NIR spectroscopy provides easy, cost-effective method for food allergen testing

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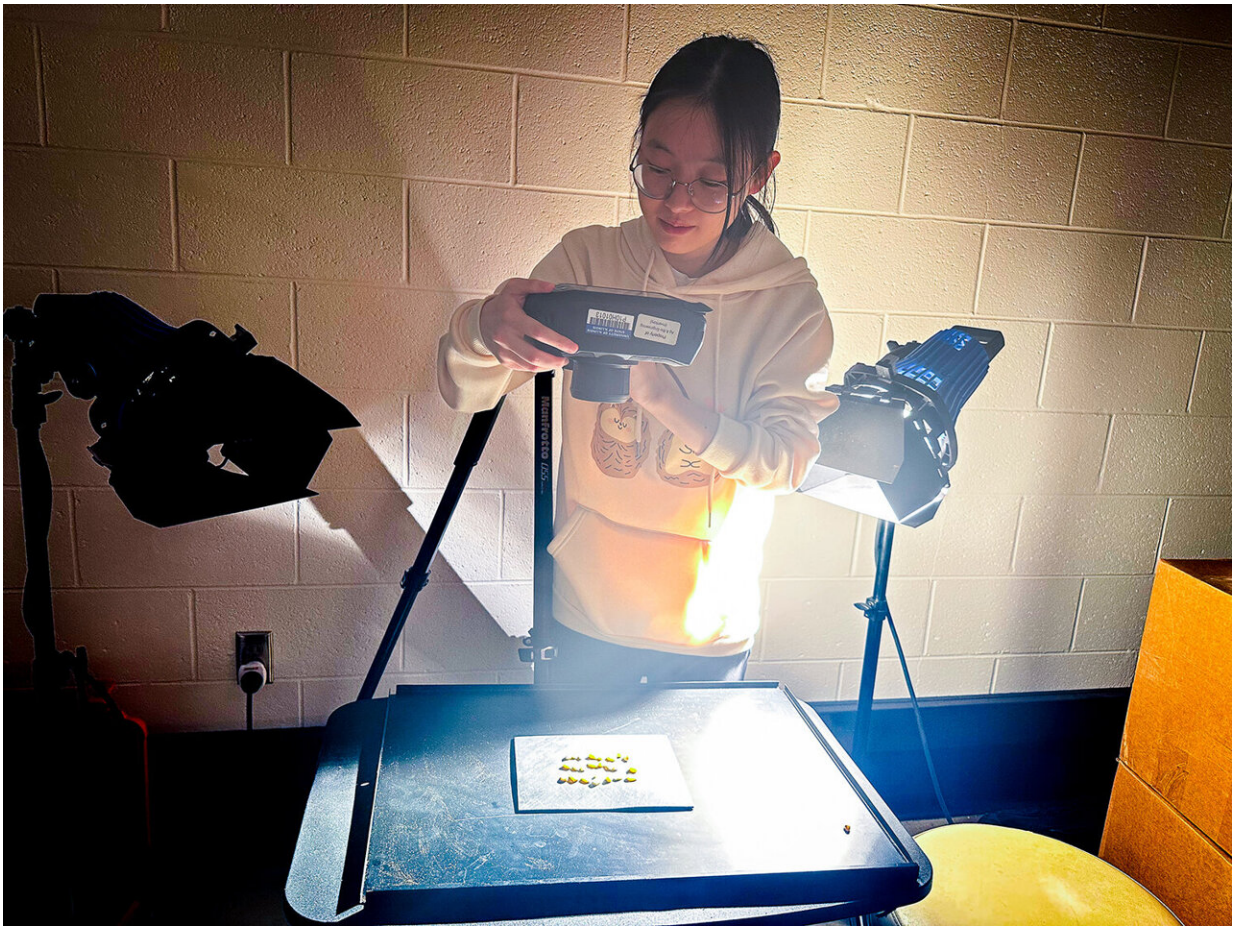

Lisa Wu, undergraduate student in Agricultural and Biological Engineering at the University of Illinois, conducted research on detecting food allergens with near-infrared spectroscopy. Credit: College of ACES.

