Proceedings of ICMMGH 2026 Symposium: Cell and Molecular Biology: Understanding Immune Cell Functions
DOI: 10.54254/2753-8818/2026.PJ30121

Evaluating the Effectiveness of China's Food Traceability System in the Context of Nutritional Transition

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Abstract. With the rapid nutritional transition and increasing prevalence of chronic diseases such as obesity, diabetes, and cardiovascular disease, China faces new challenges in public health management. In this context, food traceability systems have become an innovative tool to enhance food safety management and nutritional transparency. This study adopts theoretical analysis and case studies to examine how China's current food traceability system can evolve from a safety-oriented model to a health-oriented governance framework. The research integrates Nutrition Transition Theory and Food Safety Governance Theory to analyze the policy and technological dimensions of traceability development, focusing on the integration of blockchain, IoT, big data, and wearable technologies in creating an intelligent closed-loop network linking production, consumption, and individual health feedback. The findings reveal that although China has made substantial progress in food safety governance, the existing system still lacks sufficient integration of nutritional data, health information, and public participation. The study highlights the importance of unified data standards, cross-departmental coordination, and public engagement in achieving a comprehensive, health-oriented traceability model. However, this research is limited by its qualitative approach, lack of empirical validation for wearable technology applications, and contextual focus on China. Future studies should incorporate quantitative evaluations, interdisciplinary approaches, and international comparisons to promote the intelligent and global development of health-oriented food traceability systems.

Keywords: Food traceability system, Nutrition transition, Public health governance, Digital technology integration, Health-oriented policy

1. Introduction

In recent years, the incidence of chronic diseases such as obesity, diabetes, and cardiovascular disease has continued to rise, and chronic diseases have become one of the main factors affecting the health of Chinese residents [1]. The World Health Organization (WHO) points out that a healthy diet is crucial for preventing various forms of malnutrition and non-communicable diseases (including diabetes, cardiovascular disease, stroke, and cancer) [2]. However, with the acceleration of globalization and urbanization, people tend to consume more high-energy, high-fat, high-sugar, and high-salt/high-sodium foods, while reducing their intake of fruits, vegetables, and dietary fiber. As the WHO's "Overview of Healthy Eating" shows, this unhealthy dietary pattern has led to a high

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incidence of diet-related chronic diseases [2]. Food traceability systems are considered a new way to improve food safety management and food nutrition transparency. The initial intention of establishing a food traceability system stems from the need to ensure food safety. Its purpose is to ensure that regulators can promptly identify and resolve any food safety issues by establishing a complete traceability system from production, distribution to consumption. However, most current food traceability systems only focus on the safety supervision of the entire food traceability process, lacking attention to the traceability of food nutrition components and the integration of health information, resulting in incomplete nutrition information and lagging public health management. Therefore, given the rapid development of China's nutrition transition, building a new food traceability system that not only focuses on food safety but also provides consumers with nutritional information and supports health management has become increasingly important. This study will use theoretical analysis and case studies to explore how China's food traceability system can address the growing burden of chronic diseases in the context of rapid nutrition transition, and evaluate the actual effectiveness of the food traceability system in public health governance. The study will also analyze the shortcomings of current food traceability policies and technology applications, and propose policy recommendations to promote the transition to "health-oriented traceability."

2. Theoretical framework

2.1. Nutrition Transition

Nutrition Transition is the concept put forward by the American nutritionist Barry Popkin in 1990s to describe the influence of economic growth, urbanization, and social transformation on the structure of diet and population health [3]. According to this theory, as the economic level increases and the food industrialization and urbanization continue, a gradual transformation in the nutrition regime of the population is expected as it becomes more of a modern food system of high fat, high sugar, high salt, and energy content [4]. This change commonly causes a huge rise in long-term non-communicable diseases (NCDs) including obesity, diabetes, and cardiovascular disease. According to WHO, unbalanced diets and excessive energy intake are major risk factors for chronic diseases. China is undergoing a typical nutritional transition: while diets have become more diversified and nutrition levels have improved, the prevalence of obesity, diabetes, and hypertension—particularly among urban residents and adolescents—has risen sharply, reflecting both overnutrition and imbalance. The Nutrition Transition Theory suggests that improving dietary quality, optimizing food supply, and strengthening information management can reduce chronic disease burdens and enhance population health. Therefore, establishing a balanced food safety and nutritional traceability system holds significant theoretical and practical value for advancing the Healthy China strategy.

