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Simulated recalls of fish products in five Nordic countries

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Abstract

Simulated recalls of fish products sampled in retailer shops were conducted in five Nordic countries to indicate the effectiveness and accuracy of chain traceability systems. The results suggested poor traceability practices at the vessels/auctions and revealed that batch sizes at the last traceable step of the raw material vary considerably. However, the existing traceable information seemed to be easily accessible. Altogether, the fish industry in the Nordic countries seems not to be fully prepared for a recall. Improved traceability awareness and practices in the whole chain can limit the batch sizes and minimize costs in case of a real recall.

Keywords: Simulated recalls; Traceability; Fish industry

1. Introduction

Food scares such as mad cow disease (BSE) in the UK beef industry in 1996 and the dioxin contamination in Belgium in 1999 have increased the demand for traceability (Derrick & Dillon, 2004; Frederiksen & Gram, 2003; The Standing Committee on the Food Chain & Animal Health, 2004). The inability to trace products through the food supply chain can ruin a company, as all the company's products will have to be removed from the market if the company cannot prove that certain batches of the product are not contaminated. Thus, traceability facilitates product withdrawal and recall by making it possible to trace a product back to its source, to identify other products affected and to locate the products in question.

The size of the batches at the individual steps in the supply chain is critical; large batch sizes may be cause for concern due to the value they represent. It would be beneficial for each step in a supply chain to determine an appropriate batch size based on e.g. the cost of having to destruct large batches during a possible recall, the cost of implementing traceability for smaller batches, and the expected frequency of critical faults. Apart from the costs associated with a recall, the damaging effect of a recall on the company's brand can be devastating. Limiting batch sizes creates the opportunity to be proactive and enable brand protection.

A truly functional traceability system includes both internal and external, or chain, traceability, as illustrated in Fig. 1. Not only is it necessary to be able to identify the immediate previous supplier and the immediate subsequent recipient of a company's product, but in order for traceability to be a useful tool for the optimization of processes and the utilization of traceable information, it is also crucial to be able to identify which raw materials came into

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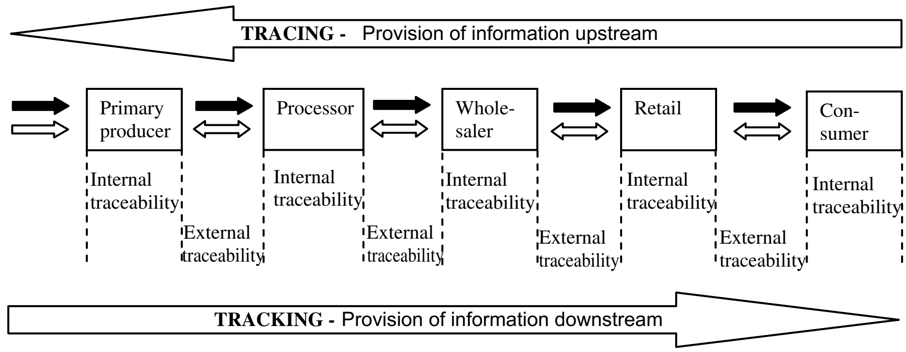

Fig. 1. Traceability along the food supply chain. Filled arrows show the product flow; open arrows show the information flow. Modified after Schwägele (2005) and GS1 (2006).

the company, which processes they went through, and of which of the company's final products they are a part (Moe, 1998; Storøy, Forås, & Olsen, 2007). Lastly, the usefulness relies on these identifications being a part of the standard operating procedures of each company in a supply chain. Otherwise, the batch size to be recalled will be larger than necessary. In such cases, the traceable information may primarily be useful only for recall purposes.

In addition to limiting the cost of a recall, specific pieces of information made available by traceability can be used actively towards the consumer for storytelling and internally for industrial statistics and chain management. Thereby, traceability also becomes a tool to create a higher product value.

External, but not internal, traceability is a requirement of Article 18 in the European Union's Regulation (EC) No. 178/2002, effective January 1, 2005, which states that all food products must be traceable one step forward and one step back at any point in the supply chain (excluding sales to the end consumer) (Anon, 2002b). This regulation applies to all food business operators residing in an EU member country. The United States has imposed similar requirements via the Bioterrorism Act of 2002 (Anon, 2002a).

