In under Three Minutes New Gluten Test Detects Hidden Wheat in Food

Wheat bread has been a central part of the human diet for centuries. Yet today, gluten, the main wheat protein, is suspected of triggering potentially serious food reactions. This means the need to test foods for gluten in such individuals.

Study

About 8% of children and 13% of adults have food allergies, mainly to wheat, peanuts and tree nuts, milk, eggs, soy, fish, sesame, and shellfish. These allergies cost about $25 billion in healthcare alone. Tests are needed to accurately identify allergen-containing foods, especially since those with food allergies tend to be more food-insecure.

Wheat-related conditions include celiac disease (an autoimmune disorder, not a classic allergy) and non-celiac gluten sensitivity. Gluten-related immune reactions are triggered primarily by the gliadin component of this wheat protein. Being largely insoluble, gliadin precipitates to form fibers in the presence of glutenin, increasing the chances of cross-contamination and making it difficult to detect.

Cross-contamination and mislabeling of restaurant items and mass-produced foods are quite common despite regulatory policies and statutes. Patients with celiac disease often cannot eat out safely or have a limited range of safe foods.

Gluten testing based on enzyme-linked immunosorbent assay (ELISA), surface plasmon resonance (SPR), or electrochemical sensors is typically costly and complex. This prompted the current study, which sought to develop a reliable yet simple test.

The new system, termed LEO (lateral flow enhanced by optical imaging), combines lateral flow assays with smartphone-based image analysis aided by Internet of Things technology.

Lateral flow assays are tests that detect the presence of a target substance in a liquid sample. They are used widely to detect pesticides, cancer-related biochemicals, and food allergens. However, they provide only qualitative results and have mediocre accuracy.

This innovative next-generation test strip combines competitive and sandwich detection methods. The lateral flow testing technology is integrated with image processing software, measuring the food's gluten content.

The competitive and sandwich detection regions have different sensitivity thresholds, providing a fixed detection range. Thus, the test includes:

- An O or control line to ensure the test works correctly.
- An E or eating line that detects 10 ppm of gluten with a competitive assay.
- An L or test line with lower sensitivity (detects five ppm) with a sandwich assay, but becomes less reliable (hook effect) at 20 ppm.

The combined format remarkably boosts the accuracy of the system. Absence of the O line indicates an invalid test. The presence of gliadin <5 ppm causes both O and E to appear. Between 5 and 10 ppm, all three lines appear.

At gliadin >10 and 20 ppm, the E line signal weakens while the hook effect affects the L line, leaving the O and L lines visible. If the O line alone is seen, it indicates that both E and L lines have disappeared due to the hook effect.

This portable system can tell whether the sample contains gliadin in less than three minutes, since it extracts gliadin using an ionic liquid. Moreover, it strongly correlates with ELISA results, with >98% agreement. Its detection limits of 5–10 ppm are well below the 20 ppm threshold that the Food and Drug Administration has for such tests.

The LEO assay results agreed well with those obtained by conventional ELISA testing, but took less than three minutes compared to three hours for ELISA.

The test system correctly detected and quantified gliadin in the sample across a range of up to 40 ppm concentrations. It was highly specific for gluten even when milk was present, since only wheat-containing samples produced signals. The gluten recovery rate was 100% in spiked rice noodle tests, showing efficient extraction under controlled conditions. The LEO interface, coupled with a smartphone, can create a shareable map of local restaurants serving gluten-free food.

Real-world tests of supposedly gluten-free dishes on a restaurant menu confirmed the high accuracy. The foods tested include burgers, salads with dressing, pizza, and beer. Over 95% of gluten-free products contained <20 ppm of gluten.

French fries were an exception, showing significant cross-contamination from the fryers used. The salads contained gluten, probably because of cross-contamination during mixing in bowls that previously held croutons or perhaps due to the dressing.

In addition, both LEO and another widely used strip-based antibody assay were used to compare commercial food products like Ferrero or M&M's chocolate, bagels, Lay's potato crisps, or Lotus Biscoff Spread. In contrast to LEO, the other strip test requires a prepared sample, a buffer that needs to be refrigerated, and more time.

The results were highly consistent. The gluten levels ranged between 0 and >20 ppm. Gliadin levels in some foods were below the ELISA detection threshold but were picked up by LEO.

The linked LEOMyFood app uploads the test results to the cloud. The results are documented with dates and locations and can be shared, creating evidence-based "food maps."

Conclusion

"With its fast, accurate results and user-friendly design, LEO supports safer food choices for individuals with celiac disease and is suitable for personal, clinical, industrial, and regulatory use." Compared to other gluten tests, it can reduce the risk of missed detections from the hook effect, is cost-effective at <$10 per test, and needs no extra equipment.

In the future, it may be extended to other common food allergens, thus ensuring food safety and promoting a secure food supply chain. Ruling out contamination can help people with dietary restrictions avoid accidental, potentially dangerous exposures.

Its adaptability could allow it to detect other compounds, including nucleic acids and toxins. "We believe that the portable LEO has the potential to revolutionize food analysis."

Source:

https://www.news-medical.net/news/20250922/New-gluten-test-detects-hidden-wheat-in-food-in-under-three-minutes.aspx