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Summary

The Nordic Council of Ministers has initiated a Nordic project focusing on reducing food waste without endangering food safety. The main findings of the study are discussed below. The report is summarizing the findings and policy recommendations from phase 2 of the project.

The purpose of the project has been to identify how date labelling legislation on food is practised in Denmark, Finland, Norway and Sweden and how the durability of food products can be affected by temperature, packaging, processing and additives. This is achieved by conducting interviews with manufacturers and retailers for qualitative and quantitative mapping for selected case products, combined with examples from the literature. The selected case products were milk, cooked ham, minced meat, smoked salmon, ready-to-eat salads and eggs.

The following general issues related to date labelling and how this affects the amount of food wastage in the food supply chain were identified:

- At the manufacturing stage:
 - Packaging:

Gas packaging, with absence of oxygen combined with high concentrations of carbon dioxide, inhibits microorganisms and extends durability of many foods. Vacuum packaging also prolongs durability. For minced beef, the interviews showed less variation in the storage temperature in retail (4 °C–5 °C) in the four countries, but there was still considerable variation in durability due the use of different packaging mixes. The packaging gas used for most types of fresh raw meat in Norway is a mixture of 60% CO₂ and 40% N₂. This CO₂/N₂ mixture gives much longer durability by reducing microbiological growth, compared to high oxygen packaging gas, which is common in the other three Nordic countries.
 - Processing and additives:

Better hygiene gives a lower level of contamination and thereby a longer time for microflora to grow to a level that causes spoilage. Lactate is sometimes used for cooked ham and has an anti-microbial effect that will prolong the durability of the product.

- At the retail stage:
 - Storage temperature:
Temperature is one of the major controlling factors of food quality and safety due to its influence on microbial growth rates. Findings from the project showed that when the temperature was lowered from 8°C to 4°C, durability increased considerably for the case products milk and cooked ham.
 - Durability and food waste:
Retail waste of minced meat decreased significantly after the durability of the product was prolonged due to a change in packaging gas composition.
 - Turnover of the products:
The study of quantifying retail waste of minced meat showed that the degree of turnover is an important parameter for food waste. Food stores with low turnover had a much higher percentage of food waste and vice versa.
 - Management:
Even in food stores with low turnover, it is possible to reduce food waste. Focusing on good management, such as ordering the right amounts, is one solution.
- At the consumer stage:
 - Information on durability after package opening:
The FIC regulation (Food Information to Consumers) requires labelling of the durability after opening, in the case of food products with a considerably shorter durability after opening. The interviews showed that some manufacturers found it difficult to establish the durability, since the durability of an opened package will always depend on whether the package is opened early or late in the durability period. Consumer studies reveal a need for guidance on how long products may be eaten after opening of the package. Since many consumers lack basic knowledge about this, they may discard food due to uncertainty about its durability. Consumers should be educated about using off-odour for evaluating durability.
 - Understanding the “best before” and “use by” date labels:
Many consumers need better knowledge of the difference between “best before” and “use by” and they tend to discard food when the expiry date has passed, regardless of the type of date label that is used.

- General understanding of food durability:
The individual consumer needs clearer and more easily accessible information on different labelling, storage temperature and durability of products.

Policy recommendations and further work

The project recommends enhanced guidance for manufacturers, retailers and consumers. For manufacturers and retailers, it is suggested to develop “best practice” guidelines and for consumers, information on different labelling and durability on products is needed. It is recommended to work further on the possibility of harmonized lower storage temperatures for perishable food products in Sweden, Denmark and Finland. The date labelling should be chosen with care. The “use-by” labelling relates to food safety and should be used only on highly perishable foods where the storage time may lead to an immediate danger to health despite storage at specified conditions. If “use-by” label is used on other products it may result in unnecessary food waste.

Eggs have specific EU legislation with a last selling date 21 days after laying and best before date after 28 days. This is due to storage in room temperature and the expected contamination with Salmonella of eggs in many EU countries. If eggs were stored in refrigerator, it would prolong durability considerably. Then the EU regulation on date marking of eggs could be altered. The Nordic statement is that eggs should not be regulated separately but treated as any other foods. While the current legislation applies, there is need for consumer education about the durability of eggs.

Foreword

The Nordic Council of Ministers has initiated a Nordic project focusing on reducing food waste in the entire food supply chain, financed by the Green Growth Program. Food waste is an important issue not only in the Nordic countries, but also throughout the EU. Targets to reduce food waste are also included in the 17 Sustainable Development Goals (SDG) in the United Nations.

Based on previous work done in the Nordic Date Labelling Project, this report investigates how date labelling legislation on food is practised in the Nordic countries and how the durability can be affected by temperature, packaging, processing and additives in the food supply chain. A case study clearly shows that longer durability reduces food waste and it is assumed that this apply to several products that have a short shelf life in the first place. Organisations involved in the project are food safety and agricultural authorities and research institutes in Norway, Sweden, Denmark and Finland. The project has progressed over three phases; the present report is from Phase 2 of the sub-project regarding date labelling. A third and final project phase will focus on developing a basis for communication of the results to the main target groups.

The project provides the opportunity to give common Nordic recommendations in future work on food waste reduction, and will strengthen the ability of the Nordic countries to influence this work, both in the EU and other international arenas.

Dagfinn Høybråten
Secretary General
Nordic Council of Ministers

1. Introduction

Food waste is an important issue not only in the Nordic countries, but also throughout the EU and globally. A target to reduce food waste is also included in the 17 Sustainable Development Goals (SDG), adopted by all UN member states in September 2015. Food waste is addressed in goal no 12; “responsible consumption and production” target 12.3.¹ In order to support this global food waste target the EU Commission has presented actions to work on reducing food waste within the proposal for an action plan for the circular economy.²

1.1 Goal and scope

The focus in the project has been on identifying how food date labelling legislation is practised in the four Nordic countries Denmark, Finland, Norway and Sweden. Companies were interviewed regarding how they establish the durability of a product and the use of date marks. The “use by” term refers to both product safety (microbiological) and quality (sensorical) while the “best before” label refers only to product quality (sensorical).

The overall aim was to optimise food labelling to minimise food waste in a Nordic perspective. Four focus areas were outlined:

1. Amount of food waste related to date labelling and relevant measures.
2. Identification of underlying causes of date labelling and durability differences between Nordic countries.
3. Issues related to durability after package opening by evaluation of consumer information regarding storage of opened packages and how the product should be stored.

¹ SDG 12.3: By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses:
<https://sustainabledevelopment.un.org/?menu=1300>

² Circular Economy Strategy http://ec.europa.eu/food/safety/food_waste/index_en.htm

4. Guidance and understanding of food labelling terms by identifying established practices/guidance and national trade standards used by food producers.

The four focus areas were used to set up a plan for the organisation of the project and find approaches that could provide answers to questions related to these issues. The approaches applied are described in detail in the next chapter. The structure of the report does not follow the four focus areas but is organised more by topic and place in the food supply chain.

It was originally intended to find quantitative data on food waste caused by date labelling along the whole supply chain, but since many companies regard this as confidential, this was not possible. For the consumer step, it was proposed to use waste composition analysis to estimate the proportion of food waste caused by the expiry of the date, but the data was inadequate for quantitative calculations and it was not possible within the project budget to implement new waste composition analysis.

2. Approach and methods

A number of methods have been used to collect data from the four different countries. The methods were also chosen in regards to covering the different perspectives, depending on which part of the value chain is in focus. Collection of data for manufacturing stage is limited to some selected products, while for the retail stage more general information is obtained. The project has not conducted studies of the consumer stage but used information from other relevant surveys.

This chapter is a presentation of the different methods and approaches used in this project, starting with a schematic overview and then described one by one in detail.

Table 1: Methods and approaches applied to obtain data in the date labelling project

Method/approach	Data source
Interviews of food manufacturers	Data collected within the project
Collection of pictures of food products with guidance for use after opening	Photos collected within the project
Compilation of legal requirements for temperature in wholesale and retail	Data collected within the project
Interviews with store managers	Data collected within the project
Mapping of food waste in retail	Data collected within the project
Waste composition analysis in retail	Data published with permission
Case study: example of trade agreement for allocation of durability	Data published with permission
Case study: extended durability and the effect on food waste	Data published with permission
Literature review	Data from literature

The application of the different methods and approaches used is described below.

2.1 Interviews of food manufacturers

Interviews were conducted with representatives of food companies that produce any of the selected products: pasteurised milk, cooked ham, minced meat, cold smoked salmon, ready-to-eat salads, liver paste, pickled herring or pesto. In short, they were asked how they establish the durability of a food product and how they choose the type of date labelling, “use by” or “best before” (definitions in Chapter 3).

An interview guide was compiled for use in conducting the interviews (Appendix 1). The interview guide had three main topics:

1. Guidance and understanding regarding food labelling terms.
2. Issues related to durability, including after opening of the package.
3. Trade standards or agreements.

The interviews were carried out by telephone and 2–3 manufacturers per product group were selected in each of the four Nordic countries.

2.2 Collection of pictures of products with guidance for use after opening

The legislation on general labelling and nutrition labelling has been merged to a common regulation on Food Information to Consumers (the FIC Regulation).³ Article 25 of this regulation, which deals with durability of opened packages, is very general and in many cases not yet implemented by the food industry. Photos of random food products with guidance for use after opening were taken. The photos were used to establish a photo library for use in the project work.

2.3 Compilation of legal requirements for temperature in wholesale and retail

The temperature in the cold chain was found to be of great importance when food manufacturers decide the durability of a food item. A compilation of the legal storage temperature requirements in each of the four Nordic countries was made.

³ Regulation (EU) No. 1169/2011.

2.4 Interviews with store managers

In all four Nordic countries, interviews with store managers have been conducted to estimate food waste and describe causes leading to food waste. To ensure comparable results from the interviews, an interview guide was compiled (Appendix 2). It contained questions regarding expiry of durability and focused on the six selected case products.

2.5 Mapping of food waste in retail

Data on food waste related to date labelling from a grocery store were mapped for six selected case products⁴ in Denmark. This approach was not used in the other countries. A registration scheme was followed to ensure standardisation of data and to make it easy for the stores to carry out the registration. A description of the registration process was developed and sent to the stores together with the registration scheme. In addition, to ensure a common understanding of product groups, registration scheme and methodology, follow-up phone meetings were held with the employees that performed the mapping.

2.6 Waste composition analysis in retail

Waste composition analysis of food waste due to date labelling from seven retail stores has been conducted in Denmark. This approach was not used in the other countries. The waste composition analysis did not initially focus on reasons for food waste. However, an estimate of the fractions where date labelling was identified as the primary reason for wastage has been given. The data is published with permission from ECONET.

⁴ Eggs, pasteurised milk, cooked ham, minced meat, cold smoked salmon, ready-to-eat salads.

2.7 Case study: Example of trade agreement for allocation of durability

A trade agreement on allocation of the durability between manufacturer, distributor and retail/consumer is intended to give most of the shelf life to the consumer. However, in some cases the internal date for the manufacturer or distributor expires, but the product still has good remaining durability. A strict system can cause a lot of additional work to sell the product and increase the risk of product waste. An interview with a producer was conducted to illustrate this. In addition, an example is given of how the sale of a product is distributed regarding the expiry of the internal durability date.

2.8 Case study: Extended durability and the effect on food waste

A case study was conducted by a retail company to document how the amount of food waste was affected by prolonged durability. A manufacturer of minced meat changed the packaging gas from high oxygen to a mix of carbon dioxide and nitrogen to prolong the shelf life of the products. A large retailer in Norway registered data for food wastage before and after the change of packaging gas.

The data is published with permission from the retailer and the statistical analysis was conducted as a part of this project.

2.9 Literature review

A literature review including studies of date labelling and food waste was conducted. The literature was used to investigate further the focus areas that are also examined through case studies, interviews, etc. to support the findings in this work.

3. Durability terms and legal requirements

The basic requirements of date labelling are of course controlled by legislation. The same legislation applies throughout the EU and the EEA (the European Economic Area including Norway, Iceland and Liechtenstein). Both general labelling and nutrition labelling are regulated in the FIC Regulation⁵ – Food Information to Consumers – implemented in December 2014.

This chapter covers the different terms used for date labelling and the varying conditions due to national legislation and decisions made by the manufacturers.

3.1 Date labelling terms

There are two types of date labelling, “best before” and “use by”. The legislation does not state how to test the durability of foods; that is up to the companies to decide.

3.1.1 “Best before”

The “best before” labelling relates primarily to the food quality rather than to food safety and it is an appropriate date labelling for most foods. It is the length of time in which the producer guarantees that a certain food item can be expected to retain its original condition in unopened packaging. When the “best before” date has passed, the producer has no longer legal responsibility for the quality of food item. However, foods that have passed their “best before” date may still keep an acceptable quality for a long time. How long the product can have adequate quality after the expiry of the best before date will vary widely depending on the product, packaging and storage. There is for example a big difference in the actual shelf life of fresh and canned products. Legally, the responsibility of the maintained food quality is transferred to the retailer after the

⁵ Regulation (EU) No. 1169/2011, Articles 24–25. See Appendix 3 for full text.

