Scientific and Social Research, 2025, Volume 7, Issue 6
https://ojs.bbwpublisher.com/index.php/SSR
Online ISSN: 2981-9946
Print ISSN: 2661-4332

Exploration of Digital and Intelligent Empowerment in Food Safety and Quality Control

Xiang'an Liu*

Haide College, Ocean University of China, Qingdao 266100, Shandong, China

**Author to whom correspondence should be addressed.*

Abstract: Food safety is closely related to people's lives, and people's health, life safety, and quality of life. Strengthening attention to food safety and quality control is not only the cornerstone of social harmonious development, but also the common expectation and pursuit of the people. With the deepening of the digital era, the rapid development of information technology provides new tools and means for food safety and quality control, and provides greater protection for people's lives and health. In this context, this paper will take digital intelligent technology as the entry point, food safety and quality control as the starting point and foothold, to explore the digital intelligent technology in the field of food safety and quality control of the specific application, practical significance and development trend, in order to use modern technical means to further ensure the safety and reliability of food.

Keywords: Digital intelligent; Food safety; Food quality control

Online publication: June 13, 2025

1. Introduction

With the rapid development of information technology, digital intelligence technology has shown more and more potential and a positive role in all walks of life, and also plays a positive role and influence in the food safety monitoring industry [1]. Digital intellectualization technology is widely used in food production, processing, circulation, sales, and other links, and plays a positive role in improving the efficiency and level of food safety and quality control. Food safety means that the food is non-toxic and harmless, and meets the nutritional requirements. Quality control refers to a series of requirements for food to meet regulations and standards, both of which are an important part of the food field, and digital intelligence empowerment brings unprecedented possibilities for it.

2. The specific application of digital intelligent empowerment in food safety and quality control

2.1. Artificial intelligence

Artificial intelligence technology shows great potential in various industries and is also a powerful tool for ensuring food safety and quality control [2]. The application of artificial intelligence technology in automated monitoring and intelligent analysis improves the monitoring efficiency of foreign bodies in food, quickly and accurately detects foreign bodies in food, and classifies and removes them, thus improving food safety. Artificial intelligence technology can also be applied to mechanical maintenance, through predictive maintenance, to reduce the failure rate of equipment and avoid equipment problems that lead to production interruptions and other problems. In addition, artificial intelligence technology has a unique value in intelligent decision-making and plays an important role in food safety risk assessment and early warning systems.

2.2. Big data

Big data analysis technology shows high value in food marketing. Through in-depth analysis of market trends and consumer behaviors, it can help enterprises adjust sales strategies and improve economic efficiency. Big data analysis technology can also accurately analyze product problems and optimize reform, in-depth analysis of food production, warehousing management, logistics, transportation, and other links, combined with other technologies for all-around adjustment and optimization, improve the comprehensive quality of products, to enhance product sales and consumer interest [3].

2.3. The Internet of Things

The application of Internet of Things technology in food safety and quality control is more extensive, covering production, processing, transportation, and other links, among which product circulation and tracking play a particularly positive role [4]. For example, fresh products have very strict requirements for transportation, and the temperature and humidity in transportation vehicles and warehouses are closely related to product safety and quality. Internet of Things technology can comprehensively monitor the transportation and storage environment, provide real-time feedback through the temperature and humidity sensor, and immediately issue an alarm when it exceeds the predetermined scope, reminding the staff to take corresponding measures to ensure that fresh food is not affected, thus maintaining food safety through accurate environmental control.

2.4. Blockchain

Blockchain technology, with its characteristics of decentralization and traceability, plays a key role in food safety traceability [5]. From the perspective of agricultural products planting and processing, the application of blockchain technology can comprehensively track the whole process of agricultural products planting, picking, processing, and sales to ensure the transparency and authenticity of information. Enterprises can use blockchain technology to trace the source, and in the event of food safety problems, quickly locate the source of the problem and take effective measures to provide technical support for quality control. Consumers can scan the two-dimensional code and bar code attached to the product to trace the source, production process and quality of the product, improve the understanding and trust of the product, but also can expand the traceability scope to the entire production line, to achieve information openness and transparency, improve the credibility of the enterprise [6]. At the same time, the blockchain is also immutable, which effectively avoids the risk of enterprises producing and manufacturing counterfeit and shoddy products, and further enhances the security of food safety and quality control.

3. The practical significance of digital intelligence empowerment in food safety and quality control

3.1. It is conducive to improving the efficiency of supervision

For example, in food safety supervision work, manual sampling inspection and screening are required, which inevitably leads to problems such as narrow coverage area, low efficiency, and large resource investment, making it difficult for food safety to be fully guaranteed. In addition, in the event of food safety problems, it is impossible to locate the source of the problem in a short period of time, which causes certain damage to the optimization and reform of enterprises and the rights and interests of consumers. The application of digital intelligence technology, such as the use of big data analysis, can optimize sampling strategy, improve sampling accuracy and coverage, and the application of artificial intelligence technology may achieve full coverage of product inspection, which greatly improves the reliability of food safety [7]. Technologies such as the Internet of Things and blockchain can quickly and accurately locate the source of problems, shorten the response time, help enterprises to optimize and reform in a timely manner, and also protect consumers' right to know and enhance their trust in products.

