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High-warranty traceability system in the poultry meat supply chain: A medium-sized enterprise case study

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ABSTRACT

The concept of food traceability can be traced back 5000 years to Egyptian society. Over the last decade, traceability has become recognized as an essential food safety and food quality tool. Food safety legislation and voluntary standards have delineated different traceability frameworks, which can be assigned to two models: a generic, low-warranty traceability procedure or a specific, high-warranty traceability procedure. The latter is based on the documentation of the material and information collected from an organization and among parties in a supply chain. A risk-assessment based approach is needed to determine the best traceability procedure for each food product produced by a specific organization. This paper focuses on a medium-sized enterprise case-study operating in the poultry meat supply chain. The benefits and difficulties of implementation of a traceability system were discussed. This surveyed case-study provides a partial explanation as to why traceability in this sector is mainly being driven by food safety regulations, even if it also has potential as a visible value-added marketing tool. The lack of process automation is the underlying reason for complex implementation of a specific high-warranty traceability tool. A perspective schematic of straightforward traceability implementation is finally illustrated.

1. Introduction

Information on the origin of food has always been important to consumers. In Egyptian society during the pre-dynastic age, wine was put into an earthenware amphora sealed with clay. On the amphora the provenance vineyard and the year of production were indicated (Bresciani, 1997).

The food supply chain is constantly changing, as are the incidence and type of foodborne diseases afflicting modern-day society (Raspor, 2009). Consumer concern about threats associated with food is growing and food traceabilty has become a key tool to increase consumers' trust (Van Wezemael, Verbeke, Kügler, de Barcellos, & Grunert, 2010).

Traceability is the ability to track the location history of a product, including the materials used for its manufacture (raw materials, ingredients, additives, packaging materials), related information (quality and safety specifications for the materials used, equipment used, processing parameters) and responsible organizations (organizations involved in the feed and food chain). It is a technical tool to assist an organization to achieve several objectives (Donnelly & Olsen, 2012; Kondo, 2010; Peri, Lavelli, & Marjani, 2004, chap. 11; Smith et al., 2005). The main functions of traceability embrace the principles of managing accidental safety risks, gaining consumers' trust, and supporting quality improvement. Additionally, Smith et al. (2005) reviewed the uses of traceability systems to ensure animal well-being and Kondo (2010) showed a perspective role of traceability in achieving precise agriculture. A more detailed description of these points is shown in Table 1.

Golan, Krissoff, and Kuchler (2005) described that food organizations develop traceability systems differing in: a) breadth, i.e. the amount of information collected; b) depth, i.e. how far back and how far forward the relevant information is tracked; and c) precision, i.e. the degree of assurance with which the traceability system can pinpoint a particular food product's movement or characteristic.

Under European Union Law there are different definitions for "traceability", which can be allocated in two opposite models. According to the simplest definition that is present in the Regulation (EC) 178/2002, 'traceability' means the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution. Food business operators must maintain relevant information from their suppliers and must keep records of their delivery to customers, i.e. must track one step forward and one step backward for their organization in the supply chain. Compliance with this Regulation does not require internal traceability within an organization, where blending or fractionation

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Table 1
Purposes of traceability systems.

General aims	Specific aims
To effectively manage accidental safety risks	• To isolate the source of food safety problems and limit its diffusion • To minimize costs for product recalls and withdrawals
To gain maximum consumers'/ customers' trust; to facilitate value-based and value-added marketing	• To identify the companies that are involved in food production and are responsible for its safety/quality • To enable quality claims (especially "credence attribute"[a]) to be verified • To comply with country-of-origin and international customers' regulations
To promote quality improvement within an organization and a supply chain	• To facilitate problem-solving based on objective records • To facilitate exchanging information among parties in a supply chain
To support animal well-being	• For surveillance, control and eradication of animal diseases • For biosecurity protection of the national livestock population
To achieve precise agriculture	• To record useful data for intelligent farming guidance

[a] "Credence attributes" are characteristics that consumers cannot discern even after consuming the product", such as: "country-of -origin, free-range, earth-friendly, not fed antibiotics, no added hormones, fed a vegetarian diet, etc". For these attributes, record-keeping, auditing and validation are essential elements of verification.