“best before” date. Foods may be sold or donated after they have passed the “best before” date if the quality is considered good.

3.1.2 “Use-by”

The “use-by” labelling relates to food safety. It should be used on highly perishable foods where the storage time may lead to an immediate danger to health despite storage at specified conditions. After the “use by” date has passed, such foods are considered to be unsafe to eat. Therefore, if a product is labelled with a “use by” date, it can neither be sold nor be donated after that day. Hence, the date labelling should be chosen with care. Otherwise, edible and safe food may be discarded, with unnecessary food waste as the result.

3.2 Durability of opened packages

The durability of a product can change when the package is opened. For consumers, it may be difficult to know how long they can use a product after opening. The durability after opening is affected by the type of packaging, use of packaging gas, product characteristics and storage temperature as well as consumer handling of the products.

According to Article 25⁶ of the FIC Regulation, when foods require special storage conditions and/or conditions of use, those conditions shall be indicated. To enable appropriate storage or use of the food after opening the package, the storage conditions and/or time limit for consumption shall be indicated, where appropriate.

This concerns especially foods with long durability in unopened packages, where the durability shortens after opening. For foods with no major change of durability after opening, information regarding storage conditions is sufficient. As the rules came into effect in 2014, they are still considered as new for many EU member states.

To gain an understanding of how manufacturers determine the durability after opening and how they provide information to the consumer, the companies were asked about this as a part of the interviews that were conducted regarding durability. The responses from the manufacturers are described in the next chapter for each of the case products.

⁶ Regulation (EU) No. 1169/2011, Article 25. See Appendix 3 for full text.

3.3 Examples of guidance for use after opening

Examples of consumer guidance regarding storage and durability after opening of the product and use of the product are shown in Table 2. The examples are randomly selected and have no connection to the interviews conducted in this project. The examples in this section emphasise that suitable standardised/regulated instructions for storage and use could be useful in order to avoid misunderstandings.

Table 2: Examples of consumer guidance of food products

Product	Examples of guidance text
Soya milk	Opened packaging can be stored in refrigerator up to 5 days (max. 7 °C) <i>Öppnad förpackning förvaras i kylskåp i upp till 5 dagar (max. 7°C)</i>
Smoked salmon	After opening, must be consumed within 3 days <i>Åpnet forpakning spises innen 3 døgn</i>
Liver paste	The product will have limited durability after opening (5-7 days) <i>Produktet får begrenset holdbarhet etter åpning (5-7 dager)</i>
Liver paste	The liver paste tastes best within 3-4 days after opening of the packaging <i>Pastajen smakar bäst om den förtärs inom 3-4 dagar efter det at asken öppnats</i>
Pickled herring	After the jar is opened, tastes best within 14 days <i>Öpnad burk smakar bäst inom 14 dagar</i>
Pesto	After opening: lasts for 10 days in refrigerator <i>Åpnet: Holdbar 10 dager i kjøleskap</i>
Custard	May be stored unopened at room temperature. After opening, has a shelf life of about 3 days at 0-4 °C <i>Kan uåpnet oppbevares ved romtemperatur. Etter åpning holdbar i ca 3 dager ved 0 °C -4 °C</i>
Mini meatballs	Storage: max. 5 °C Preparation: Heat in frying pan or microwave. Can also be eaten directly from the package. <i>Opbevaring: ved højest 5 °C</i> <i>Tilberedning: Varmes på stegepande eller i mikroovn. Kan også spises direkte fra pakken.</i>

3.4 Storage temperature requirements in wholesale and retail

According to the EU FIC Regulation (No. 1169/2011), the conditions for foods requiring special storage or use must be stated. This means, for example, that the storage temperature must be given on the label. Further, according to Regulation (EC) No. 853/2004 there are legal temperature requirements to be met during production and transport of certain animal food products, for example meat after slaughter, poultry, large and small game, minced meat and milk products. These common EU rules apply in all the Nordic countries.⁷

There are a few common EU requirements on storage temperatures mainly applying for wholesale businesses. Therefore, storage temperatures in retail are mainly regulated nationally. Hence, there are different legal requirements for storage temperature in retail and wholesale among the Nordic countries. Sweden distinguishes itself from Denmark, Finland and Norway in that it has an established practice instead of legal requirements for storage temperature. The Swedish established practice for storage temperature of perishable foods is generally higher than that of the other Nordic countries.

The legal requirements for temperature in retail for the selected case products in Denmark, Finland, Norway and Sweden are shown in Table 3 below, followed by a short description of the national requirements for each country.

Table 3: Legal requirements regarding storage temperature for selected foods

	Denmark	Finland	Norway*	Sweden
Pasteurised milk	Max. 5 °C	Max. 6 °C	Max. 4 °C	No specific legal requirements
Cooked ham, MAP**	Max. 5 °C	Max. 6 °C	Max. 4 °C	No specific legal requirements
Minced beef	Max. 5 °C	Max. 4 °C	Max. 4 °C	No specific legal requirements
Cold smoked salmon	Max. 5 °C	Max. 3 °C	Max. 4 °C	No specific legal requirements
Ready-to-eat salad, with chicken	Max. 5 °C	Max. 6 °C	Max. 4 °C	No specific legal requirements

Note: * The requirements applies only if a temperature has not been labelled by the manufacturer.

** Modified atmosphere packaging.

⁷ EC No. 853/2004, which lays down hygiene rules for foods of animal origin.

In Denmark, the storage temperature for the products above is regulated by Danish Order No. 788 of 24 July 2008 on Food Hygiene (DK Order on Food Hygiene). In Finland, the temperatures are also determined by national regulations.⁸ In Norway, the manufacturer's indication of storage temperature for perishable foods shall be considered. If such indication is not given or there are no national guidelines⁹ developed according to article 8 in regulation (EC) No. 852/2004, storage, transport and retail for perishable foodstuffs should be at 4 °C or lower.

3.4.1 Regulation of storage temperature in Sweden

In Sweden, the law does not regulate storage temperature. Instead, it is up to the food producers to decide which storage temperature a particular food should have. However, according to Article 25 of the FIC Regulation (see Appendix 3), conditions for storage and use must be stated when specifically needed. This means that the storage temperature must be indicated on refrigerated foods.

Despite no legal regulation of storage temperature, many documents published by the National Food Agency (NFA) specify +8 °C as an example of storage temperature. These documents are for example guidance documents on hygiene, a “control handbook” for retail and one for restaurants and institutional kitchens. In contrast, on the website of the NFA (www.slv.se), consumers are advised to store refrigerated foods at + 4–5 °C to extend durability and reduce food waste.

Work with a government mandate to reduce food waste in Sweden has been conducted since 2013. As one of the initiatives, a working group of industry stakeholders has started a dialogue with the aim to reduce the storage temperature in the food chain. The main objective is to reduce food waste. A reduction of the storage temperature could also have benefits in terms of quality and safety. For example, a reduction to 4 °C extends the time to the expiry date by about a week. Further, the *Listeria* bacterium multiplies much more slowly at 4 °C than at 8 °C. A lower storage temperature also enables a lowering of the nitrite and salt content of processed meat products. Today, the National Food Agency recommends 4–5 °C in its advice to consumers and it would be beneficial if producers used

⁸ Decree of the Ministry of Agriculture and Forestry on Food Hygiene in Approved Establishments 795/2014; Decree of the Ministry of Agriculture and Forestry on Food Hygiene in Food Premises 1367/2011 + Evira Guidance on Food Hygiene in Food Premises 16025/4; Regulation on Hygiene of Foodstuffs of Animal Origin 853/2004/EC; Evira's Instruction 16025/2 on Food Hygiene in Food Premises in 2013.

⁹ Regulation on Hygiene of Foodstuffs 22 December 2008 No 1623.

the same temperature. As many other countries have a lower temperature in their cold chain, a lower storage temperature is likely to facilitate the export of Swedish food.

In autumn 2015, a working group consisting of various partners from the food industry was appointed to work on the issue, with the aim of lowering the storage temperature in the food chain in Sweden by 2020.

4. Underlying causes for differences in date labelling

In the previous phase of the project, considerable variation in the stated durability of different products between manufacturers and between countries was found. Therefore, more knowledge was needed about the causes of those differences and follow-up interviews with food manufacturers in Denmark, Finland, Norway and Sweden were conducted. This chapter is a systematic review of the results of these interviews compared using eight food product categories.

4.1 Interviews

The interviews focused on factors affecting food durability such as processing, packaging, usage of product, date labels “best before” or “use by” and guidelines for the consumer. The companies were also asked how they relate to regulations and their experiences with food authorities.

To compare results between companies and countries, eight food product categories were selected as study objects, see Table 4. In each country, 2–3 manufacturers of each product were interviewed. Manufacturers of five products were interviewed regarding date labelling and durability, and for an additional three products to examine the durability and guidelines to the consumer after opening of the packaging. For all the details in the interview guide, see Appendix 2.

Table 4: Food categories included in the interviews with food manufacturers in Denmark, Finland, Norway and Sweden

Durability and date labelling of unopened packages	Guidelines for consumers on opened packages
Milk, pasteurised	Liver paste
Cooked ham, MAP*	Pickled herring
Minced beef, without water and salt, MAP*	Pesto
Cold smoked salmon, sliced and vacuum packed	
Ready-to-eat salad, containing heat-treated chicken	

Note: * Modified atmosphere packaging.

4.2 Milk

All the selected milk products have “best before” labelling, and the durability stated on the package varied from 8 days (Sweden) to 14 days (Norway), see Figure 1. The figure shows that the stated durability decreases as the storage temperature increases.

4.2.1 Underlying causes

All dairy companies interviewed test product durability by microbiological and sensorial analyses. The storage temperature has the greatest influence on actual durability length, since the same packaging technique is used for all the selected products. Manufacturers’ own assessments can also explain differences in durability stated on the package. In addition, improvements in the process techniques will influence actual durability and allow for an extension of the “best before” dates. One of the manufacturers reported that the product has been given two days longer durability during the past year. The reason is that more modern equipment has been installed at the dairy, which has resulted in better hygiene, a lower level of contamination and thereby longer time for spoilage microflora to reach a spoilage level.

Figure 1: Durability on milk packages, stated in days. Maximum storage temperature is shown above each bar (for Sweden recommended temperature)

4.2.2 Predictive model

Figure 2 illustrates the growth of *Pseudomonas* in milk causing spoilage of pasteurised milk at different storage temperatures. It shows the prediction of growth and how long it takes until they reach the maximum culture density and the highest concentration. The maximum density of *Pseudomonas* has a good correlation with the point in time when the product will be identified as spoiled. It should be noted that there are no microbiological criteria for *Pseudomonas* in milk.

The modelling is performed using the Food Spoilage and Safety Predictor (FSSP model).¹⁰ The general growth model uses the model described in Martinez-Rios *et al.* (2016). It is assumed that the starting contamination is 1 cfu/ml of *Pseudomonas* species.

Figure 2: Illustration of spoilage of pasteurised milk due to growth of *Pseudomonas* sp. at a temperature range from 2 to 10 °C

The figure shows growth of the spoilage organism *Pseudomonas* species at temperatures from 2 to 10 °C, expressed as log colony forming units (cfu) per ml. It is evident that the lower the storage temperature, the longer it takes to reach the maximum cell count, and the resulting spoilage. A storage temperature of 4 °C (as used in Norway) will lead to the maximum amount of bacteria after about 8.5 days, whereas this level would be reached after about 4.5 days if the same milk was stored at 8 °C (as in Sweden).

¹⁰ <http://fssp.food.dtu.dk>

4.2.3 Consumer guidance

It is common to give information about the storage temperature on the package, but most manufacturers have no other consumer guidance for milk, except one manufacturer stating, “Do not put strong-smelling products in the immediate vicinity of the milk”. One of the manufacturers has consumer guidance on the product label for the opened package, stating that the product remains good in the refrigerator for 3–4 days. Microbial risks for the product in an opened package depend on how the consumer handles the package and the temperature in the refrigerator. There are no special microbial risks for the product itself, because milk is spoiled before it becomes dangerous to drink. Bacteria grow in a cold environment, but for milk that is not a food safety problem, only a quality problem. There are great variations in initial levels of *Bacillus* species, but these bacteria will grow much faster at higher temperatures.

4.3 Cooked ham

The “use by” label was used for MAP-packed cooked sliced ham products in Finland, Denmark and Norway, while “best before” labelling was used in Sweden. Durability displayed on the package of MAP-packed cooked ham varied from 17 to 45 days. Storage temperature was 4 °C for products in Norway, 5 °C in Denmark, 6 °C in Finland and 8 °C for cooked ham in Sweden. As seen in Figure 3, the stated durability decreases as the storage temperature increases. One of the products was packed in folded packaging (wallet type) and had a durability of 17 days. All the products were packed in modified atmosphere packaging (MAP) using 70–80% N₂/20–30% CO₂ gas mixture.

