

Dynamically predicted shelf-life label in minced meat product

A consumer-driven design and analysis

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DIVISION OF PACKAGING LOGISTICS | DEPARTMENT OF DESIGN SCIENCES
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MASTER THESIS



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This Master's thesis has been done within the Erasmus Mundus Joint Master Degree FIPDes, Food Innovation and Product Design.



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Abstract

Dynamically predicted shelf-life label (DPSL) has been discussed to be one of the solutions to curb meat waste. Therefore, the research about the DPSL label and the perceptible information obtained by minced meat consumers is conducted. The research purpose is to identify the critical factors to design a DPSL label for minced meat consumers, and to design and assess the label with the consumers. Two research questions (RQs) are defined: *RQ 1. What are the critical factors to design a DPSL label in minced meat product for consumers?* and *RQ 2. How do consumers perceive the information from a DPSL label in minced meat product?*

The research used a qualitative approach comprised by three stages, which were insight mining, DPSL label development, and usability test. From insight mining, three personas were developed, comprised of autopilot consumer, steadfast consumer, and cautious explorative consumer. This finding led to four critical factors: (1) sustainability communication; (2) detailed information; (3) size and dimension; and (4) quick decision-making support. DPSL label prototypes were then developed and tested to the minced meat consumers through usability tests.

The results show that the consumers perceive the information from the DPSL label in minced meat product by two different approaches, which are sustainability and meat freshness. The sustainability impression was perceived by the 'too good to waste' title and the green-blue border line colour. However, the meat freshness impression was perceived by the 'check the meat freshness here' title and the orange-red-blue border line colour. The circle symbol was perceived as a clear and scientific symbol for the consumers. The indicator text explaining the symbol, 'fresh-still good-spoiled', was perceived short and positive by the consumers. The QR code can give more information about the DPSL label, and the DPSL label size of 7cm x 4 cm is recommended for further design development. The explanatory text 'meat freshness changes the colour inside the circle' was perceived short, and it mentioned the two elements, which were the location of the colour, and the change of the colour. These two elements were fundamental and should be kept along the language modification. Finally, the findings of this research have pushed forward the DPSL label studies. To guarantee that the message reaches the intended audience, whoever creates the DPSL label should consider the consumer-driven design. The customer predominantly causes food waste; thus, technology integrated into packaging combined with clear information can avoid it.

Keywords: dynamically predicted shelf-life label, first moment of truth, intelligent packaging, second moment of truth, usability test.

Executive summary

Introduction and project aim

Minced meat was considered as one of top ten waste in the supermarkets' meat department in Sweden. For five years, Swedish minced meat contributed to 8.6 tonnes in-store waste, whilst imported minced meat contributed to 2.7 tonnes in-store waste. The facts imply that the solution to curb meat loss and waste is needed, as a pathway towards sustainability development.

Packaging contributes to curb meat waste, as it is designed with 'fit-for-purpose' across the supply chain. It also becomes a communication medium to assist consumers who want to make better-informed choices. However, studies found that the consumers' lack of understanding of the date label caused the unnecessary wasted food. Meat product was discarded in the consumers hands, and more than 50% of them reasoned because it had passed the printed shelf-life date. Therefore, dynamically predicted shelf-life (DPSL) label is developed to give more accurate food shelf-life than printed static shelf-life, thus curbing meat waste can be achieved. Studies related to DPSL label have been established for more than twenty years, nonetheless studies related to the DPSL label and perceptible information obtained by the consumers are scarce.

According to the problem, this research aims to identify the critical factors to design a DPSL label for minced meat consumers, as well as to design and assess the label with the consumers. Therefore, two research questions (RQs) are defined: *RQ 1. What are the critical factors to design a DPSL label in minced meat product for consumers?* and *RQ 2. How do consumers perceive the information from a DPSL label in minced meat product?*

Methodology

The research used a qualitative approach comprised by three stages, which were insight mining, DPSL label development, and usability test. In the stage 1, the insight mining was conducted by exploring the critical factors from two different perspectives: (1) minced meat consumers, and (2) experts, which are design expert, food safety expert, and supply chain expert. In-depth interviews were conducted online through Zoom software, recorded, and transcribed in a modified verbatim with Office365 transcription and manual editing shortly after. The most insightful

quotations were highlighted manually, then the content was then summarised into insights to design the personas and the critical factors.

In the stage 2, DPSL label designs were developed according to the personas and the critical factors from the stage 1. Three designs were chosen for the first usability test. The label designs were modified according to the consumers' feedback, then three new design prototypes were presented for the second usability test.

In the stage 3, the first usability test simulated first moment of truth (FMOT) and second moment of truth (SMOT) scenarios to the consumers. The second usability test was conducted to assess the response of the participants towards the improvement of the prototype. In-depth follow-up interviews were conducted at the usability laboratory, recorded, and transcribed in a modified verbatim. Notes were also taken during the usability test to highlight the insights and attitudes from the consumers regarding the labelled packaging. Those insights were compiled about how the consumers perceived the information from a DPSL label in minced meat product.

Result and discussion

From the interview with consumers and experts in stage 1, three personas were developed, which were autopilot consumer, steadfast consumer, and cautious explorative consumer. The autopilot consumers tended to feel satisfied with the current status quo of the label design, and they did the shopping decision by habitual activities unconsciously. The steadfast consumers showed the tendency to believe in their personal perspective, thus they set an established pattern and is less open to a new change in the label. The cautious explorative consumer showed a deeper interaction to the minced meat label, they invested more time to understand the information provided in the label.

The finding of three personas led to four critical factors, which are (1) sustainability communication; (2) detailed information; (3) size and dimension; and (4) quick decision-making support. The sustainability communication is related to cautious explorative consumers, who are more aware of sustainability issues. Detailed information is related to the steadfast and cautious explorative consumers, who demand for more information to trust the DPSL label. Size and dimension, as well as quick decision-making support are related to autopilot consumers, who demand the label to be not intrusive to their current habits. The three personas and four critical factors were considered in the development of DPSL label design. Later the perceptible information gained by the personas was explored in the FMOT and SMOT scenarios of the usability test.

In the usability test, the personas perceived the information from a DPSL label in minced meat product by two different approaches, which were sustainability and meat freshness. The sustainability impression is related more to cautious explorative consumers, while the meat freshness is related more to steadfast and autopilot

consumers. The sustainability impression was perceived by the ‘too good to waste’ title and the green-blue border line colour. However, the meat freshness impression was perceived by the ‘check the meat freshness here’ title and the orange-red-blue border line colour.

Furthermore, the DPSL label size of 7cm x 4 cm was perceived just right and proportional to different sizes of the minced meat package. The circle symbol was perceived as a clear and scientific symbol for the consumers, hence it did not lead to confusion. The explanatory text ‘meat freshness changes the colour inside the circle’ was perceived short, and it mentioned the two elements, which were the location of the colour, and the change of the colour. These two elements were fundamental and should be kept along the language modification.

The indicator text of ‘fresh-still good-spoiled’ was perceived short and positive by the consumers. The QR code benefited for the cautious explorative consumers to get an access for more information about the DPSL label. Hence, the final DPSL label designs are depicted below.



Conclusion

There are four critical factors identified to answer RQ 1, which are (1) sustainability communication; (2) size and dimension; (3) detailed information; and (4) quick decision-making support. Consumers perceive the information from a DPSL label in minced meat product differently in FMOT and SMOT scenarios. In FMOT scenario, three critical factors which are sustainability communication, size and dimension, and quick decision-making support are more related to the grocery behaviour of the consumers. The DPSL label should be self-explanatory thus the consumers can understand the information within a limited time when shopping. In SMOT scenario, the critical factor of detailed information is more related to the storing, use, and disposal behaviour of the consumers. Therefore, DPSL label should not confuse the consumers by providing appropriate information about the meat freshness, thus they could take a correct action as a response from it.

Recommendation for company

The consumers perceive the information from a DPSL label in minced meat product by two different approaches, which are sustainability and meat freshness. Different design attributes support each approach separately. Having a sustainability impression may be ineffective if the consumers will not understand how the DPSL label works, due to the unclear message from the DPSL label. Therefore, focusing on the meat freshness impression may be better to introduce a new DPSL technology in the market to the consumers, rather than sustainability.

Furthermore, a DPSL label size of 7cm x 4 cm is recommended to be the size for further design development from this research, and to place the DPSL label on the top left of the minced meat packaging. It is essential to not modify two elements in the explanatory text, which are the location of the colour, and the change of the colour. One recommended explanatory text from this research is 'the colour inside the circle will change according to the meat freshness'. The indicator text of 'fresh-still good-spoiled' was perceived short by the consumers, and it added a positive impression rather than 'fresh-alright-spoiled' text.

Recommendation for further research

Further qualitative research with more participants is recommended to be conducted. An on-site grocery and home observation could be conducted to reduce social desirability bias, and the study using eye tracking could be conducted to confirm the consumers' perceptible information gained from this research with quantitative data. Lastly, further study related to the consumer behaviour to discard edible food product that has passed the 'best before' date of minimum durability can be conducted for a better understanding related to this issue.

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List of acronyms and abbreviations

DPSL	Dynamically predicted shelf life
EVOH	Ethylene vinyl alcohol
FAO	Food and Agriculture Organisation
FMOT	First Moment of Truth
FSC	Food supply chain
MAP	Modified Atmosphere Packaging
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
RQ	Research question
SDG	Sustainability Development Goal
SMOT	Second Moment of Truth
UMOT	Ultimate Moment of Truth
ZMOT	Zero Moment of Truth

1 Introduction

1.1 Background

1.1.1 Food loss and food waste

Food and Agriculture Organisation (FAO) defined that the consequences of nutrition loss, and unnecessary food discarding before it reaches to consumers, are considered as food loss (FAO, 2015). Food loss occurs in the earlier stage of supply chain. The inefficiencies in food production and processing may lead to the loss of nutritional value, even it may lead to the discarding of the food prior to reaching the consumers.

While food loss occurs in the earlier stage of supply chain, food waste occurs in the later stage of supply chain. Food waste happens because the consumers throw out excess foods that are of good quality and fit for consumption, or to let the foods spoil (FAO, 2015).

Food loss and waste happen globally. Around 14% of food produced is lost from the post-harvest stage up to the retail stage, and 12% of it is meat and animal products (Food and Agriculture Organization, 2019). In Sweden, 1.2 million tonnes of food are wasted annually (Swedish Environmental Protection Agency, 2013).

Specifically, raw meat contributes to 7% of the total edible food waste in Sweden, whilst the meat industry stands for 15% of global greenhouse gas emissions and 25% of a Swedish consumers' climate impact (Gerber et al., 2013; Swedish Board of Agriculture, 2019a).

Another study conducted further by Erikson (2015) shows that the minced meat was considered as one of top ten waste in the supermarkets' meat department. For five years, Swedish minced meat contributed to 8.6 tonnes in-store waste, whilst imported minced meat contributed to 2.7 tonnes in-store waste. The facts imply that the solution to curb meat loss and waste is needed, as a pathway towards sustainability development.

1.1.2 The role of packaging and label in avoiding food waste

Meat loss and waste occur throughout the entire food supply chain (FSC), starting from primary production to consumption. Reflecting to this concern, packaging contributes to curb meat loss and waste. Packaging is designed to effectively contain and protect food or be ‘fit-for-purpose’ across the supply chain to minimise food waste. Minimising food waste is generally the priority, because it accounts for a larger proportion of the life-cycle environmental impacts of the food packaging system (Verghese et al., 2015).

Furthermore, packaging functions as a communication medium to provide food information from the producer to the consumers. Food label should be clear and understandable to assist consumers who want to make better-informed food and dietary choices (European Commission, 2011).

The role of consumers to interact with the food, the packaging, and the information provided by the label may contribute to curb meat waste. A study by European Commission (2018) estimated that in the EU the food waste generated by the consumers were up to 10% of the total amount, which was associated with misunderstanding the expiration dates.

Meat and fish contributed to 15-31% avoidable food waste where consumers cited the ‘date label’ as a factor contributing to the disposal of the food (Questa and Murphy, 2014). Another study named ForMat showed that a meat product was discarded in the consumers hands, and more than 50% of them reasoned because it had passed the expiry date (See Figure 1). This behaviour led to the unnecessary wasted food and was probably due to the consumers’ lack of understanding of the date label (Hanssen and Møller, 2013). Therefore, it is essential to explore the information perceived by the consumers and their interaction with the packaging.

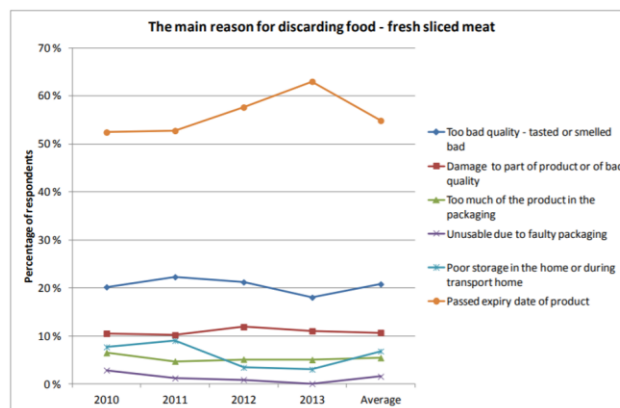


Figure 1. Reasons for discarding fresh sliced meat 2010-2013 (Hanssen and Møller, 2013)

1.1.3 Dynamically predicted shelf-life (DPSL) service to curb meat waste

Answering the problem of how the shelf-life information in the packaging may lead to food waste, a development of a modified shelf-life marking has been explored by researchers. A study by Goransson (2019) explored the use of DPSL service as the modified shelf-life marking, compared to the current printed static shelf-life. The DPSL service is a conceptual information service system in the supply chain to monitor and communicate food quality and FSC operational process quality (See Figure 2). Therefore, DPSL service communicates a more accurate food shelf-life than printed static shelf-life.

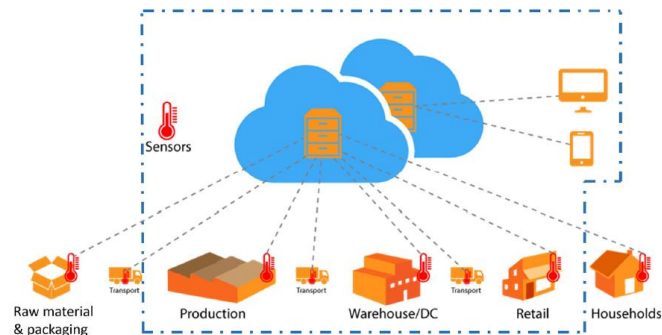


Figure 2. The concept of a DPSL service: Sensors placed on food packages continuously communicate the quality of the food throughout FSC, from the production until the consumer picks up his/her perishables in the retail store (Goransson, 2019)

The study conducted by Goransson (2019) explored the role of DPSL service throughout FSC, starting from the production until the consumers picked up the food package in the retail store. However, it is also essential to understand the role of DPSL label in the hands of consumer after purchasing from the store.

DPSL continuously measures food quality, thus the actual shelf-life of food product is determined in real time (Björklund and Letellier, 2020). Compared to the printed static shelf-life label in meat product, the DPSL label showed a value added to sustainability by giving an accurate indication of whether the meat product had spoiled, thus it could reduce meat waste (Mustafa and Andreescu, 2018).

A report published by Swedish National Food Agency (2016) explained that a reduced temperature in the cold chain with a combination of a modified shelf-life marking could curb meat waste in the consumers. However, the Swedish National Food Agency did not recommend a general prolongation of shelf-life to prevent food waste in the earlier stage of supply chain. The reason was that the products with an increasing shelf-life would decrease the flexibility of the supply chain. It might contribute to the products spending more time in storages, instead of the prolonged shelf-life being allocated to the consumers. Therefore, it is important that

DPSL label is purposely designed to curb food waste for the consumers without altering the flexibility of the supply chain.

Furthermore, a study was conducted to understand the impact of DPSL label to curb meat waste in the hands of consumer. A study by Zeinstra and Haar (2020) explored the use DPSL label compared to the current printed static shelf-life label, which was applied to meat, fish, milk, and ready-to-eat meals. The result showed that by unlocking the shelf life by two more days with DPSL, the number of people reporting to eat the product increased from 2% to approximately 20%, and the number of people discarded the product decreased. Hence, there is greater opportunity of DPSL label to curb consumer waste, compared to printed static shelf-life label.

Specifically, a colorimetric freshness sensor used in DPSL label relies on colour change as a biomarker of meat degradation (Kerry and Butler, 2008; Lydekaityte and Tambo, 2020). By having the sensor in DPSL label, consumers do not value printed shelf-life date, but on colour change to convey information and make decision about meat quality prior to consumption. Therefore, a paradigm shift of consumer behaviour could happen due to the change of shelf-life date label from the printed static shelf-life to DPSL.

Studies related to a colorimetric freshness sensor in DPSL label have been established for more than twenty years (Kerry and Butler, 2008; Lydekaityte and Tambo, 2020). However, studies related to the DPSL label and perceptible information obtained by the consumers are scarce. There are opportunities to explore how perceptible information obtained by the consumers that would lead to the reduction of meat waste. Hence, it is important to identify and evaluate the critical factors to design a DPSL label in meat product for consumers.

1.2 Purpose and research question

1.2.1 Purpose

The purpose of the research presented in this thesis is twofold:

- (1) to identify the critical factors to design a DPSL label for consumers;
- (2) to design and assess the label with the consumers.

Reflecting that the minced meat has the biggest mass sold compared to other categories in the supermarket's meat department (Eriksson, 2015; Eriksson et al., 2014), this research focuses to the DPSL label development in the minced meat product.

