Research Article
Research on Fresh Produce Food Cold Chain Logistics Tracking System Based on RFID

Qu Yan

Shandong Yingcai University, Jinan 250104, China

Abstract: The development of food cold chain is associated with people's lives, there's distance between the current level of cold chain logistics construction and social development, but food quality and safety problems caused by uncontrollable logistics sectors are also intensified increasingly. In this study, we discusses the application of RFID in the cold chain logistics of fresh products in all aspects of production, processing, storage, transportation, sales and proposed RFID-based fresh produce cold chain traceability system from the view of food safety by combing the development of fresh produce cold chain logistics and related literature. We expect fresh produce cold chain traceability system can ensure fresh produce safety from farm to the table, which may be a reference to the development of China's food industry.

Keywords: Cold chain logistics, fresh products, RFID, tracking system

INTRODUCTION

Cold chains are common in the food and pharmaceutical industries and also in some chemical shipments. One common temperature range for a cold chain in pharmaceutical industries is 2 to 8°C. But the specific temperature (and time at temperature) tolerances depend on the actual product being shipped. Unique to fresh produce cargoes, the cold chain requires to additionally maintain product specific environment parameters which include air quality levels (carbon dioxide, oxygen, humidity and others), which makes this the most complicated cold chain to operate. Food is the basis for the maintenance of human survival and development, food safety concerns for sustainable development of the national economy, which impact the government's prestige and stability of the society. In recent years, China has experienced a series of major consumers of food safety incidents, such as "Red Duck", spices isolated "Sudan", "turbot" event, Fuyang "Big Head" inferior milk powder. "clenbuterol "poisoning, etc., which are not only a threat to consumers' health and life, but also harm society (Wang *et al*., 2012). Our country has a large population, the per capita consumption of fresh products account for a large proportion of the total food consumption and cold chain logistics is an important way to ensure the safety of fresh produce (Golan *et al*., 2004). However, Some problems such as China's high cost of fresh produce cold chain logistics, the lack of transport process monitoring, the lower level of management, logistics facilities, equipment and technology, which are all resulting in a fresh produce quality and quantity of product damage during delivery, causing consumer decline in consumer quality, undermining the satisfaction of consumer. The introduction of RFID technology in the food industry to ensure the effectiveness and accuracy of the information collected to strengthen all levels of food safety and monitoring and management, coordination of multiple aspects of the food chain and increase the transparency of food sectors to ensure food safety.

In this study, we discusses the application of RFID in the cold chain logistics of fresh products in all aspects of production, processing, transportation, storage, sales and proposed RFID-based fresh produce cold chain traceability system from the view of food safety by combing the development of fresh produce cold chain logistics and related literature.

MATERIALS AND METHODS

Fresh products cold chain logistics development situation in China: Fresh products are also known as perishable goods, are difficult to preserve, including fruits and vegetables, meat, aquatic products and processed foods into four categories. Fresh products are characterized mainly in perishable damaged, save cycles, value primarily through its "fresh". Cold chain logistics refers to the sensitive food which always stored in low temperature environment in production, storage, transportation and sales to ensure the food quality reduce the loss of food logistics system. Compared with developed countries, China's cold chain logistics development started late, low-level, but also in its infancy. In recent years, although the growth of the industry, investment and gradually improve the cold chain system, the scale and systematic cold-chain logistics system has not yet formed, there are some problems exist in cold chain Logistics:

Firstly, infrastructure construction, cold storage facilities and cold chain equipment of cold chain logistics is seriously insufficient, existing facilities obsolete equipment, now new high equipment costs, development and distribution of inequality cannot provide protection for low perishable food distribution system, 80 to 90% of the preservation of perishable foods are ordinary trucks and lack of technical standards, low in technical content (Lin *et al*., 2012).

Secondly, the current implementation of the cold chain is lack country or industry standards, cold chain technology in many types of food cannot be fully applied, the food distribution process cannot be real-time tracking, monitoring and management is not conducive; and there is a serious imbalance between upstream and downstream because of lacking overall planning and integration of cold chain industry, which making the food cold chain resources integration difficulties. The situation cause about 20-25% of fruit and 30% of vegetables rotted in transit transport and storage every year, which the total reached a million tons per year, more than 75 billion Yuan in direct economic losses (Shangmei and Xuemei, 2013).