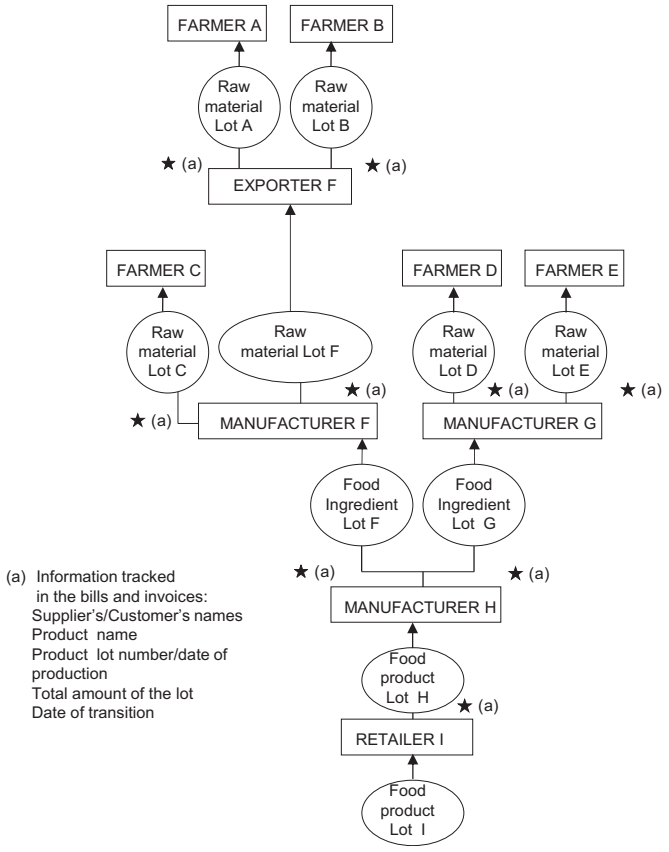

Fig. 1. A generic, low-warranty traceability plan for a food product. ★ = information capture points; (a) information to be captured.

of inputs generate loss of the identity of the resulting outputs. For the sake of argument, Fig. 1 represents a framework for this traceability system, which can be applied for instance to bread processing. For a single unit of bread (lot I in Fig. 1) that is present in a retailer, the name of the baker (manufacturer H) can be traced, since the retailer has to be able to trace back one step. The baker shall trace the lots of flour received from his suppliers (lots G and F in Fig. 1). However, the baker is not obliged to trace the history of each flour lot and link it to the bread obtained. Indeed, the baker can blend flour lots having different origins to standardize the technological characteristics of the flour, or can blend or split flour lots to obtain the adequate quantity for production capability. In the case of contamination of one of the flour lots used for bread production, the baker shall recall or withdraw from the market all the bread potentially produced from that lot. Since it is not possible to distinguish the history of the contaminated flour lot, the amount of bread to be recalled/withdrawn is larger than that which is actually contaminated. In any case, this procedure is suitable for foods that can be considered as having a low risk of contamination. It can be concluded that the application of Regulation (EC) 178/2002 leads to a generic (nonspecific) low-warranty traceability of the food supply chain.

A second, more complex definition for traceability was that introduced by the Regulation (EC) 1760/2000 establishing a system for the identification and registration of bovine animals and rules for the labeling of beef and beef products. An explicit definition of traceability is not provided by this Regulation, but it establishes a system which fits the ISO 22005 definition of traceability as "ability to follow the movement of a feed or food through specified stages of production, processing and distribution" (this latter definition was also adopted in the Regulation (EC) 1935/2004 on materials and articles intended to come into contact with food). In fact, operators and organizations marketing beef in the European Community are required to track the link between the meat and the animal from which it was derived. This is illustrated in Fig. 2, which shows the flow of materials and information among operators of the bovine meat chain from the animal to the beef product. The application of Regulation (EC) 1760/2000 leads to a specific, high-warranty traceability system for any product unit in the food supply chain. This latter traceability system can also be applied in other food production sectors based on a voluntary option, in compliance with the ISO 22005 standard. The effectiveness of this traceability system is based on the implementation of the internal traceability, which allows continuous identification of product location, history, destination and technical specifications during processing.

The above-mentioned traceability systems, either "generic" or "specific", are two opposed models to which a food organization shall conform depending on the regulations applicable to its sector, to its customers' requirements, and to its internal objectives and its own technological and economical resources.

The objective of this paper is to present a case-study on internal traceability, which facilitates discussion of both the advantages and difficulties of setting up this high-warrant traceability procedure.

2. Methodology

Preliminary information on the selected case-study were gathered from internal documentation from a company, namely HACCP procedures and records. A traceability procedure was developed according to the basic requirements of the international standard ISO 22005. Various audits were conducted to verify the process flow sheet and the flow of materials in the selected plant, with particular attention to operations such as lot splitting, mixing and recycling. This allowed identification of the information to be