Figure 3: Durability stated on packages of cooked ham in days. Maximum storage temperature is shown above each bar (for Sweden recommended temperature)

4.3.1 Underlying causes

In all four countries, nitrite and ascorbate were used as additives, mainly for stabilizing colour. One manufacturer in Sweden and two in Norway also used lactate as an anti-microbial additive. The third manufacturer in Norway in these interviews will start using lactate in 2016 based on retailers demand for food safety in cooked ham products. Lactate prolong shelf life by inhibiting the growth of spoilage by lactobacilli without negative effect on sensory quality. Lactate also inhibit growth of *Listeria monocytogenes* which is the main risk factor of this product for a vulnerable part of the population with potential severe consequences (Blom *et al.*, 1997).

Listeria monocytogenes is a risk in cooked ham as in all highly perishable sliced meat products with long shelf life. *Listeria monocytogenes* can grow in unopened package, but the growth rate increases after opening the package because of the lost inhibiting effect from the MAP packaging. However, the risk is low, if consumer do not contaminate the product after opening and handle the product in a sensible manner with unbroken cold chain.

4.3.2 Predictive model

The products selected for the interviews were packed in MAP. To illustrate the spoilage rate, the growth of lactobacilli is shown as an indicator of spoilage of a sliced cooked vacuum-packed meat product at different storage temperatures (Figure 4). The figure shows a growth model of lactobacilli at temperatures from 2 to 10 °C, expressed as amount of colony forming units (cfu) per gram on a log scale. It is evident that the lower the storage temperature, the longer it takes to reach the maximum cell count. A storage temperature of 4 °C (as used in Norway) will give the maximum cfu after about 26 days, whereas this level would be reached after about 18 days if the same product was stored at 6 °C (as in Finland), and after about 12 days if stored at 8 °C (as in Sweden).

Figure 4: Illustration of spoilage rate of vacuum-packed sliced meat at a temperature range from 2 to 10 °C. Modelling in accordance with the FSSP model

There are no microbiological criteria for lactic acid bacteria in sliced meat products. Spoilage of vacuum-packed meat is caused by lactobacilli, although spoilage occurs later than when the maximum amount of bacteria is reached. Therefore the maximum concentration is not actually the point where spoilage is noticed. However, the relative durability of the product is clearly illustrated.

The modelling is performed using the FSSP model.¹¹ The general growth model for Lactobacilli is applied in this example, using an initial contamination of 1 cfu/g. It is assumed that the sliced meat has 4% salt in the water phase, a pH of 6.0 and has had 60 ppm of nitrite added.

4.3.3 Consumer guidance

Manufacturers' responses varied on whether they supply durability statements for opened packaging on product labels. Several of the manufacturers stated that they do not have any consumer guidance because it is difficult to know the conditions after the package has been opened. Others indicated that their products have a durability stated on the package from 3 days to 4–5 days after opening. One manufacturer stated that they have introduced consumer guidance on the package to be in line with the FIC Regulation, whereas previously they did not indicate it on that type of product. Another manufacturer answered that they are aware of the requirements for durability statements for opened packagings, but it is difficult to set a time limit. There is a difference in durability of the opened package, depending on whether it is opened at the start of or towards the end of the durability period.

4.4 Minced meat

All the minced beef products were labelled with “use by”. The durability stated on packages of the different minced meat brands varied from 6 to 18 days.

4.4.1 Underlying causes

All manufacturers used the same type of production process but they used different packaging gas and storage temperatures. The storage temperature ranged from a maximum of 4° C (Finland, Norway and Sweden) to a maximum of 5° C (Denmark).

¹¹ <http://fssp.food.dtu.dk>

Figure 5: Durability stated on packaging of minced meat in days. Maximum storage temperature is shown above each bar (for Sweden recommended temperature)

The packaging gas used for the products with the longest durability (B1 and B2) was a gas mixture of 60% CO₂ and 40% N₂. This CO₂/N₂ mixture results in slow microbiological growth. The packaging gas for the products with shorter durability (B4–B9) used high oxygen, which consists of 70–80% O₂ and 20–30% CO₂. High oxygen is mainly used to give the meat an initial bright red colour, which is attractive to consumers (Kim *et al.*, 2010). However, it also gives a shorter shelf life compared to the CO₂/N₂ mixture, i.e. 8–9 days for minced meat. Further, high oxygen is known to provide several unwanted properties like rancidity, inhibition of tenderisation of the meat, and early browning in the inner portion of the meat at heat treatment (Sørheim, 2014).

One manufacturer (product B3) used vacuum packaging and their minced beef had a stated durability of 10 days. Packaging in MAP gives a longer actual shelf life than vacuum packaging since it is not possible to withdraw all the air during the vacuum process. It allows the bacteria some air to grow inside the packaging. Therefore, the vacuum technique does not inhibit growth as effectively as MAP. CO₂ efficiently reduces the growth of most bacteria, and the effect is generally proportional to the CO₂ concentration in the package.

4.4.2 Consumer guidance

The manufacturers have different views on consumer guidance on the label of minced meat. Some companies stated that it is important to give guidance because the shelf life shortens dramatically in the atmospheric environment: “The product should be used within one day of opening”. Another guideline is “packaging should be opened 10–15 min before use”. Other manufacturers stated that they do not have any consumer guidance because the product is usually all consumed at once or it is to be heated. It is difficult to set a date of expiry after opening since it depends on how the customer treats the opened package, the temperature in the refrigerator, etc. Two manufacturers have guidance for use of the product: the meat must be well cooked.

The interviewed manufacturers have assessed that the microbial risks for the product are not related to the opening of the packaging. The product may have bacterial growth if there is access to air and the temperature is high, but there are no microbial risks after cooking. The risk mainly depends on how the consumer handles the product once it is opened, since there is always a risk for crosscontamination during handling of minced meat.

4.5 Cold smoked salmon

The stated durability of cold smoked salmon ranged from 14 to 30 days. All the selected products in Denmark, Finland and Norway have “use by”, while the Swedish products have “best before”. One of the Swedish manufacturers stated that they prefer to have “best before” since the product has relatively long durability. However, for some products they also have “use by”, because some customers require this due to private label production.

Figure 6: Durability of smoked salmon in days. Maximum storage temperature is shown above each bar (for Sweden recommended temperature)

The storage temperature ranged from a minimum of 3 °C (Finland) to 4 °C (Norway and Sweden) and a maximum of 5 °C (Denmark). All the products were vacuum packed.

4.5.1 Underlying causes

Two manufacturers used lactate and acetate to adjust the pH in order to stabilise the product and inhibit *Listeria*. The difference in storage temperature does not explain the difference in durability stated on the package, since the products with the lowest temperature also had the shortest stated durability. Moreover, the products with additives do not have longer durability than those without.

4.5.2 Consumer guidance

The products have no general consumer guidance on the package except the storage temperature. For opened packaging, the guidelines vary. The durability stated after opening of the packaging is recommended as 1–2 days for product S9 and up to 3 days for products S4 and S5. The manufacturers estimated a longer actual durability, but it is difficult to indicate a date for this on the package since the customer's handling of the package is unknown. For product S3 the durability was given as "Use within a few days", leaving consumers to make their own assessments based on this.

Manufacturers without consumer guidance stated in the interview that the use by date is not valid if the package is opened and it is impossible to know how the consumer handles the product after it has been opened.

The microbial risks for the product in an opened package are especially related to *Listeria* for risk groups, i.e. pregnant and immuno-compromised persons. If the product has been opened for several days, it will be spoiled to some extent. In addition, consumer handling of the product is always connected with risk of microbial growth.

4.6 Ready-to-eat salad

For ready-to-eat salads, the “use by” label is utilised in Denmark, Finland and Norway and “best before” in Sweden. The durability stated on the package varied from 2 to 14 days, see Figure 7. The storage temperature was 4 °C for products in Norway, 5 °C in Denmark, 6 °C in Finland and 8 °C for products in Sweden.

Figure 7: Durability of ready-to-eat salads in days. Maximum storage temperature is shown above each bar (for Sweden recommended temperature)

4.6.1 Underlying causes

The products had different packaging. The product with the longest durability used MAP packaging and a gas mixture of N₂/CO₂ (14 days, 6 °C and 8 days, 8 °C) and N-mixture (9 days, 4 °C). The other products had ambient air packaging.

4.6.2 Consumer guidance

For unopened packages, the only consumer guidance on the label indicated the storage temperature. For opened packages, one manufacturer said that they provide user guidance on some salad packagings since some salads can be eaten hot and these have instructions for heating. The other manufacturers do not have any guidance and state that the reason is that the product is meant to be eaten at once or that the durability does not change according to whether the packaging is opened or not.

4.7 Durability in opened package

Durability and storage instructions for opened packages of liver paste, pickled herring and pesto were examined in interviews with manufacturers using the sections “Durability” and “Storage conditions of opened packaging” in the interview guide.

4.7.1 Liver paste

Liver paste is stable due to high temperature heat treatment in the packaging. The only risk is recontamination by the consumer or that the product may develop mould. The product labels vary in guidance to the consumer on stated durability and storage. The various guides are shown for each product in Table 5.

Table 5: Guidance of durability after opening of the package for selected products of liver paste

Producer No.	Guidance
DK-1	Durability after opening: 7 days at max 5 °C but at most until the “use by” date.
DK-2	Durability of 2–3 days after opening.
FI-1	The product tastes best if it is consumed within 3–4 days of opening.
NO-1	The product has limited durability after opening. 5–7 days.
NO-2	Chilled product, 0–4 °C
NO-3	Chilled product and packed in protected atmosphere.
SE-1	-
SE-2	Product in opened package should be consumed within 7 days.

Examples of guidelines are: “Durability after opening: 7 days at max 5 °C but not longer than until the ‘use by’ date”, “The product has limited durability after opening, 5–7 days” and “Durability of 2–3 days after opening”. One manufacturer explicitly stated having changed the guidance on the package to comply with the FIC Regulation. This requires labelling of the durability after opening, especially for foods with long actual durability in the unopened package, which shortens after opening (Appendix 3). The actual durability of liver paste is reduced once the package is opened and therefore this type of product requires labelling.

4.7.2 *Pickled herring*

Only one manufacturer of pickled herring has consumer guidance on the product after opening and stated that it is necessary since the vacuum sealing is broken when the product has been opened. “Product in opened packaging should be stored in a refrigerator at +8 °C and consumed within 14 days”. Another manufacturer said in the interview that the reasons for not having consumer guidelines for the product after opening of the packaging is that the durability after opening depends so much on the storage conditions and on how the product is used that it is not possible to give general guidance on this.

One manufacturer has not yet date-labelled the product, but stated that it seems reasonable to have this labelling to be in line with the FIC Regulation. However, they are hesitant about adding such labelling since they believe it might result in increased food waste. Nowadays, many consumers seem to lack knowledge of food handling and just trust the labelling on the package when it comes to food quality. Another concern is that it is hard to fit a great deal of information into the restricted space available on the label.

Most of the selected products were packed in a glass jar, but one of the products had a plastic packaging. The product in a plastic tray had slightly shorter durability displayed on the packaging compared to the products in jars. Glass is completely impervious, i.e. 100% airtight. Plastic packaging is not entirely airtight, which makes the product more likely to oxidise than in a glass jar. The closing of the lid is also very important for the durability. The various guidelines are shown for each product in Table 6.

Table 6: Guidance of durability after opening of the package for selected products of pickled herring

Producer No.	Guidance
FI-1	-
NO-1	Storage temperature 0–4 °C.
NO-2	-
NO-3	Storage temperature 0–4 °C.
SE-1	-
SE-2	In opened packaging, product should be consumed within 14 days. Keep in refrigerator at +8 °C.

The manufacturers assess that there are no additional microbial risks connected with the product in opened packaging. Over time the product will of course spoil due to for example growth of yeast, or go rancid due to decomposition of fat. The product has low pH and high salt concentration, which makes it stable in terms of the risk for microbial growth.

4.7.3 *Pesto*

Pesto is not produced in the Nordic countries and since the retailers decide on the information text to put on the packages, they are responsible for the validity of facts/instructions stated on the label. The interviews were therefore conducted with personnel from the retailers' quality departments. Since the products are not produced in the Nordic countries, it is assumed that the guidance is the same, and only products on the Swedish market were included in this part of the interviews.

Two of the three retailers indicate the durability time for opened packaging on their labels. Retailer 1 gives the guideline: "Opened packaging to be kept in refrigerator at +8 °C for about 15 days" and Retailer 2 states: "Opened package will last for one week in the refrigerator, longer if the contents are covered by oil." The background for this guidance is that the retailer considers the opened package to have considerably shorter durability than the unopened package. As seen in the guidance on the package, one of these retailers has judged that the product is safe for at least 15 days when stored in the refrigerator. That is based on product analysis for microorganisms, yeast and mould. The other retailer has a durability of one week stated on the package. This retailer has assessed that the microbial risks for the product are low.

One of the three retailers does not give any guidance regarding durability, but states the following on the package: "Opened packaging to be kept in refrigerator at +8 °C". This retailer did not consider it relevant to give any further information regarding durability. None of the retailers

gives consumer guidance on use of the product, since it is commonly known that it can be eaten directly without prior treatment. The various guidelines for each product are shown in Table 7.