There is a limited amount of literature on simulated recalls in the food industry. Recently, Karlsen and Senneset (2006) have developed a method for conducting a survey to test the fish industry's readiness to recall fish products. They found that 63% of the selected fish products could be traced back to the fishing vessel or breeder. In addition, they wished to establish the status of traceability systems in the Norwegian fish industry. Hence, their method also focused on the industry's use of GS1's Global Trade Item Number (GTIN) (EAN·UCC, 2002) and the TraceFish standard's GS1-based GTIN+ to identify trade units, the knowledge and application of the TraceFish standards (European Committee for Standardization, 2003a, 2003b), and the use of electronic information transfer.

The present study also focuses on testing the preparedness of the fish industry to successfully recall a product. However, the preparedness is evaluated not only in terms of the last traceable step of the raw material in the chain, but also in terms of the size of the batch at the last traceable step and the time needed to perform the recall operation. To achieve this aim, a simulated recall of a given number of fish products in five Nordic countries was carried out.

2. Methods

Simulated recalls were performed in five Nordic countries (Denmark, the Faroe Islands, Iceland, Finland, and Norway) in 2006–2007 based on a modified version of the method developed by Karlsen and Senneset (2006). Due to differing objectives compared to their study, the following points are not included in the present method: (a) mapping of the product information against the TraceFish standards, (b) investigation of how batches are identified throughout the supply chains and what kind of traceability systems the companies use, and (c) the number of times the researchers communicated with the companies. However, similar traceability logs to record information about the traced product are used in both methods.

Because of the changes made to the method, the present method is described step-wise below and schematically in Fig. 2. The step numbers refer to the steps shown in Fig. 2.

Step 1: Three to five fish products were chosen in each of the five countries. The products included at least one fresh, unprocessed fish product from an independent fish monger or a fish monger in a supermarket (shop-in-shop) and at least one frozen, unprocessed fish product from a supermarket. The rest of the product types and shop types were optional. Fish products caught in national waters or farmed nationally were chosen as this would best reflect the traceability levels in the particular countries. In this article, unprocessed fish is fresh or frozen either whole or filleted. Products that have undergone further treatment, including modified atmosphere packaging, are considered processed. For these products, only the fish/seafood was traced and not other ingredients such as spices, oil, batter, vegetables, etc.

Step 2 (A and B): Information that could be used to trace the product was noted from either the consumer package or, if the product was not in a consumer package, from interviews with the shop personnel. Examples of such information are (A) from the consumer package: name of

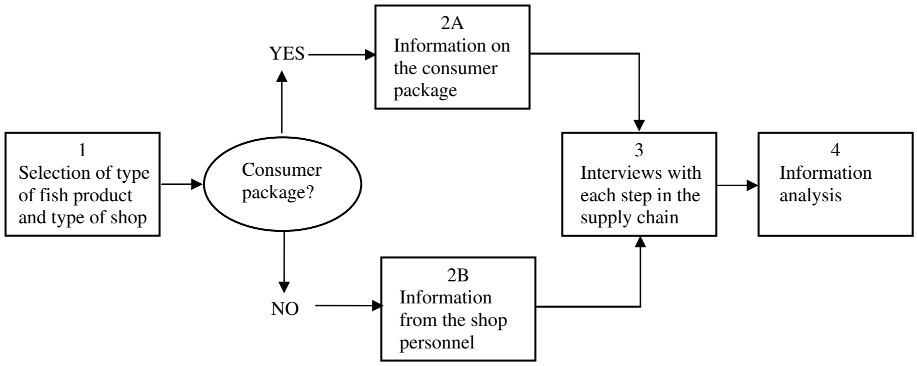

Fig. 2. Outline of the survey method. Modified after Karlsen and Senneset (2006).

brand owner, species of the main ingredient, country or area of origin of the main ingredient, internal batch number, and production date and (B) from the shop personnel: species of the main ingredient, name and telephone number of the shop/wholesaler from whom the fish was bought, invoice number, and batch size received from the previous shop/wholesaler.