Food allergies pose a significant health risk, resulting in numerous hospitalizations every year, as even trace amounts of allergens can trigger severe reactions. Cross-contamination of food products can happen easily in the production process, so it's important to have reliable methods of testing for allergens.

A new study conducted at the University of Illinois explores the application of near-infrared (NIR) spectroscopy to detect three types of allergens in quinoa flour. The researchers say the method is fast, easy, non-invasive, inexpensive, and highly accurate.

"Detecting adulterated allergenic components in food could benefit millions of people around the world who suffer from food allergies," said Qianyi (Lisa) Wu, an undergraduate student in the Department of Agricultural and Biological Engineering, part of the College of Agricultural, Consumer and Environmental Sciences and The Grainger College of Engineering at U of l, and lead author on the paper. The project was supported by a grant from the Office of Undergraduate Research at U of I.

"We use an NIR device to measure spectral information through the reflectance of light in the samples. We tested models with different wavelengths to determine the best NIR system for allergen detection," she added.

The researchers used NIR spectroscopy to identify three common allergens—peanut, sesame, and wheat—in quinoa flour, a gluten-free grain that is often used as a wheat substitute. Adulterated or contaminated quinoa could be dangerous for people with allergies, so it is crucial to find any presence of allergens.

Traditional laboratory methods for allergen detection typically involve complex DNA analyses that require costly equipment and specialized

personnel. These methods are time-consuming, involve the use of chemicals, and often result in destruction of the sample, so industry scientists are seeking better approaches to detect allergens.

"NIR spectroscopy offers numerous advantages. It is non-destructive, non-invasive, and doesn't use chemicals. It provides results in real time, and with a short training period, anyone can perform the analysis," said Mohammed Kamruzzaman, assistant professor in ABE and Wu's faculty advisor. Kamruzzaman is corresponding author on the paper.

NIR spectroscopy uses near-infrared light to measure the absorbance of different wavelengths, Kamruzzaman explained.

"Each material has a unique 'fingerprint' of light absorbance. When allergens are present in the quinoa flour, the NIR instrument can detect them. Then we use machine learning to analyze the gathered information, allowing us to identify the allergens and quantify their concentration," he said.

NIR spectroscopy is an indirect method of analysis, so it is not 100% accurate but comes very close. Even if it doesn't capture the exact amount of contaminants present in the food, it will identify whether the allergen is there or not, and that is what the consumer needs to know, Kamruzzaman stated.

Other techniques usually focus on detecting a single allergen, but this method can detect multiple allergens simultaneously. It can easily be modified to detect additional allergens and to test other products than quinoa.

The researchers said it will not be difficult to develop low-cost miniature sensors based on their methodology. These sensors can be used in various settings, including industry facilities, restaurants, and even

homes. Eventually it may even be possible to have a mobile phone app that can detect food allergens on the spot.

Wu said the opportunity to conduct research as an undergraduate student has been instrumental in deciding her future plans.

"During my sophomore year, I attended an American Society of Agricultural and Biological Engineers (ASABE) meeting and Dr. Kamruzzaman gave a speech introducing his research topic. I thought it sounded really interesting, so I contacted him, and that's how I got involved," Wu stated. "I was thinking about going to graduate school, but I wasn't entirely certain. After being engaged in research for several years, I have discovered my passion for it."

Wu received a U of I Graduate College Illinois Distinguished Fellowship, and upon graduating with her bachelor's degree in May 2023, she will continue directly into a doctoral program in ABE with Kamruzzaman.

"Lisa has done outstanding work with a small grant from the Office of Undergraduate Research. It is truly inspiring for undergraduate students to realize they can do meaningful research and publish their findings. This can serve as motivation for other students to engage with faculty and actively pursue research opportunities. I'm always open to students reaching out to me for potential involvement in research projects," Kamruzzaman added.

The paper, "Reagent-free detection of multiple allergens in gluten-free flour using NIR spectroscopy and multivariate analysis," is published in the *Journal of Food Composition and Analysis*.

More information: Qianyi Wu et al, Reagent-free detection of multiple allergens in gluten-free flour using NIR spectroscopy and

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