


Chapter 4

Smart IoT–Based Framework for Real– Time Food Adulteration Detection Towards Healthy Living

Eduard Babulak

 <https://orcid.org/0000-0003-2450-090X>
National Science Foundation, USA

Alan Biju

*Amal Jyothi College of
Engineering, India*

S. N. Kumar

*Amal Jyothi College of
Engineering, India*

Albert Joji

*Amal Jyothi College of
Engineering, India*

Neenu Rose Antony

*Amal Jyothi College of
Engineering, India*

Arunima Dilimone

*Amal Jyothi College of
Engineering, India*

Nikki John Kannampilly

*Amal Jyothi College of
Engineering, India*

Dejlo Shaju

*Amal Jyothi College of
Engineering, India*

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ABSTRACT

Food adulteration is an ongoing and dynamically increasing challenge to public health, economic authenticity, and food system confidence around the world. This survey provides an overview of recent developments in the detection of food adulteration, with special emphasis on the utilization of Internet of Things (IoT) technologies and machine learning strategies for real-time inspection and analysis. The research classifies adulterants, impacted food products, and related health effects, as well as examines traditional and novel detection methods such as spectroscopy, chromatography, and sensor-based systems critically. Focus is given to IoT-based frameworks that employ an assortment of physical and chemical sensors for decentralized and autonomous adulteration identification. In addition, the chapter compares current implementations, limitations in sensor calibration, data accuracy, standardization, and the lack of region-specific datasets for machine learning model training. Through an outline of the present technological state and an enumeration of research priorities, including the interoperability, regulatory support, and data privacy, this research is targeted at future developments toward scalable, cost-efficient, and smart food safety solutions. The survey highlights the revolutionary role of smart technologies in restructuring food quality assurance and safeguarding consumer health in developed and developing settings.

1. INTRODUCTION

Food adulteration is the intentional or accidental mixing of lower-quality or toxic substances into the food, thus lowering the quality, nutritional value, and safety of the food. It comes in many forms like the addition of cheaper substitutes, coloring with non-food items, or mixing with poisonous chemicals. Some examples are adding water into milk, brick powder into chili powder, or artificial coloring into turmeric. These adulterants not only deceive consumers but also bring grave health consequences such as food poisoning, organ damage, and chronic diseases like cancer. Food adulteration poses a persistent and worldwide concern for public health, food safety, and economic stability. As the global food supply chain becomes

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