Step 3: The brand owner/producer and each successive step backward were contacted by telephone to obtain the following information:

(a) the company name and telephone number of the previous step in the chain and a contact person at that step,

Table 1
Example of a traceability log

Date of selection of product	August 22, 06
Shop/fish monger	Supermarket A, Street B, City C
Information on the consumer package:	
Product (including species)	MAP fillets of plaice
Brand owner	Company D
Producer, address	Company D, City E, Denmark
Producer's telephone number, homepage	12 34 56 78, www.companyD.dk
Authorization no.	DK 1234
Country/area of origin	North-east Atlantic Ocean
Country of processing	Denmark
GS1 number	1234567890123
Internal batch number	No labelling
Production date	August 17, 2006
Best before date	August 24, 2006

Step	Company and contact person	Aid	Date	Time start	Time end	Estimated or measured time (min)	Information received
Retailer	Name of supermarket A	Purchase in shop	August 22, 06	18.25	18.28	3	On label (see above)
Producer	Name of company D, contact person F	Telephone	August 23, 06	11.00	11.04	60 (estimated by company D)	Called company D. Required an email
Producer	Name of company D, contact person F	E-mail	August 23, 06	11.05	11.20		Wrote mail to F with information about the project and information from the consumer package
Producer	Name of company D, contact person F	E-mail	September 5, 06	7.33	7.33		Received mail from F. Plaice bought at fish auction G, 2975 kg plaice, size 4, August 16, 06
Auction market	Name of fish auction G, contact person H	Telephone	September 5, 06	11.05	11.10	5	Company D bought 2975 kg plaice, size 4 from collector I on August 16, 06. Fish auction G sold in total 17,863 kg plaice, size 4 for collector I August 16, 06
Collector[a]	Name of collector I, contact person J	Telephone	September 5, 06	12.47	12.49	2	Received unknown quantity of plaice from 32 different vessels in one harbor August 16, 06. The fish was caught over several days

[a] A collector prepares the fish for auction by unloading the vessel, size-grading the fish and rating the fish according to freshness.

(b) the size of the batch including the given product, which was received from that company, and any other data to identify the batch (e.g. date, invoice number),
(c) in the event of a genuine recall situation, the time the company would estimate was necessary for them to find the information that they supplied to this study.

This procedure was repeated until the origin, being the fishing vessel or the fish farm, was reached. If this was not possible, the last traceable step was recorded as a number of fishing vessels or fish farms. The companies contacted were informed that this test was a part of a research project in the Nordic countries. The companies were also assured full anonymity and that there were no commercial interests in the project. As in the method of Karlsen and Senneset (2006), the companies were not required to verify their information by presenting orders, invoices, or other documentation.

Step 4: The information received about each traced product was recorded in a traceability log, as illustrated in Table 1. Thereafter, the results from the five countries were collected and assessed according to (a) the last traceable step in the chain, (b) the size of the batch at that step, and (c) the time needed to determine (a) and (b).

3. Results and discussion

The summary of the results of the simulated recalls is shown in Tables 2a, 2b, and 2c. It is seen that the levels of traceability differ from one product to the next. There are no similarities regardless of whether the products are grouped according to country or product type. This could be because there are too few products to see any difference among the groups.

The last traceable step varies from one vessel to 50 vessels. In 10 cases out of 18 (56%), it was possible to trace the fish products back to just one vessel or fish farm. Karlsen and Senneset (2006) were able to trace 63% of 16 fish products in Norway back to a single vessel or fish farm. If the investigated products were to be recalled, the economic losses for the involved companies could have been minimized if it was possible to trace each product back to one vessel or fish farm. The results indicate that improvement of chain traceability is needed at the steps at the beginning of the supply chains (e.g. the vessel and auction). In a study of three Danish fish supply chains, Frederiksen and Bremner (2001) also found that mixing of different catch days and vessels often occurs at the auctions, resulting in traceability back to the individual fishing vessel being lost at the auction. Improvement of traceability practices, also in other parts of the supply chain, could in the best case limit the recalled batch size to one single fish, but a more realistic objective in the fish industry is to obtain a batch size, which is reasonable, yet cost-effective both during production and in terms of a recall.

All the steps in the supply chains investigated in the present study comply with the one step forward, one step back traceability requirement in the EU Regulation (EC) No. 178/2002, since it requires, as a minimum, the ability to establish which type of products is supplied from which group of suppliers (The Standing Committee on the Food Chain & Animal Health, 2004), not which unique products are supplied from which unique supplier. Hence, a last traceable step of more than one vessel complies with the one step forward, one step back requirement of the EU Regulation.

The obtained information about the last traceable step can be used for marketing purposes, i.e. storytelling. Clearly, traceability back to a single vessel can be used by stating the name of the vessel that caught the fish. It is also possible to tell a story even if the last traceable step is 50 vessels. "This fish is caught in the North Sea by one of 50 fishing vessels from the harbor of xyz" offers more knowledge about the history of that fish than one which is simply labelled "Caught in the North-East Atlantic," as required by EU Regulation (EC) No. 104/2000 and No. 2065/2001 (Anon, 2000, 2001). However, the latter information must be stated on the package as well.