Study on fresh product traceability chain logistics:
Traceability is the ability to trace the history, applications, host sites or similar products or activity by using the historical identity has been recorded (Yang, 2009). Traceability System refers to the ability to protect the product safety from production, processing to consumers by recording relevant information stored in the system. When it comes the product quality problems, you can query links problems occur, the product recall and to take corrective measures, thus ensuring the quality and safety of food. Food safety traceability system can manage all aspects of the food supply chain and be retroactive to manage security system by using the technology such as coding and automatic identification technology, which is based on the quality and safety management system based on Li (2009).

Domestic scholars focused on the issue of logistics traceability of food supply chain traceability systems applications. Zhao *et al*. (2012) designed fresh produce traceability system based on the two-dimensional code recognition phone quality and safety; Zhang *et al*. (2012a) proposed the RFID technology, wireless data communication technology, network technology and database technology used in design traceability system for food safety testing; Fengtian (2012) constructed vegetables supply chain security systems a vegetable security RFID-based supply chain system; Zhang *et al*. (2012b) developed Akzo apple quality and safety traceability system based on RFID, GIS, database, NET, JSP technology by taking Xinjiang Aksu apple as a example, but few studies is about the introduction of the RFID traceability chain logistics fresh products to solve the problem. Therefore, we introduce RFID in cold chain logistics to monitor all aspects of the fresh products in produce, cycle, sales and so on, which is

currently an important issue worthy of study to ensure the entire flow is safe, efficient and transparent (Wang and Ao, 2012).

RFID (Radio frequency identification) commonly known as electronic tags, is a non-contact automatic identification technology implemented using radio frequency communication. It uses radio frequency signals to automatically identify the target object and its information signs, registration, storage and management, the whole recognition process can work in a variety of harsh environments without human intervention. It characteristic of long-range identification, can use in any environment, content renewability, batch read, large capacity and easy to imitate, etc. In recent years, RFID technology is developing rapidly. According to the latest research says IDTechEx, RFID market-including passive and active RFID tags, readers, software and services - from this year's $ 7.88 billion in 2013 to grow to $ 9.2 billion, indicating that the market within a year will grow 17%.

RESULTS AND DISCUSSION

The Establishment of food cold chain logistics traceability system can be easily real-time tracking, tracing inquiries for the staff on all aspects of the whole process or supply chain system, which provides a solid protection to ensure the quality and safety of food by, ensure the continuity of the whole food chain traceability. We provides a full visual tracking platform for the enterprise to reduce costs, improve the flow of regulatory efficiency and eventually protect the cold chain of food safety by combing the business processes, logistics processes and monitoring traceability management. The design of the system shown in Fig. 1.

Production and processing sectors: The sector is mainly the management of the production and processing of fresh products, when the fresh product processing is complete and packaged into finished products, RFID tag identity is affixed in the bag and recorded in the data storage warehouse, which realize the fresh product identification and traceability. Such as the fresh variety, origin, animal feed products, such as the name and number of times, the use of disinfectants and other vegetables and fruits, such as application of fertilizer, exposure time, etc. All these information closely related to health and safety of consumer is data analyzed and can help to find the reasons for the rapid identification of product failure, the quality of the raw data for future traceability.

Transport links:

- RFID tag is attached in the configuration container truck refrigerated containers. When fresh produce packaging into refrigerated containers, boxes IDS
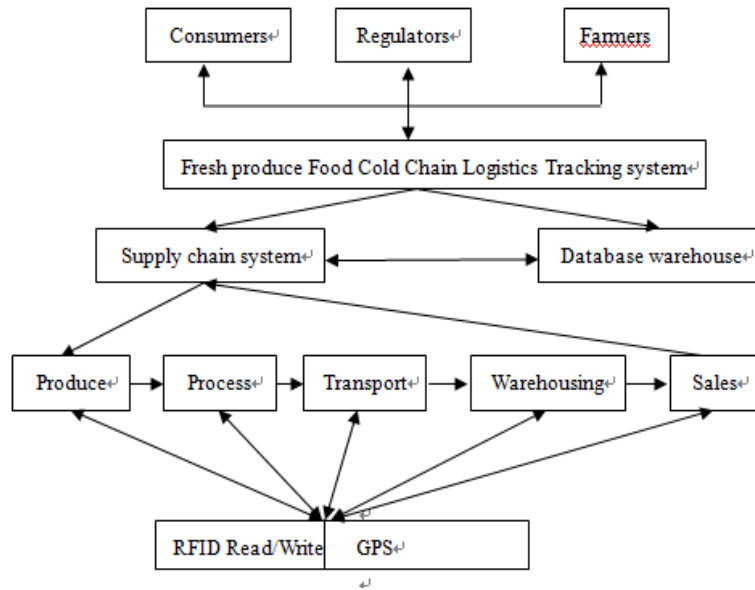
Fig. 1: Food cold chain logistics traceability system

