

# What Is Food Traceability?

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*M. Espiñeira*

ANFACO-CECOPESCA, Vigo, Spain

*F.J. Santaclara*

IDIS CHUS, Santiago de Compostela, Spain

## 1. Introduction

The traceability of the food sector has become a priority. It is essential to provide transparency and security to consumers who are demanding healthier products with a higher quality and the best nutritional characteristics. But it is also important for producers, because it ensures the quality of the raw material which is introduced into the food chain, allowing certification and accreditation of their products, quickly locating problematic items, and implementing control systems, preventing fraud and unfair competition between producers.

The legislation developed and the implementation of specific regulations on traceability have established control systems, both quality and safety, along the food chain, ensuring the quality of the products which are available in the market. This, coupled with the implementation of traceability systems in the food industry, has increased the transparency of the market, facilitating the opening of markets, the internationalization of many products, and the overall growth of the food industry.

## 2. What Is Meant by Traceability in the Food Industry

Traceability involves the ability to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward). Traceability allows the early warning for quality problems and hazards and efficient product recall when needed. Each trade unit of each food material is given a unique identifier which accompanies it and is recorded at all stages of its progress through its food chain. It allows the detailed monitoring of properties of food products as they are made and as they move through supply chains, from harvest through transport, storage, processing, distribution, and sales (IUFoST, 2012; Van der Vorst, 2006). Chapter 2 defines and analyzes the food supply chains, focusing in systematically mapping food supply chains and designing the information architecture of food traceability systems.

Despite the importance of traceability in food supply chains, there are several constraints and problems that make its implementation and application to long food supply chains difficult. Some of them are analyzed in Chapter 3, including the prevention of information loss, importance of standardization of information between different links

in the supply chain, or the effect of granularity levels and heterogeneous mixture of lots. In order to overcome these difficulties, new technologies have been incorporated to traceability systems, and specific applications which facilitate and expedite the collection and exchange of information between the different operators of the food chain continue their development.

### 3. The Need to Incorporate New Technologies in Traceability Systems

Currently, regional, national, and global networks and services are being rolled out to enable end-to-end traceability in food supply chains. To implement traceable food supply chains, technological innovations are needed for product identification, process and characterization, information capture, analysis, storage and transmission, as well as overall system integration (Chapter 4). This book describes and discusses the current technologies applied to food industry traceability, including future trends and examples of the effective use of this technology in the food sector.

A major feature of any traceable supply chain is the ability to trace back the history and consistently track the physical location of the products in the overall supply chain. Innovations in geospatial science and technology, such as radio frequency technology and mobile tracking devices, have the potential for collecting and transmitting data to distant locations for storage and analysis. Advances in identifiers and sensor and indicator technology, as well as changes in consumer communities, are setting the stage for further development within the food industry, as well as in the interaction of industry and end consumers. A summary of these recent developments is given in Chapter 4, highlighting potentials, critical points, expected trends, and interdependencies of this changing domain.

Among the technology for automated monitoring of processing, displacement, and storage of food items is the RFID (Radio Frequency Identification) technology. It has a great potential for traceability, logistics, supply chain management, and quick response systems. A review of challenges and opportunities of RFID technology applied to food traceability is showed in Chapter 5.

An effective traceability chain is an integrated system of distinct components involving data collection, the analysis, storage, and transmission of the recorded information, and a full backward and forward control system that permits the tracking of the product history. Such an integration of technologies relies on the application of appropriate information and computer systems and links the traceability chain to a central database (Opata, 2003). The software integration in food traceability is described in Chapter 10, where the benefits and specific needs for the food industry, both consumers and suppliers, are discussed.

In order to improve and optimize food traceability, it is recommended to implement in the traceability systems real-time tracking and remote monitoring at some stages. Chapter 11 shows how real-time tracking and remote monitoring can reveal, in many cases, the unseen issues, reducing the undesired situations, the handling of the goods, and the food waste. It also shows the implementations of the new information

technologies will provide intelligence to the traceability system which, combined with the most recent advancements, can create solid and reliable food traceability.

In the case of animals, two main components are required in the process of tracing: the technologies for the identification of animals and technologies for the storage and management of information. The working principles of these technologies are described in [Chapter 9](#), with a focus on the main issues that deal with the implementation of effective systems for the traceability of animals.

Another fundamental aspect in the traceability systems applied to the food industry is the control of the authenticity of the raw material or a processed product. Several analytical methods have been or are currently used to authenticate or trace foods ([Chapter 6](#)). These analytical methods are based on different technologies such as molecular methods, Near-Infrared (NIR) spectroscopy, and Inductively Coupled Plasma–Mass Spectrometry (ICP-MS), among others. Recent advances in genetic methods currently applied to traceability are described in the [Chapter 6](#), and its application in several food products is discussed. Also, [Chapters 7](#) and [8](#) are focused in the use of NIR and ICP-MS, respectively, including examples on the applications and uses related with authenticity and traceability in food products.

Recent advances in the mentioned technologies are included in each chapter, including future trends for the application of these to food traceability.

