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Policy Framework and Implementation Guidelines for Agentic GenAI Integration in Food Safety Systems

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Abstract This paper presents a comprehensive review of artificial intelligence (AI) applications in food safety and quality control, focusing on emerging technologies including generative AI, agentic AI systems, and automated compliance solutions. This review synthesizes current research and industry applications, highlighting how AI-driven systems are transforming food safety protocols, enhancing regulatory compliance, and improving overall food quality management focusing on last two years. We examine various AI implementations, from optical imaging for bacterial detection to intelligent compliance agents and generative AI for supply chain optimization. This paper synthesizes current research and industry applications across multiple domains: automated visual inspection systems that detect contaminants with precision exceeding human capabilities; predictive quality analytics that forecast potential safety issues before they manifest; AI-driven regulatory compliance systems that continuously monitor and interpret complex regulatory requirements; and autonomous agentic systems that make real-time decisions without human intervention. The review also addresses significant technological innovations, including the FDA's development of AI tools for regulatory operations, generative AI applications for scenario planning and documentation, and cloud-based AI architectures deployed across major platforms. Critical challenges are examined, including data quality requirements, regulatory validation frameworks, system integration complexities, and ethical considerations. The paper concludes with policy recommendations for government implementation, proposing structured approaches to AI validation, data sharing incentives, regulatory modernization, research support, and ethical oversight.