Journal of Food Engineering 102 (2011) 1–8

Contents lists available at ScienceDirect

Journal of Food Engineering

journal homepage: www.elsevier.com/locate/jfoodeng

Granularity and its importance for traceability in a farmed salmon supply chain

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ARTICLE INFO

Article history:
Received 30 March 2010
Received in revised form 15 June 2010
Accepted 25 June 2010
Available online 21 August 2010

Keywords:
Granularity
Critical traceability points
Chain traceability
Internal traceability
Farmed fish
Fish feed

ABSTRACT

Identifying the optimal granularity level of traceable units is necessary when implementing traceability of food. This study examines granularity in a farmed salmon supply chain through the qualitative methods interview, observation, and document analysis. The results show that fish feed and farmed salmon can have fine or coarse granularity of the batches. Fine granularity will give large numbers and smaller batch sizes. Coarse granularity will give fewer numbers and bigger batch sizes. The granularity correlates to different levels depending on the application of information within a company and between companies in supply chains.

1. Introduction

Opara and Mazaud (2001) brought up a central question when it comes to implementing traceability of food; what entity to trace? The size of this entity will be different depending on the application of information (Moe, 1998). An application of information for quality and process optimization purposes may demand smaller entities. According to Senneset et al. (2007), it is advantageous when units have equal properties, in order to have control over production processes, statistical verification processes, and issuing quality certificates. A simpler traceability system can be developed depending on different factors. Such a system can be used when the risk of contamination is low (Storøy et al., 2008), or when the requirements for controlling production processes are less stringent. One of the reasons for increased focus on traceability is to reduce the number of recalls (Dupuy et al., 2005). The key is to design a traceability system that offers the right degree of information at an acceptable cost (Cheng and Simmons, 1994).

According to Kim et al. (1995), it is not possible to trace an entity before it is a Traceable Resource Unit (TRU). TRUs are entities with similar characteristics and that have gone through the same processes. It is difficult to define TRUs with never-ending batches because there are no starting and stopping points in the production (Moe, 1998).

To be able to trace foodstuffs it is essential that the different granularity levels of the traceable units are defined (Bertolini et al., 2006). The granularity can be at different levels depending on the application of information by companies in a supply chain, regulators, and customers (Bollen et al., 2006), and the level of granularity affects the precision of product traceability (Riden and Bollen, 2007). For example, the use of smaller batches can limit the number of batches affected when a recall is necessary (Storøy et al., 2008). The benefit of finer granularities in the units is the ability to add more information to the units (Bollen et al., 2007). Finer granularity will increase recordings of information, which can be a disadvantage if a company has to carry out a high number of manual recordings. Electronic recording technology is preferred, given that it provides efficient information recordings.

The definition of batch size for a product must be determined before any information can be linked to the product and be traceable (Bertolini et al., 2006). Karlsen et al. (2010) and Global Solution One (GS1, 2007) described this in more detail and pointed out that the sizes of three different traceable units should be defined. These units are (i) batch, (ii) Trade Unit (TU), and (iii) Logistic Unit (LU). Batch is the quantity of product going through the same processes. In some sectors this is called lot, which is a grouping of resources to one unit (Steele, 1995). TU is the smallest traceable unit distributed between two companies in a supply chain (Storøy et al., 2008). Several TUs can be packed together in an LU.

No published research papers have been found discussing different granularity levels of traceable units while implementing food traceability. The aim of this study is to identify the critical traceability points (CTPs) of fish feed and farmed salmon (*salmon salar*) in general, and to identify different granularity levels of fish feed and farmed salmon in particular. A CTP is a point where systematic information loss occurs when information about a product or process is not linked to a product and recorded systematically

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doi:10.1016/j.jfoodeng.2010.06.022

(Karlsen et al., 2010). The results from this study could be used to provide input when designing an electronic traceability system for food and in practical implementation of food traceability.

First, this paper describes the method used in the study. Next, the production of fish feed and farmed salmon is described, including a presentation of how to achieve improved traceability for the studied products. Then, different granularity levels for fish feed and farmed salmon are discussed, and finally, the most interesting findings in this study and implications for future research in this area are presented.

2. Method

One fish feed factory (FeedCo), three suppliers of ingredients in fish feed (IngredCo) and a salmon farmer (SalmCo) in Europe were included in the study. These companies had a supplier-customer relationship.

