

Intelligent Device for Detecting Pesticide Residues and Sweetness in Thin-Peel Fruits

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Abstract

Agricultural chemical use raises concerns about food safety and fruit quality, affecting consumer health and export value. Chemical residues in thin-peel fruits undermine consumer confidence and market access, while fruit sweetness is a critical indicator of quality and ripeness that strongly influences grading and pricing. Conventional methods for assessing fruit safety and quality, such as gas chromatography–mass spectrometry (GC-MS), high-performance liquid chromatography (HPLC), and refractometers, provide high accuracy but are costly, time-consuming, require specialized expertise and chemical reagents, and involve destructive sample preparation, making them unsuitable for rapid and on-site applications. This project aims to develop a low-cost, user-friendly intelligent device for measuring chemical residues and sweetness in thin-peel fruits with minimal sample destruction and real-time data display. The device integrates an AS7263 near-infrared (NIR) sensor, redesigned from commercial systems to reduce cost, for effective Brix measurement, together with an SGP30 volatile organic compound (VOC) gas sensor to detect volatile compounds associated with chemical residues in fruits. This combined sensing approach enables reliable and practical fruit quality assessment. Development results indicate that the prototype can accurately, rapidly, and cost-effectively assess the sweetness and safety of thin-peel fruits, thereby increasing technological accessibility for small-scale farmers and the broader agricultural industry, supporting improved quality control, promoting food safety and security, strengthening consumer confidence, and facilitating compliance with national and international fruit export standards.

Keywords

Food safety, Thin-peel fruits, Near-infrared (NIR) sensing, Fruit sweetness, Chemical residues.