The research is conducted to provide the information about how the consumers obtained perceptible information from DPSL label in minced meat products. The information is expected to be beneficial for a future development of DPSL label. Hence, DPSL label can be further designed more effectively, and a more responsible consumption behaviour in the end consumers is expected to be achieved.

In a broader perspective, the research aspires to the pursuance of Sustainability Development Goal (SDG) #12 Responsible Production and Consumption. One of the SDG #12 targets is to halve the global food waste per capita at the retail and consumer levels by 2030. Meat waste, as explained in the background, has contributed significantly to the edible food waste. Therefore, an active contribution is needed to be an integrative part and enabler in achieving this ambition.

1.2.2 Research questions

In accordance with the research purpose, a study about the consumers' perceptible information to DPSL label in minced meat product is conducted. The research contributes to fill the gap between the current studies about the DPSL label, the lack of information about how consumers interact with the DPSL label, and how it gives a better perceptible information obtained by the consumers.

Therefore, two research questions (RQs) are defined:

RQ 1. What are the critical factors to design a DPSL label in minced meat product for consumers?

RQ 2. How do consumers perceive the information from a DPSL label in minced meat product?

1.3 About company

Innoscentia is a Swedish start-up company founded in 2015 that aims to enable the paradigm shift of food labelling by developing DPSL service that indicates the food status in real time, both visually for consumers and digitally for blockchain systems. Innoscentia helps to unlock the lost shelf-life by monitoring the food freshness in real time compared to the current 'best before date'. The technology aims to avoid the edible food waste, thus it enables the packaging and food industry to optimise their value chain.

Innoscentia has developed a sensor based DPSL service as a quality indicator of fresh meat products that are stored in the fridge in real-time with analogue and digital solutions. The analogue solution consists of a colorimetric freshness sensor. This sensor relies on the colour change of the sensor ink to provide an actual shelf-life information to consumers, whereas the digital solution relies on Internet of

Things that can connect to smartphones and larger digital systems to provide traceability throughout the value chain (See Figure 3).



Figure 3. Illustration of analogue (left) and digital (right) solutions of Innoscentia

For the analogue solution, Innoscentia aims to develop the label design attached to the meat products, that can communicate to the consumers about how fresh the product is, or when is the best time to consume the product. Focusing on the analogue solution, this research develops label options in fresh minced meat product and provides information about how the consumers get a perceptible information from the label.

1.4 Delimitation

Constrains prior to project experimentation is acknowledged by Innoscentia as explained in Table 1. Furthermore, the colour change of sensor from white if the meat is fresh, to purple if the meat is spoiled, cannot be modified (See Figure 4). Please note that the Figure 4 is just to illustrate the sensor reaction to the freshness change of meat product. The label design is still a preliminary development and is flexible for modification during the project.

Table 1. Constrains identified prior to project experimentation

Constrains	Details
Colour change of sensor	The colour changes from white if the meat is fresh to purple if the meat is fully deteriorated and inedible (See Figure 4).
Label printing mechanism	The printer only accommodates flat printable label design and does not accommodate braille, embossed, or textured label.
Label integration in meat packaging	The main process is to have adhesive layer to stick the label to the lid, the label is placed underneath, then a functional barrier is covered the label. It is one-way functional barrier that will allow the gas from the meat atmosphere goes to the sensor, but not the other way around.
Size	The size of the label is around 9 cm x 5 cm or smaller.
Consumer behaviour	The consumer is expected to follow the storage condition of the minced meat product, i.e., to store it in the fridge of 2 to 4°C. Other storage behaviours, for example to store it in the freezer, is not included in the study.



Figure 4. Illustration of sensor colour change as an indicator of meat freshness

Reflecting to the constrains mentioned in Table 1, this project was not focused on exploring the universal design of the DPSL label. It would not investigate how the DPSL label was perceived by the consumers with visual impairments and other cognitive disabilities.

Furthermore, acknowledging the three constrain aspects, which are: (1) the latter production-scale label to work merely in the fridge of 2 to 4°C; (2) the indicator colour changes merely from white to purple; and (3) the size of the prototype to be 9cm x 5cm or smaller, the DPSL label development in this project would work in these aspects and would not alter things stated.

2 Theoretical framework

2.1 Intelligent packaging

Food packaging nowadays is evolving. The packaging function includes additional features such as improve product quality and product longevity. The devices and methods applied to achieve these functions may be categorized as smart packaging, including intelligent packaging (Holman et al., 2018), engineered to monitor the freshness of the food and give some indication regarding freshness status (Dainelli et al., 2008). Smart packaging is any packaging that can enhance the primary functions of the package to be more efficient in order to preserve, protect, facilitate convenience, or communicate with the supply chain actors and consumers, in comparison to conventional packaging (Brockgreitens and Abbas, 2016; Priyanka and Parag, 2013).

Smart packaging is classified into four models according to the function it enhances and the way in which the improvement is achieved (Lydekaityte and Tambo, 2020). The four models of the smart packaging are (1) active packaging; (2) intelligent packaging; (3) ergonomic packaging; and (4) interactive packaging, as depicted in Figure 5.

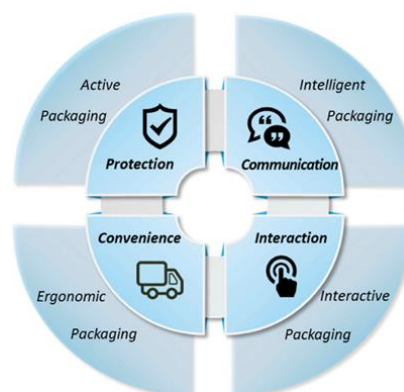


Figure 5. Model of the main packaging functions in relation to the capabilities and features of smart packaging types (Lydekaityte and Tambo, 2020)

Intelligent packaging is a system that is capable to perform intelligent functions, such as detecting, sensing, and communicating. It facilitates decision making to prolong shelf-life, improve safety and quality, and alert people about possible issues.

Reflecting to that, the research focused on the role of intelligent packaging to the consumers. Intelligent packaging with incorporated indicators informs consumers how fresh the product is or when is the best time to consume the product.

The European Commission has established requirements related to intelligent packaging in Regulation EC 450/2009. The intelligent materials may be composed of one or more layers, or parts of different types of materials, such as plastics, paper and cardboard, or coatings and varnishes. The substances responsible for the intelligent function can be contained in a separate container, for instance the inclusion of the substances in a small paper sachet. On the other hand, the substances can be directly incorporated into the packaging material, for instance the incorporation of the substances in the plastic of a plastic bottle.

It is important that the intelligent packaging is adequately labelled to allow identification by the consumer of the non-edible parts. Consistency of such information is indispensable to avoid confusion at consumer level. Therefore, intelligent materials should be labelled with appropriate words and be accompanied by a symbol whenever materials are perceived as edible (de Tandt et al., 2021).

Furthermore, the intelligent materials should not disrupt the recycling method of the food plastic packaging. The easiness to recycle should be considered because a taxation on non-recycled plastic waste has been imposed since the 1st of January 2021 (European Commission, 2011). A tax rate of EUR 0.80 per kilogram of non-recycled plastic packaging waste has forced the industries to reduce the nonrecycled plastic waste.

DPSL label is considered as a type of intelligent packaging. DPSL is defined by Buisman et al. (2019) as a shelf-life label that can be adjusted to the actual quality of the product, either by adjusting the date or by indicating the quality of a product with a different technique, such as colorimetric freshness sensor. Hence, DPSL provides a better product quality prediction by adjusting the shelf-life dynamically, compared to printed static shelf-life.

2.2 Labelling and label

According to Regulation EC 1169/2011, 'labelling' means *any words, particulars, trademarks, brand name, pictorial matter or symbol relating to a food and placed on any packaging, document, notice, label, ring, or collar accompanying or referring to such food*. However, 'label' means *any tag, brand, mark, pictorial, or other descriptive matter, written, printed, stencilled, marked, embossed, or impressed on, or attached to the packaging or container of food*. Label is one of elements in food labelling, which comprises of commercial components referring to the food product, for instance label, printed brochures, signage, informational

handouts, and other documents that go with the food product (European Commission, 2011).

There are twelve lists of mandatory information that must appear directly on the package or on an attached label of prepacked food within the European market, and one of the lists is the date of minimum durability, or as known as the shelf-life date (European Commission, 2011). The date of minimum durability should be preceded by words 'best before' or 'use by'. For meat products, the date of minimum durability used varies between 'best before' and 'use by' in Sweden. A study by Møller et al. (2015) showed that minced meat products in the Swedish market labelled both 'best before' / 'bäst före' in Swedish and 'use by' / 'sista förbrukningsdag' in Swedish.

The varieties of the date of minimum durability for minced meat products lead to different treatment of the products. The products with 'use by date' are considered highly perishable from a microbiological point of view and can lead to an immediate danger to human health. After the 'use by' date, the products are deemed to be unsafe. Thus, the products with 'use by date' can be consumed up until the end of the date, but not after, even though it looks and smells fine. However, 'best before' indicates the date until when the food retains its expected quality. That means, the products with 'best before' can be consumed after the date, but it may no longer be at its best quality (European Commission, 2011, 2004a).

2.3 Minced meat product

Minced meat is considered as 'fresh meat' according to Regulation (EC) 853/2004. That means it refers to meat that has not undergone any preserving process other than chilling, freezing or quick-freezing, including meat that is vacuum-wrapped or wrapped in a controlled atmosphere (European Commission, 2004a). According to European Food Safety Authority (2014), the raw material for minced meat must be derived from skeletal muscle including adherent fatty tissues, and not from scrap cuttings or scrap trimmings (other than whole muscle cuttings), or meat containing bone fragments, skin, or head meat. The example of minced meat is depicted in Figure 6.



Figure 6. Example of minced meat (Farmison & Co, 2021)

According to European Commission, minced meat must be prepared from animals other than poultry within no more than 6 days after slaughter. In the mincing process, fresh or semi-frozen meat pieces are pressed in a rotating spiral shaft or pump-type system against a rotating knife and through a static end plate with holes of 1.5mm to 10mm in diameter. This process disrupts the meat cellular structure, and the ordered fibrillar structures including myofibres and connective tissue, releasing tissue fluids (European Commission, 2004b).

Minced meat is a highly nutritious medium that readily supports bacterial growth, such as the pathogens *Salmonella* spp., verocytotoxigenic *Escherichia coli* (VTEC), *Listeria monocytogenes* and *Yersinia enterocolitica*. However, most pathogens will not grow at chill temperatures, and those that are capable of growth, such as *L. monocytogenes* and *Y. enterocolitica*, will multiply slowly. Thus, if the initial microbiological load on carcasses and cross-contamination during processing are controlled, as well as the integrity of the chill chain is maintained, the impact of time of storage on public health risk should be minimal. The former is dependent on the development and application of effective Hazard Analysis and Critical Control Point (HACCP) and prerequisite actions including those covered by Good Hygiene Practices (GHP), as required under Regulation (EC) 852/2004 (Swedish Board of Agriculture, 2019b).

Minced meat is considered as a highly perishable product. Therefore, a hurdle concept should be implemented to combine several treatments to limit the growth of microorganism. Regulation (EC) 853/2004 requires minced meat to be wrapped or packaged, and to be chilled to an internal temperature of not more than 2°C, or frozen to an internal temperature of not more than -18°C. These conditions must be maintained during storage and transport.

Furthermore, packaging is used to contain and protect the minced meat against deterioration along the supply chain from mechanical, chemical, and biological hazards. Mechanical properties and barrier properties against gases, especially oxygen and carbon dioxide, are the essential criteria for the packaging materials selection (Schmid et al., 2016). The mechanical properties help to resist the

mechanical stress, whilst the barrier properties help to inhibit the microbiological, biochemical, and enzymatic activities, resulting in an extension of shelf-life (Cenci-Goga et al., 2020).

One of packaging types that is commonly used for minced meat is a tray packaging, as depicted in Figure 7. The packaging material often used for tray is Polypropylene (PP), and multilayer barrier films used for the lid film, typically Polyethylene terephthalate (PET), Ethylene vinyl alcohol (EVOH), PP, and Polyethylene (PE) layer structure (Schmid et al., 2016).



Figure 7. Example of tray packaging for minced meat product (VertMarkets Inc., 2021)

Modified Atmosphere Packaging (MAP) is used in minced meat packaging that consists of carbon dioxide, oxygen, and nitrogen in different ratios, to provide extended quality and shelf life of minced meat (Djordjevic et al., 2017). Carbon dioxide extends the lag phase of cell reproduction due to its potent inhibitory activity toward bacteria from the family *Enterobacteriaceae* (Cornforth and Hunt, 2008). Oxygen is responsible to the oxidation of vitamins and lipids, the growth of anaerobic microflora. However, it is desirable as the part of the MAP ratios because oxygen helps the myoglobin remaining in the form of muscle pigment to preserve the red colour of the meat, and also to prevent growth of the anaerobic microorganisms (Zhou et al., 2010). Nitrogen prevents collapse of the package and is used as a replacement for oxygen to prevent oxidation, rancidity, the growth of aerobic microorganisms, and propagation of mould (McMillin, 2008).

2.4 Consumer behaviour towards minced meat product

During the period 1980–2018, total consumption of meat in Sweden has increased by 32% to 84kg per capita per year (Swedish Board of Agriculture, 2019b). A study to understand consumer behaviour towards meat consumption was conducted by Bandell (2020). According to the study, fresh meat was most often bought the same day as it would be consumed. Meat was most often only in the fridge for a few hours. It could be in the fridge for 1 to 4 days, though it was less common reported. For

families, the meat could be in the fridge up to a week, but rarely longer than that. The finding is aligned with the storage time studied by Marklinder et al. (2004) that reported 27% of the respondents stored minced meat less than one day, 42% of the respondents stored it for 1 day, 17% stored it for 2 days, and 4% stored it for 3-4 days.

Moreover, a study to understand minced meat handling in Swedish consumers was conducted by Marklinder et al. (2013). The result showed that 40% of consumers considered that raw minced meat should be stored at 0-5°C. However, 30% of consumers did not know which temperature that was adequate for storing minced meat and 28% considered that a temperature from 6°C and upwards (>10°C) was a proper temperature to store minced meat.

Another study was conducted to observe Swedish consumer handling practices to minced meat product (Marklinder et al., 2004). According to the study, 47% of the consumers stored minced meat product in middle shelf of refrigerator, 30% of the consumers stored in top shelf, and 21% of the consumers stored in bottom shelf. The average storage temperature of minced meat was reported 6.2°C, with 22% of the consumers storing it above 8°C. The consumer behaviour in storing minced meat product does not align with the requirement stated in Regulation (EC) 853/2004 that minced meat must be chilled to an internal temperature of not more than 2°C.

2.5 Human-package interactions framework

Knowledge about the interaction between consumer and the package is essential to understand how the consumer uses and performs task with the packaging. The interaction between consumer and the package is described by de la Fuente and Bix (2010) in a human-package interactions framework, as depicted in Figure 8. This framework creates and evaluates how a product performs in the consumers, adapted from five stages of human-package interactions, and four components of Usability Theory (see Table 2 and Table 3).

Table 2. Five stages of human-package interactions (de la Fuente and Bix, 2010)

Stage	User's System	Details
Exposure	None	User is exposed to necessary information
Perception	Perceptual	Information is input into one or more of the five senses
Encodation	Cognitive	Information is transformed into an internal representation
Comprehension	Cognitive	User assigns meaning to the encoded information
Execution	Motor	Thought is translated into actions by activating the muscles

Table 3. Four components of Usability Theory (de la Fuente and Bix, 2010)

Components	Details
User	The characteristics of the person, including perceptual, cognitive, and physical capabilities, beliefs, habits, previous experience – including the perceptual system

	(sensory stimulus handling from the outside world), the motor system (actions control), and the cognitive system (processing to connect the perceptual system as input and motor system as output).
Task	The series of actions and goals to be accomplished, such as identifying, following instructions and directions, opening, dosing, reclosing, storing, disposing, etc.
Pack	The object of the interaction; the design of the package and product.
Context	The physical and social environment in which the interaction takes place, including characteristics like lighting, seating, distractions, temperature, pressures, other people, etc.

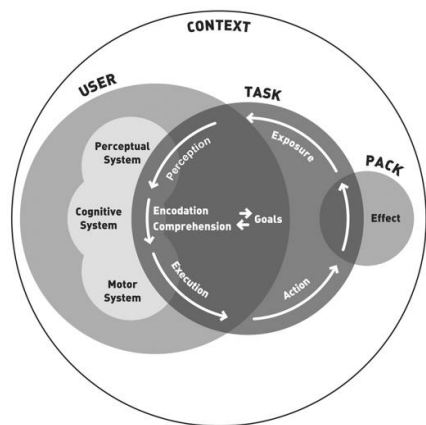


Figure 8. Human-package interaction framework (de la Fuente and Bix, 2010)

In a human-package interaction, there are five cyclic stages involved, which are exposure, perception, encodation, comprehension, and execution. It is interacted with the three user's system, which are perceptual system, cognitive system, and motor system. The perceptual system manages the sensory stimulus from the outside of the user. It is connected with the motor system by the cognitive system, and consequently the motor system controls the action of the user.

2.6 Moments of truth

The consumer journey is defined by Stephens (2016) in four moments of truth, which are Zero Moment of Truth (ZMOT), First Moment of Truth (FMOT), Second Moment of Truth (SMOT), and Ultimate Moment of Truth (UMOT), as depicted in Figure 9.