3.2. It is conducive to information sharing

The application of digital intelligence technology can connect all links and subjects of food safety in series, so as to realize information sharing more effectively and solve food safety problems [8]. From the perspective of food production, sales, and other links, digital intelligent technology strengthens the traceability link, so that consumers can intuitively see the source and production process of food, enhance information transparency, and provide protection for food safety. From the main body of food safety, relevant government departments, enterprises, and consumers can share information, jointly supervise the food production and circulation links, build a new pattern of food safety information co-construction, co-governance, and sharing, and improve the comprehensive effectiveness of food safety and quality control.

3.3. It is conducive to enhancing the management level

Digital intelligence technology can further refine the management of food safety, replace manual instability, eliminate human error as much as possible, and improve the efficiency and accuracy of food safety inspection. At the same time, it can also realize the comprehensive monitoring of all links in the food field, realize the whole process traceability from the source to the end, and comprehensively improve product quality [9]. In addition, artificial intelligence and other technologies can also accurately predict problems in the food production process, identify potential problems in advance, reduce the possibility of accidents, and ensure food safety and quality control.

4. The development trend of digital intelligence empowerment in food safety and quality control

4.1. Achieve technological innovation

The application of digital intelligent technology in food safety and quality control faces many uncertainties, as well as many problems and challenges at the level of technology development and implementation. For example, the accuracy, security and integrity of data have a great impact on digital intelligent technology; The quantity and variety involved in the food field, how to improve the compatibility of technology; The adaptability of digital intelligent technology upgrading and enterprise development and the cost challenges brought by it, etc.,

strengthen the application of technology and practical innovation has become the primary issue. With the rapid development of information technology, digital intelligent technology shows a development trend of integration and innovation. The comprehensive application of high-tech means such as artificial intelligence and big data provides new development ideas for improving the accuracy of food safety risk assessment and the accuracy of the early warning system, and is a powerful tool for food safety and quality control. Based on this, the relevant subjects responsible for technology research and development should recognize the importance of data, strengthen data security protection measures, ensure the safety and accuracy of data in the process of collection, transmission, storage, and use, and avoid data problems affecting the decision-making of food safety and quality control [10]. At the same time, technological innovation should take into account the compatibility and integration issues, for the complex process and many links in the food industry, the technical compatibility between different equipment and software, to develop standardized interfaces and protocols, in order to reduce the integration cost and complexity. Government departments should strengthen financial support for small and micro food enterprises to help them overcome financial difficulties, realize technological upgrading, and adapt to the development trend of digital intelligence technology.

4.2. Provide personalized services

Food safety issues involve multiple entities, and digital intelligence technology can meet the different needs of different entities, provide personalized services, and ensure food safety and quality control in an all-around, multi-level, and multidimensional way [11]. First of all, the enterprise level. The enterprise involves many links, such as food production, transportation, and storage, and the digital intelligence technology plays its own role in each link. Taking the cold chain transportation link as an example, fresh food has extremely high requirements for the preservation environment, especially in the summer high-temperature season, which is a huge challenge to the safety and preservation of fresh food. The importance of cold chain transportation is self-evident, and the application of digital intelligence technology plays a key role in product transportation and freshness preservation. Artificial intelligence technology and Internet of Things technology play a positive role in the intelligent development of cold chain transportation. Enterprises can realize real-time monitoring of transport vehicles through these technologies and make intelligent adjustments according to the sensitivity of products to temperature, humidity, etc., to ensure that the transportation link is adapted to the storage requirements of products [12]. At the same time, it can also use digital intelligence technology to strengthen the frequency of inspection of cold chain transportation, predict potential risks through data analysis, timely adjust the transportation plan, and ensure the quality and safety of food in transit. Secondly, the consumer level. Through blockchain tracking technology, with the help of two-dimensional code scanning technology, consumers can scan through mobile phones to watch product information in real time, improve the security and transparency of information, and enhance the trust of consumers and products. At the same time, artificial intelligence technology can also combine the needs of consumers, push the right food for them, and improve the consumption experience. Finally, at the level of regulatory authorities, digital intelligence can be used to improve the supervision of food enterprises and sales stores, relying on intelligent software for real-time monitoring, improve the visibility of supervision, detailed understanding of food production and store hygiene anytime and anywhere, to achieve remote monitoring and improve regulatory efficiency. In addition, an online information sharing platform can also be built to record the use of food additives in the production process, raw material procurement information, inventory temperature and humidity warning, etc., to urge enterprises to self-check and self-correct in a timely manner [3].

