

Research on the Construction of Fresh Food Traceability System in the Context of Blockchain

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ABSTRACT

In recent years, due to the occurrence of safety accidents in food processing enterprises, it is necessary to use fresh food safety traceability system to strengthen the supervision of food supply. Based on the five basic characteristics of blockchain, namely, decentralization, openness, autonomy, anonymity and immutable information, this paper conducts in-depth analysis on the problems of insecurity and vulnerability of fresh food traceability system. The fresh food traceability scheme based on block chain technology is proposed to construct a more reasonable traceability system. Meanwhile, the feasibility and effectiveness of the fresh food traceability scheme are demonstrated by combining application cases, providing a reasonable reference for the construction of fresh food traceability system.

Keywords: Blockchain technology, Fresh food, Food safety, Traceability system

1. INTRODUCTION

Since the novel Coronavirus outbreak in 2019, many enterprises have experienced slow development and faced bankruptcy, gradually exposing the problems of traditional supply methods, which further promotes the development of blockchain. In this new situation, the quality and safety of fresh food is very important. In recent years, there have been food safety problems of varying degrees in various industries in various countries, from bird flu and mad cow disease incidents in animal husbandry, to melamine and pickled cabbage incidents in food processing, and then to the third-party logistics and packaging of imported food carrying viruses, contamination and deterioration and other repeated pollution incidents. This infringes consumer economic interest seriously, also harm consumer health likewise. The establishment of fresh food traceability system is the key to ensure the quality and safety of fresh food, so the establishment of food traceability is an important link in the development of fresh food in China.

Food traceability research has always been an important part of food security, and food traceability is usually realized by block chain technology. Li Jianjun, Su Fangyuan et al. [1] proposed the organic food traceability system by using blockchain technology, and proposed corresponding countermeasures for the problems existing in the security and credit systems. Liu

Zongmei [2] uses "block chain + RADIO frequency identification technology" to build a food traceability platform to quickly locate the responsibility of food safety incidents. Yang Hongzhi, Li Na et al. [3] used blockchain to analyze the data of hebei cold chain food traceability platform, providing theoretical support for epidemic prevention and control. Based on the above research, from the perspective of food traceability system construction, block chain technology is used to find a breakthrough in the problems of food traceability to ensure that the rights and interests of consumers are protected.

2. BLOCK CHAIN

2.1. Definition and Features of Blockchain

Chain block is a kind of decentralized database, in the currency as the foundation, will contain the currency trading network information block, block of data produced by using cryptography to connect, used to verify the information and generate new data block, according to the block of time sequence was orderly cohesion, form chain structure, known as block chain.

Blockchain is an innovative development and application model of computer science and technology in the era of Internet economy, with five basic characteristics that are generally agreed [4]. The first is

decentralization, which is the use of distributed computing and storage without the need for a centralized management organization, and the rights and obligations of any organization are equal, and the data in the whole system are jointly maintained through each node; the second is openness, except for encrypting the private data of the parties to the transaction, the whole system is transparent, and anyone can access information data or extend new applications through the public interface; the third is autonomy, which is based on relevant norms and protocols to realize the data related to product exchange among the nodes of the management system in a trusted environment, gradually transforming the trust between people into the trust between people and machinery, and free from human factors; fourth is information immutability, which means that when the information is authenticated and saved to the database, it is permanently saved, and when the nodes of the simultaneous control system are less than 50%, the modification is invalid. The fifth is anonymity, each node follows a fixed algorithm to perform the exchange between each other, and the nodes of the transaction can be trusted by each other without disclosing their identity information.

2.2. Framework of Blockchain

The blockchain architecture is usually divided into six layers, each of which performs a separate but indivisible core function to create a trust mechanism [5].

