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Combining Deep learning and Raman Spectroscopy for rapid pesticide screening

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Ensuring compliance with maximum residue limits (MRL) for pesticide residues in fresh produce is crucial for food safety. Traditional detection methods such as chromatography and mass spectrometry, while accurate, are often time-consuming, expensive, and require complex sample preparations. This study aimed to evaluate the effectiveness of combining Raman spectroscopy with deep learning algorithms for rapid and non-destructive pesticide screening in various vegetables. Samples of kales, spinach, tomatoes, lettuce, and Chinese cabbage were spiked with varying concentrations of Chlorothalonil pesticide, and Raman spectra were acquired. These spectra were processed to reduce noise and enhance signal quality. A convolutional neural network (CNN) was then trained to predict pesticide concentrations based on the preprocessed spectra. Additionally, an API was integrated to allow for practical deployment and interaction with the models.
The results demonstrated that the CNN model could accurately predict pesticide concentrations, significantly reducing analysis time and cost compared to conventional methods. The integration of the API facilitated real-world application, enabling easy interaction with the models. This combined approach of Raman spectroscopy and deep learning not only provided a fast, cost-effective, and non-destructive method for pesticide detection but also ensured compliance with food safety regulations. The study concludes that this innovative technique holds great promise for enhancing food safety practices by ensuring compliance with regulatory standards and enhancing consumer confidence in the quality of fresh produce.

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