking at a row of the glowing dyes used in the whiskey-distinguishing 'tongue.' Credit: Sebastian Hahn

What works well for whisky could work well for other beverages and

even for biological materials, which are also complex mixtures. "What you can do for whiskies, you could in principle be able to do for other consumer goods," says Bunz. "You could do it yourself in a kitchen, assuming you had a plate reader and the right conjugated polymers and knew what polymer to look for. In principle, everyone could do this."

More information: *Chem*, Han et al.: "A hypothesis-free sensor array discriminates whiskies for brand, age and taste" www.cell.com/chem/fulltext/S2451-9294(17)30174-2 , DOI: 10.1016/j.chempr.2017.04.008

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