Table 7: Guidance of durability after opening of the package for selected products

Producer No.	Guidance
SE-1	Opened packaging to be kept in refrigerator at +8 °C
SE-2	Opened packaging to be kept in refrigerator at +8 °C for about 15 days
SE-3	Opened package will last for one week in the refrigerator, longer if the contents are covered by oil.

5. Can extension of durability decrease food waste?

This chapter discusses how the shelf life of a product affects the amount of food waste. A case study documents the amount of product waste in retail before and after a change of packaging gas that prolonged the actual product durability, thus allowing for longer shelf life. The chapter also includes results from the literature of similar studies.

5.1 A case study of extended shelf life and food waste

A manufacturer of minced meat changed its packaging system by switching the packaging gas from high oxygen to a CO₂/N₂ gas mix (Hauer, 2015). The extended durability was used to prolong the shelf life provided on the labelling of the products. A large retailer in Norway registered data for food wastage before and after the change in durability stated on the product package. The data consisted of the number of units sold and the number of units that had passed the use by date and thus were discarded. The corresponding purchasing value for units sold and units discarded were included in the data. The data basis was specified for three varieties of minced meat in 629 stores in Norway.

The packaging gas used is important for the durability of the product. In this case, the packaging gas was changed from high oxygen (70% O₂/30% CO₂) to 60% CO₂/40% N₂. In general, high oxygen gives an actual shelf life of 9–10 days for minced meat, while the CO₂/N₂ gas mix gives an actual shelf life of 18 days. In this case study, the durability displayed on the package was prolonged from 10 days to 18 days for minced beef and to 14 days for minced pork. The durability was thus greatly increased. The question was whether a far longer sales period would affect the amount of food wastage, or if these products would be sold anyway due to a high turnover rate. The data was analysed statistically by the software SPSS.

Since the three minced meat varieties had different durability stated on the package, they were analysed separately. The statistical analysis showed that food wastage before and after was significantly different

($P > 0.0001$) for all three varieties of minced meat. Figure 8 shows the mean values of waste of the three varieties of minced meat before and after prolonging the durability stated on the consumer package.

Figure 8: Mean values of food wastage (%) for three varieties of minced meat before and after prolongation of the durability stated on the consumer package

To determine whether the food wastage depended on the turnover rate, the stores were divided into three groups on the basis of low, medium and high turnover rate for these products:

- Low – fewer than 4,000 product units sold per month.
- Medium – 4,000–8,000 product units sold per month.
- High – more than 8,000 product units sold per month.

The analysis showed that food wastage was significantly different ($P > 0.0001$) between stores with different turnover rates. Figure 9 shows the mean values of waste for low, medium and high turnover rate before and after changing the packaging gas. Stores with a low turnover rate had about twice as much wastage of minced meat (%) as stores with a high turnover rate.

Figure 9: Mean values of food wastage (%) for low, medium and high turnover rate before and after prolongation of the durability stated on the consumer package

The data showed significant differences between the percentage of food wastage in the periods before and after an extension of durability displayed on the package for all three varieties in total and for each of them separately. Considering the turnover rate by splitting into low, medium and high according to numbers of sold products, it becomes clear that stores with a low turnover rate have a much higher percentage of food wastage and vice versa. This applied both before and after the change but the level was much lower after the change. Compared to the stores with a low turnover rate, the stores with a medium turnover rate had 30% less product wastage. Similarly, stores with a high turnover rate had 50% less product wastage before the change. After the change, the differences were even greater.

The gas mixture of 60% CO₂ and 40% N₂ is used for most types of fresh raw meat, i.e. minced meat, hamburger meat, pork, lamb, poultry and certain types of beef in Norway. This CO₂/N₂ mixture gives long microbiological shelf life. The meat usually has a dark red colour. Discoloration of meat in the CO₂/N₂ gas mix can mostly be avoided by the packaging processes. In other Nordic countries, it is common to use so-called high oxygen, which is 70% O₂ and 30% CO₂, for most types of fresh raw meat. Some pathogenic bacteria grow faster in meat in a high oxygen gas mix than in a 60% CO₂/40% N₂ gas mix. See also Section 4.4 on minced meat.

5.2 Literature review of extended durability

A study conducted by WRAP (Lee *et al.*, 2015), describes the possibilities for reducing food waste by extending the durability. In the report, the following terms regarding durability were used:

- Total life: actual shelf life.
- Maximum life: total life + margin.
- Available life: time available for the consumer.
- Opened life: time period that a product should be consumed once opened.

Manufacturers and retailers have been interviewed on how the durability is determined. It was especially the cooling temperature in the consumer's house that was regarded as a limiting factor and surveys showed that the average temperature is 7 °C. The total life for some selected products showed great variation, as did the available life. Calculations of the economic and environmental savings through increased shelf life estimated that if the durability displayed on the package were extended by one day it would save the grocery trade 800,000 tons and households 170,000 tons of food waste.

The study identified the following measures to reduce food waste:

- Challenge buffer time (margin of expiry date until the product is considered as having poor quality and/or insufficient food safety), which may be set too carefully
- Develop standards for durability of opened package: "after opening the package should be used within x days" (recommends using only where food safety is a limiting factor).
- Increase product available life. This time can vary widely. This can be improved by better stock rotation.
- Distribution of durability. The industry standard specifies that 75% of the time should remain when the goods are delivered to the grocer. It is not recommended that items that do not comply with this time are rejected, but instead daily negotiations and joint contributions should be used to improve delivery results in terms of durability.

A Dutch study has also assessed the practice of date labelling and determination of the durability: “Expiry Dates: a Waste of Time?” (Soethoudt *et al.*, 2013). It discusses whether products should be labelled with date of packing, so that consumers themselves can assess the durability. Some manufacturers may set a shorter shelf life to give the impression that the product is fresher. The shelf life can be extended by changes in processing, manufacturing method and packaging solution. A new EU website introduces new technology in this area. An extension of the shelf life is generally a trade-off situation between reducing food waste and food safety. It is also considered whether there are other technical solutions that can replace or supplement date labelling.

The net costs and benefits of reduced storage temperature in supermarkets have been examined in a Swedish study (Eriksson *et al.*, 2015). The expiry date is identified as one of the most important reasons for food waste. Prolonging the shelf life by reducing storage temperature in supermarkets can be one way to reduce food waste. Data for waste of different food categories and microbial growth at different temperatures was used to estimate how much the durability displayed on the package can be prolonged and how much food waste can be reduced by this measure. It was found that for products with high environmental impact and high costs, the reduced storage temperature gave a net saving, in both economic and environmental terms. For products with low impact and low waste initially, the impact from reduction of the storage temperature was higher than the benefits of reducing food waste. The conclusions from this study support previous findings (Jensen *et al.*, 2013; cited in Naturvårdsverket, 2014). It was concluded that lowering the temperature during storage and transport may reduce the avoidable food waste from consumers who do not discard food based only on the date labelling. If reduction of the temperature during storage and transport is combined with longer durability because of lower temperature, it may reduce the avoidable food waste from consumers who rely entirely on date labelling and do not consume products after the expiry date.

In a Swedish study (Jonsson, 2012) “Date labeling of food – for the benefit of producers, retailers and consumers?”, interviews with companies in the food industry were conducted to identify how they determine product durability. The interviews showed that sensory and microbiological testing is conducted in similar fashion in the dairy and the meat industry. The “best before” dates in the studied companies are set with some margins. How large the margins are was difficult to assess. The companies stated that the most important factors for long durability are a

good product, unbroken cold chain and low temperatures from production to consumer.

The manufacturers are responsible for determining correct shelf life from a food safety perspective (Hanssen *et al.*, 2011). Manufacturers also have primary responsibility for finding packaging solutions that provide the best durability. Both shelf life displayed on the package and packaging solutions should be chosen in consultation with actors in the value chain. Product flow in relation to date labelling is a shared responsibility for all actors in the value chain, to ensure sufficient flexibility in distribution of shelf life.

5.3 Summary of findings

The durability of a food product can be extended by changing the manufacturing process, the packaging solution, as seen in the case study, or by increasing the available time of the product in stores by decreasing the time at manufacturer/wholesaler or reducing the storage temperature.

The case study showed that food wastage was significantly lower after the durability of the product was prolonged due to a change of packaging. This finding is also supported by the WRAP study, which has calculated large savings by prolonging the durability by one day. The Swedish study showed that the “best before” dates are set with some margins. How large the margins are was difficult to assess, but it seemed possible to challenge this margin, which might have been set too carefully. An extension of the shelf life is generally a trade-off situation between reducing food waste and food safety. If companies are to prolong the durability stated on the product, it is important to have a good production process, unbroken cooling chain and low temperatures from producer to consumer.

The literature review identified measures to reduce food waste. One of these was to increase the product durability available for the consumer in the store. This can be done by distribution of durability, reduced storage temperature and a technological shift that allows for labelling with longer durability. The distribution of durability is important but should be used with care to avoid the food products being rejected by the retailer, due to expiry of the time allocated for manufacturer and wholesaler. Reduced temperature is particularly relevant in countries that have a storage temperature above 4 °C. However, it is especially for products with high waste and high environmental impact that a reduced storage temperature will provide economic and environmental benefits.

6. Factors causing food waste related to date labelling in retail

To estimate amounts and causes of food waste, a variety of methods have been used: interviews with store managers, waste composition analyses in retail store and mapping of food wasted during a week in a supermarket.

This section of the report will elaborate the results and findings from these qualitative studies. There is also a summary of literature on food waste in retail.

6.1 Summary of food waste in retail

The interviews and literature on the retail sector showed that the most important reasons for food waste are as follows:

- The main reason for food waste in retail is that the wrong amount of a product is ordered.
- Consumers are looking for the products with the longest remaining shelf life, making it more difficult to sell those with short remaining shelf life. The fewer different dates, the less wastage.
- Promotions lead to food waste, because it is difficult to order the right amount. Promotions are important from a marketing perspective; however, the sale only shifts from one brand of a product to another, which may lead to food waste for the competing brands of the specific product.
- A large product range can be a driver towards higher wastage overall, and particularly for products with a short shelf life.
- Organic products as a group had a higher percentage of waste in all four supermarket sections studied.

Other important findings are:

- Most retailers reduce the price of products before the expiry date by 30–50%.
- None of the retailers in the four Nordic countries sells products that have passed the “best before” date, although this is allowed. The reasons are that the retailers need to uphold high standards for their store and the lack of customer information and knowledge regarding the date labels.
- The retailers showed interest in redistributing food, but strict regulations and documentation requirements makes the process difficult in practice.
- Mapping of food waste in retail in Denmark showed that most of the products studied were discarded because they had passed the expiry date.
- From the waste composition analysis conducted in one week in seven Danish supermarkets, it was estimated that 29% of food waste from one supermarket is due to the expiry date.

6.2 Mapping of food waste in retail

In an attempt to find out how much of food waste was due to the expiry date, one store in Denmark registered the amount and causes of food waste during two weeks of August 2015.¹² The methodology applied for this pilot mapping consisted of the following steps:

- A registration scheme was developed to ensure standardisation of data and to make it as simple as possible for the stores to carry out the registration. Apart from the expiry date, alternative reasons for discarding the products were added to the scheme. This was done in order to ensure that a category was available for all products discarded. In this way, it was possible to obtain data on the proportion discarded due to date labelling compared to other reasons.

¹² Five stores were contacted and agreed to participate in the mapping of food waste, but only one of the stores delivered the data in the end. This might partly be due to timing as it was very close to the summer vacation when routines might differ.

- A detailed description of the project and the registration process was developed and sent to the stores together with the registration scheme. In addition, follow-up phone meetings were made with the staff involved in the mapping to ensure a common understanding of product groups, registration scheme and methodology.

The pilot mapping shows that most of the products registered were discarded because they had passed the expiry date (48 out of the 54 items wasted). In this project, the mapping was conducted as a limited case study of one store and therefore there was no basis for comparison between stores.

The method tested can be useful for further analysis of food waste related to date labelling for specific products. In order to use the registration system for further research it is useful to keep the following recommendations in mind:

- Contact stores directly or choose stores that are independent (might have more autonomy).
- Choose stores with an interest in environmental issues.
- Secure a representative group of stores for comparison (size, type, location, target group, etc.).
- Choose the right time, when the stores are not too busy (not around vacations etc.).
- Describe clearly the benefits for the stores (e.g. knowledge about their waste, CSR).
- Make a clear and simple description of how to carry out the registration.
- Make a simple registration scheme – use Excel sheets and a set-up that makes it easy to compile data.
- Ensure that the store sells and has defined the products that belong to each of the fractions investigated/registered.
- Make sure that relevant data about the store is available (turnover, etc.).
- Offer the store the option of being anonymous in reports, etc.