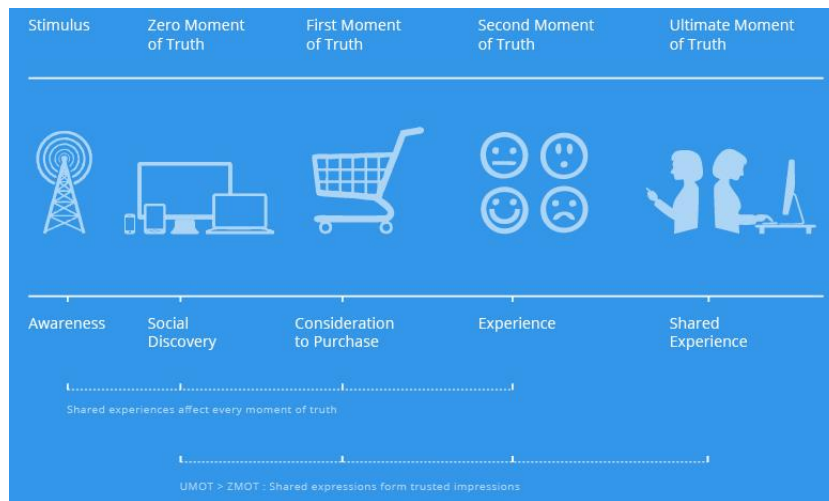


Figure 9. Moments of truth and the consumer journey (Solis, 2013)

ZMOT, or discovery, refers as the moment when the customer is seeking a solution. FMOT, or exploration, is defined as the experience when the customer has the initial contact with the product. It is the three to seven seconds precious moments after a shopper encounters a product on the shelf in a store. SMOT, or consumption, is also coined by as a moment that the consumer use and experience the product after purchasing the product. Lastly, UMOT, or shared engagement, is a moment when customer shares the experience with others who often experience their own ZMOT.

3 Methodology

3.1 Research approach

This research addressed a research problem in which the variables were unknown and needed to explore, hence the research was considered as a qualitative research (Creswell, 2015). Different than qualitative research, a quantitative research described a research problem through an explanation of the relationship among variables. This research explored how the consumers obtained the perceptible information from the DPSL label, as well as to develop a detailed understanding of this phenomenon.

The data in this research was collected based on words and videos from the interviews, thus the qualitative database was analysed into a larger meaning of findings. Statistics were not used to analyse the data, but the words and videos, thus it was considered as a qualitative research. The research did not collect numeric data from a large number of people using instruments, as it was done in a quantitative research.

Furthermore, an interpretation of the meaning of the data was made according to a flexible, emerging structures, including the researcher's subjective reflectivity and bias. The finding in this research was reflected to the existing research about the consumers behaviour towards minced meat product and the interrelation themes.

3.2 Research process and methods

The research process comprised by three stages, which were: (1) insight mining; (2) DPSL label development; and (3) usability test. In the Stage 1 – insight mining, the data collection and analysis explained in two different subsections. Later in the Stage 2 – DPSL label development, the prototyping process was described. Finally in the Stage 3 – usability test, four subsections were presented starting from the data collection of the first usability test, the data analysis of the first usability test, the data collection of the second usability test, and the data analysis of the second usability test. The summary of the research is explained in Table 4.

Table 4. Summary of the research process

Stage	Description
Stage 1 – insight mining	Exploring the critical factors from two different perspectives: (1) minced meat consumers, and (2) experts, which are design expert, food safety expert, and supply chain expert.
Stage 2 – DPSL label development	Developing the DPSL label prototype according to the critical factors mined from the Stage 1.
Stage 3 – usability test	Testing the DSPL label prototype to minced meat consumers for two times, started with conducting the first usability test, improving the DPSL label design, and finally conducting the second usability test.

3.2.1 Stage 1 – Insight mining

3.2.1.1 Data collection

For the first stage, the insight mining was conducted by exploring the critical factors from two different perspectives: (1) minced meat consumers, and (2) experts, which are design expert, food safety expert, and supply chain expert.

Interviews with minced meat consumers

An in-depth interview was conducted with various minced meat consumers with a script of semi-structured questions (See Appendix 1) used to explore the consumer behaviour in minced meat consumption. The interview was conducted to the consumers until the response saturation was achieved by finding information that continued until no more could be found to add to them (Creswell and Poth, 2018). The minced meat consumers for the interview were selected with criteria as follows: (1) Swedish citizen or European Union citizen who had lived in Sweden for more than three years; (2) consume minced meat; (3) comfortable to speak and to have interview in English.

In total, 11 interviewees had represented the consumer behaviour and interaction to the shelf-life label in minced meat products. Consumers were asked to voluntarily consent to take part in the interview process. The interview was conducted online in February and March 2021 through Zoom software for around 60 minutes, and was recorded and transcribed in a modified verbatim with Office365 transcription and manual editing shortly after.

Furthermore, the insight gained from the consumers interview were used to develop personas of the consumers, and to identify the critical factors in understanding shelf-life label.

Interviews with experts

An in-depth interview with the experts was conducted to explore the critical factors of designing shelf-life label for minced meat product in related perspectives that

needed to be considered, which were design, food safety, and supply chain. The experts' contacts were obtained through snowballing, of which one expert referred to another.

For the design expert, a person with design background related to technology in the packaging and small sensor was interviewed. For the food safety expert, a senior lecturer with experiences educating consumers about food safety and nutrition was interviewed. For the supply chain expert, a person with DPSL supply chain and logistics background was interviewed.

A script of semi-structured questions for the in-depth interview with the experts is presented in Appendix 1. A consent was taken from the experts to voluntarily take part in the interview process. The interview was conducted online in February 2021 through Zoom software for around 60 minutes and was recorded and transcribed in a modified verbatim with Office365 transcription and manual editing shortly after.

3.2.1.2 Data analysis

The insights were organised by transcribing the interview with a modified verbatim transcription. The modified verbatim transcription was used because it was easier to read compared to the initial verbatim transcription. That means, the repetitions, fillers, stutters, and false starts in the initial verbatim transcription were left out. The transcription was conducted using Office365 transcription and manual editing. After editing the transcription the interviews, the most insightful quotations from the consumers were highlighted manually.

According to the in-depth interview analysis, the consumers' behaviour patterns in minced meat consumption and the use of packaging were identified. The content was then summarised into insights to design the personas according to Cooper et al. (2014) as depicted in Figure 10.

The persona was described by a narrative instead of item lists, and it was placed around behaviour patterns. According to Brangier and Bornet (2011), similar to the fictional characters, personas need to attract attention so they should be easy to remember, sound, as well as humanised. Scenarios were also created in order to understand engagement throughout the various stages of the consumers behaviour.

The critical factors were identified according to the in-depth interview analysis and the personas. According to the consumers' and the experts' explanation, and according to different characteristics of the personas, the essential consideration to design the DPSL label was found and highlighted manually. Thus, the similar insights were extracted to main points of the critical factors.

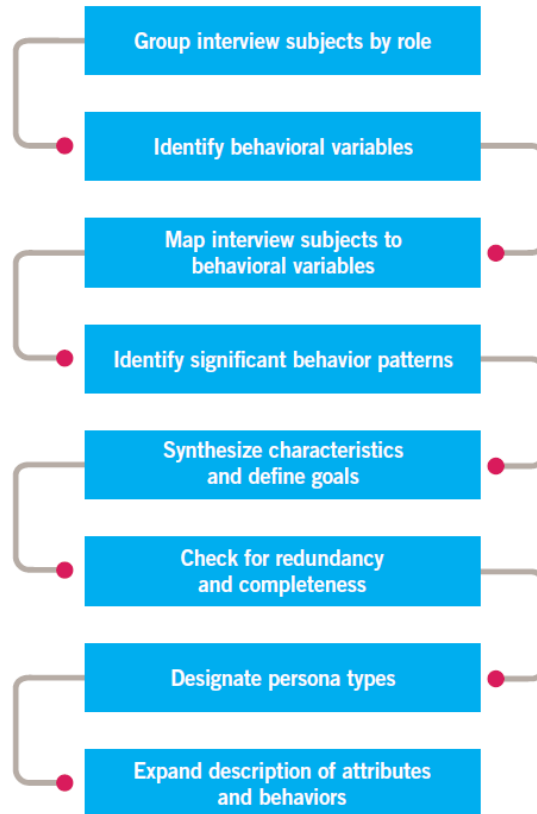


Figure 10. Overview of persona creation process (Cooper et al., 2014)

3.2.2 Stage 2 – DPSL label development

In the second stage, DPSL label design was developed according to the critical factors and personas mined from the first stage. To develop the DPSL label prototypes, the critical factors determining the DPSL label were translated into design principles. The design principles were developed into the art direction in a brainstorming process (See Appendix 2), thus it was sketched and designed.

The first design prototypes were sent digitally to supervisors for suggestions, then three designs were chosen for the first usability test. After having the first usability test session, the label designed was revised according to the consumers' feedback. Three new design prototypes were presented for the second usability test.

The outcome of this stage was the creation of different DPSL label prototypes. The DPSL label design development was conducted with a support from Innoscentia and IKDC that provided the prototype label materials in March 2021.

3.2.3 Stage 3 – Usability test

In the third stage, a usability test was conducted in the usability testing laboratory at IKDC in April 2021. The usability test simulated the scenarios of use of minced meat products in the supermarket and at home. The usability test was conducted by inviting six minced meat consumers to the laboratory, one consumer at a time, to express their opinion while interacting with the DPSL label prototypes.

Reflecting to the aim of the research, and the limitation to find participants for face-to-face usability test at IKDC during the pandemic, six consumers would be considered sufficient to address the problems of the DPSL prototypes. The study from Macefield (2009) explained that by acquiring six participants, the percentage of the usability problems discovered would be in the range of 70.7%-100%. Hence, six consumers would provide the information about how the consumers obtained perceptible information from DPSL label, that would be beneficial for a future development of DPSL label.

The usability test was conducted two times to the same consumers. The first usability test was to get a comprehension about the initial prototype. Afterward, an improvement of the DPSL label design was developed, then a second usability test was conducted to evaluate the response of the participants towards the improvement of the prototype.

The minced meat consumers for the usability were selected with the criteria as follows: (1) Swedish citizen or European Union citizen who had lived in Sweden for more than three years; (2) consume minced meat; (3) comfortable to speak and to have interview in English face to face.

A script of semi-structured questions for the usability test is presented in Appendix 3. A consent was taken from the experts to voluntarily take part in the interview process. The usability test was conducted for around 60 minutes each, recorded and transcribed in a modified verbatim with Office365 transcription and manual editing shortly after. A note during the usability test was also taken to highlight the impromptu insight and gesture from the consumers.

3.2.3.1 Data collection – the first usability test

The first usability test was conducted according to de la Fuente and Bix (2010), and the summary is explained in Table 5.

Table 5. Summary breakdown of users, contexts of use and tasks of the first usability test

Pack	User	Context of use	Task
Intelligent sensor (3 different samples)	Minced meat consumers	FMOT: simulating buying at the supermarket	<ul style="list-style-type: none"> • Identifying the meat freshness • Buying
		SMOT: simulating storing, use, and disposal at home	<ul style="list-style-type: none"> • Storing • Identifying the meat freshness • Disposing

The setting of the first usability test is depicted in Figure 11, and the DPSL label designs used are depicted in Figure 12.

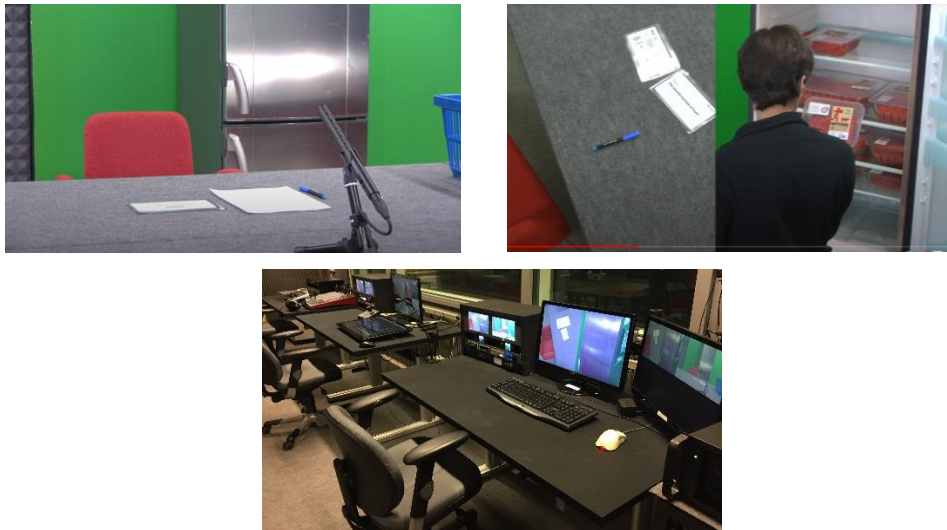


Figure 11. The setting of the first usability test on stage (top left and right) and backstage (bottom)



Figure 12. The DPSL label designs used in the first usability test: Prototype 1 (top left), prototype 2 (top right), prototype 3 (bottom)

In the first usability test, the insight from the stage 1 was considered to create the protocols. Reflecting to the personas from the stage 1, two different scenarios were developed, which were the FMOT and the SMOT (Stephens, 2016). The scenarios were developed to understand different consumer behaviours towards minced meat product, from buying to disposing.

In the FMOT, a refrigerator was put in the lab, and different minced meat packages are put in the refrigerator with different combination of the package sizes and the shelf-life label prototypes. The DPSL label prototype was added on the left top of the lid of the minced meat package. The samples of the minced meat package with the DPSL label prototype for the FMOT scenario are explained in Table 6, and the DPSL placement is depicted in Figure 13.

Table 6. Sample for the FMOT scenario

Size	Shelf-life label	Sample code
0.5kg	Prototype 1	a1
0.5kg	Prototype 2	a2
0.5kg	Prototype 3	a3
1.0kg	Prototype 1	b1
1.0kg	Prototype 2	b2
1.0kg	Prototype 3	b3
1.8kg	Prototype 1	c1
1.8kg	Prototype 2	c2
1.8kg	Prototype 3	c3

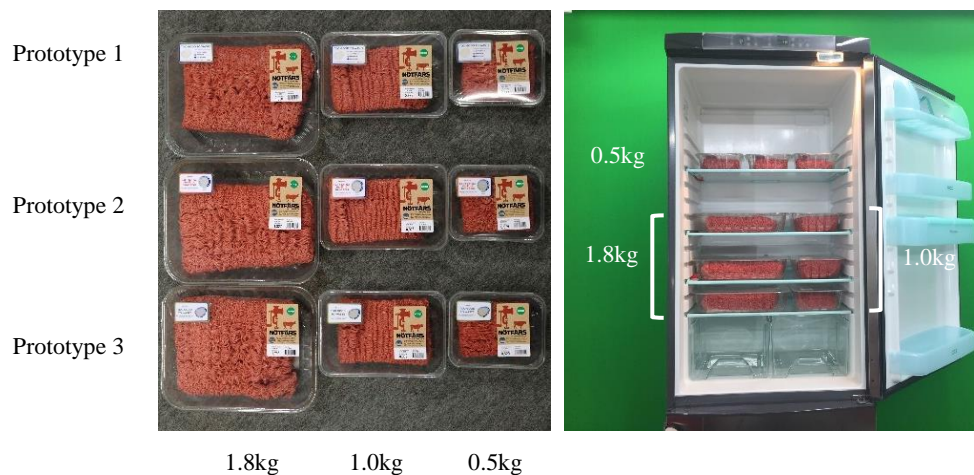


Figure 13. The DPSL placement in the minced meat package (left) and the package placement the refrigerator (right)

Different than FMOT scenario, in the SMOT scenario different colour indicators were presented to simulate different stage of minced meat freshness at home (fresh, half spoiled, spoiled/inedible). That means, in every prototype design, the colour indicators showed three different colours, which were white, light blue, and dark blue. Furthermore, the printed shelf-life date on the package was made to pass the date of which the usability test will be conducted. Hence, it would simulate a scenario that the package was ‘already expired’ according to the printed shelf-life date.

The prototypes for the SMOT scenario are explained in Table 7, and the DPSL placement is depicted in Figure 14. The prototype merely used the 0.5kg size of minced meat package to reduce the number of prototypes. The 0.5kg package was the smallest size of the minced meat package, hence it was the most appropriate size to test the composition of the label in the limited free space of the lid. Moreover, the choice of 0.5kg package would not affect the consumer because this package is the most commonly bought according to Swedish Market Basket Survey by the National Food Agency (2017).

Table 7. Prototype for the SMOT scenario

Freshness colour indicator	Shelf-life label	Prototype code
Fresh (pale white)	Prototype 1	x1
Half spoiled (light blue)	Prototype 1	y1
Spoiled (dark blue)	Prototype 1	z1
Fresh (pale white)	Prototype 2	x2
Half spoiled (light blue)	Prototype 2	y2
Spoiled (dark blue)	Prototype 2	z2
Fresh (pale white)	Prototype 3	x3
Half spoiled (light blue)	Prototype 3	y3
Spoiled (dark blue)	Prototype 3	z3

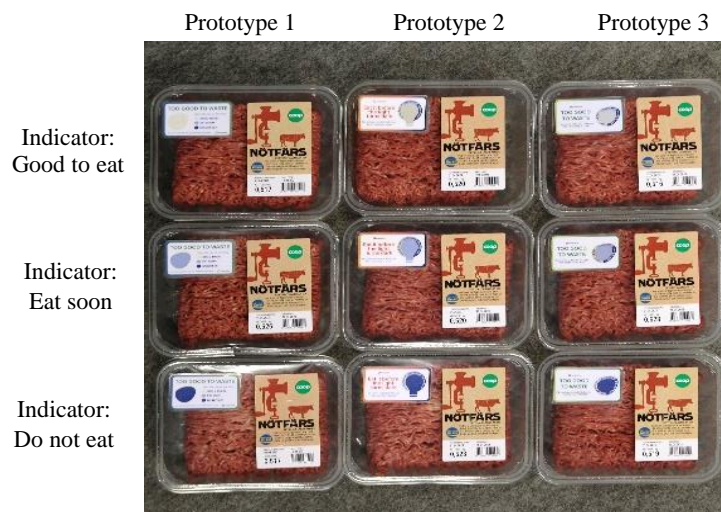


Figure 14. The DPSL placement in the minced meat package

3.2.3.2 Data analysis – the first usability test

The result was organised by transcribing the video conversation with a modified verbatim transcription using Office365 transcription and manual editing. The video was also used to revisit the gesture during the usability test. A note during the usability test was taken to highlight the impromptu insight and gesture from the consumers.