4.3. Strengthen the construction of talents

Talent is the basis for the innovation and development of digital intelligence technology. It is of great importance to strengthen talent training and introduce the effective application of digital intelligence technology in the food field. First of all, actively introduce talents. The application of digital intelligent technology in the field of food involves two major fields of food and information technology. The actual demand for talents is also biased towards compound talents who know both food science and information technology, so as to be able to meet the needs of intelligent system development, operation, and maintenance [14]. However, judging from the current situation, talents with interdisciplinary ability are relatively scarce, and how to effectively attract and train interdisciplinary talents has become a top priority. Colleges and universities can meet this market demand, set up more interdisciplinary courses and majors, realize the close combination of food safety and information technology, and cultivate compound talents with an interdisciplinary knowledge background. At the government and enterprise level, the introduction and training of relevant talents can be strengthened. For example, the government can attract and retain outstanding talents by issuing supportive policies, providing tax incentives, strengthening support for relevant scientific research projects, and other incentive measures. On the one hand, enterprises can increase the welfare benefits of talents to attract outstanding talents to apply for jobs; on the other hand, they can strengthen cooperation with scientific research institutions, universities, and other institutions to jointly develop customized training programs and train targeted talents. Secondly, strengthen on-the-job staff training. Employees are an important component of food enterprises, and their understanding and application of log-intelligent technology are directly related to the actual effect of food safety and quality control [15]. Therefore, enterprises should organize regular internal training to cultivate employees' good information literacy and improve their skills in operating and managing digital intellectualization systems. At present, many food enterprises are faced with the challenge of difficult staff training, high time and capital cost, which has a negative impact on the training effect. Therefore, enterprises can combine the actual development needs through flexible and varied training methods, flexibly adjust the training content and other forms, improve employees' information literacy and technology application level, and provide the foundation for the application and promotion of intelligent technology.

5. Conclusion

Food safety is closely related to people's happiness and social stability. With the rapid development of information technology, digital intelligence technology has brought unprecedented changes to the food field, become an important driving force for food safety and quality control, and also brought new opportunities for the development of the food industry. The deep application of high and new technologies such as big data technology, artificial intelligence, Internet of Things, and blockchain in the field of food safety and quality control can effectively improve management efficiency and quality, realize information sharing, and provide a new development direction for the food industry. Relevant departments should pay full attention to the effective application of digital technology, and provide solid support for food safety and quality control by vigorously introducing outstanding talents, improving the treatment of talents, promoting technological innovation and other means, and then formulating personalized services based on the actual needs of companies and other entities.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhang GY, 2025, Research on the Optimization and Upgrading Path of Food-related Majors in Higher Vocational Colleges in the Digital and Intelligent Era. Journal of Liaoning Agricultural Vocational and Technical College, 27(2): 58–62.

[2] Cao SM, 2024, Research on the Innovation Strategy of Food Safety Supervision Model in Colleges and Universities Based on Digital and Intelligent Means. Science & Technology Vision, 14(32): 107–110.

[3] Wu XL, 2024, Research on the Optimization of the Development Strategy of Y Food Company in the Digital and Intelligent Era, thesis, Qingdao University.

[4] Liu TJ, Cai XD, 2024, Research on the Agricultural Product Information Traceability System Based on Blockchain and Internet of Things Technology. Logistics Science and Technology, 47(24): 44–50.

[5] Liu XQ, Wang FL, 2025, Food Safety Control of Fresh Agricultural Product Supply Chain Based on Digital and Intelligent Means. China Food Safety, 2025(1): 44–47.

[6] Li BY, Sun FQ, 2025, Digital and Intelligent Illumination of Those Hidden Corners of Food Safety — The 2024 CeMAT ASIA Innovation Salon Was Successfully Held. China Storage & Transport, 2025(1): 24–25.

[7] Jin X, 2024, Digital Intelligence Empowerment, Building a "New Defense Line" for Food Safety. Informatization Construction, 2024(11): 54–55.

[8] Pan ZJ, 2024, Buy with Confidence — Digital and Intelligent Construction Builds the Food Safety Defense Line in Summer. China Food Safety, 2024(7): 50–52.

[9] Wang XZ, 2024, Practical Research on the Food Quality and Safety Control System in Food Safety Supervision. China Food Industry, 2024(24): 71–73.

[10] Ye YD, 2024, Construction Criteria and Key Points of the Digital Management System for Food Safety. China Food Industry, 2024(23): 62–64.

[11] Lai SP, Xiao DW, 2024, Digitalization-driven Externalization: The Transformation Logic of Catering Service Safety Supervision Mode. Chinese Public Administration, 40(7): 143–154.

[12] Xu K, 2024, Exploration of Food Safety Supervision under the Background of Digital Reform. Food Safety Guide, 2024(11): 1–3.

[13] Hao C, 2024, Research on the High-quality Development of the Food Industry Driven by the Digital Economy. China Food, 2024(2): 108–110.

[14] Zheng HZ, Dong HJ, Sun L, 2023, Research on the Construction Path of the "Su Food Smart Chain" Food Safety Supervision Platform in the Context of the Digital and Intelligent Era. Modern Food, 29(1): 139–143.

[15] Wang J, Cao H, 2024, Research on Food Safety Supervision Issues under the Background of Internet+. China Food Industry, 2024(21): 53–55.