6.3 Waste composition analysis to estimate food waste

ECONET is a Danish consultancy specialised in waste composition analysis. In 2012, they collected data from seven retail stores during one week (ECONET, 2013). Based on the waste composition analysis, it is estimated that 29% of the food waste from the supermarkets was due to the expiry date. The top five fractions wasted due to date labelling can be seen in Table 8 below:

Table 8: The top five fractions of waste due to date labelling in 7 Danish stores during 1 week

Fraction	Percentage of total food waste from supermarkets
Dried, frozen and other preserved food of vegetable origin	8.4%
Liquid dairy products	6.6%
Fresh, not processed food of animal origin	6.0%
Dried, frozen preserved food of animal origin	3.8%
Processed food of vegetable origin	1.2%

6.4 Interviews with store managers

In all four countries, interviews with 11 store managers have been conducted, but in Denmark and Norway such interviews were only conducted to supplement the findings from other methodologies employed. Nevertheless, these results give a good impression of how food waste and date labelling are handled in retail. The interview questions focused on the six case products, but more general information also emerged during the interviews.

In order to obtain as representative results as possible, several retailers from different food chains were contacted. However, it was difficult to get participants to agree to such a questionnaire and the data are therefore not as representative as originally planned. The results include data from the following retailers and types of concept stores:

- A major food chain in Sweden: two local retailers with a limited selection of products, three retailers with a wide selection of products and one retailer with a wide selection of products, including non-edible products.

- Three retailers in Finland: two with a wide selection of products and one with a smaller selection of products. All of them have also non-edible products in their selection.
- One retailer from Denmark.
- One retailer from Norway with a wide selection of products, including non-edible products.

The interviews were conducted face-to-face or via telephone and the questions were sent to the retailers approximately a week in advance.

6.4.1 Location and demography

How the retailers manage their products in terms of decreasing their food waste is related to where the stores are located and thus different customer demands due to demographics and culture. For example, due to more single households in a particular area, some retailers order more single packaging than others do. Further, reducing prices in one of the stores (in Stockholm) was never even considered, as this would impair the image of the store as a high quality retailer in the city centre. Hence, it is clearly very important for the store manager to know the neighbourhood and the habits of the customers.

6.4.2 Deliveries and types of ordering

In Sweden, the majority of the products in this food chain are automatically ordered via pre-set computer data typed in by the store managers. Thus, these ordering data are based on retail experience. However, sometimes manual ordering also takes place, mainly in connection with upcoming advertising campaigns, special offers or for holidays such as Christmas and Easter. In Finland, the case products are delivered on almost all weekdays, see Table 9. The retailers stated that consumers are looking for products with the longest remaining shelf life, making it more difficult to sell those with a shorter remaining shelf life.

Table 9 summarises the range in the answers from the retailers on estimated frequency of delivery of the products included in the study.

Table 9: Estimated frequency of delivery of products included in the study based on interviews with 11 store managers

Product	Frequency of delivery, days/week		
	Sweden	Finland	Norway
Eggs	5–7	3–5	1
Milk (pasteurised)	5–7	5	5
Cooked ham (sliced and MAP-packed)	5–7	5	1
Minced beef, without water and salt, MAP-packed	5–7	5	1
Cold smoked sliced salmon, vacuum packed	2–7	5	1
Ready-to-eat salad, containing heat-treated chicken	3–7	5	2

In Norway, the stores can get daily deliveries. However, the interviewed store wants delivery only once per week for most products (milk and ready-to-eat salad twice a week), since it is easier to manage fewer dates. The retailer stated that the fewer different dates to choose for each product, the less wastage. In addition, too large a selection can increase waste.

6.4.3 Date labelling and reduced prices

One retailer in Sweden has a policy of reducing prices on all products as the best before/expiry date approaches. The products are given a 20% discount two days in advance, and a 50% discount on the best before/expiry date itself. Approximately 95% of all products with reduced pricing are sold and it is rarely necessary to use the 50% discount, according to the retailer.

Products sold fast and kept shortly in the store are not normally discarded due to the expiry date and thus the prices on these products are seldom reduced. The majority of the interviewed retailers in Sweden and Finland stated that most of the products included in the current study are sold quite fast. However, there are exceptions, such as cooked ham, smoked salmon and eggs. Regarding cooked ham, one retailer mentioned that they used to sell four different brands of cooked ham but now only one is offered to customers as the demand for the product has decreased over time. The ham that is left unsold when a new delivery is received is

discarded if there are two days or fewer left of the shelf life. Another retailer also mentioned cooked ham as being the most troublesome of the products in the study regarding date labelling.

Only one retailer mentioned that they never discard minced meat. On occasion, the other retailers need to reduce the prices on minced meat one or two days before the expiry date. One retailer orders the minced meat manually unlike the others and sometimes reduces the price of the meat three days before the “use by” date. The retailer used to pay the cost of discarding the meat but noticed that there is a demand for close-to-date meat in stock and started to reduce the prices by 20% if necessary. However, this is only done if unexperienced personnel have made the manual order or after a campaign where too large volumes were ordered.

Ready-to-eat salads have a very short durability, which one of the retailers considered a problem. The supplier of one retailer delivers new salads every day and takes back the salads with two remaining days to the “best before” date as they do not look fresh enough for customers. It is, however, unknown what happens to the salads that the supplier takes back. In one store, the supplier collects 4–14 unsold salads at every delivery. Generally, the retailers seemed to have less knowledge on this product since the supplier pays for the discarded items.

In Finland, some retailers often reduce the price of products two days before the expiry date, with a reduction varying between 30% and 50%. Orange/red tags mark these products and this has decreased the amount of food waste remarkably. Instead of red tags, some stores prefer campaigns with reduced prices to fit in better with the profile of the store. All the retailers stated that the requirements from the chain for a broad selection of different brands are causing food waste, especially in packed ham.

In Norway, some products are sold at reduced price before the expiry date. However, if price-conscious customers find a product that has expired, they can ask for a good price. Usually there is no return of the product from retailer to supplier, only if the product has defects or quality deviations. If a store chooses to accept a large amount of a product with a short remaining shelf life, the supplier will cover the deficit, if not everything is sold.

None of the retailers in the four Nordic countries sells products that have passed the “best before” date although this is allowed. The reasons are a need for retailers to uphold high standards for product quality and the store in general and also a lack of customer information and knowledge of the meaning of the labels.

6.4.4 Other comments from retailers

Many stores stressed the connection between promotions and food waste related to date labelling. The manual orders made for such occasions often lead to ordering too high quantities of products. The promotions are important from a marketing perspective; however, the sale only shifts from one brand of a product to another, potentially resulting in food waste for the competing brands. Further, a promotion running at a competitor's store may cause food waste for that product without the knowledge of the retailer.

All retailers work carefully to educate staff on shelf rotation i.e. putting the older products at the front and the new deliveries at the back of the shelf. They stated that there was therefore practically no food waste due to lack of shelf rotation.

None of the retailers in Finland and Sweden freezes meat close to the expiry date in order to sell the frozen product to customers. Reasons given by the retailers include:

- Lack of sufficient knowledge about the regulations.
- Do not want to sell a product after the expiry date even if it is frozen.
- Cannot be sure how the consumer handles the product after it leaves the store.
- It does not pay off.
- There is no customer demand for frozen meat.
- It is too complicated as a new date label is required.

Two of the Swedish retailers freeze meat before the expiry date in order to use it for later in-store cooking to produce minced meat sauce, hamburgers, etc. to sell.

Generally, all the retailers work continuously with reducing in-store food waste by:

- Educating staff.
- Making sure the right volumes are ordered; several factors need to be considered in planning orders.
- Balancing full shelves against no food waste.
- Reducing prices.

- Changing selection of products (e.g. discontinuing unpopular products and changing packaging size in line with local household composition).
- Rotating the products on the shelves.

Many retailers stress the problem that the customer is uninformed about the difference between the “best before” date and the “use by” date. The customers strongly interpret “best before” as if it should be thrown away after this date, instead of trusting their own judgement, according to the retailers. Consumers should trust and utilise their senses when evaluating what is still edible and what is not. Further, there seems to be a lack of knowledge of how to utilise leftovers. In addition, the right storage temperature in the consumer’s refrigerator was seen as an important factor in food waste. One of the retailers also points out customer behaviour in stores, e.g. touching and pressing vegetables or fruit when choosing them. Sometimes products are even thrown or otherwise mishandled. Consumer demand for a full selection of all products at all opening hours was recognised, but a broad selection was also considered as a competitive factor.

6.5 Literature review on food waste in retail

The Norwegian ForMat project is a collaborative project covering manufacturers, wholesale and retail in the food and beverage sector. Data from the project have shown that a very large part of in-store food waste concerns “unsaleable items” which have expired or have degraded quality (Hanssen *et al.*, 2011). This accounted for 90% of recorded wastage in stores. However, the expiry date or loss of quality before sale is the secondary reason why food becomes waste, being considered as a symptom or effect of other primary causal factors.

The data from the ForMat project showed a clear connection between the percentage of food wasted and turnover, where wastage increased with decreasing turnover. However, with a clear focus on reducing food waste, it is possible to achieve low wastage despite low turnover. Product range is also an important factor, since product groups with low turnover generally have much more food wastage than those with higher turnover. A large product range will be a driver towards higher wastage overall, and particularly for products with a short shelf life. The purchasing departments of retail chains must balance breadth of selection against food

waste. Too large a range in selected product groups is a major challenge in terms of avoiding food waste.

The ForMat project also conducted a survey of retailers' own perceptions of important reasons why food becomes waste. The results showed that too large quantities in relation to turnover are often ordered, and that large stocks of products can expire before they can be sold (Hanssen *et al.*, 2011). The reason that manufacturers' stocks are too large may be the need to produce greater volumes per production series; this can be remedied through better information flows and prognoses for orders.

In many cases trade guidelines rather than legislation determine what is discarded. The stores follow their own rules based on how the products are being sold (Martinsson, 2014). None of the stores in this Swedish study sells food beyond the "best before" date. The stores are responsible for the products' quality (EU 178/2002). They consider it too risky to sell products past the "best before" date, which are in fact regarded as unsaleable. Also, consumers may confuse "best before" with "use by" and often throw away food at home based on the "best before" date.

The Swedish environmental protection agency has compiled results from Swedish and other studies on the reasons behind the generation of food waste (Naturvårdsverket, 2014). In the study, it was assessed that one of the main reasons for avoidable food waste in retail stores is that the wrong amount of a product is ordered. This problem is greater in smaller stores. Customer expectations of a wide range of products with various brands and types as well as full shelves during all opening hours is also liable to increase avoidable food waste.

A Danish study from Miljøstyrelsen (Miljøstyrelsen, 2014) has revealed some important measures to reduce food waste:

- Education of staff in stores "through information and education, focusing on the fact that it may be acceptable that a few products occasionally are sold out or nearly sold out".
- Increased use of discounted products that are close to their expiry date, possibly through automatic reduction of the price.
- Donating food close to expiry to social organisations.
- Encourage suppliers and central warehouses to supply mislabelled or excess food to food banks.
- Promote foods in packages that minimise food waste by the consumer, for example through variation in size and ease of reclosing the package after opening.
- Optimised packaging for each product to ensure maximum life.

- Prolongation of life by technological solutions such as lower temperature in the cold chain.
- Use of products close to expiry date in ready-made meals in the store.

In a Dutch study (Soethoudt *et al.*, 2013), some additional measures are proposed as examples of good practice in stores to reduce food waste:

- Guarantee that all products have at least seven days' remaining shelf life when arriving to store.
- Good inventory management using bar codes to identify products two days before the expiry date and reduce the price.

Some of the proposed actions have been implemented in Norwegian retail, showing that retailers have increased awareness in recent years and therefore more frequently reduce the prices of products approaching their expiry date, and give food to the Food Bank or directly to catering establishments (Stensgård & Hanssen, 2015).

6.5.1 Waste of organic food

Organic food has been specifically studied (Eriksson *et al.*, 2013) to examine whether organic food products have a higher level of waste. The relationship between turnover and percentage of waste was the same for organic and conventional products, where the majority of the organic products were sold with low turnover and high wastage. For products (organic or conventional) with low turnover, the shelf life and wholesale pack size (which determines the minimum order volume) are critical in determining the waste percentage. Waste reduction measures that involve decreasing the wholesale pack size and/or increasing shelf life thus have the potential to be effective in this case, as would measures that increase turnover. Disclosure of products with low turnover would most likely reduce overall waste, but it is impossible to carry out because it is often preferred to have a certain proportion of organic products. Most retailers probably see increased turnover in combination with an increased focus on waste reduction as a better solution.

7. Trade agreements for allocation of durability

The actual shelf life of a product is also determined by how the total durability is allocated between the manufacturer and the retailer. Trade agreements regulate how fast the product gets distributed to the retailer.

This chapter describes those trade agreements, illustrated by responses from the interviews and an example from Norway.

7.1 Interviews of manufacturers and retailers

7.1.1 *Sweden*

In an interview with a Swedish food chain, it was stated that a product reaching wholesale should have two-thirds of its shelf life left, and half of the total shelf life has to remain in retail. However, deliveries mostly take place even faster than the requirements. The interviews with the manufacturers revealed that the trade agreement seems to depend on the product. One dairy stated that retailers want to have fresh milk produced the same day, but it is not an absolute requirement. They promise the retailers two-thirds of the durability time. A manufacturer of smoked salmon says that 75% of the shelf life must be available for the retailer. For private labels, the remaining shelf life varies. For cold smoked salmon with a shelf life of 21 days, retailers often want to have 16–17 days at their disposal. For minced meat and cooked ham, the manufacturers have 5/6 of the shelf life set aside for the retailers, but this may vary slightly in practice. One manufacturer mentioned the difficulty of keeping to these agreements at times, but that good planning can solve this. For meat products, many retailers are used to receiving three weeks' durability, but the manufacturer stated that their 17 days was usually adequate.

