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Digital Approaches to Food Safety: A Literature Review of Food Traceability, AI-Based Hazard Detection and Authority Monitoring

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Abstract: *Food-safety management increasingly draws on digital records, connected devices and automated text analysis. This review examines three selected studies that address different parts of this area: digital and predictive food-safety practices [1], smartphone-supported food traceability [2], and text-based food-hazard classification [3]. The studies offer useful ideas for monitoring products and organizing incident information, but the selected papers do not describe a complete process linking anonymous consumer reports to authority investigation and case tracking. To address this gap, FoodGuard AI is proposed as a web-based complaint-management system with optional anonymous reporting, evidence submission, AI/NLP-supported hazard classification, a unique tracking ID and an authority dashboard. The system is a proposed design; its performance and practical value must be established through implementation and testing*

Keywords: Food Safety, Anonymous Complaints, Hazard Classification, Natural Language Processing, Traceability, Authority Monitoring, FoodGuard AI

I. INTRODUCTION

Food-safety concerns can involve spoiled or contaminated products, unhygienic handling, incorrect labels and undeclared allergens. When information about these issues is incomplete or reaches the responsible organization late, it may be difficult to assess the problem and follow it through to a resolution. Digital systems can help collect and organize information, but the ability to monitor products or classify text does not by itself provide a complete public complaint process.

The selected studies investigate three related areas. Zazueta-Vega et al. discuss digital and predictive approaches for managing food-safety risks [1]. Syafrudin et al. examine a smartphone-based traceability approach supported by RFID, sensors and databases [2]. Randl et al. describe a shared research task focused on identifying food hazards and product categories from text reports [3]. Their work provides useful context for digital monitoring, product records and text analysis.

This review compares these studies, considers the limitations relevant to a consumer-facing system, and identifies the research gap motivating FoodGuard AI: an AI-based anonymous food-safety complaint, hazard classification and authority monitoring system. The proposed application is intended to let consumers report concerns, obtain a tracking ID and check progress while authorized personnel review and manage cases.

II. LITERATURE SURVEY METHOD

This paper presents a focused review of three selected studies published in 2025 and 2026. They were selected because they relate to digital food-safety management, food traceability and text-based hazard classification. The review considered each study's purpose, approach, data or setting, reported contribution and limitations. The findings were then compared to identify features not covered by the selected research. Because the review includes only three papers, it should not be treated as an exhaustive assessment of all work in food safety.

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III. REVIEW OF RELATED STUDIES

A. Digital and Predictive Food Safety

Zazueta-Vega et al. examine how digital tools and predictive methods may support food-safety management [1]. Their review describes a progression from conventional, reactive controls toward more data-driven and adaptive practices. It also discusses barriers that may affect the responsible use of these technologies, including disconnected information sources, cybersecurity and privacy concerns, unequal access to digital infrastructure, and the need to make automated decisions understandable and auditable. The proposed maturity framework is conceptual, so its value in practical settings requires further evaluation.

For FoodGuard AI, this study highlights that a digital platform should consider more than technical functionality. Privacy, secure information handling and the ability for staff to review automated outputs are important design considerations. The study does not itself provide the consumer complaint workflow proposed in FoodGuard AI.

B. Smartphone-Based Food Traceability

Syafrudin et al. describe a traceability approach using a smartphone, an RFID reader, environmental sensors, GPS and database services [2]. The work was considered in a kimchi supply-chain setting in Korea. The system records product-related events and environmental information so that relevant details can be viewed through a web interface. The authors also discuss the performance of data-storage options and challenges such as scaling the system, inconsistent internet access, sensor reliability and stakeholders' willingness to share information.

This research illustrates how digital records can help track products and their conditions. However, traceability and complaint management serve different purposes. A complaint platform also needs to capture a person's report, preserve anonymity when requested, route a case for review and record changes in its status. FoodGuard AI focuses on these complaint-handling functions; RFID-based product tracking is not claimed as a current project feature.

C. Text-Based Food-Hazard Classification

Randl et al. report on the SemEval-2025 Food Hazard Detection Challenge, which evaluated systems that predict food-hazard and product categories from textual incident reports [3]. The study describes a labelled collection of 6,644 reports and evaluates classification at broad and more detailed category levels. It identifies uneven representation across classes as a challenge: some labels have many examples, while others appear rarely. The reported results indicate that detailed classification is more difficult than predicting broad categories. Some approaches explored generated training examples and combinations of models to improve results.