The batch sizes at the last traceable step vary from 5 kg to 600,000 kg. This large range may be due to differences in the type of fish business operators, i.e. different types and sizes of vessels used and differences in the size of the industry for different fish species. The large quantities indicate that the steps at the beginning of the supply chains should reconsider whether they have appropriate batch sizes and traceability procedures.

The batch size at the last traceable step is chosen in order to have comparable data. The cause of a recall may of course be located at all steps along the supply chain, and the batch sizes at these steps most probably

Table 2a
The results of the simulated recalls of fresh fish products in five Nordic countries

Country	Species (fillets)	Last traceable step	Batch size	Estimated time necessary (min)
Iceland	Haddock	One vessel	562 kg (one day's catch)	20
Finland	Lavaret	One vessel	5 kg (one day's catch)	10
Faroe Islands	Cod	50 small vessels in two harbors	6009 kg (three days' catch)	95
Denmark	Cod	20 small vessels in Øresund	One day's catch of 20 small vessels	60
Norway	Cod	One fish farm	4000 kg (one day's harvest)	36
Norway	Saithe	One small vessel	2700 kg (one day's catch)	23

Table 2b
The results of the simulated recalls of frozen fish products in five Nordic countries

Country	Species	Last traceable step	Batch size	Estimated time necessary (min)
Iceland	Haddock fillets	Six vessels through three auctions	1661 kg (one day's catch)	60
Finland	Perch fillets	Seven vessels in the Bothnian Bay and the Kvarken Archipelago	387 kg (four days' catch)	69
Finland	Herring fillets	One vessel	112,729 kg (one day's catch)	95
Faroe Islands	Haddock fillets	One vessel	600,000 kg (two months' catch)	100
Denmark	Saithe fillets	One vessel	45,235 kg	60
Norway	Sea trout	One fish farm	One day's harvest at one fish farm	11

Table 2c
The results of the simulated recalls of optional fish/seafood products in four Nordic countries

Country	Fish/seafood product	Last traceable step	Batch size	Estimated time necessary (min)
Iceland	Frozen breaded haddock portions	Five vessels in one harbor	39,039 kg (one day's catch)	60
Finland	Chilled rainbow trout in tomato sauce	One fish farm	9600 kg (one day's harvest)	45
Faroe Islands	Frozen C&P[a] shrimps	One vessel	335,140 kg (two months' catch)	50
Faroe Islands	Frozen fried fish cakes (haddock)	Three small vessels in two harbors	717 kg (one day's catch)	140
Faroe Islands	Canned cod roe	50 vessels	Three months' catch of 50 vessels	52
Denmark	MAP[b] plaice fillets	32 vessels in one harbor	Several days' catch of 32 vessels	70

[a] C&P = cooked and peeled.
[b] MAP = modified atmosphere packed.

differ. For example, if the unfortunate conditions causing the recall are in the refrigerated truck transporting the end product to the retailers, it would most probably be a smaller batch size that would be recalled than if the unfortunate conditions were on the factory trawler that caught the fish. Needless to say, this requires that the cause of the problem prompting the recall has been pinpointed.

The time needed to identify the last traceable steps and the corresponding batch sizes varies from 10 min to 140 min, which is acceptable. Not all the products in the survey have been traced back to a single vessel or farm. If this was possible for those products, then the time needed would be prolonged. Despite that, the reported time indicates that the traceability systems, whether paper-based or computerized, work at most of the steps. The products are marked in such a way that the companies are able to trace them back, and the existing information about the paths of the products is readily available.

Even though Karlsen and Senneset (2006) recorded the time used in acquiring the information from the companies, the time was unfortunately not reported, so no comparison can be done. Karlsen and Senneset (2006) state that the time recorded does not give a realistic picture because the companies would have prioritized differently in case of a real recall. Indeed, the involved personnel would put other work aside to focus on tracing and tracking the affected products. Therefore, in the present study, time used on unsuccessful telephone conversations (e.g. the person in charge was not present) and time spent waiting for a return call, for example, were omitted. Instead, the companies were asked to estimate the time they would need to find the information if a genuine recall were to happen. In this respect, it is important for companies to be aware that they have not only one, but several, employees that have access to the companies' traceable data.