## 4. Regulations and Legislation on Food Traceability

In this growing global market, food supply chains are becoming longer and more complex. As a result, the tools of traceability become necessary in order to offer transparency to both consumers and food manufacturers ([Chapter 13](#)). For the same purpose, the regulation of traceability requirements and restrictions have been developed. [Chapters 12](#) and [13](#) summarize the current legislation in food traceability in the European Union and the United States, respectively.

[Chapter 12](#) describes the EU food traceability legislation, how it came into being, what the legal text entails, what the consequences of this text are, and if the approach of the legislature is consistent throughout the legal norms. It also evaluates if the legal text has weaknesses, because traceability systems implemented as minimum requirements of this text can be ineffective, and supply chains may thus become vulnerable to fraud.

On the other hand, [Chapter 13](#) summarizes the current legislation in force in the United States, as well as the ongoing development of legal requirements, guidance, and rule-making at the US Food and Drug Administration (FDA) to meet the legislative requirements in the Food Safety Modernization Act of 2011 (FSMA). The chapter also shows the perspective on future developments in this area, working to develop further standards in a global context.

One of the complications in food traceability affects products internationally, since legal requirements and regulations are different in each world area. This examination led the authorities to note the importance of harmonization of traceability requirements and regulations to minimize the potential for misunderstanding and delays due to the difficulties in understanding the practices of each country. At present, efforts are being

made to strengthen interoperability in order to overcome unintended trade restrictions and to improve traceability of food products globally (Charlebois et al., 2014).

## 5. Effective Use of Food Traceability

One of the most important applications of traceability is the return of a dangerous product that has already been supplied or made available to consumers by the producer or distributor (Chapter 14). Traceability is essential to guarantee the location of products and facilitate their recall when safety and quality standards have been breached (Opara, 2003). Chapter 14 provides an overview of the product recall process and explains how food traceability can be effectively used in product recall. It also explains how the recall process can be optimized by reducing the batch dispersion and root cause analysis through the traceability system.

Other effective use of traceability in the assurance of food quality is the authentication of the origin and composition of foods. It guarantees the origin and good production practices in the elaboration of foods for human consumption. Chapter 15 is focused in the use of traceability in evaluating origin claims. It describes and discusses the target analytes and analytical procedures used to discriminate foods from different areas or production methods. It includes examples of some of the most commonly evaluated foods for origin claim.

In addition to the development of international sourcing and markets, additional factors such as increased out of season demand and ethnic diversity of resident populations, have resulted in the increased requirements for a wider and deeper (specialist product) range on offer in more countries across the world, leading to the need to access a wider source origin of supply. This book describes the application of the traceability through different food chains, showing the greatest difficulties associated with each sector, the methodologies used, the most recent advances, and future prospects focused on that sector or particular application.

Another staple are cereals, and high demand generates the substitution of the cheaper cereal grain with the more expensive one or adding inferior cereal grain to the premium one, resulting in extremely widespread adulteration or mislabeling of cereal grain. Chapter 16 provides an overview concerning the current and the most effective uses of different analytical techniques that have been developed for determining the geographical origin in order to discriminate different origins of cereal grain, confirming their authenticity. Its advantages and limitations are discussed, and future trends are described.

The meat (and livestock) sector has been at the forefront of policy and industry developments concerning traceability. In a large part, this is due to the outbreak of several food safety crises that have affected this sector in recent years. It had served to focus public attention on food safety but also stimulated demand for more information on the source of food products and the production and processing methods in use within food supply chains. Chapter 17 examines the roles, outcomes, and implications of traceability in meat and livestock supply chains. It examines public and private sector approaches to meat and livestock traceability and discusses the implications for its effective use in meat supply chains.

The authenticity assessment in dairy products is an important issue not only to the economic point of view, but also to medical requirements, food allergies, or religious practices (Mafra et al., 2008). Traceability monitoring systems allow the safety and quality of food products across processing, packaging, storage, and distribution to be controlled properly. Chapter 18 focuses on the preservation of the quality of dairy products along the food chain. It introduces a monitoring protocol based on temperature sensors to track the environmental stresses experienced by dairy products during milk-run delivery tours. The aim of this traceability protocol is to assess the environmental and physical conditions experienced by dairy products during the transport and storage activities, identify criticalities, and measure the effectiveness of logistics and material-handling operations in addressing the quality and the shelf life of the dairy products.

In the case of animal feed industries, traceability can mean several different actions, such as the possibility to track a feed during production phases and to follow the distribution routes until the final destination. However, a key point for the safety and quality of a feed is represented by the type and characteristics of ingredients. For this purpose, one of the most innovative and popular technology is the DNA-based traceability, now widely accepted as playing a key role. Chapter 19 discusses the most commonly used methods to obtain an effective use of traceability in the feed chain, focusing on the identification of animal and plant species and/or genetically modified plants and on the presence of toxin-producing microorganisms. It also describes the future perspectives for feed traceability based on new technology advances.

## 6. Future Trends

The advances in food traceability and the effective use of traceability in different supply chains which are described in this book are a reflection of the ability of traceability systems as a tool to ensure safety and quality in the food industry. The constant improvement of the methodologies currently being used, the incorporation of new technologies, and the adaptation to the needs of the different food sectors will overcome the current limitations, providing greater efficiency, speed, and reliability in the traceability systems. All this will increase transparency and ensure that products reach the international market, promoting consumer confidence and the growth of the food industry.

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