Harnessing Digital Agriculture for Food Science Innovation: A Review of Emerging Tools for Postharvest Quality, Safety, and Nutrition Enhancement

Chukwudi Ernest Ogbete, Miriam Ahunna Ofoeze

Biotechnology and Cassava Program, National Root Crops Research Institute, P.M.B 7006, Umudike, Abia State, Nigeria.

Abstract

Digital agriculture is transforming food systems by integrating advanced technologies into crop production, postharvest handling, and food processing. While significant progress has been made in precision farming, applying digital tools to enhance food science outcomes, particularly in postharvest quality, safety, and nutrition, remains less explored. This review looks at how emerging digital agriculture technologies such as Internet of Things sensors, near-infrared spectroscopy, artificial intelligence, and blockchain are shaping the future of food science. It emphasizes their roles in enhancing raw material quality, reducing postharvest losses, improving traceability, and enabling real-time monitoring of nutrient retention and food safety indicators. Case examples from root and tuber crops like cassava and sweet potato demonstrate potential applications in resource-limited settings. This paper also discusses how these tools can support functional food development and quality assurance during storage and processing. Key gaps in knowledge, technology access, and interdisciplinary integration are highlighted, along with recommendations for research, capacity building, and policy support. By establishing practical connections between digital agriculture and food science, this review aims to foster cross-sector innovation and guide efforts toward more sustainable and nutritious food systems.

Key Words: *Digital Agriculture, Food Science, Postharvest Quality, Nutritional Monitoring, Emerging Technologies*