7.1.2 Norway

Retailers in Norway have a trade agreement with suppliers on common guidelines for labelling and allocation of product durability (STAND 001). This agreement includes a standard for allocation of shelf life of products. The actual shelf life of a product is divided into three parts, manufacturer, distributor and retail/consumer, see Table 10. For products with a shorter shelf life than 17 days, individual agreements are made.

Table 10: Extract from the Norwegian trade agreement for allocation of total shelf life (in days)

Total shelf life	Manufacturer	Distributor	Retailer/consumer
90	30	30	30
50	10	12	28
25	4	8	13
17	3	5	9

7.1.3 Denmark and Finland

In the interviews with manufacturers from Denmark and Finland, no particular rules for remaining shelf life were found; practice varied depending on the product and retail chain. Some Finnish manufacturers stated that there should be a certain minimum time of the actual shelf life left when the product arrives at the retailer. However, there are no specific standards. Retail chains determine in contract negotiations the minimum remaining shelf life for the products.

7.2 An example of application of the Norwegian STAND 001

As mentioned in the previous section, retailers in Norway have a common trade standard for allocation of product durability, called STAND 001. Under this agreement, a product with a total shelf life of e.g. 17 days allows the manufacturer only three days from the date of production until it reaches the wholesaler, see Table 10. If the manufacturer fails to sell the product to the wholesaler within that time, it is still possible to sell it directly to the store. However, that requires considerable extra organisation, including a separate agreement, ordering through wholesalers, special labelling, additional transport and a reduced price. That implies that the sale of a product after the last day of the manufacturer's share of the shelf life is much more resource-intensive and also requires that the store

is willing to accept the product. The sale thus becomes less profitable for the manufacturer. Although manufacturers, wholesalers and retailers make efforts to get most products distributed within the agreed expiry date, there will always be products which make it difficult to follow the guidelines. The existing system is too rigid, and it is important to find procedures that promote flexibility.

Data from one manufacturer shows how this functions in practice (Bjørnhaug, 2015). Table 11 shows an example of sale of products from one randomly selected week.

Table 11: Percentage of products that were sold by the manufacturer's last date, and by 1, 2 and 3–5 days after the expiry date, i.e. saved from wastage

Products	Available days	Sold by the last day	Sold by 1 day later	Sold by 2 days later	Sold by 3–5 days later
Steaks and fillets	4	97.2%	99.2%	99.9%	100%
Minced meat	3	98.2%	99.8%	100%	100%
Sausages	7	89.3%	93.9%	95.0%	100%
Fresh sliced meat	7	97.5%	99.4%	99.9%	100%
Ready-made food	4	99.7%	100%	100%	100%

The table shows that between 93% and 99% of the production volume was sold before the shelf life allocated to the manufacturer had expired. This means that the manufacturer must make separate agreements to sell the remainder, as described above. The table shows how much of a product was sold by the manufacturer's expiry date, and by 1, 2 and 3–5 days after the expiry date, i.e. finally reaching a 100% sold product. The table does not include products that were wasted, but only lists products that were actually sold and thus saved from wastage, to illustrate how the system is functioning.

The following factors affect wastage at the manufacturer level (Bjørnhaug, 2015):

- Listing, i.e. how many stores/chains in which the product is represented.
- Sales volume.
- Lead time, i.e. time from ordering until the products are delivered.
- Production frequency and requirements for batch sizes.
- Distribution frequency.
- Weather dependence of the product.
- Wholesalers' margin stock.
- Products at a central warehouse or as wholesaler's regional stock.

A network organised by ForMat has proposed introducing flexible durability, allowing a product to have a longer shelf life in winter, when there is little risk of interruption to the cold chain during distribution. The expiry date is often determined on the basis of a worst case scenario (high temperatures, long transport distances, etc.). The network has therefore considered the use of flexible durability during the year, such as a longer shelf life in winter and a shorter one in summer. This is in line with the legislation of the national food authorities.

8. Legislation on durability and date labelling of table eggs

All table eggs produced within the EU and EEA must be sold to the consumer within a maximum of 21 days after laying.¹³ This period is based on storage in room temperature and the rate of growth of *Salmonella*, but most consumers in the Nordic countries store their eggs in the refrigerator. This leads to a food waste which is discussed in this section.

The purpose of this “date of delivery” is to maintain a reasonable, harmonised shelf life. Consequently, table eggs must be sold to the end consumer within 21 days after they have been laid. The “best before” date rule in the EU for table eggs is specified in another regulation¹⁴ as 28 days from laying, but this regulation is not part of the EEA agreement. In Norway, the durability of eggs is generally said to be 28–35 days.

The durability of 28 days is the period in which a correctly stored egg normally retains its specific properties and it is mainly linked to quality parameters and not to safety parameters. However, the specific serotype *Salmonella* Enteritidis is less likely to be found in laying hens in the Nordic countries than in EU countries in general. This specific serotype may be present inside the egg and grows in the egg when it is stored at room temperature. Storage at refrigerated temperatures limits the growth of both spoilage bacteria and *Salmonella*.¹⁵ The common position in the Nordic countries is that eggs should not be regulated separately but treated as any other foods, i.e. that it is up to the companies to decide the labelling and durability of the product. As long the current legislation yield there is need for consumer education about the durability of eggs.

¹³ Regulation of the European parliament and Council (EU) No. 853/2004, Section X, Chapter I.

¹⁴ Regulation of the European Commission (EU) No. 589/2008, Article 13.

¹⁵ EFSA Scientific Opinion on the public health risks of table eggs due to deterioration and development of pathogens. EFSA Panel on Biological Hazards (BIOHAZ). EFSA Journal 2014;12(7):3782.

Since there are no specific requirements in the legislation to store eggs refrigerated, storage at room temperature was taken into account when the specific durability and storage conditions were set. Hence, refrigerated storage would increase the durability of table eggs considerably and waste of egg would probably be significantly decreased if the legislation were adapted to reality.

8.1 Literature review of wastage of eggs due to date labelling

Eggs labelling is unique, for which EU legislation determines both the date by which they must be sold (21 days from laying) and the “best before” date (28 days from laying). There are two reasons for the legislation that gives a relatively short shelf life of eggs. In most EU countries, the eggs are stored at room temperature and there is a higher risk of contamination with salmonella in Europe than in the Nordic countries. When eggs are refrigerated, which is common practice among grocery stores and consumers in the Nordic countries, they have a shelf life of two to three months.

It is a problem for stores that eggs cannot be sold in the week prior to the “best before” date (Martinsson, 2014). Unlike many other products, the “best before” on eggs could be set later without compromising the quality of the product. The Stockholm Consumer Cooperative Society and Svensk Dagligvaruhandel (Naturvårdsverket, 2014) state that the common EU regulation on labelling of eggs results in unnecessary food waste. A survey of Swedish consumer behaviour on storage of eggs showed that 94% of those asked stored their eggs in the refrigerator. One in five of the respondents discarded eggs after the “best before” date.

A case study has quantified the amount of egg waste from grocery stores and the emissions this generates (Persson, 2015). Furthermore, the effect of extended shelf life on egg wastage was estimated. The case study was based on data from six Willy’s stores in Sweden. The data consisted of a five-year time series with entries for each week and individual store. The results showed that the stores in the study had an average egg wastage of 0.32% of their egg sales. The waste varied quite a lot both from year to year and between stores. Ordering the wrong amount of eggs can result in much wastage, especially at times like Christmas and Easter.

The results from the case study showed that waste could potentially be reduced by 36% by extending the sales period to 90 days. The conclusions drawn from the study are that egg wastage is generally low in the studied stores but that there is considerable variation. However, these six stores are all large, and may therefore be expected to have less waste than smaller stores. In comparison, the Norwegian ForMat project showed that egg waste in retail was reduced by 30% from 2010–2013 to 0.6% of sales value (Stensgård & Hanssen, 2015). These data are representative of approximately 70% of the Norwegian retail sector, since the stores are spread throughout the country and vary in size and whether they have a deli counter.

9. Consumers' attitudes and understanding

Several surveys of consumers' attitudes and understanding of date labelling have been conducted and some relevant studies are reviewed in this chapter. The temperature in the consumer's refrigerator is an important element in the durability of food, and a study of this has also been included in this chapter.

9.1 Surveys on data labelling

During autumn 2015, SP Food and Bioscience conducted a web-based survey to examine Swedish consumers' attitudes to labelling with a "best before"/"use by" date (Dynahmat 2015). The survey was part of the Dynahmat project, which focuses on reducing food waste. In the survey, respondents were asked their opinion on various statements regarding food date labelling. For each statement, there were four possible answers: not true at all, true to some extent, true to a large extent and completely true. A total of 256 responses were received, with a clear majority of women at 73%, compared to 27% men. Each possible answer could receive from 4 to 1 points on a descending scale, where "completely true" received 4 points and "not true at all" received 1 point. For each answer, the points awarded were multiplied by the number of respondents and the total was then divided with the number of respondents to obtain an average score. Table 12 shows the calculated average score for each statement for all respondents. The answers show that the consumers are inconsistent and it shows that they have not understood the meaning of the labels "use by" and "best before".

Based on the results of the survey, it is possible to conclude that the age group 20–30 years to a *greater* extent than the other groups assumes that the producer has set the correct durability time for the product, throws away products after the expiry date (both "use by" and "best before") and is afraid of getting ill from eating food products that have passed their expiry date. Further, it is possible to conclude that, in relation to the other groups, the age group 61–70 years to a *lesser* extent believes

that it is good to have long durability, throws away products that have passed their “use by” date and is afraid of getting ill from eating food products that have passed their expiry date.

Table 12: Statements from a survey on consumer attitudes to date labelling of foodstuffs and average scores for all respondents

Statement	Average score
1. If the best before date has passed, I make up my mind about on whether the product can be eaten or not	3.3
2. I look at the durability labelling	3.1
3. On the best before date, I make up my mind about whether the product can be eaten or not	3.0
4. Durability labelling influences whether I buy a product or not	2.9
5. Products with long durability contain more preservatives than products with shorter durability	2.7
6. I assume that the producer has set the correct durability for the product	2.6
7. It's good to have long durability	2.4
8. Producers are setting too short durability	2.3
9. If the best before date has passed, I throw away the product	2.1
10. I'm afraid that the food product will taste or smell bad when the expiry date has been reached	2.1
11. Date labelling gives me all the information necessary to decide whether the product is still of good quality	2.0
12. I'm afraid of getting ill if I eat a food product that has passed its expiry date	1.8
13. If the use by date has passed, I throw away the product	1.7
14. Products are often of bad quality on the best before date	1.5

Several studies by Stockholm Consumer Cooperative Society have been conducted to estimate the amount of food waste in Sweden (cited in Naturvårdsverket, 2014). Calculations based on results from waste composition analysis have shown that Swedish consumers discard 81 kg food waste per capita annually, excluding liquid waste. Consumer surveys indicated that the top three reasons for discarding food are that the consumer forgot about the food in the refrigerator, the best before date has passed and that the quality deteriorated.

In a Finnish study that aimed to explore and identify the food waste volume in the food supply chain, the average amount of discarded food in

households was found to be 23 kg per year. The main reasons for disposing of food were mould 29%, past “best before” date 19%, leftovers from meals 14% and making more food than needed 13%. The reasons for food waste varied in the foods discarded most often. For example, vegetables were generally discarded because they were spoiled, whereas food cooked at home was discarded as leftovers or due to preparing too much food. For milk products, the reason was usually having passed the “best before” or “use by” date. Bread, on the other hand, was either mouldy or otherwise undesirable, presumably due to drying out and becoming less appetising (Silvennoinen *et al.*, 2012).

In the Norwegian food waste project ForMat, a survey on consumer food waste and behaviour was conducted (Stensgård & Hanssen, 2015). The results from the survey showed that “past its expiry date” was the most common reason for discarding baked goods, sliced meat and yoghurt/sour cream. However, the share of consumers citing this reason has decreased since the previous survey. The strong focus on date labelling in the media and national food waste projects may be important reasons for this change.

The amount of food waste related to the expiry date was estimated in a Dutch study (Soethoudt *et al.*, 2013). It was found that 10% of food waste of fresh products by the consumer relate to the date label, and 5% for products with a long shelf life. Among fresh products, it was particularly dairy products and eggs which had a high percentage of wastage associated with date labelling.

The reasons for wastage for various product groups are very diverse (Westerhoven & Steenhuisen, 2010). Being past the expiry date is an important reason to throw out meat, fish, cheese and dairy products. For cheese and to a lesser extent butter and viscous dairy products, another reason is mould. The reasons for wasting beverages also vary. For coffee and tea, an important reason is that too much is made, followed by decline in freshness. For fruit juice and beer, the main reason to discard is that the product has passed its “best before” date.