This study provides a basis for considering NLP as a way to organize food-safety reports. However, its results should not be assumed to transfer directly to consumer-submitted complaints, which may be short, informal, misspelled or written in different languages. FoodGuard AI would require suitable data, evaluation and a human-review process for uncertain or consequential predictions.

D. Common Issues Across the Studies

Across the selected studies, data quality and coverage affect the usefulness of automated analysis [1], [3]. Practical adoption can also depend on infrastructure, connectivity and cooperation among organizations [1], [2]. In addition, privacy and the ability to examine automated decisions matter when digital outputs may influence real-world action [1], [3]. These shared concerns suggest that a complaint platform should combine automation with secure records, appropriate oversight and testing.

IV. COMPARATIVE ANALYSIS

The papers address different levels of the food-safety problem. The review by Zazueta-Vega et al. considers digital development and governance [1]; Syafrudin et al. focus on product tracking and sensor information [2]; and Randl et al. examine classification of incident text [3]. Their contributions are complementary, but the selected studies do not

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present an integrated workflow covering anonymous consumer reporting, hazard classification, authority investigation and complaint progress tracking. Table I summarizes the comparison.

TABLE I: COMPARISON OF THE SELECTED RESEARCH PAPERS

Study	Main Focus	Approach / Evidence	Contribution	Relevant Limitation
Zazueta-Vega et al. [1]	Digital and predictive food safety	Review of prior work and maturity framework	Discusses digital adoption and governance	Framework needs practical validation; public complaint handling is not its focus
Syafrudin et al. [2]	Food traceability	Smartphone, RFID, sensors and databases	Supports digital product-history and condition monitoring	Scaling, connectivity and sensor issues; not a complaint workflow
Randl et al. [3]	Text-based hazard classification	Challenge using labelled incident reports	Studies prediction of hazard and product labels	Rare labels are difficult; no complete authority follow-up process

The comparison suggests an opportunity to connect reporting, automated organization and case follow-up in one system. This is a design opportunity inferred from the scope of the selected papers, not a claim that the entire research field lacks such systems.

V. RESEARCH GAP

Based on the three selected papers, the following gaps are relevant to the proposed project:

1. Consumer reporting channel: The selected studies focus on digital food-safety approaches, traceability or classification of incident reports rather than describing the complete consumer complaint process [1]–[3].
2. Anonymous submission: The reviewed papers do not describe a dedicated mechanism for anonymous consumer food-safety complaints.
3. Consumer-written text: The classification results in [3] do not establish how well a model would perform on informal consumer submissions. This is a question for future testing, rather than a proven failure of the method.
4. Authority case management: The selected studies do not describe a single end-to-end workflow for assigning complaints, recording investigation progress and tracking closure.
5. Responsible automated decisions: Privacy, data governance and the reviewability of AI results remain important considerations for a system that may support official action [1], [3].

FoodGuard AI is proposed to explore these needs by combining optional anonymous reporting, evidence upload, AI/NLP-assisted hazard classification, a unique tracking ID and an authority dashboard. Its actual effectiveness must be established through development and evaluation.

VI. PROPOSED FOODGUARD AI SYSTEM

FoodGuard AI is planned as a Python-based web application for submitting and managing food-safety complaints. A consumer will be able to enter the issue details and, where appropriate, attach supporting evidence. The system will generate a unique tracking ID and use an AI/NLP module to suggest a hazard category from the complaint text. Authorized staff will review the complaint, investigate it and update its status. The consumer can use the tracking ID to check progress.

The intended workflow is shown in Fig. 1: Consumer → Complaint Submission → Optional Anonymous Reporting and Evidence Upload → Tracking ID Generation → AI/NLP Hazard Classification → Complaint Database → Authority Review and Investigation → Status Update → Consumer Progress Tracking.

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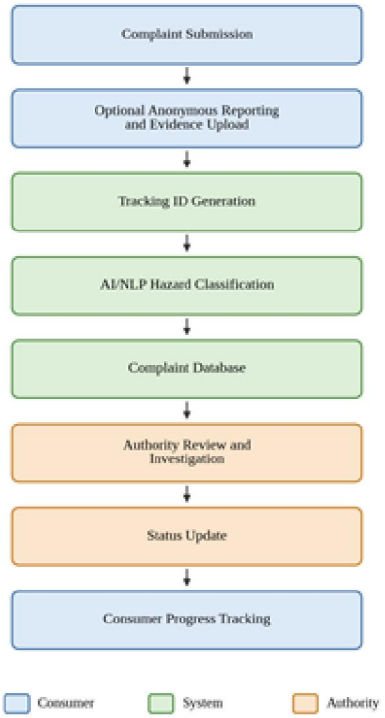


Fig. 1. Proposed workflow of the FoodGuard AI system.

