

This Technology Can Help Regulatory Bodies Screen Samples Faster and More Often

12 May 2026 | News

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As spice adulteration continues to pose serious challenges to food safety, quality assurance, and consumer trust in India, researchers are increasingly exploring faster and more accessible technologies for detection. Prof. Sushil Kumar Singh, Assistant Professor, Department of Food Process Engineering, NIT Rourkela and his team at National Institute of Technology Rourkela have developed a patented system that combines Fourier Transform Infrared Spectroscopy (FTIR) with advanced analytical models to rapidly identify and quantify adulteration in spices. Unlike conventional laboratory methods that are often time-consuming and expensive, the innovation aims to deliver quicker, cost-effective, and scalable testing solutions for the food industry. In this interview, Prof. Singh discusses the inspiration behind the technology, the challenges involved in integrating spectroscopy with data-driven models, its potential applications across different food categories, and how it could support both industry quality control and regulatory surveillance in the future. Edited excerpts;

What inspired your team at National Institute of Technology Rourkela to focus specifically on rapid spice adulteration detection?

We saw that there were a lot of problems with adulteration in India with spices. The usual methods of testing are slow, expensive and not easy to access. So we wanted to make a system that's fast, reliable and can be used by the industry to

control quality and make food safer.

How does your FTIR machine learning system improve upon traditional methods like chromatography in terms of speed, cost, and scalability?

Traditional methods like chromatography are very accurate but they take a long time, need special skills, and are expensive. In contrast, our FTIR machine learning system significantly reduces analysis time, minimises sample preparation, and lowers operational costs. It is also more suitable for routine industrial screening, where multiple tests need to be conducted daily.

Could you explain how the system quantifies the level of adulteration rather than just detecting its presence?

The system uses data from FTIR and machine learning models that were trained on samples with known levels of adulteration. This helps the model learn patterns and estimate the percentage of adulteration. The system does not just give binary results; it also measures the level of adulteration in spices.

What were the biggest technical challenges in integrating Fourier Transform Infrared Spectroscopy with machine learning models?

The big challenges were handling data, removing noise and selecting the right features. We also had to make sure the models work well with samples and conditions. This required planning and validation of the dataset.

The study reports ~92 per cent accuracy in detecting sawdust in coriander powder—how does performance vary across different spices and adulterants?

The performance of the system depends on the type of spice, adulterant and the quality of the training data. We got around 92 per cent accuracy for sawdust in coriander powder. The system's performance may vary for spices and adulterants and it can be improved with more data.

How feasible is it for small and medium-sized food businesses in India to adopt this technology in their quality control processes?

It is possible. It depends on whether they have access to FTIR instruments. Since our system is software-based, businesses that already have FTIR systems can use it easily. For smaller enterprises, shared facilities or third-party testing laboratories could be a practical pathway.

Can this system be adapted for detecting adulteration in other food categories beyond spices, such as oils or dairy?

Yes, it can be adapted. But each food category is different, so we need to collect data and develop new models. This will take time and research.

What kind of infrastructure or training would industry players need to deploy this system effectively?

Users would need an FTIR spectrophotometer, a mid-range computer, and basic training in handling spectral data and operating the software. Familiarity with standard laboratory procedures would also be beneficial.

How do you see this innovation supporting regulatory bodies like food safety authorities in strengthening compliance and surveillance?

This technology can help regulatory bodies screen samples faster and more often. It can be used to identify suspicious samples, which can then be tested further using other methods. However, it is not meant for on-the-spot testing.

What are your next steps in terms of industry collaborations, pilot testing, and commercialisation of this patented technology?

We just got the patent and are planning to work with big spice companies to test and commercialise the technology. We want to make sure it works well in industrial settings and refine it for large-scale use.

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