From the transcription, the most insightful quotations from the consumers transcription were highlighted. The quotation was tabulated according to the four critical factors, then was compared for the analysis. The design attributes perceived by the consumers to meet the critical factors were remained unchanged, whilst the design attributes which did not meet the critical factors were improved for the second usability test.

3.2.3.3 Data collection – second usability test

In the second usability test, three revised design prototypes were presented for one consumer at a time. The second usability test was conducted without specific scenario and roleplay, as the first usability test was conducted. Meanwhile, an in-depth interview was conducted in the second usability test to explore the perceptible information from the consumers regarding the revised DPSL label design prototypes. The setting of the second usability test is depicted in Figure 15. Compared to the first usability test, the setting of the second usability test was modified to focus more into seating area of the consumer, because there was not scenario before the fridge as it was in the first usability test.

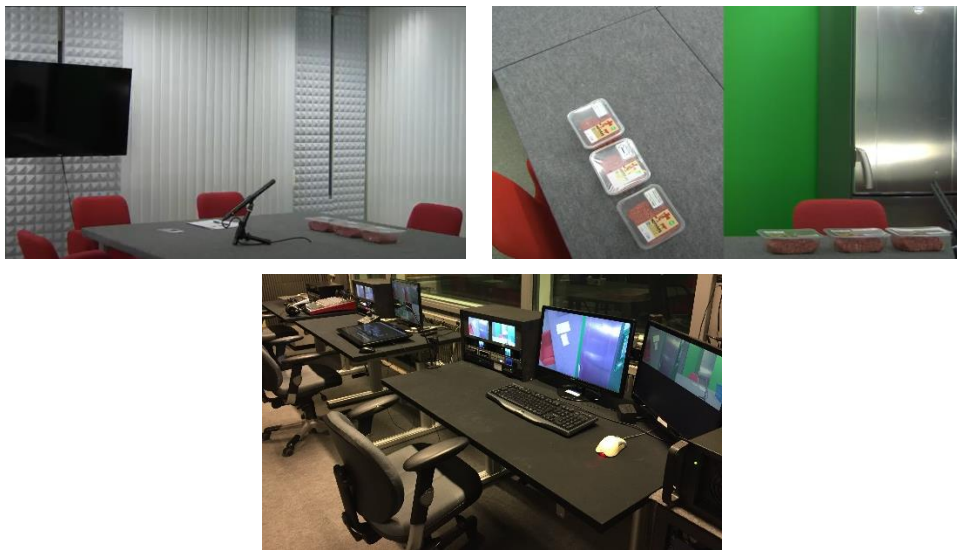


Figure 15. The setting of the second usability test on stage (top left and right) and backstage (bottom)

The prototypes design for the second usability test was also modified according to the data analysis of the first usability test. In general, the changes were made in the attributes of the label which were related to the four critical factors, for instance the title, explanatory text, indicator symbol, indicator text, colour, etc. The DPSL label designs used and the DPSL placement are depicted in Figure 16.



Figure 16. The DPSL label designs used in the second usability test: Prototype 1 (top left), prototype 2 (top right), prototype 3 (middle); and the DPSL placement in the minced meat package (bottom)

3.2.3.4 Data analysis – the second usability test

The result was organised by transcribing the video conversation with a modified verbatim transcription using Office365 transcription and manual editing. The video was also used to revisit the gesture during the usability test. Furthermore, a note during the usability test was taken to highlight the impromptu insight and gesture from the consumers.

From the transcription, the most insightful quotations from the consumers transcription were highlighted. The quotation was tabulated into matrix according to the four critical factors, then was compared with the first usability test's result. The insight was then extracted into suggestion of how the consumers perceived the information from a DPSL label in minced meat product.

3.3 Research quality

Throughout the process of data collection and analysis, the accuracy or credibility of the findings was of utmost importance. To describe the trustworthiness, Creswell (2015) explained the strategies to validate qualitative research projects according to Lincoln and Guba (1985). The trustworthiness could be established in four ways: (1) credibility; (2) transferability; (3) dependability; and (4) confirmability.

Credibility is the qualitative counterpart to internal validity. In this research, the credibility was established through developing themes and codes using multiple data sources and the information gathered from multiple sources of information, individuals, or processes. Transferability is the external validity to generalise the findings in other contexts by other researchers. In this research, the transferability was established by explaining the context of the research and detailed descriptions of the procedures according to literatures. Dependability enables the repeat of the research by using overlapping methods that provides the reliability. In this research, the dependability was addressed through interview protocols. Confirmability is the objectivity of the qualitative research. In this research, the confirmability was established through variety of participants, open ended questions in the interview, and transcribed using qualitative analysis software.

Some possible limitations are acknowledged in the research methods. The biases might arise, for instance social desirability bias and hindsight bias according to Natesan et al. (2016). In all the interviews, there might be a social desirability bias that consumers might answer according to the socially desirable behaviours, and not according to their own behaviour. Therefore, the variations of the consumers were participated in this research to reduce the bias. Meanwhile, the difficulty to find participants in the pandemic situation led to inviting two consumers from the insight mining (stage 1) to participate in the usability test (stage 3). As a result, there was a tendency that the two consumers predicted the usability test, that might also cause the hindsight bias.

4 Results

4.1 Stage 1 – Insight mining

4.1.1 Participant characteristics

The final participants for the insight mining consisted of 12 minced meat consumers living in Sweden, as detailed in Table 8. The consumers answered the questions during the in-depth interview, and showed the location where they put the minced meat in their fridge at home. The racial, social, and cultural diversities were not investigated in this study because the study requires deeper understanding of different anthropology aspects, as it also needs more consumers to analyse the pattern.

Table 8. Demographic variations of the consumers

Consumers	Gender	Age (years old)	Marital status	Municipality	Number of people living in the same house	Visual disability
Consumer 1	Female	41-50	Married	Malmö	5	Wearing glasses
Consumer 2	Male	21-30	Single	Lund	1	No
Consumer 3	Male	21-30	Single	Lund	1	No
Consumer 4	Female	41-50	Separated	Malmö	3	No
Consumer 5	Female	51-60	Living Together	Karlshamn	2	Wearing glasses
Consumer 6	Female	51-60	Married	Gothenburg	4	No
Consumer 7	Female	Over 60	Married	Karlshamn	2	Wearing glasses
Consumer 8	Female	41-50	Married	Karlshamn	5	No
Consumer 9	Female	41-50	Married	Lund	4	Wearing glasses
Consumer 10	Female	51-60	Single	Svedala	3	Wearing glasses
Consumer 11	Male	41-50	Married	Hörby	4	Wearing glasses
Consumer 12	Male	51-60	Married	Staffanstorp	3	Wearing glasses

Furthermore, design expert, food safety expert, and supply chain expert were interviewed in this stage (See Table 9). The experts answered the questions during the in-depth interview, and provided some literatures for further readings.

Table 9. The experts' characteristics

Expert	Topic of discussion	Experience
Design expert	To explore the symbol, design, and hierarchy of information in the label and smart sensor in the packaging	<ul style="list-style-type: none"> • 11 years' experience as designer with semiotics expertise • 5 years in house designer in TetraPak, structural packaging and embedded technology in the packaging • Involved in Copenhagen Institute of Interaction Design for small sensors design
Food safety expert	To explore the information of minced meat products safety and Swedish consumer behaviour	<ul style="list-style-type: none"> • Senior lecturer at Uppsala University • Expertise in food microbiology • Experience in consumer education to food safety and nutrition in household level in Sweden
Supply chain expert	To explore the interaction of shelf-life date in the supply chain and the role of DPSL service	<ul style="list-style-type: none"> • PhD at LTH • Research in intelligent packaging and logistics solutions to reduce food waste • Managing research and innovation for food and supply chain projects at Lund University

4.1.2 Consumer behaviour towards a minced meat product

Various consumer behaviour was captured from the consumer related to the minced meat product, comprised of different points: (1) consumer's groceries behaviour; (2) consumer's storing and use behaviour; and (3) consumer's disposal behaviour.

4.1.2.1 Consumer's groceries behaviour

According to the interview, most of consumers did groceries every 2-3 days and buy minced meat every week. The modified atmosphere packaging is the most common type of minced meat packaging they usually buy in the supermarket. However, some of the consumers also bought the fresh minced that was grounded directly when they bought it from a producer or 'lanthandel' store, which was packed in a vacuum meat packaging.

Related to the buying power behaviour, all of consumers thought that the type of meat was their main consideration prior to buying minced meat. Most of consumers checked the expiration date for fresh product, such as meat and bread. Thus, they often checked the minced meat shelf-life when they bought the product. The price of the minced meat product was not the important factor for consumers older than 40 years old.

Related to the shelf-life date in the minced meat package, the interviews showed that the consumers would check the date according to the time they would cook the

meat. However, they would be fine to buy the discounted price of minced meat product even though it was closed to the shelf-life date. *“I wouldn’t mind buying the meat that is closed to be expired, if I cooked it the same day. If not, the store will throw the meat anyway,”* explained the consumer.

Furthermore, most of the consumers did not have difficulties of reading the label. However, the symbols (flag, animal shape, eco label) were easier to be recognised rather than text from far distance. One of the consumers would take the photo of the label and to zoom it with her mobile phone to read the information of the label when she forgot to bring her glasses to the store.

Regarding the different date of minimum durability in the minced meat product (which preceded by words ‘best before’ / ‘bäst före’ in Swedish or ‘use by’ / ‘sista förbrukningsdag’ in Swedish), most of consumer did not know that there were two different types of the date of minimum durability. There was one consumer who thought that the date of minimum durability in the minced meat package must be ‘sista förbrukningsdag’ in Swedish, which were not the case in Sweden. Beyond that, several of the consumers knew that there was another the date on the minced meat label, which was the information of when the meat was packed.

4.1.2.2 Consumer’s storing and use behaviour

Reflecting to the consumers behaviour related to how they store and use the minced meat product, all of the consumers cooked the meat in less than 3 days they bought the meat. Half of it also stored it in the freezer sometimes. Some insights were captured, *“I stored the meat that I would cook in more than 3 days, and the leftover fresh minced meat in the freezer.”* and *“I would not put the fresh meat in the freezer. However, I will process the fresh minced meat first, then to store the cooked minced meat in the freezer.”*

Furthermore, most of consumers did not have dedicated shelf in the fridge to put the minced meat. Yet, the consumers had the preference to store minced meat more in the middle and bottom shelves, rather than in the top shelf (See Figure 17).



Figure 17. Different minced meat storing behaviour: to put the minced meat in the top shelf of the fridge (left), the middle shelf (middle), and the bottom shelf (right)

4.1.2.3 Consumer’s disposal behaviour

Regarding to the consumer’s disposal behaviour, the consumers rarely had the spoiled minced meat at home (around 1-3 times per year). Most of the consumers

disposed the minced meat package in the bin for plastic trash. However, few of them disposed the minced meat package in the general waste because the recycling system they had was merely for the hard plastics, and the plastics they got from a producer or 'lanthandel' store were not categorised as the ones. There was merely one consumer who separated the lid and the tray, then to throw both plastics in the bin for plastic trash.

4.1.3 Persona development

According to the interview with the minced meat consumers, the behaviour patterns in minced meat consumption and the use of packaging were identified and summarised into insights to design the personas. The formation of personas was essential to help defining the critical factors, by giving different insights of circumstances that needed to be considered. The interview insights led to the pattern identification of the consumers, which were classified as personas. The three personas captured were: (1) autopilot consumer; (2) steadfast consumer; and (3) cautious explorative consumer.

The knowledge of the personas was then used as the consideration to address the critical factors. For instance, the autopilot consumers needed the information that could be recognised intuitively more than the cautious explorative consumers. Another need was addressed differently, for instance the cautious explorative and the steadfast consumers needed more detailed information about the technology behind the DPSL label compared to the autopilot consumers. Therefore, the critical factors were developed by highlighting the needs from different personas, supported by the insights from the experts.

4.1.3.1 Autopilot consumer

The autopilot consumers tended to feel satisfied with the current status quo of the label design, and they did the shopping decision by habitual activities unconsciously. Some of the behavioural patterns captured, for instance the consumers did not have much time to read the label properly with an autopilot behaviour. *"Most of the time it's kind of like I'm totally in rushed running into the store, grabbing what's on the shelf,"* explained one autopilot consumer.

Another autopilot consumer stated, *"I don't care that much about the label, I think I look more at what I said before that it looks good. I think the reason maybe why I don't pay much attention to the label is because if I go into the same place for many years, it's kind of the same."* Another autopilot consumer reflected the same behaviour, *"Sometimes when you go into the store, you just go with the list and you're really focused. Just pick and you have a standard repertoire of certain foods that you always pick the same because you know it works. Yeah, the more information it will take more time. I will just look for the relevant information."*

4.1.3.2 Steadfast consumer

The steadfast consumers showed the tendency to believe in their personal perspective, thus they set an established pattern and is less open to a new change in the label. The steadfast consumers relied on their sense to detect the product, for instance, *“And sometimes when I eat something that is slightly older, if I'm insecure then my husband tells me that if it doesn't really taste bad or smells bad, he says that maybe I will have a little bit of a loose stomach.”* The steadfast consumers believed on their own behaviour, that might not reflect the objective knowledge. For instance, they believe to store the minced meat product in the freezer, while the storing recommendation of the product stated to store it in 2-4°C. *“I cannot answer you the shelf-life because I never thought about it, because considering that I always buy it, put it directly in the freezer so it keeps the validity longer,”* explained one consumer.

Another behaviour pattern captured that there was a consideration from the steadfast consumers that a product with longer shelf-life might do harm to them. *“You know, sometimes when I buy a bread and the expiry dates or any product where the expiry date is really far ahead, then I would sometimes wonder how is that possible. It's like for me it's a sign of that there's something wrong like natural bread would,”* described the consumer. Another consumer explained, *“If it's a very long shelf life than I guess you would start to consider what type of preservative they're using to meat.”*

4.1.3.3 Cautious explorative consumer

The cautious explorative consumer showed a deeper interaction to the minced meat label. They invested more time to understand the information provided in the label. *“At the label is important, I think because if I buy a new product then I always look at the label more carefully. It was easier to just find on the information of the date and I don't think it's too much. I mean usually you have to pick up the product to look at the little. Yeah it should be clearer. You have to pick it up or like take it out of the fridge and look at it to see what the expiry date is. They will usually have a flag so that you can see like in the fridge without picking it up.”* The cautious explorative consumers perceived that the date of minimum durability is important, *“Yeah, I always look at the expire dates, I always. And I want the one with the longest. I go inside and oh maybe there is another I take that one, then I feel as if I have got a better product.”*

Furthermore, the cautious explorative consumers would give more effort to understand the label even though they faced barrier, *“Sometimes when you have a problem with the label, you know what as an old person do. A kind of hack the trick if you forgot your glasses or something, then you take your mobile phone and you take a picture of the label and then you zoom in.”* They did not think that information on the label was overwhelmed, rather they asked for more information on the label. *“I want to know as much as possible. The more information they would give, I would*

probably be happy to know it. I think it's important to the label, so you know what kind of meat that you're getting and the amounts of kilos and validity. Be better if it were more detailed information about the meat, the age for example.” said one consumer. Another consumer asked for more information on the label, *“I wonder why would it be more expensive and why could they make it last longer? So then they would have to tell me that they have a process that makes this so say for example.”*

The cautious explorative consumers also tended to be more cautious to sustainability aspect and more aware to recycling methods. For instance, *“I will buy it if it's like it's reduced price because it's like the end date. I don't like wasting food. I mean they're going to throw it away. I'd rather buy Swedish meets, than buy like meat from other countries. Yeah, both of those reasons, which are the environment and like at least I know that.”* Another consumer was accustomed to the recycling habit, *“I separate the lid from the tray, because I know it's maybe not the same plastic in those.”*

4.1.4 Critical factors

Reflecting to the insights mined from the consumers and the experts, and reflecting the pattern from the personas, five critical factors were identified to develop a DPSL label, which were: (1) sustainability communication; (2) detailed information; (3) size and dimension; (4) quick decision-making support; and (5) food supply chain consideration. The consumers quotes were summarised from similar opinions in the interview. The opinions were then extracted into one quote to illustrate the consumers' motivation to certain phenomenon.

4.1.4.1 Sustainability communication

The need of objective disclosure was captured by the consumers, the food safety expert, and the supply chain expert insights. The consumers who were concerned about sustainability showed that it was essential to mention the objective of the DPSL label to the consumers. Several quotes such as, *“And also I will buy it if it's like it's reduced price because it's like the end date. I don't like wasting food. I mean they're going to throw it away,”* and *“I'd rather buy Swedish meats than buy meat from other countries. Both of those reasons, which are the environment, and at least I know that,”* showed that it was critical to mention the objective of DPSL label to curb meat waste to the consumers.