The proposed workflow is a conceptual design. It does not claim that AI classification replaces official assessment or that the system has already been deployed.

VII. MAIN MODULES

The main modules of the proposed system and their relation to the complaint database are shown in Fig. 2.

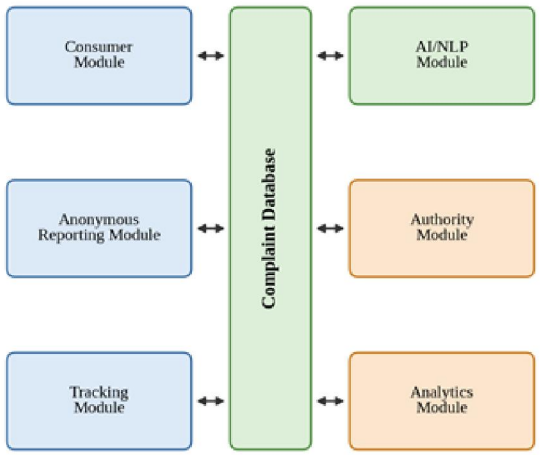


Fig. 2. Main modules of the proposed FoodGuard AI system.

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A. Consumer Module: Provides a form for entering the complaint, food or vendor details, location and supporting evidence.

B. Anonymous Reporting Module: Supports reporting without displaying the complainant's identity in the complaint workflow when anonymity is selected. The implementation must define what data are collected and how they are protected.

C. AI/NLP Module: Analyses the complaint description and suggests a possible hazard category. Its predictions require testing and should be available for human review.

D. Authority Module: Enables authorized personnel to view complaints, review evidence, manage investigations and update statuses such as New, Under Review, Investigation, Resolved or Rejected (Fig. 3).

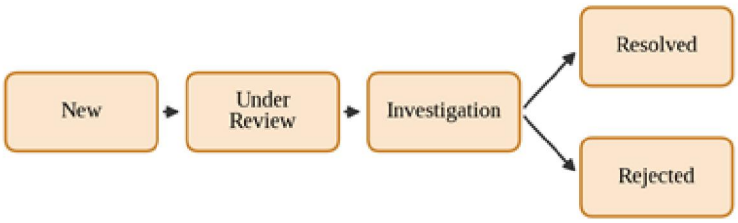


Fig. 3. Example complaint statuses managed by the Authority Module.

E. Tracking Module: Generates a unique complaint ID so a consumer can check the current status without needing to disclose the complaint publicly.

F. Analytics Module: Summarizes complaint counts, pending and resolved cases, and patterns by hazard category or location, subject to the quality of recorded data.

VIII. EXPECTED BENEFITS AND LIMITATIONS

The proposed platform may make complaint records easier to organize, provide consumers with a way to follow case progress, and help authorities prioritize and review reports. AI/NLP may reduce the manual effort needed to sort complaints, but the extent of any benefit must be measured during testing.

Potential limitations include incorrect AI predictions, insufficient training examples for uncommon hazards, misleading or incomplete submissions, privacy risks, limited internet access and the need for authority participation. Appropriate access controls, human review, clear status management and systematic testing would be needed before real-world use.

IX. FUTURE SCOPE

Possible future improvements include a mobile application, multilingual complaint entry, evaluation of advanced language models, image-analysis support for uploaded evidence, geographical analysis of recurring complaints, email or SMS notifications, stronger audit records and integration with official food-safety systems where approval is available. These are potential extensions and are not described as implemented features of the current proposal.

X. CONCLUSION

This review considered three recent studies on digital and predictive food-safety practices, smartphone-based traceability and text-based hazard classification [1]–[3]. The studies offer useful approaches to digital monitoring, product information management and automated analysis, while also showing that data quality, infrastructure, privacy and classification reliability require attention.

The comparison identifies a project opportunity in connecting consumer complaints with hazard categorization, authority action and progress tracking. FoodGuard AI is proposed as a web-based platform that combines optional anonymous reporting, evidence submission, AI/NLP-assisted classification, a unique tracking ID and an authority

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monitoring dashboard. Implementation and evaluation are needed to determine its accuracy, usability, security and practical value.

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