

Title: Smart HACCP and Digital Transformation in Food Safety: Practical Applications of Specialized Food Sensors

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Abstract

While traditional HACCP systems have significantly contributed to preventive food safety, they face inherent operational limitations, such as time-consuming manual record-keeping, vulnerability to human error, and delays in identifying critical control point (CCP) deviations. To overcome these challenges, the Korea Agency of HACCP Accreditation and Services (KAHAS) has spearheaded "Smart HACCP," an IoT- and ICT-driven digital management system that enables automated, real-time monitoring and data recording across critical processing stages (e.g., cooking, chilling, sanitizing, and metal detection).

Recognizing that small-sized enterprises (under 10 employees) comprise over 80% of domestic food manufacturers and face barriers due to high implementation costs and legacy equipment diversity, KAHAS developed 15 types of low-cost, food-specific smart sensors—including automatic chlorine sensors, magnetic iron particle detectors, CIP monitoring sensors, and vision-based display data extraction sensors. Integrated with standardized digital log solutions and free cloud infrastructure, these technologies allow seamless on-site adoption without excessive infrastructure upgrades.

Empirical field analysis of 54 food manufacturing plants demonstrated remarkable improvements: monitoring frequency increased by 133 times, digital log conversion reached 75.9%, monitoring time decreased by 73.4%, and product defect rates were reduced by 49.7%. This presentation shares real-world case studies across diverse food processing sectors and outlines the role of sensor-driven Smart HACCP in modernizing food safety control toward international harmonization.

Keywords: Smart HACCP, Digital Transformation, Food-Specific Sensors, Real-Time CCP Monitoring, Small and Medium Enterprises (SMEs), KAHAS