Furthermore, the food safety expert addressed that curbing meat waste in the shelf-life label could be stated as the objective, *“It could be more or less in a sustainable way of thinking. If you could focus more on the perspective of sustainability. I think that could be more relevant for the sensor. Of course, to throw away food it is really high cost for our environment. So, if you don't promise anything about food safety, it could be very efficient way of keeping a food sustainable”*

The supply chain experts also provided a similar perspective on how communicating the objective to curb meat waste was needed in the DPSL label: *“We know that it's good to this one, but it can be kept longer, so that's kind of how we change the words for the consumers to make it more positive to use it longer. To waste less food basically and to be safe in your decisions that I can use this food. Still, I don't need to be worried about being sick or something like that. So yeah, I think that will make the consumers safer in their decisions.”*

4.1.4.2 Detailed information

There was a behaviour captured through the interview with the consumers that they would spend more time to understand the label if it were new for them or they did not feel familiarised with it. Furthermore, a clear detail was considered as a critical factor, reflecting to some quotes from the consumers: *“I wonder why would it be more expensive and why could they make it last longer? So then they would have to tell me that they have a process that makes this so to say for example.”* and *“If it's a very long shelf life then I guess you would start to consider what type of preservative they're using to meat.”* showing that there was a doubting expression that DPSL label might make the minced meat product became ‘less natural’ than the product with printed static shelf-life label.

Another insight was also captured about the importance to put the storage recommendation in the shelf-life label. It was related to the different consumers behaviour captured to store fresh minced meat in the freezer, and not in the refrigerator as recommended in the packaging. The food safety expert mentioned, *“But I also know from experience that Swedish consumer, normally they put the minced meat in the freezer. Of course this is a custom from the past days. It is very sensible product and they also they are raised in that past time when the minced meat shelf life was expired in just one day.”* This behaviour was further confirmed when having the interview with consumers.

The storage recommendation of DPSL label was also related to the behaviour of the consumers who did not do a proper control to their own refrigerator temperature. A quote from the food safety expert highlighted the importance to declare the storage recommendation, *“We already know that consumers don't know how to control temperature in there. They may have the 9 or 10 degrees even in the fridge.”*

4.1.4.3 Size and dimension

The size of DPSL label was critical to support the consumers having a perceptible information while interacting with the label. A current printed static shelf life had been detected to be sometimes too small for consumers. *“I'm not thinking so much about it, but sometimes when you have a problem with the label, you know what as an old person do. A kind of hack the trick if you forgot your glasses or something, then you take your mobile phone and you take a picture of the label and then you zoom in,”* expressed a consumer.

There was also a need to design a DPSL label that can be recognised from the store shelf without the consumers to take out from the shelf. *“I mean usually you have to pick up the product to look at the little. Yeah, it should be clearer. You have to pick it up or like take it out of the fridge and look at it to see what the expiry date is. Yeah, they will usually have a flag so that you can see like in the fridge without picking it up.”*

However, there was no specific limit of how much the best size of the DPSL label should be. The design expert said that, *“Designers provide the understanding or the method of understanding for the product development effort to understand the consumers and the people. There is no clear-cut answer because the only thing that I could say is that it has to be understood by the people that are using it.”*

Furthermore, the size determination was also related to the further development of the label by the designers. It was critical to provide a size range for the designer to be flexible in the further label development, as it was in accordance with the design expert quote, *“X dimension Y dimension is set like, if you can give a span there, the better. If you can say this is, it should be at least 20 millimetres, but it could be up to 40 millimetres without any like major implications to cost of product. Designers love that.”*

4.1.4.4 Quick decision-making support

DPSL label should be designed to support a quick decision-making by the consumers while purchasing the product. It was aligned with the consumer persona ‘autopilot consumer’ who did not invest much time to read through the label. This critical factor was also mentioned by the supply chain expert, *“It was like what should I use this for if they have to read through a lot or something, it should be easy for then it should be a quick decision. It should be something that they feel safe with, but they don’t question like yeah, is this really true?”*

Furthermore, a quick decision-making support was related to the lack of understanding of the consumer about the shelf-life label. The consumers interviewed did not know that there were two different shelf-life dates in minced meat, which are ‘best before’ or *bäst före* in Swedish, and ‘used-by’ or *sista förbruknings* in Swedish, as shown in Figure 18. Therefore, looking to the consumer behaviour which pay attention to the label in a very short time, it is critical to design a shelf-life label that can support a fast decision. The difference of shelf-life date was confirmed by the food safety experts. Furthermore, the Swedish National Food Agency answered in their website, *“It is not mandatory to have ‘sista förbrukningsdag’ for minced meat.”*



Figure 18. Different shelf-life date label in minced meat: best before (left) and used by (right)

4.1.4.5 Food supply chain consideration



The design of DPSL label should not alter the food supply chain (FSC) network that had been established. The changing of shelf-life label in the primary packaging from printed static shelf life into DPSL should not ruin the flexibility of the supply chain. It should focus more into the allocation time in the consumers, rather than the products to spend more time in the FSC storage. Therefore, it was critical to make sure that the FSC had their own data of shelf-life date of the minced meat products and did not rely on the DPSL label in the primary packaging. It was also confirmed by the supply chain experts, “*Changing the static shelf life into the dynamic one in the primary packaging will not change anything in the whole supply chain because they have their data from another source.*” However, this critical factor was not included in further result and discussion, because it did not relate directly to the consumer behaviour, as mentioned in the scope of the project.



4.2 Stage 2: DPSL label design development

In the second stage, the four critical factors obtained in the first stage were tabulated and analysed, resulting into several actions that were considered prior developing the DPSL label design. The need was identified according to different personas of the consumers, combined with different perspectives from the experts and the need of the company. The summary of the analysis is explained in Table 10.

Table 10. Summary of the analysis for the DPSL label design development

No	Critical factor	Need identification	Reflection and inspiration	Action to take
1.	Sustainability communication: reinforcing consumers to make	<ul style="list-style-type: none"> Autopilot and cautious explorative consumers: Create a more positive statement for the 	Design principle: <ul style="list-style-type: none"> Create a sustainability message which attracts the consumers 	Create the slogan to resemble the food waste fight

	responsible choices	<p>consumers to use the product longer</p> <ul style="list-style-type: none"> • Food safety expert: The inability to promise food safety, but to be an effective way to keeping a food sustainability • Supply chain expert: The change in the primary package does not alter the supply chain management of the product • Innoscentia: Differentiation to competitors 	<ul style="list-style-type: none"> • Communicate the freshness & quality <p>Mood board:</p> 	
2.	Detailed information: Creating consumers' trust to a new innovation	<ul style="list-style-type: none"> • Cautious explorative consumer: The assurance that it does not alter the product quality and it is aligned with the regulation • Food safety expert: Various storage temperature in the fridge happens without the consumers ever realise and the freezing behaviour in the consumers • Supply chain expert: The change in the primary package does not alter the supply chain management of the product • Designer: Do not put too much information on the label • Innoscentia: Build consumers' trust 	<p>Design principle:</p> <ul style="list-style-type: none"> • Communicate that it is aligned with the regulation • Accommodate different consumer behaviour in storing meat • Communicate that the technology does not harm the meat <p>Mood board:</p> 	Create the explanatory text about the technology
3.	Size & dimension: Supporting consumers to comprehend the information easily	<ul style="list-style-type: none"> • Autopilot consumer, steadfast consumer, cautious explorative consumer: Strategic placement and proportional size label will help customer to understand the given information with ease 	<p>Design principle:</p> <p>Adjust the label dimension to be easily recognised</p>	Do market visit and propose the size of the label after having a comparison with the store label

		<ul style="list-style-type: none"> • Food safety expert: It does not mislead the consumers between the food safety and food quality • Supply chain expert: The change in the primary package does not alter the supply chain management of the product • Design expert: A size range will give a room to the designer to design the label better in the later stage • Innoscentia: A size range without significantly impacting to the cost is needed 	<p>Mood board:</p> 	
4.	<p>Quick decision-making support: Facilitating consumers to have a more efficient life</p>	<ul style="list-style-type: none"> • Autopilot consumer, steadfast consumer, cautious explorative consumer: Support a fast, automatic, and instinctual decision making in the first moment of truth • Food safety expert: Consumers did not realise there are different 'date of minimum durability': 'sista förbruknings' and 'bäst före' • Supply chain expert: The change in the primary package does not alter the supply chain management of the product • Design expert: Simplicity design will catch people's attention than the complicated one • Innoscentia: Shifting the strategies to keep pace with the impatient consumers 	<p>Design principle: Create a design that can be perceived quickly by the consumer from a distance, for instance, while standing before the store chiller</p> <p>Mood board:</p> 	<p>Create intuitive symbols and attributes in the label</p>

After creating the summary, a brainstorming was conducted to explore the art direction in each critical factor, as explained below.

4.2.1 Sustainability communication

Two different slogans were created to resemble the sustainability message, which are 'too good to waste' and 'eat it before the light turns dark'. The idea was to compare how the consumers perceived different sustainability communication, whether it was more provoking for the consumers by having a marketing slogan like 'too good to waste' without clearly directing to the function of the label, or by having an intuitive message 'eat it before the light turns dark' that delivered the function of the label.

Furthermore, the sustainability message was explored by creating different tonality of the label colour, which were blue-green on the prototype 1, yellow-red-blue on the prototype 2, and light green-dark green on the prototype 3. The questions were defined to understand how the consumers' impression to the colour and how they related the impression to the sustainability.

4.2.2 Detailed information

The detailed information was created to give more explanation about how the technology worked. The text 'The colour indicator tells you the freshness of the meat' was intended to meet this critical factor.

Furthermore, the indicator explanation was created into three different phrases according to different freshness of the sensors resembled, which were 'Good to eat', 'Eat soon', and 'Do not eat'. The indicator explanation referred to different action that the label tried to tell the consumers.

The information about how the consumers should store the product and dispose the package was not included in the label. Since the addition of the label would not alter the storage recommendation of the product and the recycling process of the package, it was opted to have less information on the DPSL label. However, the consumers' perception about how the DPSL label would alter the behaviour of the storing and disposing the product was later explored in the usability test.

4.2.3 Size and dimension

According to the market visit to different supermarket, the store label size was found to be 6cm x 11cm, ± 1 cm. The label size did not change along the change of tray size. The label size was proportional which was 1/3 of the package length of the 0.5kg minced meat package, as depicted in Figure 19.

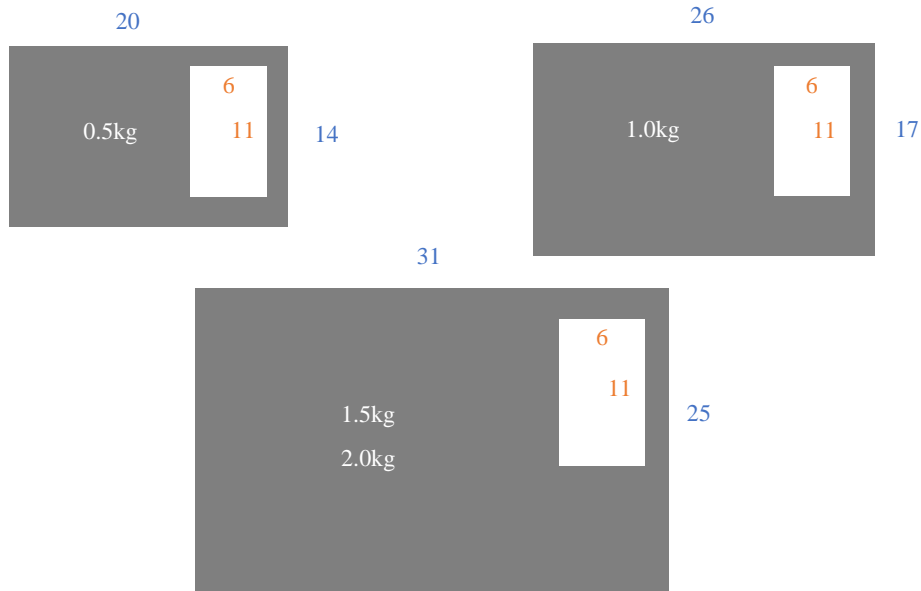


Figure 19. Different size of minced meat package and the store label size

Reflecting to the size constrain from Innoscentia that the DPSL label should be 9cm x 5cm maximum, and the size of different minced meat package from the market visit, the size of DPSL label prototype was determined into 7cm x 4 cm. The size was chosen to be the proportional size that resembled 1/3 of the smallest size of the minced meat package (0.5kg).

Furthermore, the DPSL label would be placed on the top left of the packaging, as depicted on the illustration in the Figure 20. The follows the natural reading curve for Westerns that the top left corner is a corner people pay attention to when reading, that the eye moves from top to bottom and left to right (Cooper et al., 2014).

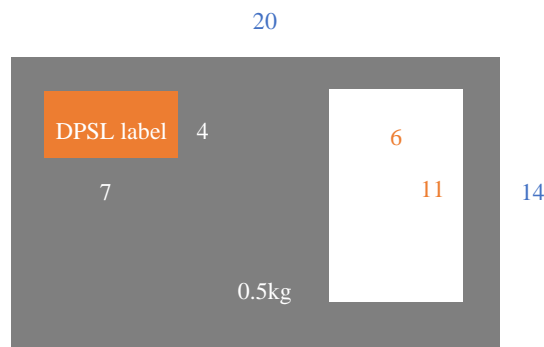


Figure 20. Illustration of the DPSL label prototype compared to minced meat package and the store label

4.2.4 Quick decision-making support

The quick decision-making support was explored by doing a brainstorming about the symbol and colour art direction, as explained in the Appendix 3. After conducting the brainstorming, two different symbols were chosen for the indicator, which were the shape resembling the Innoscentia logo, and the light bulb symbol. The shape resembling the Innoscentia logo simulated the uniqueness of the DPSL label prototype, whilst the light bulb symbol supported the slogan ‘eat it before the light turns dark’.

Furthermore, the indicator explanation ‘Good to eat’, ‘Eat soon’, and ‘Do not eat’ was placed differently in the DPSL label prototype. One was placed the indicator explanation horizontally (See prototype 1 in Figure 21), and the others integrated the indicator together with the indicator symbol in a whirling shape along the symbol (See prototype 2 and prototype 3 in Figure 21). Finally, according to the art direction analysed from the critical factors, three DPSL label prototypes were developed as depicted in Figure 21.



Figure 21. The DPSL label designs used in the first usability test: Prototype 1 (top left), prototype 2 (top right), prototype 3 (bottom)

4.3 Stage 3: Usability test

4.3.1 Participant characteristic

The final participants for the usability test consisted of 6 minced meat consumers living in Sweden, as detailed in Table 11. In the pandemic situation, people were

obliged to stay at home and were restricted to go to the campus without exemption. Hence, two consumers from the insight mining (stage 1) were invited to participate in the usability test. It was preferably to find different consumers to prevent a hindsight bias (Natesan et al., 2016), which was a tendency to predict the test because the consumers already got the knowledge from the previous stage.

Table 11. Demographic variations of the consumers

Consumers	Gender	Age	Marital status	Visual disability
Consumer 1	Male	51 - 60	Single	No
Consumer 2	Female	41-50	Married	Wearing glasses
Consumer 3	Female	31-40	Living together	No
Consumer 4	Female	51-60	Married	Wearing glasses
Consumer 5	Male	41-50	Married	Wearing glasses
Consumer 6	Female	31-40	Living together	No

4.3.2 The first usability test

4.3.2.1 Consumer behaviour towards minced meat product

According to the first usability test, all consumers paid attention to the date of minimum durability whenever they wanted to buy minced meat package. Half of the consumer were aware there was a different date of minimum durability in the minced meat product (which preceded by words ‘best before’ / ‘bäst före’ in Swedish or ‘use by’ / ‘sista förbrukningsdag’ in Swedish). Most of consumers also paid attention to the date of packing / ‘förpackningsdag’ in Swedish. One even would merely buy the product with ‘förpackningsdag’ date that was the same with the date the consumer bought it, without paying attention much on the date of minimum durability.

In the FMOT scenario, 4 consumers chose 0.5kg package, 1 consumer chose 1.0kg package, and 1 consumer chose 1.8kg package, according to their usual consumption of minced meat product. The prototype 1 was chosen by 4 consumers as the DPSL label they preferred most, followed by the prototype 2 by 2 consumers, and none choosing the prototype 3. The consumers insight related to the prototype attributes will be explained in the following 4.3.2.2 subsection about critical factors.

In the SMOT scenario, consumers often stored the minced meat product in the refrigerator for few days prior to processing it. Some of them perceived that the technology to prevent the meat waste at home would not be the thing they absolutely needed. *“The thing is, I’m the kind of person that when I buy something I prepare it immediately. I seldomly keep it in the package so meat spoilage would not be the kind of an issue for me,”* explained one consumer.

Furthermore, few of them stored the minced meat in the freezer if they did not cook the meat right away. All of them cooked the raw minced meat thoroughly after they opened the packaged. However, some of them stored some of the processed minced

meat in the freezer. *“I wouldn't have kept everything in the fridge from the beginning if I were not going to use it right away. I would put it in the freezer because I wouldn't like to end up in this situation that eventually just throw away food,”* said the consumer.

When the SMOT scenario posed them to have 3 minced meat packages which were already passed the ‘bäst före’ date with three different DPSL colour indicators, most of the consumers did not throw away the minced meat with an indicator ‘do not eat’ directly. They opted to check the minced meat with their senses (seeing and smelling) and tried to cook and tasted it, even though the indicator showed ‘do not eat’. The consumer expressed, *“If I'm in this situation, I wouldn't throw it away just because the label is telling me that I should throw it away. I would open it out, smell it, I would check the meat. I would check myself the quality of the product, not just a label.”*

Only 2 consumers who did not want to risk eating the minced meat package with the ‘do not eat’ DPSL indicator label. They have a similar opinion, *“Perhaps I will smell, but I would get suspicious since it says ‘do not eat’ and the expiry date has passed. Actually, I don't think I would eat it. I wouldn't eat it, no.”*

4.3.2.2 Critical factors

The results are presented according to the four critical factors previously identified, which were (1) sustainability communication; (2) size and dimension; (3) detailed communication; and (4) quick decision-making support. The analysis of the sustainability communication is listed in Table 12.