The data layer starts with a "creation block", after which similar new blocks are strung together to build a master chain, which is continuously extended with the addition of new blocks and has various technologies, such as hash functions, timestamps, etc. [6]; the nodes in the network layer are able to receive and produce information and communicate with each other through a common blockchain. maintain communication between nodes, which is implemented to exchange information between nodes in the blockchain network [7]; in a decentralized environment, the consensus layer enables decentralized nodes to reach consensus in the system for data validity [8]; the incentive layer mainly provides certain incentives for nodes to participate in blockchain maintenance and other tasks [9]; the contract layer specifies how each node conducts transactions and the various details involved in the transaction process, like smart contracts, script codes, and so on [10]; the application layer implies the implementation of blockchain technology in real life, which supports various application scenarios and blockchain cases [11].

3. FRESH FOOD TRACEABILITY

3.1. Fresh Food Definition

Fresh food refers to fruits and vegetables, meat, aquatic products, cooked food, etc. It is classified as a primary product, a product that has not been baked and other processes, but simply preserved and organized for sale on the shelves, of which the most representative is the "fresh three products" of meat, fruits and vegetables and aquatic products.

3.2. Status of Fresh Food

Fresh food is essential in consumers' daily life, and with the continuous improvement of living standard, consumers' demand for fresh food has gradually increased. By reviewing the relevant data (Figure 1), the largest production is vegetable production, which increased from 597.666 million tons in 2011 to 749.129 million tons in 2020, with a growth rate of 25.34%; fruit production increased the most significantly, from 210.886 million tons in 2011 to 286.923 million tons in 2020, with a growth rate of 36.51%. It proves that the production of fresh food is growing steadily.

3.3. Fresh Food Safety Traceability System

In the fresh food supply chain, the traceability of fresh food is achieved to ensure product quality. Based on this, following the principle of "one step forward, one step back", the traceability of fresh food is theoretically realized: the information related to the production of fresh food is tracked and traced during the production, processing and sales of fresh food, which gives the traceability of fresh food. Combined with national food safety standards, the framework of fresh food traceability system can be derived (as shown in Figure 1)

However, the implementation of the food traceability system will have the following problems: 1) the past traceability information claims still remain at the low level stage such as date, quality level, additive content, etc., but products with traceability should also have high-level information such as staff involved in the production process, which poses challenges to the automatic information collection technology and data storage technology, etc.; 2) if we want to improve the supervision of the centralized food traceability system level, an authoritative institution needs to intervene and act as a third-party trust intermediary, which not only affects the operational efficiency of the system but also affects the normal operation of the system because of the security of the central server; 3) the information exchange between enterprises relies on the third-party trust intermediary, however, the transparency and trustworthiness of information exchange between enterprises is not ideal due to the declining social credibility of the regulatory authority.