2.2. Food safety governance

Food safety governance reiterates the point that it is necessary to have a multi-layered, multi-stakeholder strategy in food production and consumption, and such a strategy requires the government, business, and the community [5]. The essence of this system of governance is the collective action of the governments, business and consumers, which is based on the institutional innovation and control technology to provide the flow of food safety information. Globalization and the different intricacies of food supply chains have increased the level to which food safety concerns are not only restricted to the production phase of the supply chain but have now been extended to transportation, processing, retail and consumption. The operation of traditional food safety

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management is mostly directed towards the quality control of the product at hand; however, with the food safety challenges becoming more critical; the current food safety governance theory supports the multi-layered management that is transparent and open to control. That is, food safety does not just protect the consumer right against harmful substances, but that of knowing and acting as well by making the information about the food as transparent as it can be. A system of good governance in food safety incorporates the use of technology, regulations and active participation of the citizens to build a full-fledged, end-to-end regulatory framework which can handle food safety matters that are becoming ever more complicated.

2.3. Food traceability systems

Food traceability systems are also a major tool of the public governance. They have a dual aim not to make food safe, but also to safeguard the health of the populace. Thus, the assessment of the effectiveness of such systems must be done in multidimensional form and comprehensive view [6]. Concerning the aspect of governance, the extent of policy enforcement is an indicator of the effort the government as well as its ability to enhance the development of the traceability system including institutional completeness and enforcement. The technological adoption rate is the level of integration of digital technologies, including blockchain and the Internet of Things, into the traceability practices and the impact they have on streamlining the performance of the system. Moreover, the confidence of populace is a decisive factor in defining the effectiveness of the system as a whole. Since trust forms the foundation of social governance, both clarity and ease of use of a traceability system has a direct impact on consumer participation. At last, health outcomes are the end evaluation criterion that will determine whether the traceability-system is going to make a difference in the overall management of health of the population and assistance in reducing chronic diseases as a result of a bad diet.

3. Case study – China as an example

3.1. Existing food safety policies and system construction

Following the implementation of the Food Safety Law in the year 2009, food safety management system in China has reached a new phase which is characterized by a government-led and multi-actor co-government [7]. A food safety traceability system has been set up in this country that takes into account every area of food production, distribution, and consumption. The food traceability system, which has been established as per the Food Safety Law, is intended to bring about transparency in the food safety information enabling the capability of a food traceability within the food system [7]. The main idea of almost all this system is that the food production enterprises, enterprises of distribution and retailers create complete traceability files in order to provide the correct safety information on every step of food production. At the local level, Beijing, Zhejiang, Guangdong, and other areas are working on the development of electronic traceability systems on agricultural products. The example of Beijing is that the city has developed a full process traceability system of agricultural production, which does not only deal with the origin and destination of agricultural products but also tracks safety indicators, pesticide residues. Local practices offer experience and point of reference over the creation of national food safety traceability framework. Although policies and system building ensure that the food safety is guaranteed to some extent, it is still incomplete in terms of integrating the nutritional information and health data. The food safety traceability system is primarily focused on elimination of the presence of dangerous

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substances in food, however, it does not consider the traceability of the nutritional elements and the effects that they have on health. As such, the present food safety policy has an urgent need to be reformed into a more detailed policy of health traceability.