Table 12. Analysis of the sustainability communication from the first usability test

Critical factor	Consumer quote	Key insight	Next action
Sustainability communication	It has this green colour, which you think it's like environmental, it's good, safe. Yeah, the red one was a bit, uh, I didn't even look at the right one because it was so similar to the meat that you do see.	Green colour related to sustainability.	The green colour remained.
	No, I connect to the freshness of the meat. The green colour would connect if it would have something saying that this is a recycled material. But this is not for me. This is not connected to sustainability. This is connected to the freshness of the meat. But it is sustainable because then you are not wasting meat of course. But in that case, to me sustainability was then I just look at it and say OK it has been produced in Sweden, so it doesn't take long for transportation. And then maybe the plastic is done in a special way. But this specific label is referring to the freshness of the meat. So thinking about the quality of the meat and not how sustainable it is, the sustainability can look that is made in	The sustainability message was indirect, which was related to the meat waste reduction. The label was more connected to the freshness of the meat.	Explored how to improve the sustainability impression.

	Sweden or if there was somewhere that the plastic has been made in us.		
	'Too good to waste' is like already making me think of how I should use it. You don't even have to read specifically more details, but you already know it's reminding you to rethink the consumption or how to prepare the food, so that's already take triggering. And because of these capital letters you read it right away too, so that's a good thing.	'Too good to waste' title related to sustainability.	'Too good to waste' title remained.

Focusing on the title of the DPSL label, 'too good to waste' resembled the sustainability, while 'eat it before the light turns dark' helped consumers to understand how the DPSL label worked. *"I think this is more positive as well. I think 'too good to waste' is more positive than 'eat it before the light turns dark,"* explained the consumer. Furthermore, the consumer perceived green colour to the sustainability, and red colour to the meat.

The impression of sustainability was not perceived by the consumers directly. The DPSL label was perceived more into the meat freshness indicator than sustainability. The sustainability message was related to the meat waste reduction, which the consumer perceived indirectly. Thus, the sustainability communication would be improved in the second usability test.

According to the size and dimension, the size of the DPSL label was perceived just right, compared to the store label. The consumer also said that the DPSL label should not be made bigger for the bigger minced meat package size.

Focusing on the text size, the consumer explained that the size was also just right. *"No, I think this is good because I need reading glasses and I can read without it,"* explained the consumer. The analysis of the size and dimension is listed in Table 13.

Table 13. Analysis of the size and dimension from the first usability test

Critical factor	Consumer quote	Key insight	Next action
Size and dimension	First of all because it's small. The letters are big which I actually like. All in general, the label or in general the the good thing is the size. Well, it's not interfering with anything else, and it's a good extra measure of it so I would not change the the size.	The size of label and the letters helped people to get the information faster.	The size of the label and the font size remained.
	This size is totally OK because this (the store label) is big, this (the DPSL label) is small, so people will tend to look at the smaller label.	The size of DPSL label intrigued consumer to read that first than the store label.	The size of the label remained.

	I think this (the DPSL label) one is good if you put the label on the bigger package. And I think the size of the whole label is good.	The size of the label should remain the same on the bigger minced meat package.	The size of the label remained in the bigger package.
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Furthermore, the critical factor related to the detailed information was explored, as seen in Table 14. At first, few consumers did not get the idea of the DPSL label function and how it worked. Hence, an improvement of the explanatory text was needed to help the consumers getting the perceptible information better.

Most of consumers perceived that the indicator text integrated with the indicator symbol as in prototype 2 and 3 was confusing. However, the consumers perceived the horizontal indicator text was better even though it took more space in the label.

Some changes in text colour and text wordings were also needed, as well as the hyperlink for the consumer to get more information about the technology.

Table 14. Analysis of the detailed information from the first usability test

Critical factor	Consumer quote	Key insight	Next action
Detailed information	I mean, I understand why it is written do not eat, but maybe if you write 'good' then maybe it would be better if you write this as 'bad'. I think it's a bit more like if you read 'bad' then you think oh I have to consume it. And 'do not' is like saying 'listening to your parents do not do this', so maybe not everyone will follow.	The indicator text 'do not eat' tended to be too commanding.	Changed the indicator text 'do not eat' into something less commanding
	Or I mean the description maybe in a different colour? Because I think this is blue. just do it like in dark green or black to make it more neutral.	The indicator text blue colour did not help consumer to recognise the information.	Changed the indicator text colour into more neutral colours.
	No, I don't think it's confusing if the label tells different thing compared to the date. The date is just a prediction of course, and this (the DPSL label) is like more actual. I think it's like informative and a good feature. There is absolutely nothing wrong with it or anything like that, but it's not a replacement of the date. I mean it's always good to have this extra information. It gives an extra indicator of the food inside. Also, it doesn't really interfere with other.	The DPSL label and the date of minimum durability on the package together did not confuse the consumer.	The DPSL label remained together with the date of minimum durability.
	Yeah, because if you have this (prototype 1) one you take it and you look like this. If you take these ones (prototype 2 and 3) you have to turn it around.	The integrated indicator text to the symbol	Formulated the indicator text horizontally.

		confused the consumer.	
	And then you have some explanation under the colour indicator tells you the freshness of the meat. Maybe it would have been better if it was in black, which the colour indicator tells you the freshness of the meats, because it's it's in some blue.	The explanatory text colour did not help consumer to recognise the information.	Changed the explanatory text colour into black.
	I don't know if it's gonna change the colour because it doesn't says it will. And how it will do that, I don't know, but something is going to tell me that it's going to change the colour because I otherwise I don't know.	The explanatory text did not help consumers to understand how the label worked.	Modified the explanatory text to be clearer.
	I would like to have a website link where you can read about the technology. How does it work? I would check it definitely yes.	More information about the technology was needed.	Add hyperlink to the technology information.

The analysis of the quick decision-making support is explained in Table 15. Some changes in the symbol and the text colour were needed to support the consumers having a quicker decision.

Table 15. Analysis of the quick decision-making support from the first usability test

Critical factor	Consumer quote	Key insight	Next action
Quick decision-making support	When I see both labels, this (the store label) I don't read at all or I hardly look at it, and then I start looking at this (the DPSL label) one. It's something you read right away. You already know what to read, where to look.	The size of label helped people to get the information faster.	The size of the label remained.
	It's like if it's dirty in the packaging, like if something that was leaking somehow, you know, like a water drop. if you have like some waterdrop some stain in white in a paper then it gives this impression.	People perceived the indicator symbol from the prototype 1 as an unclear symbol.	Change the symbol.
	Then I would stay by the light bulb and I would leave this egg out because the light bulb makes more sense. If you would change this eggy thing to a rounder shape, then maybe that's better. The circle or or square is more scientific and more accurate than this. This is more child-like or artistic form.	People perceived the indicator symbol from the prototype 1 as an unclear symbol.	Change the symbol into rounder shape.

	The first is the text is easy for me to read and understand, and it's perhaps makes me make me do a quick decision	The text font helped consumer to perceive the information.	The text font remained.
	This one is easier because it says 'eat it before the light turns dark', and that's the only thing you need to know. As I said this, this label is very self-explanatory. Maybe I would go to eat it before the light turns dark. Would be the first thing because if you think about it in terms of message to read comes first.	The text 'eat it before the light turns dark' helped the consumers understanding the DPSL function.	'Eat it before the light turns dark' remained.
	So in terms of colouring, this green gives the impression of something. If you think about meat, for example when it's only towards green or grey, it gives the impression that it's getting bad or it's getting old. And if you have already the connexion of these colours here, together with the green, it can give impression that is less fresh than this one because this (prototype 2) you have so a little bit more orange and red and then connects to the meat. The colouring makes a difference because then you want a red meat and then have a little bit more reddish here. Then you connect to the freshness. If I'm not mistaken, red and orange are related also to food somehow, isn't it? I think the red colour is making me see it and read it and actually think about the text.	The red colour related to the meat and freshness.	Changed the red colour to explore more about sustainability impression.
	I think I would have preferred it like that because it's not red. It is like a warning colour or something, It was worse compared to when it was green.	The red colour related to warning.	Changed the red colour to explore more about sustainability impression.

4.3.3 The second usability test

Some modifications were made according to the result from the first usability test. Three new DPSL labels were developed, as depicted in Figure 22. According to the sustainability communication critical factor, the border line colour was previously in three different colours, which were blue-green, orange-red-blue, and light green-dark green. In the second usability test, the DPSL label used blue-green border line colour which showed a sustainability perception from the first usability test. Furthermore, the titles of the DPSL label were 'too good to waste' and 'eat it before the light turns dark' in the first usability test. In the second usability test, the two titles remained, and one additional title developed, which 'check the meat freshness

here'. The additional title was added to explore how the consumers perceived a direct information from the title.



Figure 22. The DPSL label designs used in the second usability test: Prototype 1 (top left), prototype 2 (top right), prototype 3 (bottom)

For size and dimension critical factor, there was no modification from the first usability test to the second usability test. The font size and the DPSL label size showed that it supported the clear information perceived by the consumers. However, a further question was asked to explore whether the consumers had other preferences of the DPSL label location, or the existing placement on the top left packaging was found just right.

There were several changes referred to the detailed information critical factor, which were the changes of the explanatory text, the indicator text, and the hyperlink addition. The explanatory text was perceived unclear and did not reflect the self-explanatory function of the label. Hence, three text modifications were developed according to the symbol, for instance ‘the colour inside the circle will change according to the meat freshness’ for the prototype 1, ‘the colour below will change according to the meat freshness’ for the prototype 2, and ‘the colour insight the bulb will change according to the meat freshness’ for the prototype 3.

There was slight modification of the indicator text ‘do not eat’ which gave too strong impression for the consumers. Hence, the indicator text for the second usability test was ‘good to eat-eat soon-too late to eat’. Furthermore, one additional indicator text ‘fresh-alright-spoiled’ was created to compare from the existing indicator text. The indicator text ‘good to eat-eat soon-too late to eat’ commanded the consumers of what decision they should take regarding the minced meat quality, while ‘fresh-alright-spoiled’ merely showed the quality of the minced meat without suggesting the decision for the consumers. The indicator text was made all horizontally,

compared to the first usability test that was integrated with the symbol in the prototype 2 and 3.

In the second usability test, a QR code was added to give a hyperlink access, thinking about possible cautious explorative consumers who would then have an option to understand the technology behind the DPSL label better.

Lastly, the indicator symbol was modified to address the quick decision-making support critical factor. In the first usability test, the company symbol and lightbulb were used, while in the second usability test a circle with arrow was developed to accommodate the insight to have more rounded symbol and to give more sustainability impression. Furthermore, a bar symbol was developed, and the lightbulb symbol remained.

Results from the second usability test are hereby explained according to the four critical factors, which were (1) sustainability communication; (2) size and dimension; (3) detailed communication; and (4) quick decision-making support.

4.3.3.1 Sustainability communication

Starting with the sustainability message, the title of the DPSL label was perceived into two different messages, which were sustainability and meat freshness. The title 'too good to waste' contributed to the sustainability impression to the consumers. *"This one is 'too good to waste' is very related to food waste. Then you also have this circle symbol with arrow then it gives impression of sustainability,"* explained one consumer. It gave the positive impression than any other proposed title, as one consumer described *"The 'too good to waste' is like more at the positive way. 'Eat it before the light turns dark' and 'check the meat freshness here' make you think, maybe little insecure about to meat freshness as well. I don't know how to check it, and this one tells me 'you have to eat it before the light turns dark', so I have to think more. This ('too good to waste') is just telling me to eat it because I can and it's not bad. Yeah, so it's more positive."*

However, there were different opinions whether the arrow symbol was necessary or not. *"The arrow and circle are like a vicious circle. If you do one thing that influences the next, there are consequences. And if you do things then there is good or bad consequence, I think. So I think it's to prepare stuff quicker so that it doesn't get so quickly spoiled or that you have to throw it away,"* explained one consumer who perceived the arrow symbol positively related to sustainability. However, the arrow was perceived confusing by another consumer, *"I like the text 'too go to waste' because that reminds me about don't waste any food I can still eat. I like that very much. But without the arrows, I think. This is confusing somehow. It doesn't even really relate to any sustainability impressions."* It was further explained by another consumer, *"I wouldn't have these arrows, just a normal circle. I think this is confusing somehow. You know all the symbols for recycling is always some kind of arrow. Meat is not recycled. You shouldn't recycle meat in that way. If you have*

to discard it, you should make a fertiliser or biogas or so. But for me as a consumer I wouldn't buy recycled meat.”

Even though the title ‘too good to waste’ gave sustainability impression, the consumers explained that it would be misleading, *“I like these two: ‘eat it before the light turns dark’, it's very clear. Also ‘check the meat freshness here’ is also very clear and the message goes more straight to the consumer. ‘Too good to waste’ is like.. does that message change if the indicator colour is darker, or it's still the same headline if it's blue in here? For example if it's ‘too good to waste’ and the indicator colour is blue, it's a mixed message there because it's supposed to be wasted.”* It might lead to confusion because it did not help the consumer to get the idea of how the DPSL label worked.

On the other hand, the title ‘eat it before the light turns dark’ and ‘check the meat freshness here’ contributed to the meat freshness to the consumers. They perceived that the labels were self-explanatory, and they understood how the DPSL label worked from the title. *“I don't think ‘too good to waste’ is a good sentence. It doesn't explain what this is for. ‘Eat it before the light turns dark’ is giving instructions of what this is about. So ‘check the meat freshness here’ is related to the product inside, which is the meat,”* explained one consumer.

4.3.3.2 Size and dimension

According to the size and dimension critical factor, the consumers still perceived that the DPSL label size were just right, *“This one is actually less intrusive than the ordinary label, because obviously you want to look at it. Because it's easy to see and I don't have to pick up the package and check it out and I just look at the label. No, exactly I like it. It's very easy to see.”* Furthermore, the font size was considered as fine, as one consumer explained, *“Even without my reading glasses I can read it and I have plus three, so I've pretty strong farsightedness. And there is more bright light at the store. I think it's just right. Don't do it bigger or smaller.”*

However, there was a new insight about the DPSL label placement on the packaging. Some consumers preferred to have the DPSL label separated from the store label and to be placed on the top left of the packaging. *“I would prefer to have everything compact in one place. So because as I said, this is just one gets used to something, and for me I go right away for what I need. Then I go for the packaging date, the day validity, and all of this, and then okay, there is this one (DPSL label). I look first at the information I'm looking for and then I look at this (DPSL label) one after. So if you have everything at once, it will be better.”*

Some other consumers, however, opted to have the DPSL label on the same side with the store label thus there would be more empty space to see the meat inside. *“I don't think they (the store label and DPSL label) work fine together (in one side). I have a habit that to start reading at the beginning or like at the top of the page. Even if you take the meat, then that's the first thing what catches your eye is you look up.”*

So I think the position is good. It's not disturbing the meat. I would leave it there would not change it."

4.3.3.3 Detailed information

The consumers perceived the information better from the explanatory text 'the colour inside the circle will change according to the meat freshness' from the second usability test, compared to 'the colour indicator tells you the freshness of meat' from the first usability test. *"It does say it if you look at it. The darker it gets, the less edible it is. So at least that's easy,"* explained the consumer who understood the function of the DPSL label after reading the text. *"The explanation 'the colour inside the circle will change according to the meat freshness' is a little too long, but very good and clear rather than 'the colour indicator tells you the freshness of meat'. I like this one better because this is a little bit more technical and scientific. It says there something is happening inside and this is monitoring what's happening inside. So it's not too much,"* described a consumer. There was also a recommendation to shorten the title without sacrificing the information obtained, *"Maybe if we switched the sentence around, rather than 'the colour inside the circle will change according to the meat freshness' into 'meat freshness changes the colour inside the circle', it will be shorter."*

There were two different opinion about the indicator text in the consumers. The indicator text 'good to eat-eat soon-too late to eat' was perceived more positive than 'fresh-alright-spoiled'. *"I think I should like the text 'good to eat-eat soon-too little to eat' than 'fresh-alright spoiled' because it's more positive. I want fresh, so I maybe I just don't pick this one if it's just 'alright'. This 'eat soon' is fine, I will eat it soon. I won't buy it because I wanted fresh, but it's just 'alright'. So I don't want it. You do it for the environment, so eat it soon because tomorrow it's too late and then you cannot eat it and you could throw it away."* Furthermore, it was also perceived more general, and the 'fresh-alright-spoiled' was perceived more personal. *"I think I should like the text 'good to eat-eat soon-too little to eat' more than that one. 'Fresh-alright spoiled' is like on personal. You try to reach people a little bit more with the text. And I think I would prefer 'do not eat' than 'too late to eat'. There's more of a warning of it than 'too late to eat',"* described one consumer.

However, the indicator text 'fresh-alright-spoiled' was shorter, thus the consumers perceived the information faster than reading the indicator text 'good to eat-eat soon-too late to eat'. One consumer explained, *"I like this 'fresh-alright-spoiled'. I like things that are straight to the point. I want to check if this label is referring to meat freshness. That's what I want to look at. It tells me what I need to know so I even like this better because it's just one word."* There was a recommendation from a consumer to change 'alright' into 'still good' for a more positive impression. *"Or maybe we could set 'still good' because it is still a bit alright. I think if it says alright then well, it is not good, but it's alright. I prefer still good compared to alright,"* explained the consumer. This recommendation improved the impression to the

indicator text, therefore ‘fresh-still good-spoiled’ perceived as short and positive at the same time.