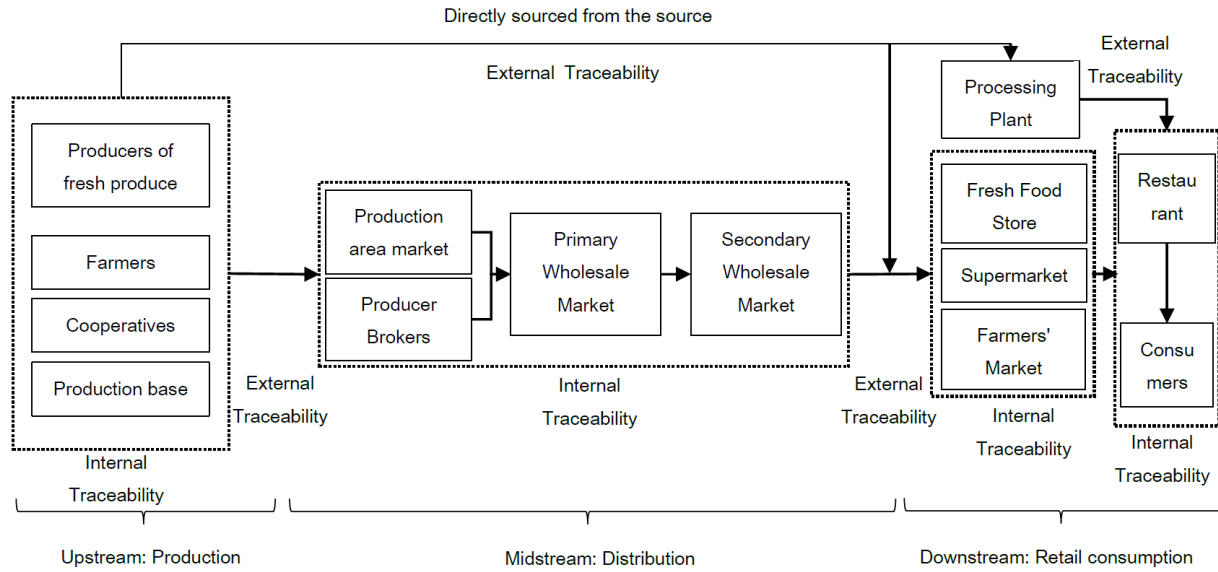


Figure 1 Fresh food traceability system

4. APPLICATION OF FOOD SAFETY TRACEABILITY SYSTEM BASED ON BLOCKCHAIN TECHNOLOGY

The main links of the fresh food traceability system are briefly introduced above; the workflow of food traceability, including the main chain participants such as suppliers, processors and distributors, will be introduced in detail below, taking the supply of pig food as an example [12].

Production link: in this link is mainly the farm. The farm employees enter the identification information of livestock into the system, complete the construction and archiving of the product information system, and then improve the specified information of livestock, including birth, vaccine, sales, and other related information. When the livestock flows to the next node, the current node enterprise needs to send a transaction application to sign a smart contract inside the blockchain with the next node, and the system automatically manages the authorization between the receiving nodes and records the data all transaction development process after the transaction is completed, and the next node comes to be responsible for the maintenance and update of the company's product information. In addition, in the production link needs to comply with a series of relevant regulations, so the production link should also include the government quality inspection department and has the right to check the product information and to certify whether it is qualified by private key.

Processing: The initial processing in this segment is mainly in the slaughterhouse. After receiving the livestock, the slaughterhouse is licensed to maintain and update the product information, which mainly includes information on the origin, slaughter, testing and retention, and sale of the livestock. Among them, the testing and

retention information requires the participation of food testing related certification department and electronic signature to certify the safety of the product. In the post-processing is mainly product packaging. It mainly includes material, time, weight and other related specified information. At the same time, it is necessary to generate labels with basic product information to provide an entry point for the majority of consumers to inquire.

Logistics link: This link is mainly for logistics and transportation companies. Relying on the mature logistics and transportation positioning system, accurate geographical information is provided. The company acting as the transport needs to supplement the information related to transport, including the form of transport, in and out of storage time, location and other information. Products are usually managed in batches, like containers and other large storage spaces, so product information should include the identification of the storage space, which can meet the company's batch management and also update the safety and epidemic prevention information of the products.

Sales link: This link is mainly for marketing companies. The products may take direct sales or multi-level distribution and other ways to reach the retail link, so the company needs to enter the information of product source, sales time and price in the system to ensure the completeness of product information in the system and also to ensure the timeliness of system information update.

Traceability link: This link is mainly designed for consumers. When consumers choose the products, they can access the product information and obtain the necessary basic information through methods such as labeling information on the outer packaging, bar codes and QR codes.

If a food safety accident occurs, it is mainly managed by law enforcement departments, and government departments can obtain higher authority through private keys to investigate and study the details of the products in the process from breeding to consumption, from which the origin of the safety accident problem can be found, or by improving the accuracy of the information of the logistics company of the products, so as to recall similar problematic products and ensure consumers' physical safety and rights maintenance.

5. CONCLUSIONS

Based on the working principle and 5 basic features of blockchain, this paper combines with the food traceability system to establish a fresh food traceability system, and verifies the timeliness and security of the scheme in the form of examples to improve the anti-tampering ability and solve some problems of fresh food traceability. From fresh food production, processing to transportation, sales and consumer and law enforcement traceability at every step to ensure product information traceability and find the source of food problems in a short time, so that blockchain technology can play its advantage in the fresh food traceability process.

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