RESEARCH NEWS

Rapid detection of pathogens in insect farms

Keeping Bugs Healthy

There is fresh momentum in our protein supply — and it's moving along on six legs. Insects are a source of protein with a smaller resource footprint than conventional alternatives in every possible way. To ensure the safety of insect farms and their products, Fraunhofer researchers have developed a system that reliably detects pathogens right away, at low cost and with the possibility of automation.

Little creepy-crawlies, big potential: From grasshoppers to beetles and migratory locusts, insects are a sustainable alternative to protein derived from meat or fish. Insect farms require much less water and space than conventional livestock farms, and insects also utilize previously unused secondary products of the food industry in the process. And even if they are hardly ever consumed directly in this country, they can still supply other forms of livestock with valuable protein, on land and in the water.

Still, like all monocultures, raising insects for food is fraught with the possibility of disease. To ensure the safety of industrial production and its products, the experts at the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB and the Fraunhofer Institute for Molecular Biology and Applied Ecology IME teamed up in Fraunhofer's FutureProteins flagship project to develop a system that quickly and reliably detects multiple pathogens at the same time. Their use case: the yellow mealworm beetle.

One beetle, many foes

Fighting disease effectively on an insect farm requires fast, cost-effective action. The culture-based testing methods that are currently common cannot do the job. "It takes several hours to go from taking a sample to when it is analyzed in the lab, and generating the findings can take up to two days. Delays like that can mean downtime for the entire farm," explains project manager Jens Wetschky, an expert on virus-based technologies at Fraunhofer IGB.

The sheer variety of potential pathogens is another challenge. The beetles can be infected directly at various stages, or they can find their way into the system via the insects' food, where they may prove to be dangerous to both the insects themselves and the animals that receive mealworm beetle protein in their feed. To narrow down the issue, the experts at Fraunhofer IME selected eleven relevant organisms, from bacteria and fungi to parasites, and established three additional process controls for quality assurance purposes.

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Customized for use on-site

To detect all these different target species in insect farms, the experts from Fraunhofer IGB looked to coronavirus testing, which involves a method, derived from molecular biology, of identifying the infectious organism through its genetic information. The only issue is that the underlying technology can only detect a limited number of pathogens at once. In light of the variety involved, the researchers decided to combine the method with DNA microarray technology, utilizing a multiplex approach with 14 reactions that take place simultaneously.

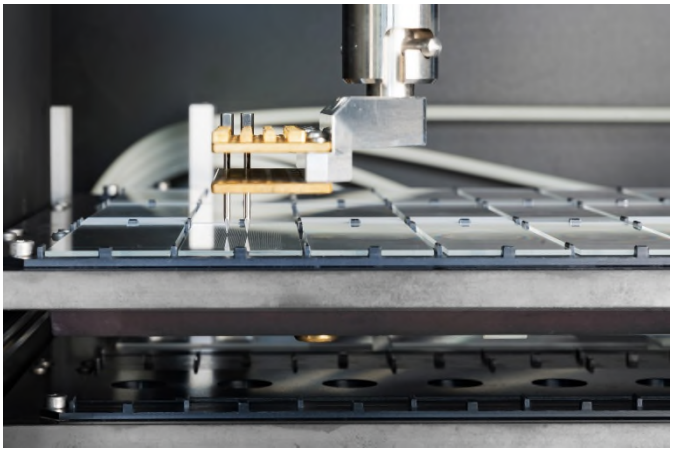
The bioinformatic challenge in this lies in searching the selected pathogens' genomes for unique sequences that can be reproduced at the same time via polymerase chain reaction (PCR) without interacting with each other.

Marked and uniquely identified

The results are persuasive, and not just at the lab scale; the system has also been established and validated successfully in the application environment. The equipment can be used without special expertise.

Operators can simply take a few insects out of the farm for sampling. The sample is prepared during DNA extraction and then undergoes PCR testing. The DNA sequences are amplified, marked with fluorescent dye at the same time, and then fixed on a microarray using DNA probes. The array reads the individual segments optically and marks any pathogens that are present. For especially reliable results, the experts from Fraunhofer IGB incorporated additional process controls. The added controls ensure that each and every individual process step has been performed correctly while ruling out false negatives.

Christoph Binder, an expert at Fraunhofer IGB, explains: "Our goal is to refine the current format to the point where it can be fully automated. That's especially attractive to customers with big insect farms."



Specific DNA sequences found in pathogens are reproduced, marked and fixed on a microarray for the multi-parallel detection system.

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