Most of the consumers said that they would not scan the QR code, either at the store or at home. *“I don't think ever would have been investigating the QR code,”* stated one consumer. Only few of them were willing to scan the QR code, *“I think this one is okay, like better compared to other three before. And here we have some QR code as well.”* There was a concern from the consumer who perceived that the QR code was confusing because it was too small. *“Because it's so small, it's like you think it's some kind of decoration. You would not think to scan it. Because I think this is like the logo of the company. So I don't know whether the QR code is for the information about the label or is it the information about the company. So maybe that's why it's a bit confusing depending on what the QR code would be for, is it for the label? If it's there then I would probably make it a bit big so that it's more visual, because then you would know that it's connected with the label,”* explained the consumer. Hence, a bigger QR code size was considered as the improvement to meet the need of cautious explorative personas.

4.3.3.4 Quick decision-making support

The circle and lightbulb circle were perceived clearer compared to the bar symbol, *“I would prefer the circle or the light bulb than the bar. I also like this kind of separated between the indicator and the explanation,”* described one consumer.

Furthermore, the colour tonality contributed to different messages. The green colour was caught the consumers’ eyes who have sustainability interest, while the red colour was caught the consumers’ eyes who were more interested to the meat freshness than the sustainability. *“Once again, I would have preferred more towards red because then we're talking about meat. I don't see it as a directly a warning,”* explained one consumer.

4.4 Final label design

Two final labels were developed according to the consumers insight from the first usability test and the second usability test (See Figure 23). The consumers perceived the information from a DPSL label in minced meat product by two different approaches, which were sustainability and meat freshness. The final DPSL label on the left side in Figure 23 reflected the sustainability, while the final DPSL label on the right side reflected the meat freshness.



Figure 23. Final DPSL label designs

The sustainability impression was perceived by the ‘too good to waste’ title and the green-blue border line colour. The impression triggered the consumers to rethink about their behaviour towards minced meat product, thus it would lead to the intention to curb meat waste. However, the meat freshness impression was perceived by the ‘check the meat freshness here’ title and the orange-red-blue border line colour. The consumers perceived that the title was self-explanatory, which was essential to minimise the confusion when the DPSL label would be introduced in the market. Moreover, the consumers associated the border line with the meat freshness, thus it helped the information to perceive the information better.

The size of DPSL label remained to be 7cm x 4 cm, because the consumers perceived that the size was just right and proportional to different sizes of the minced meat package. The circle symbol was chosen because it was perceived as a clear and scientific symbol for the consumers, hence it did not lead to confusion.

The explanatory text ‘meat freshness changes the colour inside the circle’ was chosen according to the consumer’s suggestion to improve the current explanatory text. The text was perceived short, yet it still mentioned the two fundamental elements, which were the location of the colour, and the change of the colour.

The indicator text of ‘fresh-still good-spoiled’ was chosen because it was perceived short by the consumers, and it added a positive impression rather than ‘fresh-alright-spoiled’ text. The QR code was made bigger than before to help the consumers recognising the function, thus it triggered the consumers to scan it if they needed more information about the DPSL label.

5 Discussion

The discussion in this chapter reflects about the results, based on the qualitative data gathered. Identifying the critical factors to design a DPSL label for consumers to answer the RQ 1, findings about the consumer behaviour towards minced meat product are critically discussed and compared to relevant findings from the literature. Furthermore, after designing and assessing the DPSL label with the consumers, a discussion about how the consumers perceive the information from a DPSL label in minced meat product is carried out by reflecting the design solution to answer the RQ 2.

5.1 Critical factors to design a DPSL label

The interaction between consumer and the package in a human-package interactions framework by de la Fuente and Bix (2010) helped to understand how the consumers get a perceptible information from DPSL label. The DPSL label was the object of the interaction that contributed to the five stages of human-package interactions, starting with exposure, perception, encodation, comprehension, and execution. The consumers responded with their perceptual system by explaining their impression to the DPSL label, their cognitive actions by explaining their opinion reflecting to the message on the DPSL label, and their motor system by taking actions after being introduced to the DPSL label.

There were four critical factors identified, which were (1) sustainability communication; (2) size and dimension; (3) detailed information; and (4) quick decision-making support. The four critical factors were obtained according to the insights related to consumer behaviour towards minced meat product. Reflecting the qualitative data gathered from this project with the literature, the personas behaviour towards minced meat product is explained further in FMOT and SMOT scenarios.

5.1.1 Consumer's groceries behaviour

According to the insight mining and the usability test, most of consumers explained that they checked the date of minimum durability of the minced meat product. However, most of them did not realise that there were two different types of the date

of minimum durability, which preceded by words ‘best before’ / ‘bäst före’ in Swedish or ‘use by’ / ‘sista förbrukningsdag’ in Swedish. These two paradoxical findings might be considered as a social desirability bias (Natesan et al., 2016). The consumers might tend to answer according to the socially desirable behaviours, and not according to their own behaviour. Thus, it was important to investigate this behaviour further. An on-site grocery observation and tracking of the consumers at the store might help to clarify these findings.

Furthermore, different personas reflected different behaviour at the store. Autopilot consumers may not have much time to read the label properly. It is aligned with a study conducted by EIT Food (2021) that the consumers did not spend a lot of time looking at food products before buying them. Even they also attended to fewer elements when they were faced with time pressure, than when they had no time constraints.

Hence, a quick decision-making support was established as one of the critical factors. It was purposely created to meet the need of the autopilot consumer that would just look for the relevant information. A self-explanatory label would help the autopilot consumer to decide shortly after they recognised the DPSL label, and minimising confusions for a better FMOT experience.

A detailed information could also be considered to be concise and understandable by the consumers. It was reflected, for instance in the improvement from the explanatory text ‘the colour indicator tells you the freshness of meat’, to the explanatory text ‘the colour inside the circle will change according to the meat freshness’. The improved explanatory text helped the consumers to understand the function of DPSL label better.

5.1.2 Consumer’s storing and use behaviour

Research findings about the location of minced meat storage in the refrigerator was aligned with the study from Marklinder et al. (2004). The consumers stored minced meat more in the middle and bottom shelves, rather than on the top shelf. There was not food safety reason connected to the location of minced meat storage in the refrigerator. It was observed that storing the product at the coldest location in the refrigerator was a less common behaviour in the consumers. Thus, the location to place the product was based more on practical than food safety consideration. Most consumers put the product where there was space available, or where there were used to putting them.

Furthermore, there were two storing behaviours observed which were to store the minced meat merely for few days in the refrigerator, and to store the minced meat in the freezer for a longer time. It was aligned with the study by Bandell (2013) and Marklinder et al. (2004) stated that the meat was most often merely in the fridge for a few days, and to freeze if they did not cook the meat right away.

This finding was related to the steadfast consumer persona, that showed the tendency to believe in their personal perspective to store the minced meat product in the freezer while the storing recommendation of the product stated to store it in 2-4°C. Hence, a consideration to state the storing recommendation on the DPSL label was aforementioned in the design principle for the critical factor of detailed information. However, reflecting that the information was already stated in the minced meat packaging, and the need to prioritise the critical information on the DPSL label, a trade off was made by not stating the storing recommendation on the DPSL label.

Furthermore, another insight was used as the argument of omitting storing recommendation in the DPSL label. As the date of minimum durability would not be valid anymore if the consumers froze the meat, one consumer explained that they would not believe the DPSL label anymore after freezing the meat, *“I didn't think about it because then it could also be connected to fresh meat. If I freeze then this means that it's not valid anymore because it can last longer if you have it in the freezer. This means it is not necessarily that label would work because if it's related to meet certain condition, it is not necessarily be the same environment conditions if it's in the freezer. So what I'm saying is that if I remove from the freezer, I would probably ignore everything that is on the label.”*

To mitigate the risk that might appear in SMOT scenario, some consumers showed that they were not sure that the DPSL label would work if they froze the minced meat, yet they would still use their senses to check the meat quality. *“I don't think the I don't know if the labels going to work in the freeze, but I know I'm going to either eat the meat anyway,”* explained one consumer.

Another behaviour was also observed in the consumers. It was not a problem for them to consume the minced meat products which had passed the date of minimum durability, because they would investigate it with their senses prior to deciding. It was aligned with the behaviour from the cautious explorative persona, who would be more cautious to sustainability aspect and spend more time to analyse the label comprehensively with their senses prior to taking an action. Hence, the meat spoilage would not be the case of these consumers and the meat waste tended to be minimum. The finding was antithetical with the previous studies by Quested and Murphy (2014) and Hanssen and Møller (2013). In the studies, meat and fish contributed to 15-31% avoidable food waste, and the reason of discarding was the date of minimum durability. Therefore, further investigation to confirm this behaviour would be necessary.

5.1.3 Consumer's disposal behaviour

According to the research findings, the consumer's disposal behaviour was diverse. Most of the consumers disposed the minced meat package in the waste bin for plastic recycling, although two of them disposed the minced meat package in the general

waste because the recycling system they had was merely for the hard plastics. Cautious explorative consumers might have awareness that might be different about plastic materials on the packaging, *“I separate the lid from the tray, because I know it's maybe not the same plastic in those.”*

Similar to consideration of storing recommendation, the information of recycling method was already stated in the minced meat packaging. Thus, the placement of this information on the DPSL label would be redundant and decreased efficiency of the information.

Furthermore, their disposal behaviour would remain the same for the packaging with addition of DPSL label. One consumer stated, *“Yeah, I mean this is plastic, right? So it would go together with the rest of the packaging both to the plastic. Unless there is any indication in the packaging that it has to be somehow put in a different being. But if no, then everything got into plastic, yes.”*

A literature from the Swedish Environmental Research Institute (2019) showed that the multilayer materials, leftover food on the packaging, and other unrecycled materials were sorted out and incinerated for energy recovery. Therefore, DPSL label would not alter the recycling stream of the minced meat packaging and the consumer behaviour was shown unchanged from the result. Reflecting to the need to prioritise the critical information, a trade off was also made by not stating the recycling method on the DPSL label and to rely on the recycling information stated on the minced meat packaging.

Furthermore, there was a different behaviour investigated from this research compared to the literature, related to the amount of meat waste in Sweden. According to the interview, the consumers tended to not waste edible minced meat. It was inferred from the statement that they rarely threw away minced meat (around once a year), and all of them will use their sense to see, smell, and taste the meat even though it had passed the ‘best before’ date. However, Swedish Environmental Protection Agency (2013) stated that 1.2 million tonnes of food are wasted annually in Sweden. Specifically, raw meat contributes to 7% of the total edible food waste in Sweden, (Swedish Board of Agriculture, 2019a), and minced meat was considered as one of top ten waste in the supermarkets’ meat department in Sweden (Eriksson, 2015). Therefore, the discrepancy between the literature and the result from this research should be investigated further. A study related to the consumer behaviour to discard edible food product that has passed the ‘best before’ date can be conducted for a better understanding related to this issue.

5.1.4 Consumer personas

Three different personas generated in this research, which were autopilot, steadfast, and cautious explorative personas, could be the basis for further identification of minced meat market characteristics. For instance, a study about meat quality

perception was conducted in Sweden and five other European countries (Glitsch, 2000). The meat quality model was explained in Figure 24. The ‘quality in the shop’ is closely related to FMOT, and the ‘eating quality’ is closely related to SMOT. There might be different interpretation on meat quality according to different personas. For instance, the quality label is more related to the cautious explorative persona, because this type of consumer tends to seek for the information by investing more time to read the label. The country of origin with the flag symbol is more related to the autopilot persona, since the symbol would help the consumers to make a quick decision according to their habit. The leanness of the meat is more related to the steadfast persona, that the consumers might have different standard of meat leanness and relate that to the purchasing behaviour. However, further research should be investigated to obtain more meaningful interpretation prior to taking any definite conclusions.

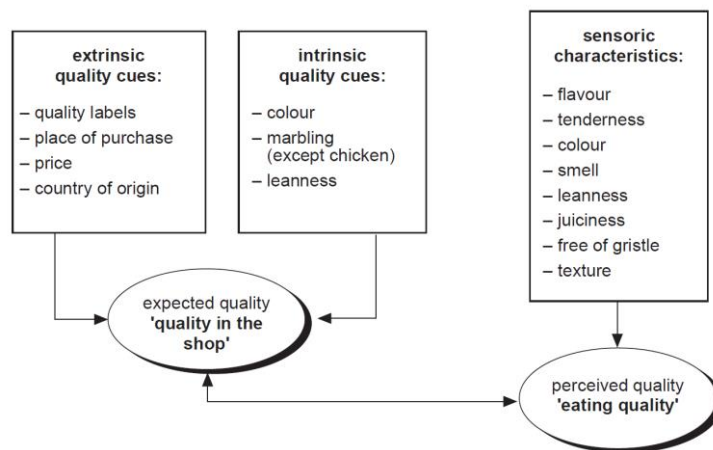


Figure 24. Meat quality model (Glitsch, 2000)

5.2 Perceptible information from a DPSL label

A discussion of how consumers understand information from a DPSL label in minced meat products is explored, based on the findings of this research, and compared to the literature. The consumer’s perceptible information is explained according to the four critical factors: (1) sustainability communication; (2) size and dimension; (3) detailed information; and (4) quick decision-making support.

5.2.1 Sustainability communication

There are two different approaches of the DPSL label design for the consumers, which were sustainability approach, and meat freshness approach with less

sustainability prioritisation. These approaches led to different DPSL design attributes, and hinge on the company objective to prioritise. If the company opt to prioritise the sustainability impression, then the impression could be perceived by the green colour tonality and the title ‘too good to waste’.

This sustainability communication is aligned with the consumer trend to pay more attention to sustainability. A survey of 4,408 respondents in 6 countries in EU including Sweden investigated that the understanding and use of sustainability labels on food products (both environmental and ethical labels) were increasingly appearing on food products (Grunert et al., 2014). According to the study, although the understanding of the concept of sustainability was limited, understanding of four selected labels (Fair Trade, Rainforest Alliance, Carbon Footprint, and Animal Welfare) was better. Especially in Sweden, many respondents came up with the other, everyday language meaning of ‘hållbarhet’, namely the sell-by-date of a product. Hence, the sustainability communication to curb meat waste as the role of DPSL label could be the company prioritisation, taking the opportunity of the consumer behaviour in Sweden.

However, the study from Grunert et al. (2014) later explained that sustainability labels currently did not play a major role in consumers’ food choices. Hence, the future use of these labels would depend on consumers’ concern about sustainability can be turned into actual behaviour.

This was reflected to several consumers who still perceived that meat freshness was the reason of choosing the minced meat product, and they did not pay attention to the sustainability. One perspective from the consumer, *“No, I connect to the freshness of the meat. The green colour would connect if it would have something saying that this is a recycled material. But this is not for me. This is not connected to sustainability, this is connected to the freshness of the meat. It is sustainable because then you are not wasting meat of course. But in that case, to me sustainability was then I just look at it, and say okay it has been produced in Sweden, so it doesn't take long for transportation. And then maybe the plastic is done in a special way. But this specific label (the DPSL label prototype_ is referring to the freshness of the meat. So thinking about the quality of the meat and not how sustainable it is, the sustainability can look that is made in Sweden or if there was somewhere that the plastic has been made in us.”*

Therefore, the company can also focus merely to the message of how the consumers could get the freshness indication from the DPSL label, rather than to focus on developing sustainability communication. The meat freshness impression could be supported by the DPSL label design, by having the red colour tonality and the title ‘check the meat freshness here’ or ‘eat it before the light turns dark’.

5.2.2 Size and dimension

The size of the label for further development is suggested to remain the same as in the research, which was 7cm x 4cm. The size was determined according to literature consideration, market visit of the different minced meat packaging, and company constraint of the maximum DPSL label size.

Furthermore, reflecting to the company constraint that the DPSL label would be maximum 9cm x 5cm, the DPSL label size obtained from the research would reduce the production cost of the label without trading off the consumer's perceptible information from the label. However, the significance of the cost reduction should be investigated further.

There were two different insights to reflect about the DPSL label location on the packaging. Some of the consumers preferred to have the DPSL label to be on the top left of the minced meat packaging, therefore the DPSL label caught the consumer's eyes.

On the other hand, other consumers preferred to have the DPSL label to be on the same side of the store label and to integrate both labels. This option, however, should consider the various store label location on the different minced meat packaging. Some minced meat packaging put the store label on the right side of the lid, or in the middle of the lid. Hence, more customisation would be needed if the company would opt to integrate the DPSL label location together with the store label.

5.2.3 Detailed information

Most of the consumers perceived that different information between the DPSL label and the store label would not be confusing. They understood that food with 'best before' date of minimum durability could be still edible although it had passed the date. However, they would rely more on their senses rather than the DPSL label. Even though the DPSL label would tell them 'do not eat', some of the consumers would still investigate it with their own senses. They were confident to taste the meat, if they investigated that the minced meat was fine according to their own senses. This behaviour was aligned with a study explained the flexibility regarding the best before date (look, smell, taste) was what the consumers did to minimise throwing edible food. People who decided whether to consume a product based on appearance and smell tended to use products two days or more after the best-before date (Netherlands Nutrition Centre, 2014). Thus, the consumers' trust to the DPSL label would not be instant. The trust would be gained by showing the correct indication of the meat quality consistently to the consumers.

The explanatory text from the second usability test 'the colour inside the circle will change according to the meat freshness' helped the consumers to understand the

function of DPSL label better, compared to the explanatory text from the first usability test ‘the colour indicator tells you the freshness of meat’. The explanatory text could also be shortened into ‘meat freshness changes the colour inside the circle’. Thus, it was essential to mention two elements: (1) the location of the colour (where the colour indication is); and (2) the change of the colour (that will change along with the change of the minced meat quality). These two elements were fundamental and should be kept along the language modification. For instance, if the label would be developed further in Swedish, the two elements would be still mentioned in Swedish while other words could be modified.