Also in the United States, the presence of food waste, and ways to reduce it, has generated significant debate among industry stakeholders, policy makers, and consumer groups (Wilson *et al.*, 2015). Many have argued that the variety of date labels used by food manufacturers leads to confusion about food quality and food safety among consumers. In a study, six food products (ready-to-eat cereal, salad greens and yoghurt, all products both large and small unit size) were given different date labels (Sell by, Best by, Use by, and Fresh by). The results showed that, when keeping other observed factors constant, date labels do influence

amounts of food waste. All products have wasted food, but the quantity of waste is greatest for the “Use by” label, and lowest for the “Sell by” label. Two-way ANOVA tests demonstrated that consumers responded differently to date labels.

9.2 Position of the date label

The position of the data label and the actual date can be of importance for the consumer. A food producer conducted a consumer survey showing that the durability labelling for many consumers is essential for the choice of product. They therefore changed the production structure to provide the customer with longer durability. The company also focused on readability of the date label. It should be easy for consumers to find the date label and on some products it could vary from time to time where the date label was placed. To get the date label in the same place every time, the company changed the design of the packaging and adjusted the packaging machine. At the same time, the font size was increased to make the text easy to find and read.

9.3 Temperature in the consumer’s refrigerator

Studies show that temperatures in private refrigerators vary widely and are often somewhat higher than the recommended storage temperature for some foods. In a Swedish study, 102 respondents were asked to store seven different products as they normally would (Marklinder *et al.*, 2004). The storage temperatures in the different products were measured the day after. A fairly large proportion of respondents had stored products at a temperature above 8 °C: minced meat (22%), milk (31%), ham (44%), smoked salmon (38%) and ready-to-eat salad (39%). Storage temperatures exceeded recommended temperatures for an unsatisfactorily large proportion of food items. Although most respondents knew the recommended refrigerator temperature, only a minority knew the temperature of their own refrigerator.

Another study (Marklinder *et al.*, 2015) investigated the food storage temperature in Swedish household refrigerators. The study showed that

the temperature at the back of the middle shelves was coldest (average 4.8 °C) and warmest at the front of the top shelves (average 7.5 °C). A relatively high proportion of food items were stored at higher temperatures than recommended. The “use by” date had passed for 30% of products, but the students did not rate these as inedible.

According to a follow-up study concerning fish products (Mattila, 2009), Finnish refrigerators are not cold enough. The results show that the average temperature was 7.4 °C, which exceeds the temperature limits set by the legislation (MMMa 37/EEO/2006) of under 6 °C for transportation directly from manufacturer, 0–3 °C if the product leaves from the wholesale warehouse as regular delivery and in retail. Evira (the Finnish Food Safety Authority) recommends consumers to keep refrigerators at 5 °C and store fish products at a maximum of 3 °C. Strict temperature limits enhance product quality, since the growth of dangerous pathogenic bacteria slows down in cold conditions. According to the study, 73% of the fridges were too warm, with temperatures reaching as high as 16 °C (Mattila, 2009).

A Norwegian study aimed to improve food safety in the domestic environment by a risk analysis of consumer food handling and evaluation of risk-reducing measures (Røssvoll *et al.*, 2009). The study consisted of a consumer survey, a case study, and a microbial experiment. It was revealed that 43% of Norwegian consumers did not know the temperature in their refrigerators. Of the remainder, 30% reported having a temperature higher than the recommended interval (0–4 °C). After the expiry date has passed, only 34% discard cold cuts of boiled ham, whilst 23% claim to still use them. The majority (62%) consider their own sensory apparatus as an important tool to evaluate the quality of cold cuts of boiled ham after the “use by” date.

10. Discussion

The overall aim of the project was to optimise food labelling to minimise food waste in the Nordic countries without challenging food safety. Food waste related to durability labelling can have several underlying causes and different measures can be implemented, depending on where in the value chain the focus is. The main findings that have emerged from the project are discussed below.

10.1 Durability and guidance

The results from the interviews revealed large variations in the durability of food products. The durability within each product category varied considerably and for some product categories, there were differences in the use of date labelling i.e. in the choice of “use by” or “best before”. After the FIC regulation fully entered into force in 2014, Sweden changed its national guidelines. These guidelines now have a greater focus on the manufacturers’ responsibility for establishing date labelling. However, since there are still differences in date labelling practices between the Nordic countries, it appears that the Swedish change has not yet been implemented at company level. There is probably a need for more guidance on this topic, not only for Swedish companies, but also those in all the Nordic countries. The interviews showed that most companies have good knowledge of the regulations. They believe that the FIC regulation is an improvement and that it defines the role of the authorities more clearly. However, some manufacturers ask for more guidelines on how to choose date labelling and decide durability. The date labelling should be chosen with care. The “use-by” labelling relates to food safety and should be used on highly perishable foods where the storage time may lead to an immediate danger to health despite storage at specified conditions. Otherwise, edible and safe food may be discarded, with unnecessary food waste as the result.

10.2 Packaging gas

The CO₂/N₂ packaging gas used for most types of fresh raw meat in Norway gives longer durability by reducing microbiological growth, compared to high oxygen packaging gas, which is common in the other three Nordic countries. The high oxygen gas mixtures remain common in the other Nordic countries and elsewhere in Europe because the oxygen gives the meat an initial bright red colour. Therefore, in practice it is not possible for a manufacturer alone to change the package gas, since most uninformed consumers will choose the product that is packed with high oxygen because of the colour. However, high oxygen package gas provides shorter durability and is known to lead to some unwanted properties, such as slowing down the tenderising process and making the meat tough. A change must take place simultaneously for all the manufacturers in each country. From a food waste perspective, it is desirable to make this change. The case study on minced meat clearly shows that longer durability reduces food waste. The feasibility of changing the packaging gas in the other Nordic countries and in Europe should therefore be considered.

10.3 Storage temperature

Storage temperatures in retail stores are a national issue and therefore differ among the Nordic countries. The storage temperature of perishable foods varies from 3–8 °C; it is generally highest in Sweden, but there are also minor differences between Denmark, Finland and Norway. It is evident that lower storage temperatures will increase the durability of food. If agreement could be reached on common lower storage temperatures, it would be possible to extend the durability of perishable food products in Sweden and Denmark, and for some products with higher recommended storage temperature in Finland. It would also simplify the situation for companies which sell their products in more than one Nordic country. A product could then have the same durability regardless of the country in which it was sold.

Food business operators must ensure that food products meet food safety criteria throughout their shelf life under *reasonably foreseeable conditions* of distribution, storage and use.¹⁶ For example, manufacturers

¹⁶ Article 3 b, Commission Regulation (EU) No 2073/2005 of 15 November 2005 on microbiological criteria for foodstuffs.

are not expected to take into account excessively high storage temperatures in the food supply chain. An unbroken cold chain is important for long shelf life of food products. Measurements with temperature loggers show that the temperature can vary widely during transport and in storage. Moreover, the temperature displayed on a refrigerator and the actual temperature may differ. Therefore, manufacturers were asked if their assessment of the durability of the product is affected by the probability that the product may be stored at a warmer temperature than that specified under storage conditions. This means that products in an efficient cold chain will in fact have longer durability than the date label shows. It also means that food products discarded because of the expiry date will generally have a fair amount of the actual durability remaining. Nevertheless, since there are still some cold chains that do not keep an unbroken temperature, it is necessary to have a good buffer of durability. Through better temperature control, it will be possible to reduce the buffer time by extending the specified durability.

10.4 Consumer guidance for opened packages

The durability of a product is no longer valid after its package is opened because it is impossible to know how the consumer handles the product after opening. Therefore, it is important to specify storage temperature and durability after opening for such products. However, a specified expiration date can also result in increased food waste, since many consumers only seem to rely on the date labelling and lack knowledge to assess food quality. According to the literature on consumer behaviour, a large proportion state that they are afraid of getting ill if they eat food past its expiry date and they discard food after this date regardless of whether it is “use by” or “best before”. Therefore, there is a risk that food waste might increase if manufacturers only specify a durability date after opening without any other guidance. Consumer guidance can be given in a better way by providing more information, as in this example for pesto: “Opened package durable one week in the refrigerator, longer if the contents are covered by oil”. This form of guidance will help the consumer to avoid food waste. Unless the product can become unsafe to eat, for example due to growth of pathogenic bacteria or mould toxin formation, the guidelines could state that the food can be eaten as long as it looks, tastes, and smells good. More consumer information is needed. Manufacturers need to give correct advice that avoids food waste without compromising food safety.

10.5 Causes and measures in the retail sector

Retailers work continuously to balance full shelves against no food waste. However, causes of food waste are complex and preventative measures may work better under some conditions than others. Generally, longer durability leads to less food waste, but above a certain turnover rate, the product will be sold regardless of the durability. That means that turnover is associated with the amount of food waste. Retail stores with a low turnover of perishable products should therefore put extra effort in ordering the right amount of products and lowering the price close to the expiry date. We do not know if a longer durability leads to less waste at the consumer stage, but this seems likely since consumers rely on the date label to a large extent. A shorter shelf life will increase the risk that products expire at the consumer stage.

Interviews and literature showed that the most important reasons for food waste in the retail stage are i) the wrong amount of a product is ordered, ii) promotions, iii) large product range and iv) low turnover. In addition, the date label in itself can cause food waste, since consumers are looking for items with the longest remaining durability, making it more difficult to sell those with shorter remaining durability. It is therefore important to focus on these areas in retail stores through information and staff training in order to reduce the level of food waste.

10.6 Legislation for eggs

The date labelling of eggs is subject to special EU legislation, which determines both the date by which they must be sold (21 days from laying) and the “best before” date (28 days from laying). There are two reasons for the legislation giving eggs a relatively short shelf life. In most EU countries, eggs are stored at room temperature and the expected contamination with *Salmonella* of eggs. If the eggs are stored at refrigerated temperatures, the growth of *Salmonella* will be limited. However, there are no specific requirements in the legislation to store eggs in a fridge; storage at room temperature was the basis of the specific durability and storage conditions. Hence, refrigerated storage would increase the durability of table eggs considerably.

10.7 Policy recommendations

The project recommends enhanced guidance for manufacturers, retailers and consumers. For manufacturers and retailers, it is suggested to develop “best practice” guidelines and for consumers, information on different labelling and durability on products is needed. It is recommended to work further on the possibility of harmonized storage temperatures for perishable food products in Sweden, Denmark, Norway and Finland.

The date labelling should be chosen with care. The “use-by” labelling relates to food safety and should be used only on highly perishable foods where the storage time may lead to an immediate danger to health despite storage at specified conditions. Otherwise, edible and safe food may be discarded, with unnecessary food waste as the result.

Eggs have specific EU legislation with a last selling date 21 days after laying and best before date after 28 days. This is due to storage in room temperature of eggs in many EU countries. If eggs were stored in refrigerator, it would prolong durability considerably. The common position in the Nordic countries is that eggs should not be regulated separately but treated as any other foods. As long the current legislation yield there is need for consumer education about the durability of eggs.

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Glossary

- *Use by Date:*
In the case of foods which, from a microbiological point of view, are highly perishable and are therefore likely after a short period to constitute an immediate danger to human health, the date of minimum durability shall be replaced by the “use by” date. After the “use by” date, a food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002.
- *Best Before Date:*
Best before date is the “minimum durability date” and means the date until which the food retains its specific properties when properly stored.
- *Vacuum packaging:*
Method of packaging that removes air from the package prior to sealing. The food is placed in a plastic film package, removing air from inside, and sealing the package.
- *MAP packaging:*
Modified atmosphere is the practice of modifying the composition of the internal atmosphere of a package in order to improve the shelf life.
- *Shelf life:*
Shelf life is the length of time a product may be stored without becoming unfit for consumption or sale. Actual shelf life is used in the report as the total durability of the product. Stated shelf life is used in the report as the durability established by the manufacturer.
- *FIC-regulation:*
Food Information to Consumers, implemented in EU and European Economic Area (EEA) in December 2014.

Sammendrag

Nordisk Ministerråd har initiert et nordisk prosjekt med fokus på matsvinn relatert til datomerking av matprodukter. Rapporten dokumenterer resultater fra fase 2 av prosjektet og anbefalinger for videre oppfølging.

Formålet med studien var å identifisere hvordan regelverket for datomerking praktiseres i Danmark, Finland, Norge og Sverige, og hvordan produkters holdbarhet gjennom hele verdikjeden påvirkes av temperatur, emballasje, prosessering og tilsetningsstoffer. Resultatene er fremkommet ved å gjennomføre intervjuer med næringsmiddelindustrien og dagligvarehandel for en kvalitativ og kvantitativ kartlegging for utvalgte caseprodukter i kombinasjon med eksempler fra litteraturen. De utvalgte caseproduktene er melk, kokt skinke, kjøttdeig, røkt laks, salat med kylling og egg.