All products originating from the same batch must be located and removed from the market during a recall. Therefore, the evident next step after this study is to track forward the batch at the last traceable step to find out where the other portions of that batch have been delivered. This will provide even more information on the preparedness of the fish industry for a recall.

The present method can be used to investigate the traceability status within other food industries and in other countries. It would be interesting to see how prepared the fish industries in other countries are for a recall.

4. Conclusion

Around half of the investigated supply chains were able to identify the origin of a product at the level of one single vessel or fish farm. The last traceable step for the remaining products was up to 50 vessels. Batch sizes at the last traceable step varied from 5 kg to 600,000 kg, the latter indicating that the fish industry, especially the fishing vessels and auctions, should reconsider their batch sizes in order to make a potential recall as unproblematic and inexpensive as possible. The time necessary to trace back the products were all under 2 h and 20 min, suggesting that the existing traceable information is relatively easy to find. Overall, the fish industry in the Nordic countries complies with Article 18 in EU Regulation (EC) No. 178/2002, but they seem not to be fully prepared for a recall and the traceability of fish products can be improved. If the information provided by traceability systems are to be further utilized by the companies in the chain to achieve a higher product value, smaller batch sizes are a must.

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References

Anon (2000). Council Regulation (EC) No. 104/2000 of 17 December 1999 on the common organisation of the markets in fishery and aquaculture products. *Official Journal of the European Communities, L 17*(21.1.2000), 22–52.

Anon (2001). Commission Regulation (EC) No. 2065/2001 of 22 October 2001 laying down detailed rules for the application of Council Regulation (EC) No. 104/2000 as regards informing consumers about fishery and aquaculture products. *Official Journal of the European Communities, L 278*(23.10.2001), 6–8.

Anon (2002a). Public Law 107–188: Public Health Security and Bioterrorism Preparedness and Response Act of 2002. *United States Statutes at Large, 116*, 594–697.

Anon (2002b). Regulation (EC) No. 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. *Official Journal of the European Communities, L 31*(1.2.2002), 1–24.

Derrick, S., & Dillon, M. (2004). *A guide to traceability within the fish industry*. Zürich, Switzerland: Sippo/Eurofish.

EAN·UCC (2002). *Traceability of Fish Guidelines*. http://www.gs1.org/docs/traceability/GS1_fish_traceability.pdf. Accessed on April 26, 2007.

European Committee for Standardization (2003a). *DS/CWA 14559:2003 Traceability of fishery products – Specification of information to be recorded in farmed fish distribution chains*. Brussels, Belgium: European Committee for Standardization.

European Committee for Standardization (2003b). *DS/CWA 14660:2003 Traceability of fishery products – Specification on the information to be recorded in captured fish distribution chains*. Brussels, Belgium: European Committee for Standardization.

Frederiksen, M., & Bremner, A. (2001). Fresh fish distribution chains. An analysis of three Danish and three Australian chains. *Food Australia, 54*(4), 117–123.

Frederiksen, M., & Gram, L. (2003). Traceability. In H. H. Huss, L. Ababouch, & L. Gram (Eds.), *Assessment and management of seafood safety* (pp. 210–215). Rome, Italy: FAO.

GS1 (2006). *The GS1 traceability standard: What you need to know*. Brussels, Belgium: GS1 Global Office.

Karlsen, K. M., & Senneset, G. (2006). Traceability: Simulated recall of fish products. In J. B. Luten, C. Jacobsen, K. Bekaert, A. Sæbø, & J. Oehlenschläger (Eds.), *Seafood research from fish to dish: Quality, safety and processing of wild and farmed fish* (pp. 251–261). Wageningen, The Netherlands: Wageningen Academic Publishers.

Moe, T. (1998). Perspectives on traceability in food manufacture. *Trends in Food Science & Technology, 9*(5), 211–214.

Schwägele, F. (2005). Traceability from a European perspective. *Meat Science, 71*(1), 164–173.

Storøy, J., Forås, E., & Olsen, P. (2007). *Recommendations for good traceability practice in the food industry*. SINTEF Report no. SFH80 A074016. Trondheim, Norway: SINTEF Fisheries and Aquaculture.

The Standing Committee on the Food Chain and Animal Health (2004). *Guidance on the implementation of articles 11, 12, 16, 17, 18, 19 and 20 of Regulation (EC) No. 178/2002 on General Food Law*. http://ec.europa.eu/food/food/foodlaw/guidance/guidance_rev_7_en.pdf. Accessed on April 26, 2007.