Using glowing yeast to keep food safe

Dioxins and dioxin-like chemicals (DLCs) are a problematic group of pollutants that come from both natural and man-made origins. They do not easily break down on their own, which means that once they are present in an area they remain there for long periods of time. This causes the chemicals to accumulate in animals that live were pollution is present and can lead to human exposure if these animals are used as food. Exposure to DLCs has been linked to numerous diseases and adverse health effects, such as disruption of the endocrine system, reproductive and developmental deficiencies, neurotoxicity, toxicity to the immune system, and metabolic diseases such as obesity and type II diabetes. Most DLCs are either classified as ‘carcinogenic to humans’ or considered to be ‘probable or possible human carcinogens’ by the International Agency for Research on Cancer. Because of this, many countries have developed regulatory bodies, such as the United States Department of Agriculture, that monitor food destined for human or livestock consumption to make sure they are free of DLCs and other potential hazards before they are released for sale.

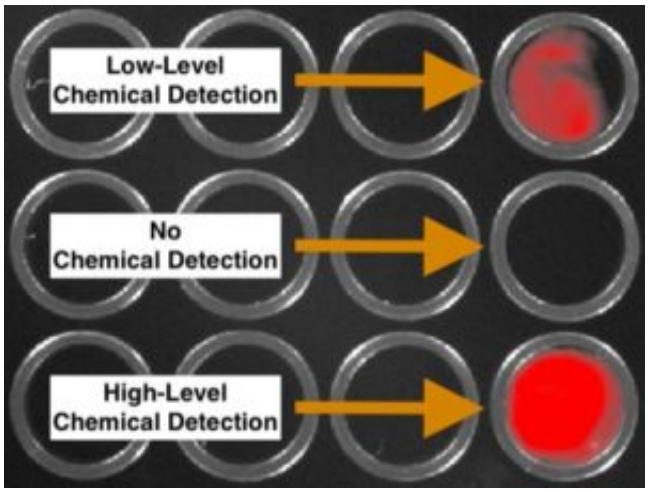

Fig. 1. The intensity of the light produced by the yeast is proportional to the level of dioxin-like chemical contamination present. Samples without chemical contamination can quickly be identified by the absence of light. Those with contamination can be rapidly categorized as high or low level to help determine the necessary next steps for further testing or dispensation.

Unfortunately, this task is easier said than done. There are many different methods that can be used to test for the presence of DLCs, but most of them are either very expensive or require a long

time to complete the test. Because there is such a large volume of food that must be screened, and only a limited budget to perform the testing, these methods make it very difficult to ensure that all food is safe. To solve this problem, we designed a new test that works quickly, is inexpensive, works with the testing equipment that is already being used, and can be performed without requiring significant training. We did this by designing a new strain of the common baker's yeast, *Saccharomyces cerevisiae*, that automatically starts to glow when it is exposed to DLCs. *S. cerevisiae*, which is the yeast that is used to make bread and beer, is safe to use around food, grows quickly, and is already used at industrial scales. To make it glow, we inserted DNA from the part of the human DLC response system that can sense DLC exposure, and genes from a glowing bacterium. By placing the bacterial genes responsible for light production under the control of the human DLC sensing system, we caused the yeast to respond to food that is contaminated with DLCs by glowing. If DLCs are present, the yeast will start to produce light. By measuring the amount of light made we can determine the level of DLC contamination present within the sample. The more contamination that is present, the brighter the light from the yeast. If the yeast does not produce any light, we know there are no DLCs present and the food is safe to eat. Tests using this yeast are able to detect DLCs similarly to the tests that are currently used, but can do so much faster and at a much lower cost. This will make DLC screening more efficient and improve the safety of commercial food products.

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Publication

A rapid and reagent-free bioassay for the detection of dioxin-like compounds and other aryl hydrocarbon receptor (AhR) agonists using autobioluminescent yeast.
Xu T, Young A, Marr E, Sayler G, Ripp S, Close D

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