I prosjektet er det fremkommet følgende resultater om datomerking, hvordan dette påvirker mengden matsvinn i verdikjeden og anbefalinger som kan gis på dette grunnlag:

- Næringsmiddelindustri:
 - Emballasje:
For mange produkter vil gasspakning gi forlenget holdbarhet pga. fravær av oksygen i kombinasjon med høye konsentrasjoner av CO₂. Vakuumpakning vil også forlenge holdbarheten. For kjøttdeig er det liten variasjon i oppbevaringstemperatur i dagligvarehandelen (4°C–5°C) i de fire landene, men det er likevel stor variasjon i holdbarhetstiden pga. at det brukes forskjellige pakkegasser.
 - Prosessering og tilsetningsstoffer:
God hygiene gi lavere risiko for kontaminering og derved tar det lengre tid for mikrofloraen til å vokse til et nivå som kan forårsake bederving. Laktat blir noen ganger brukt for kokt skinke, og har en antimikrobiell virkning som vil forlenge holdbarheten av produktet.

- Dagligvarehandel:

- Oppbevaringstemperatur:
Temperatur er en av de viktigste kontrollerende faktorer for matkvalitet og mattrygghet på grunn av sin innflytelse på mikrobiell vekst. Resultatene fra prosjektet viste at når temperaturen ble senket fra 8 °C til 4 °C, økte holdbarheten betraktelig for caseproduktene melk og kokt skinke.
- Holdbarhet:
Svinn av kjøttdeig i dagligvarehandelen ble redusert betraktelig etter at holdbarheten ble forlenget på grunn av endring i emballasjens gass-sammensetning.
- Omsetning:
Studien av svinn på kjøttdeig i dagligvarehandelen viste at omsetningen er en viktig parameter for matavfall.
Dagligvarebutikker med lav omsetning hadde en mye høyere andel av matavfall enn tilsvarende med høy omsetning.
- Bestillingsrutiner:
Selv om dagligvarebutikker med lav omsetning ofte har høyt svinn er det mulig å redusere dette ved å fokusere på gode rutiner, som for eksempel bestilling av riktige mengder.
- Forbruker:
 - Informasjon om holdbarhet etter åpning av emballasjen:
For matvarer som har en betydelig kortere holdbarhet etter åpning, krever FIC-forskriften (Food Information to Consumers) at gjenværende holdbarhet etter åpning angis på pakningen. Intervjuene viste at noen næringsmiddelprodusenter synes det er vanskelig å fastsette dette, siden holdbarheten av en åpnet pakke vil avhenge av om pakken er åpnet tidlig eller sent i holdbarhetsperioden. Forbrukerstudier viser et behov for veiledning om hvor lenge produkter kan spises etter åpning av pakken. Mange forbrukere kaster mat fordi de er usikre på holdbarheten av maten og de mangler grunnleggende kunnskap om dette. Forbrukerne bør få mer kunnskap om hvordan holdbarhet kan vurderes ved lukt og smak.
 - Kunnskap om "best før" og "siste forbruksdag":
Mange forbrukere trenger bedre kunnskap om forskjellen mellom "siste forbruksdag" og "best før", og de kaster ofte mat når utløpsdatoen er passert, uavhengig av hvilken datomerking produkter har.
 - Generell forståelse av matens holdbarhet:
Forbrukeren må få tydelig og lett tilgjengelig informasjon om

ulik datomerking, lagringstemperatur og holdbarhet av matvarer.

Anbefalinger og videre arbeid

Med bakgrunn i resultater fra prosjektet anbefales bedre veiledning av næringsmiddelindustri, dagligvarehandel og forbrukere. For næringsmiddelindustri og dagligvarehandel er det foreslått å utvikle "best practice" retningslinjer og for forbrukerne mer tilrettelagt informasjon om forskjellig merking og holdbarhet på matvarer. Det anbefales å arbeide videre med muligheten for en harmonisering av en lavere lagringstemperatur for lett bedervelige matvarer i Sverige, Danmark og Finland. Datomerking bør velges med omhu. "Siste forbruksdag" gjelder mattrygghet og bør bare brukes på lett bedervelige matvarer hvor lagringstiden kan føre til en umiddelbar fare selv om maten lagres som angitt i pakningen. Hvis "siste forbruksdag" brukes på andre produkter kan det medføre at spiselig og trygg mat kastes.

Egg har en spesiell EU-lovgivning hvor siste salgsdato er 21 dager etter legging og "best før" dato er 28 dager. Årsaken til denne korte holdbarhet skyldes at egg mange EU-land lagres i romtemperatur og at det er en vis risiko for Salmonella. Hvis egg blir lagret i kjøleskap, det ville forlenge holdbarheten betydelig og da kunne EU-regelverket om datomerking av egg bli endret. Den nordiske prosjektgruppen mener at egg ikke bør reguleres separat, men behandles som alle andre matvarer. Så lenge dagens lovgivning gjelder det er behov for forbrukerveiledning om holdbarheten av egg.

Appendix 1:

Interview guide for manufacturers

Project information

Food waste is an important issue not only in the Nordic countries, but also throughout the EU. In 2011, the EU Commission launched a long-term framework for actions for a resource-efficient Europe (flagship initiative). One of the goals is to halve the amount of waste of edible foods by 2020. In addition, the European Parliament proposed the year 2014 as the European Year against Food Waste as an awareness-raising initiative for European citizens and to focus national governments' attention on this important topic.

A Nordic project 2013–2014 (Phase 1) has been conducted to identify how food labelling legislation is practised in the four Nordic countries Denmark, Finland, Norway and Sweden and to find out whether there were any differences in how the food safety authorities interpret the legislations and give guidelines to the food producing companies. The project consisted of a survey of how the industry determines the date label and the durability. Further questions were asked through in-depth interviews with selected companies.

The project during Phase 1 provided a number of interesting answers, for example that there are differences in how food labelling is practised in Denmark, Finland, Norway and Sweden. It has also raised new questions, which will be examined further in Phase 2 of the project during 2015–2016.

Five different project activities have been outlined and these interviews will cover three of these, namely 1) Issues related to durability after package opening, 2) guidance and understanding of food labelling terms, and 3) identification of underlying causes of date labelling and durability differences between Nordic countries.

Overall aim of the project

The overall aim of the project is to optimise food labelling to minimise food waste in a Nordic perspective. A possible correlation between the length of the durability and the amount of food waste will also be explored.

Aims of interviews

- To assess whether food producers in the Nordic countries have consumer information on storage of opened packages and how the product should be stored. Often, not all of the food in the packaging is eaten at once and if the consumer is unsure of the durability, the rest of the product may be discarded.
- To identify established practice/guidance and national trade standards used by the food producers. The results may be used to develop common Nordic positions for guidance in choosing type of date labelling, which can be used for national guidelines and for input to the EU.
- To investigate the underlying causes of the different labelling and durability of products between Nordic countries, especially the generally longer durability of Norwegian products. Packaging gas is identified as one of the answers for minced beef, but it remains to find the cause for the other selected products.

Interview guide (manufacturers)

Emphasise that the answers and company names will be confidential in final project reports.

- Date:
- Name of company:
- Name of person and position:
 - (Person in charge of durability labelling)
- Name of person conducting the interview:
- Product category:
- Product name:
 - (If possible, take a picture of the product before the interview).

Briefing before the interview

- Mention roughly how long this interview will take.
- Give some general information on this Nordic date labelling project and why we want some more answers in Phase 2. (Project information is included at the end of this document).

General questions on date labelling

- Do you have a general opinion on the issue of date labelling of your food products?
- Any special challenges?
- Are you using any guidelines in your work on date labelling? (internal guidelines, industrial guidelines, National Food Authority guidelines, retail guidelines, trade standards, other documents, etc.)
- What is your experience of the food authorities regarding date labelling?

Durability (shelf life) of the product

If the same person/product as last year, use your notes and check whether there have been any changes.

- What type of date label do you use for your product (best before/ use by)?
- What are the main reasons for choosing “best before” or “use by”?
- Have you made any changes in date labelling during the past year? If so – what, why and when?
- How long is the durability (in days)?
- How is the durability decided?
- What is the storage temperature?
- What are the most important reasons for choosing the storage temperature in question?
- Have you considered that the product may be stored at a higher temperature than that specified on the product declaration under storage conditions, and does that affect your assessment of the durability of the product (buffer)?

- Do you have any other type of consumer guidance on the product label (temperature and/or other conditions)? If so, please describe the guidance.
- How is the production process from a food safety and durability perspective?
- (Ask open question, details may be sensitive information, see checklist below):
 - Heat treatment?
 - Smoking?
 - Fermentation (starter culture)?
 - Additives/preservatives (types)?
- Describe the packaging technique:
 - Type of packaging method?
 - Packaging gas composition? (Which gases and approximate percentage)
- Other concerns regarding date labelling and food safety?

Storage conditions of opened packaging

- Do you have any consumer guidance on the product label for the opened package? (storage, temperature, durability and/or other conditions)
 - If so, why?
 - Please describe this guidance.
 - If not, why not?
 - Has the company considered guidance?
- Do you have guidance for the consumer for use of the product (e.g. heating it)?
- Are there particular microbial risks for the product in an opened package?
- Do you have any plans for changes of the durability (according to the new Food Information for Consumers (FIC Regulation))?

Trade standards or agreements

Name of person and position (the person in charge of marketing):

- Does the company have trade standards or agreements with retailers? If so, which ones and how is durability of the product regulated in the standards?
- What happens if products do not meet the requirements according to the agreement/standard (do you have a plan B – give an example: sell at lower price)?

Appendix 2:

Food waste in stores

IVL Swedish Environmental Research Institute is on behalf of the Nordic Council of Ministers studying the connection between food waste in stores and date labelling. You can participate by taking a few minutes of your time to answer the questions below. The answers will provide us with material for the study. *Thank you so much for your effort!*

Table 1: Questionnaire

	Eggs	Fresh milk (pasteur- ised)	Cooked ham	Minced beef, MAP- packed	Cold smoked salmon, vacuum packed	Ready-to- eat salad, with heat- treated chicken
How often do you get deliveries? (Large orders and infrequent deliveries or the opposite)?						
Do you sell any of these products at reduced prices close to the “best before” date or the expiry date? How many days before the expiry date do you reduce the prices?						
Do you sell any of these products after they have passed the “best before” date (at reduced prices)?						
Do you send any of these products to redistribution /food banks after they have passed the “best before” date/“use by” date?						
Do these products have fast or slow stock rotation?						
How many packages of the older product do you manage to sell when the more recent product is also available for purchase?						
Give an indication of how much of each product is discarded due to passed “best before”/expiry date? (How much in percentage?)						

	Eggs	Fresh milk (pasteur- ised)	Cooked ham	Minced beef, MAP- packed	Cold smoked salmon, vacuum packed	Ready-to- eat salad, with heat- treated chicken
How is the remaining durability of the product regulated? Do you have special trade standards or agreements with suppliers to regulate this?						
How much of incoming deliveries do you complain about to the supplier?						
What happens if products do not meet the requirements?						
- Sell at lower price						
- Return the product with compensation						
- Only economic compensation without returning the product (what happens then to the product)?						

Section B – supplementary questions

- Do you sell any other food close to/after the “best before” date at reduced prices?
- How much fruit and vegetables do you discard? What are the reasons for discarding them?
- How many complaints on fruit and vegetables do you report to the suppliers in terms of amount of food? What are the usual reasons for the complaints?
- Do you freeze meat close to the expiry date for later use in ready-made in-store salads and similar after the meat has been thawed and heat-treated?
- Do you freeze meat close to the expiry date in order to sell the frozen meat to customers?
- Has the store taken any measures on the above-mentioned foods for the purpose of decreasing food waste in-store? If so, what was done and how much food was diverted from being discarded?
- What other actions have been taken to decrease food waste for other products?

Appendix 3:

Regulation No. 1169/2011, Articles 24 and 25

Article 24 – Minimum durability date, “use by” date and date of freezing:

- In the case of foods which, from a microbiological point of view, are highly perishable and are therefore likely after a short period to constitute an immediate danger to human health, the date of minimum durability shall be replaced by the “use by” date. After the “use by” date a food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002.
- The appropriate date shall be expressed in accordance with Annex X.
- In order to ensure a uniform application of the manner of indicating the date of minimum durability referred to in point 1(c) of Annex X, the Commission may adopt implementing acts setting out rules in this regard. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 48(2).

Article 25 – Storage conditions or conditions of use:

- In cases where foods require special storage conditions and/or conditions of use, those conditions shall be indicated.
- To enable appropriate storage or use of the food after opening the package, the storage conditions and/or time limit for consumption shall be indicated, where appropriate.

Source: <http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32011R1169>

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Food waste and date labelling

The purpose of the project has been to identify how date labelling legislation on food is practised in Denmark, Finland, Norway and Sweden and how the durability can be affected in the food supply chain. The project recommends enhanced guidance for manufacturers, retailers and consumers. When prolonging the durability of the product, the retail waste decreased significantly. The results show that the type of packaging gas and storage temperature is of great importance for the durability of food products. Consumer studies reveal a need for guidance on how long products may be eaten after opening of the package. The individual consumer needs clearer and more easily accessible information on different labelling, storage temperature and durability of products.

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