3.2. Technology applications

Over the last several years, the use of technological innovation in the Chinese food traceability system has come a long way, especially in blockchain, the Internet of Things (IoT), and big data technologies. The technologies are essential in food safety traceability and management of nutritional information and health data with technical assistance. The area with the most extensive adoption of blockchain technology is food traceability, to which the attribute of non-editable and non-traceable data is the greatest. A blockchain is able to provide each food item with a unique identity, documenting and examining each process of production to the consumer, thus ensuring the quality and reliability of food data [6]. Considering the example of meat and dairy firms, blockchain has been used to document the source of the raw materials, processing process, and logistics details as a kind of safety measure.

The food traceability system also makes use of IoT technology. The sensors and wireless networks allow monitoring temperature, humidity and other environmental conditions of food in real time [8]. In the case of perishable products (fresh vegetables, meat, etc), bad quality due to improper temperature regulation may be prevented successfully while transporting and storing the products [8]. The use of the big data technology enhances efficiency of the food traceability system. Once a particular company incorporates and processes data on food production and sales, the big data is capable of tracking the process of food circulation at any moment and may also assess health trends and suggest nutrition intervention.

3.3. Problems and challenges

Despite the food safety traceability system in China having come a long way over the recent years there are various issues and challenges which remain in the process of its actual implementation, particularly in combining nutritional information and use of technology. Fragmentation of system is a significant issue today. Whereas food traceability work has been initiated in some areas and food processes, the absence of data standardization and coordination among various regions and food processes have led to disjointed food traceability data. The traceability systems used by various regions and enterprises do not interoperate with each other, and thus any form of information sharing is not easy, which affects the overall performance of the system. The technology and awareness gap is also one of the outstanding problems. Some of the small and medium-sized food businesses have failed to positively embrace the use of advanced traceability technologies because they do not have enough investment in both funds and technology.

The other issues with the current food traceability system are the lack of nutritional data [9]. Nowadays, the majority of food traceability systems are concerned only with food safety control, including the level of pesticide residues and meet hygiene requirements. Nonetheless, as the rates of chronic diseases on the rise, consumers are getting to be more concerned with the nutritional value, additives, and long-term health consequences of food. The existing system has not integrated health and nutritional information, and thus has not addressed the need of the consumers to have healthy food.

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4. Discussion and recommendations

4.1. Policy dimension

In terms of policy, China needs to further strengthen its emphasis on the top-level design of the food traceability system, promoting its transformation from "safety traceability" to "health traceability." While current food safety policies have achieved some success in protecting consumers from harmful substances, shortcomings remain in the traceability of food nutritional components and health management. Therefore, the first step is to unify national food traceability standards, establish unified data formats and information sharing protocols, and eliminate system fragmentation across regions and industries. This standardization work can draw on the standardized practices of the EU and the US in food traceability, ensuring information is mutually recognized nationwide. Furthermore, the government should strengthen inter-departmental cooperation and data sharing, integrating resources from various regulatory departments and local governments. Agricultural departments, health departments, and market supervision departments can jointly promote a health-oriented food traceability system. The government should also increase incentives for enterprises, encouraging food production and distribution companies to provide information beyond safety traceability, including nutritional components and health indicators during production.

4.2. Technological dimension

Technologically, it is important that blockchain, IoT, big data, and wearable technologies are deeply integrated to improve the efficiency and intelligence of food traceability systems. Blockchain offers records that cannot be altered and guarantee the safeguarding of the safety and health information along with its transparency. IoT sensors and wireless bondage make it possible to check the state of temperature, humidity, and storage along the supply chain in real time, and 5G networks may help to considerably increase the rate of data transfer and system responsiveness.

In addition to safety monitoring, a closed-loop system between food production, consumption and individual health feedback can be established through the integration of big data analytics and wearable technologies. Physiological and dietary information of the users at the moment can be collected by wearable gadgets, including smart wristbands and nutritional patches, and can be tied into the traceability solutions to dynamically track nutritional intake and health risks. With smartphone applications that are linked to these devices, consumers would enjoy customizable knowledge about food safety and nutrition, thus improving their perceptions, confidence, and conversion to the traceability ecosystem.