associated with fresh produce refrigerated container ID; when refrigerated containers are placed into the container truck, refrigerated containers establish ID (RFID electronic tags) and truck ID (RFID electronic tags) associated, which help to prevent the theft, transfer packages and other problems by real-time location of goods.

- Intelligent refrigerated containers are used in fresh produce cold chain equipment, which can monitor the internal temperature, humidity and gas concentration and transmit real-time temperature changes inside temperature control center, the control center responsible for Smart Car information exchange terminal, the staff can cool down or heat up measures quickly to determine the fresh products storage environment during transport safety once background monitoring alarming.

Warehousing sectors:

- **Warehousing operation:** Fresh products in bulk packaging into the freezer after entering the warehouse turnover store, RFID electronic tags of refrigerator freezer associated with the internal packaging of fresh produce identity ID and writes related data and information into warehouse server.
- **In house operations:** We develop storage equipment, environmental monitoring intelligent storage environment temperature and humidity and gas concentration monitoring to determine whether storage environment is in safe state. In order to guarantee the safety of fresh products we must monitor the temperature and humidity of the storage environment and develop temperature and humidity monitoring active RFID electronic tag to realize the identification of fresh product itself at

the same time, the monitoring of the temperature and humidity of the raw product itself, in the end, The system send ID information about temperature and humidity information of fresh products to the server through the Wi-Fi.

- **Unloading operations:** After the application of RFID technology, Warehousing management system first check the fresh product information and complete unloading after get order information of consumers, which similar to warehousing operation.

Sales link: RFID tags on fresh produce packaging can effectively prevent the emergence of fake and shoddy products and monitor finished products and semi-finished products effectively. Consumers can view fresh product information on the terminal purchased in the supermarket, relevant information can even be traced through mobile terminals such as smart phones to scan two-dimensional code and now most supermarkets can be achieved in this way and most of the farmers' market can be achieved if the fresh produce is unified distributed by the country.

Database warehouse: Warehouse database includes the following relevant information, such as fresh produce and sample classification library, production units of fresh products attribute database, fresh product safety standards and safety indicators, fresh products production and management information, fresh product safety monitoring and test data.

Supply chain system: This link is mainly for warehousing and logistics management to establish traceability system in production, processing and

supply chain stores through RFID. In the logistics chain, information is recorded on pallets or goods box labels, RFID systems can be clearly got their position cartons on pallets or individual items, identity, storage and transportation history, destination, duration and other useful information. RFID systems can provide actual goods supply chain detailed data and establish a physical link between the goods and their full identity, these reliable information is collected by RFID efficiently and be fed back into the production, processing timely to guid production.

CONCLUSION

Fresh products reach consumers through the production, processing, warehousing, distribution and other series of links, fresh product chain logistics traceability system is an important measure to ensure food security. The application of RFID technology to process fresh produce cold chain, each link enables real-time security monitoring, the whole process is completely visual, which also makes the entire fresh produce supply chain logistics process is greatly simplified and effectively protect the safety of food. while government regulators can also trace the entire production and distribution process quality monitoring by means of cold chain logistics system platform and release the latest safety and production standards to farmers, production and processing enterprises and supermarkets timely. Currently, the cost of RFID is still a major bottleneck restricting the development of RFID technology; I believe that RFID technology in fresh products cold chain logistics security monitoring applications will be more widely applied with the further development of networking technology.

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