There were two different options of the indicator text with different trade-offs. The indicator text ‘good to eat-eat soon-too late to eat’ was perceived positive and general by the consumers, yet the phrases were too long. However, the indicator text ‘fresh-alright-spoiled’ was short, yet it perceived too personal and provoked the negative impression of not buying ‘alright’ minced meat product, compared to ‘eat soon’ minced meat product. Hence, the further decision could be taken by the designer and the company according to the objective prioritisation.

QR code could be useful to give more information about the DPSL technology that might be new for most of the consumers, since DPSL label had not been marketed in Sweden. It might be a designer decision further, whether the addition of QR code would help the overall impression, or it would be too much information inside the DPSL label.

5.2.4 Quick decision-making support

The quick decision-making support was gained from different design attributes, which was the colour tonality, the title, the symbol, and the overall impression of the DPSL label. There was a need to from the consumers use symbol that had round shape, or other technical symbols that resembled scientific and technology impression.

Furthermore, the title ‘check the meat freshness here’ was perceived clear and helped for a better decision-making compared to ‘too good to waste’ and ‘check the meat freshness here’. This would be a better option for the introduction stage of the DPSL label to the market, as stated in Regulation (EU) 1169/2011. In the Article 15 point 1, it was stated that the labels should appear in a language easily understood by the consumers (European Commission, 2011). Therefore, a more marketing title could be used later after the consumers would be familiarised with the technology.

6 Conclusion and Recommendation

6.1 Answering the research question

As the research had been conducted, concise answers to the two RQs in the research are explained below.

RQ 1. What are the critical factors to design a DPSL label in minced meat product for consumers?

There were four critical factors identified, which were (1) sustainability communication; (2) size and dimension; (3) detailed information; and (4) quick decision-making support. The critical factors were identified from the insight mining as the first stage of the research (See Chapter 4 section 4.1.4). These critical factors were used to reach the first purpose of the research, which was to identify the critical factors to design a DPSL label for consumers. The identification contributed as the guidance to answer the RQ 2 in the research (See Chapter 4 section 4.3.2.2 and 4.3.3) which was to explore how perceptible information obtained by the consumers.

RQ 2. How do consumers perceive the information from a DPSL label in minced meat product?

Consumers in this study perceived the information from a DPSL label in minced meat product differently in FMOT and SMOT scenarios (See Chapter 4 section 4.3.2.1, and Chapter 5 section 5.1). In FMOT scenario, three critical factors which were sustainability communication, size and dimension, and quick decision-making support were more related to the grocery behaviour of the consumers. In SMOT scenario, the critical factor of detailed information was more related to the storing, use, and disposal behaviour of the consumers. Therefore, the insight of how perceptible information obtained by the consumers would lead to more understanding of the interaction between the DPSL label and the consumers, that would be beneficial for further development of the DPSL label. The DPSL label should be self-explanatory thus the consumers could understand the information within a limited time in FMOT scenario. In the SMOT scenario, DPSL label should not confuse the consumers by providing appropriate information about the meat freshness, thus they could take a correct action as a response from it.

6.2 Recommendation for the company

The consumers perceive the information from a DPSL label in minced meat product by two different approaches, which are sustainability and meat freshness. Different design attributes support each approach separately (See Chapter 4 section 4.3.2.2 and 4.3.3, and Chapter 5 section 5.2.1), hence it is hinge on the company objective to prioritise of which approach the company will choose, whether the sustainability or meat freshness. Two recommended DPSL label designs are presented in Figure 25 below, to visualise different design approaches for sustainability and meat freshness impression.



Figure 25. Final DPSL label designs

Further studies about the sustainability concern in the company's target consumers should be conducted, prior to choosing the sustainability approach instead of meat freshness. Having a sustainability impression may be ineffective if the consumers will not understand how the DPSL label works, due to the unclear message from the DPSL label. Therefore, focusing on the meat freshness impression may be better to introduce a new DPSL technology in the market to the consumers.

Furthermore, a DPSL label size of 7cm x 4 cm is recommended to be the size for further design development. The size range also can be used to give a flexibility to the industrial designer, for instance starting with the size recommended in this research (7cm x 4 cm) to the maximum size given by the company (9cm x 5cm). However, the cost significance should be investigated further for this size range.

It is also recommended to put the DPSL label separately from the store label. The DPSL label can be placed on the top left of the minced meat packaging to follow the natural reading curve for the target consumers, therefore the DPSL label caught the consumer's eyes. However, an option to integrate both the DPSL label and the store can be explored. This option should consider the various store label location on the different minced meat packaging. Some minced meat packaging in Sweden put the store label on the left, middle, or right side of the lid. Hence, more customisation may be needed if the company will opt to integrate the DPSL label location together with the store label.

The explanatory text from the second usability test 'the colour inside the circle will change according to the meat freshness' helped the consumers to understand the

function of DPSL label. It was essential to mention two elements, which were the location of the colour, and the change of the colour. These two elements were fundamental and should be kept along the language modification. For instance, if the label would be developed further in Swedish, the two elements would be still mentioned in Swedish while other words could be modified.

Furthermore, there were two different options of the indicator text that could be chosen by the company with different trade-offs. The indicator text 'good to eat-eat soon-too late to eat' was perceived positive and general by the consumers, yet the phrases were too long. However, the indicator text of 'fresh-still good-spoiled' was perceived short by the consumers, yet it was perceived too personal. Hence, the further decision could be taken by the industrial designer and the company according to the objective prioritisation.

6.3 Recommendation for further research

There are three recommendations for further research. Firstly, further qualitative study could work with more diverse participant prior to implementation step of the DPSL label development. There were few participants in the usability test of this project during the pandemic that could be improved in a later study. The participants variation was needed in order to create a more accurate insights, by representing the target market. It can also investigate the racial, social, and cultural contribution to different consumer behaviour related to the minced meat reduction.

Second, an on-site grocery and home observation could be conducted to reduce social desirability bias. The study using eye tracking could be conducted to confirm the consumers' perceptible information gained from this research with quantitative data. The quantitative data can be gathered by the hots-pots from eye tracking technology, that will be recorded from the sight of consumers while reading the DPSL label. The on-site grocery usability test can be conducted to get more insights about the interaction between the DPSL label and the consumers. It can simulate the FMOT better than the usability laboratory, that will be beneficial for the further development steps of the DPSL label.

Lastly, the research found that the consumers did not throw the edible food product that had passed the 'best before' date of minimum durability, which was not aligned with the literature. Hence, a study related to the consumer behaviour to discard edible food product that has passed the 'best before' date of minimum durability can be conducted for a better understanding related to this issue.

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Appendix

Appendix 1

Stage 1: List of questions to consumers

Demographic

- What is your gender?
- What is your age?
- How do you describe your marital status?
- How many people live together with you?
- What is your occupation?
- Where do you live?
- Do you have visual disability?

Meat consumption

- Do you eat minced meat? How many times you usually eat minced meat?
- How many times you usually buy minced meat?
- Where do you usually buy the minced meat? Supermarket or to specialised meat and fish stores?
- What kind of minced meat you usually consume?
- Would you please tell me your process of buying minced meat at the store?
 - What factors you consider?
 - How to choose one instead of the others?
 - Discount?
 - Do you usually read the label? What information you read?
- Tell me your process of storing and cooking minced meat.
 - Fridge or freezer?
 - How long between buying and cooking?
 - Cook all, or there is a left over in the package?
 - Surpass the expiry date or not?

Meat quality

- About the quality, edibility, spoiled ones
 - Quality

- Edible
- Spoiled; ever had one?

Shelf-life label

- Label
 - What's important for you that's supposed to be in the minced meat label?
 - Do you have any problem of reading the minced meat label?
 - Best before or used by?
- Shelf-life label vs product price?
- How to store minced meat?

Recycling

- How do you usually recycle the minced meat packaging?
 - Wash?
 - Which bin?
 - Separate tray and lid?
- How do you usually recycle the spoiled minced meat?
 - Which bin?

Stage 1: List of questions to design expert

Demographic

- Where do you live? (Municipality)
- What is your occupation?
- Where do you work? (Specify the company)
- How long have you worked in design field?

Label design

- Tell me your working experience related to designing a product label.
- Tell me the process you need to do when you have a project of designing a product label, from the start to the end.
- Related to the process, how do you usually make a prototype of a product label?
- In your opinion, what are the important factors that a designer should consider when designing a product label?
- How the designers usually make a composition of a label? Is there any hierarchy of information in a label?
- What is a proportional label in your opinion? Please define and quantify.

- What are the mistakes you usually find in the market related to a product label design?
- How do you usually balance the aesthetic and the functional aspects of designing a label?
- Do you usually have a consumer research before designing a product label, or you just make it according to a client's brief?
- How do the designers design a label suitable for a colour-blind or visually impaired reader?

Stage 1: List of questions to food safety expert

Demographic

- Where do you live? (Municipality)
- What is your occupation?
- Where do you work? (Specify the company)
- How long have you worked in food safety?

Food safety

- Minced meat safety and quality?
 - Difference
 - Critical factors
- How to control the microbe?
 - Pathogen and spoilage microbes
- Expiry date
 - Current label: is it informative? Is it good enough to protect consumer?
 - What to improve?
 - Any standard by producer? Does the standard vary?
 - Why best before and used by in minced meat? what is the difference?
- New design of expiry date:
 - What should remain the same?
- Mistakes
 - Consumer while buying until storing

Stage 1: List of questions to supply chain expert

Demographic

- Where do you live? (Municipality)
- What is your occupation?

- Where do you work? (Specify the company)
- How long have you worked in your field?

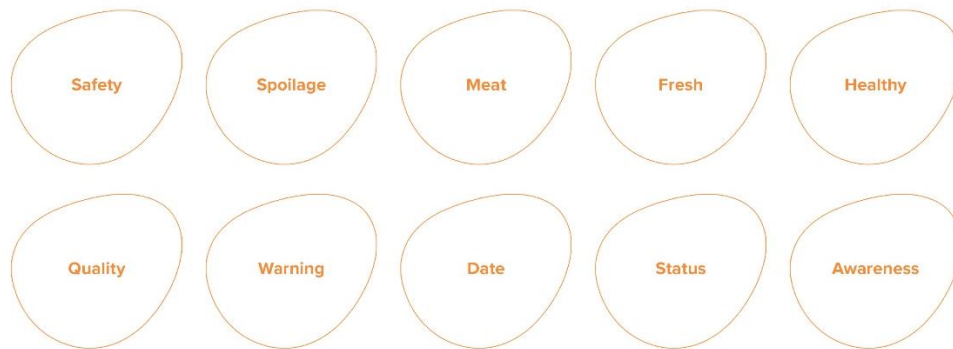
Supply chain

- How is the process of the supply chain of minced meat in Sweden?
 - Which actors involved? From production to retailer
 - What are the activities per actor?
- What are the critical factors the supply chain actors need to consider in order to maintain the product safety and quality?
- Do the supply chain actors monitor the minced meat quality and safety? How do they usually do it? Is there any track and trace?
- If the critical factors are not met along the supply chain, how do the actors usually respond?
- How do the supply chain actors utilise the shelf-life label in their activities? For example: the producer put expiry date—what is it for? Is it also beneficial for the distributor? How is it in the retailer?
- How is the expiry date added in the industry? Would you elaborate more from your dissertation?
- Is there a standard for setting expiry dates used by all producers or does this vary?
- How is the label put in the producer?
- How is the return procedure of the minced meat product if it exceeds the expiry date?
- Do the supply chain actors think that the printed shelf-life label is helpful to reduce meat waste? Please explain.
- If not, what is the better indicator for the minced meat safety and quality?
- What do the supply chain do to reduce the meat waste?
- How do the supply chain actors perform a risk mitigation? For example, if the temperature varies, how do they respond to it? Do they usually do it in real-time?

Appendix 2

Stage 2: Brainstorming from the design principles

Ideas



	Quality	Warning	Date	Status	Awareness
Symbol	Thumbs up Star Medal # Badge	Triangle Siren Bell Forbidden Megafone	Calendar Clock Hourglass Alarm	"X" mark Question mark Speech balloon Happy and sad emojis "OK"	Light bulb Eye Brain Magnifying glass Spotlight
Colour	Gold Yellow	Yellow Red	White Red Black	Black	Yellow White
	Safety	Spoilage	Meat	Fresh	Healthy
Symbol	Shield Microbes Cross Check mark Exclamation mark	Garbage bin Toxic symbol Slime Flies Greenish smoke	Cow Marbling Meatball Meat grinder Cleaver knife	Leaf Sparkling Earth Water drop Sun	Muscle Dumble Heartbeat Stethoscope Vegetables
Colour	Green White Silver	Blue Green Black	Red	Green Sky blue Yellow	Green Red

Appendix 3

Stage 3: List of questions for the first usability test

The FMOT scenario

Critical factors	Task
Quick decision-making support: to know whether the symbols are easy to understand quickly	<p>Introduction: You are at the shop you usually buy your minced meat. You are standing in front of the refrigerator with racks of minced meat before you. You want to buy one pack of minced meat with the pack size you usually buy.</p> <ul style="list-style-type: none"> Regardless of the type of meat, find a fresh minced meat package you want to buy. Where do you find the information of the meat freshness?
Size and dimension: to understand if it is the perfect dimension for consumers to understand, or it is too small or too big	<p>Now, we focus only to talk about the label on the top-left packaging.</p> <ul style="list-style-type: none"> What is your impression when you read the label? What's the message you convey from the label? What do you think the label does? Is the label easy to read for you? Can you read it without glasses? (<i>Observe if they need to bring the packaging close, put glasses on, etc</i>)
Sustainability communication: to know whether it attracts people or not	<ul style="list-style-type: none"> Why do you choose this design, instead of another design? Which design that can link to sustainability more? Which one that looks more environmentally friendly?
Detailed information: to know whether the information is too much or not	<ul style="list-style-type: none"> What is the most important information on the label for you? Do you think that the label will cause something negative/harmful to the meat? Will you trust the label?

The SMOT scenario

Critical factors	Task
Quick decision-making support: to know whether the symbols are easy to understand quickly	<p>Introduction: You are at your home. You have minced three meat packages that you have stored in your refrigerator, and you want to cook it for dinner tonight. When you see the three packages, you realize that your meat is already passed the best before dates.</p> <ul style="list-style-type: none"> Regardless the type of meat, which minced meat package you want to cook? What do you want to do with the other packages?
Size and dimension: to understand if it is the perfect dimension for consumers to understand, or it is too small or too big	<ul style="list-style-type: none"> What is your impression to see different information when you read the label on the left, compared to the label on the right? Are you confused with the information provided from the label on the left? Do you think it is clear enough?
Detailed information:	<ul style="list-style-type: none"> How will you dispose the packaging after you cook the minced meat?

to know whether the information is too much or not	<ul style="list-style-type: none"> • If you buy a new minced meat with the same packaging as you chose previously, where will you store it at your home? Now, we focus only to talk about the label on the top-left packaging. • Can you freeze the meat? Do you think the label would work after freezing? • Do you think the label would work after you open the package?
Sustainability communication: to know whether it attracts people or not	<ul style="list-style-type: none"> • Do you think the label will help you to remember when to cook the meat? • Do you think the label could contribute to the reduction of meat waste? Why and how?

Stage 3: List of questions for the second usability test

Critical factors	Question
Quick decision-making support: to know whether the symbols are easy to understand quickly	<ul style="list-style-type: none"> • Which one that attracts your eyes instantly? Why? • What do you think the label does? What is the function of the label? • If the expiry date shows you the date of when you can consume the meat, how about this label? How does it work to tell you about when you can consume the meat? • Are you confused with the information provided from the label? Do you think it is clear enough? • Does this label speed up your decision making to get the freshest minced meat? • If you can change one/some part of the label, which part you would like to change to help you decide faster to pick this minced meat?
Size and dimension: to understand if it is the perfect dimension for consumers to understand, or it is too small or too big	<ul style="list-style-type: none"> • What do you think about the size of the text and the icon? Is it too big/okay/too small? • What do you think when you compare the label with the bigger label from the store? • How about the font type and font size compared to the store label? • How would you describe your overall experience with this label on? • Do you think it is alright to put the label there (on the top left)? Or where do you think is better to put the label on the lid?
Sustainability communication: to know whether it attracts people or not	<ul style="list-style-type: none"> • Which one that gives impression of sustainability more? Why? • From which attributes of the label do you perceive the impression of sustainability? • Do you think that the label gives more sustainability impression than the label from last week? • Do you think the label will help you to remember when to cook the meat?

	<ul style="list-style-type: none"> • Do you think this label can help us fight food waste? If yes, why and how? • If you can change one/some part of the label, which parts you'd like to change to deliver the sustainability message more clearly? • Have you ever found any label that is also trying to deliver the same sustainability messages as we do?
<p>Detailed information: to know whether the information is too much or not</p>	<ul style="list-style-type: none"> • What do you think about the all the text: the title and the description? Do you like it? What to improve? • Which title do you like: 'Too good to waste' or 'Eat it before the light turns dark' or 'Check the meat freshness here'? • Which indicator description do you like: 'Good to eat-Eat soon-Too late to eat' or 'Fresh-Alright-Spoiled'? • Do you find the wording is confusing? Which part? • Any expected information is missing from the label? is yes, what information do you expect to be there? • Do you think all the detailed information is easy to understand? • If you buy a minced meat package with the label on it, where will you store it at your home? • If you have a minced meat package with the label on it, how will you dispose the packaging after you cook the minced meat? • Can you freeze the meat? Do you think the label would work after freezing? • Do you think the label would work after you open the package? • Will you check the QR code at the store/at home?