A method to identify the CTPs in the studied supply chain was made. Fig. 1 outlines each stage of the critical traceability point analysis (CTPA) used in the study. Karlsen and Olsen (submitted for publication) describe CTPA in more detail.

The case study relies on the qualitative methods interview, observation, document analysis to identify the CTPs, so-called triangulation (Denzin, 1989). Triangulation is a combination of several methods used in a study (Denzin, 1989; Yin, 2003). All methods have weaknesses and strengths. By using triangulation, the weakness of one method will be compensated for by the strength of another, which can supplement this weakness (Jick, 1979). Triangulation will increase the validity of the data in the study. Case studies relying on qualitative methods are useful when it comes to collecting real industry data and developing knowledge in a field (Näslund, 2002; Sachan and Datta, 2005; Spens and Kovàcs, 2006).

3. Results and discussion

The aim of this study was to identify CTPs and different granularity levels of fish feed and farmed salmon.

3.1. Production and delivery of ingredients

The ingredients fishmeal, fish oil, wheat, soya meal, pigment A, pigment B, vitamin premix, and mineral premix were used to produce fish feed for farmed salmon at FeedCo (see Table 1).

3.2. Production of fish feed

FeedCo produced 24,000 tons of fish feed annually, and its production capacity was 10 tons of fish feed per hour. FeedCo could produce 300–1200 tons fish feed per week (low and high sesong). The produced quantities of fish feed was dependent on the appetite of the farmed salmon. Salmon appetites are higher during the summer months due to higher temperatures in the sea.

FeedCo produced different types of feed for farmed salmon. The ingredients were stored in silos and tanks (Fig. 2), which had no identification markers (Fig. 3).

During production, different deliveries of fishmeal, wheat, and soymeal were randomly mixed. All the fishmeal in one silo was often used before a new delivery of fishmeal was received and refilled in the same silo. FeedCo carried out similar procedure for wheat. FeedCo had only one fish oil tank, thus different deliveries of fish oil were continually mixed in this tank. Pigment A, pigment

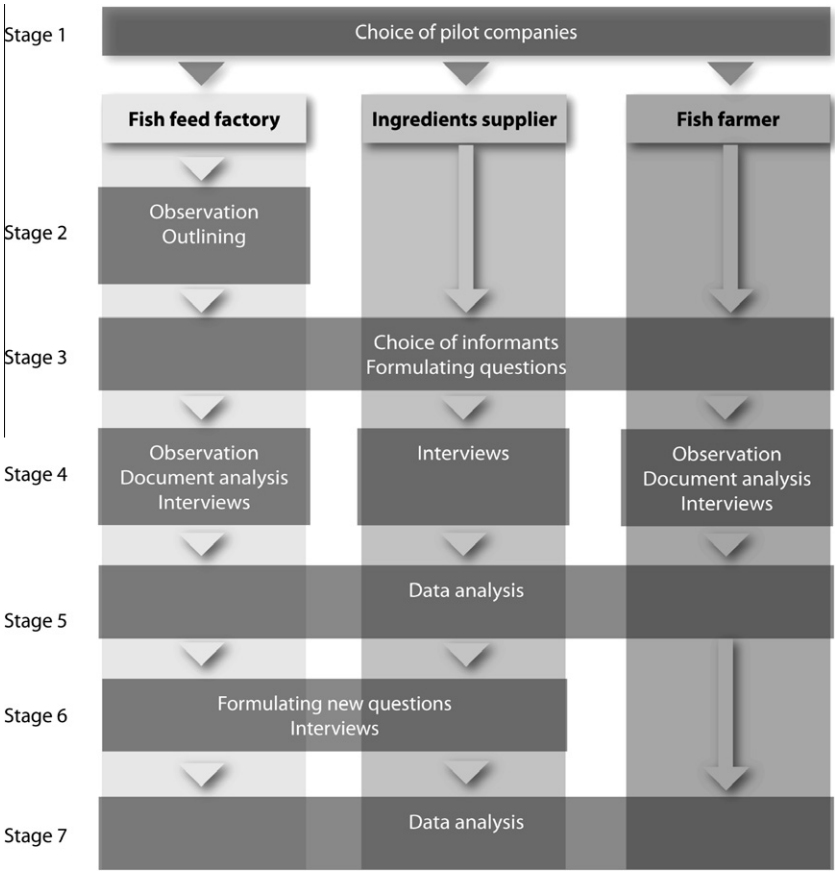

Fig. 1. Critical traceability point analysis (CTPA).