Food enterprises, regulatory bodies, and data analytics companies should cooperate to create smart food management solutions that may be health-focused. The government subsidies/technical assistance must promote the adoption of such advanced technologies among SMEs, which must include wearable-based mechanisms of providing health feedbacks into production and distribution in order to have real-time supervision and data interoperability.

4.3. Public dimension

Public engagement remains a critical component of an effective food traceability system. With the widespread adoption of smart devices, wearable technologies are emerging as a new medium for citizen participation. By linking wearable devices and mobile health applications with traceability platforms, consumers can access visualized health feedback loops, fostering changes in dietary

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behavior and improving their understanding of food safety and nutrition. Government and enterprises should utilize these digital channels to enhance public education, promote nutrition awareness, and strengthen collective trust, thus achieving a collaborative governance model integrating policy, technology, and public participation.

5. Conclusion

The study concludes that China has made significant progress in developing its food safety governance system and traceability platform. However, the current system is primarily based on safety monitoring, with insufficient attention paid to nutritional value, health information, and public participation. Combining nutritional transition theory with food safety governance framework, the paper highlights that a food traceability system is supposed to not just manage the threat of food safety but also foster the transparency of nutritional information and behavior change. In technological terms, the high level of penetration of blockchain, IoT, big data, and wearable devices allows creating a closed-loop network of production-consumption-individual health feedback. Policymakers urgently need standardized policies, cross-departmental cooperation, and policy incentives. On the societal level, the general implementation of smart devices will render the societal stratum a significant role in the governance of health. The shortcomings of the study are that it used qualitative analysis and case studies instead of quantitatively proving the effectiveness of a health-oriented traceability system or empirically testing the applicability of wearable technology in real traceability systems. Also, the study focuses on the Chinese context only. The future studies can evaluate the significance of health-oriented traceability systems in the improvement of the counsel of people on nutrition and prevention of chronic diseases using quantitative empirical research or regional pilot projects, and international comparisons, basing on the data-based traceability experiences of other countries such as the EU and the US and facilitate intelligent and global development of the Chinese food traceability system.

References

[1] Li X., Cai M., Liu Q., Ying X., & Wu S. (2023). Trends and regional variations in chronic diseases and their risk factors in China: an observational study based on National Health Service Surveys. International Journal for Equity in Health, 22, Article number: 120.
[2] World Health Organization (WHO). (2020, April 29). Healthy diet – Fact sheet. Retrieved from https: //www.who.int/news-room/fact-sheets/detail/healthy-diet
[3] Popkin, B. M. (1993). Nutritional patterns and transitions. Population and development review, 138-157.
[4] Ervin, D., López-Carr, D., & López-Carr, A. C. (2013). The nutrition transition. New York: Oxford University Press.
[5] Wu, L., Zhong, Y., Shan, L., Qin, W., & Yue, X. (2018). Social co-governance for food safety risks. Sustainability, 10(11), 4246.
[6] Jabbar, S. (2024). Securing public health: Iot and big data in food safety traceability. Pakistan Journal of Science, 76(1).
[7] Ortega, D. L., Wang, H. H., Wu, L., & Olynk, N. J. (2011). Modeling heterogeneity in consumer preferences for select food safety attributes in China. Food Policy, 36(2), 318–324.
[8] Bhutta, M. N. M., & Ahmad, M. (2021). Secure identification, traceability and real-time tracking of agricultural food supply during transportation using internet of things. Ieee Access, 9, 65660-65675.
[9] Qian, J., Dai, B., Wang, B., Zha, Y., & Song, Q. (2022). Traceability in food processing: problems, methods, and performance evaluations—a review. Critical Reviews in Food Science and Nutrition, 62(3), 679-692.