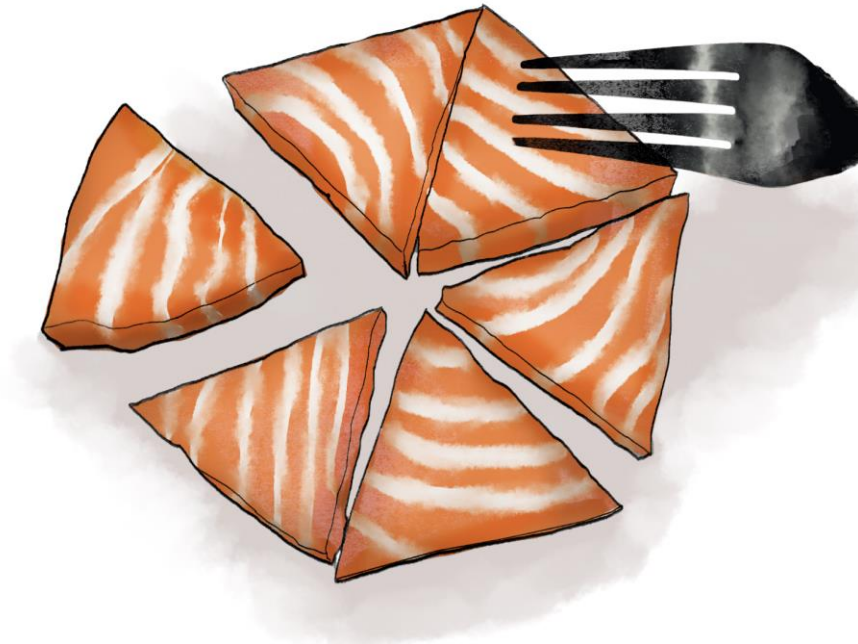




CHALMERS



Design of a 3D-printed seafood analogue

Incorporating the voice of the consumer into the design of sustainable 3D-printed food products

Degree project within the Bachelor programme Design och Produktutveckling

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Gothenburg, Sweden 2024
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Title page: Illustration of the design proposal

Thanks

First and foremost, we would like to thank RISE and FINEST for giving us the opportunity to conduct this thesis work and especially thanks to Elizabeth Hörlin, Anne Normann, Elena Costa, Astrid Ahlinder, Gustav St-Aubin at RISE and thanks to Mycorena for showing interest in the project and providing us insight into the world of alternative proteins. Also thanks to all the respondents to the survey and the focus group participants for giving their time and input to help move the project forward. A special thanks to our supervisor at Chalmers, Pontus Wallgren, for providing feedback and making sure the project and report was held to a high academic standard.

We hope that the project can provide an insight into how the voice of the consumer can be incorporated into the design of food products and that the findings and design proposal can be used as a basis for future research about 3D-printing of food analogues.

Lisa Johansson and Hedvig Olsson, Gothenburg, 2024

Abstract

This collaborative project at RISE explores 3D-printed seafood analogues to meet the growing demand for sustainable meat alternatives, involving divisions from Agriculture and Food, Material and Surface Design, and Chalmers Technical University. The study focuses on gathering consumer perspectives through focus groups involving 35 individuals with varying levels of seafood consumption, as well as different levels of aversion to new food technologies (also known as food technology neophobia). Key findings highlight fish as the primary focus, with information needs, environmental knowledge, and sustainability influencing choices. Preferences for familiar preparations, nutrient parity, and clear labeling emerge as crucial. The subsequent ideation phase yielded a final design for a 3D printed seafood analogue, named Havsudden, which is a smaller sized triangular shaped vegan fish analogue. We hope that the final design proposal aligns with consumer demands. This report contributes insights into understanding consumer attitudes, needs, and barriers for innovative, consumer-centric food products. In conclusion, “Havsudden” is a product that aims to reshape perceptions and acceptance within the seafood analogue market. Through its evolution, it gives diverse options for consumers, and is poised to pave the way for a future where seafood alternatives are embraced and celebrated.

Sammanfattning

Det här samarbetsprojektet mellan Chalmers tekniska högskola och RISE utforskar möjligheterna med 3D-printing av analoger av mat från sjö och hav, för att möta den ökande efterfrågan på hållbara alternativ. Studien fokuserar på att samla in konsumentperspektiv genom fokusgrupper baserat på 35 personer med olika nivåer av fisk- och skaldjurskonsumtion samt olika nivåer av fobi för ny matteknik (också kallat food technology neophobia). Studiens slutsatser lyfter framförallt fram rosa fisk som det centrala fokuset för en design, där hållbarhet, kunskap om miljöfrågor och ett stort informationsbehov påverkar konsumenternas val idag, när det kommer till mat från sjö och hav. Viktiga faktorer är konsumentens preferens för bekanta tillagningsmetoder, näringsmässig jämförbarhet och tydlig märkning. Den efterföljande idéfasen resulterade i en slutgiltig design för en 3D-printad fisk-och skaldjursanalog, vid namn Havsudden, vilken är en mindre triangulär vegansk fiskanalog. Vi hoppas att det slutgiltiga designförslaget möter konsumentens krav. Denna rapport ger insikter för att förstå konsumenters attityder, behov och hinder när det gäller innovativa och konsument-centrerade livsmedelsprodukter. Slutligen, "Havsudden" blir en produkt som kan omforma uppfattningen och acceptansen inom marknaden för fisk- och skaldjursanaloger. Genom fortsatt iterering är förhoppningen att denna design kan bidra till fler alternativ för konsumenter och kan bana väg för en framtid där fisk- och skaldjursanaloger uppskattas.

Glossary

Analogue/ Alternative/ Substitute - The report uses these terms synonymously and implies something that serves a similar role or function as what it is being compared to. For this instance, “an analogue to seafood” could mean a replacement or an equivalent to seafood.

FTN - food technology neophobia

FTNS / FTN scale - food technology neophobia scale

White fish - refers to a category of fish that have light, white, or pale flesh and are typically low in fat.

Red meat - meat produced from big mammals like cows and pigs.

Mycoprotein - is a protein-rich food ingredient derived from fungi, specifically from the *Fusarium venenatum* fungus. It was developed and commercialized as a meat substitute and is known for its high protein content and fiber, as well as its low fat and carbohydrate levels (Gilani & Lee, 2023).

Livsmedelsverket - The Swedish Food Agency, the governmental organization for regulating foodstuffs in Sweden

Uncanny valley - The uncanny valley is a theory proposing that as human likeness increases in an object's design, affinity towards it grows until it reaches a point of near-total accuracy, at which point affinity drops dramatically, creating a sense of eeriness or uncanniness, before rising again when true human likeness is achieved (Kendall, E. 2023).

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1. Introduction

This chapter dictates the basis for the project's thesis and surrounding information regarding limitations and outline.

1.1 Background

Discussions about consumption and development of meat alternatives have been raised for decades and recently the market for plant-based alternatives has expanded (Ishaq et al., 2022). This raise in consumption can be explained as a result of increased knowledge about the meat industry and its unfavorable effects on the environment. The Swedish Food Agency states that red meat (meat produced from cow and pig) has the worst impact on the environment in comparison to other food products (Livsmedelsverket, n.d.).

Even though there is an awareness of the detrimental impact of red meat on the environment, changing behaviors can be difficult for those who have a preference for the known texture, taste, smell and appearance of traditional foods that contain red meat (Ishaq et al., 2022). Thus we have reason to believe that plant-based alternatives that satisfy these needs have the potential to decrease red meat consumption and therefore decrease the environmental impact food has on the environment.

Research within additive manufacturing or 3D-printing has recently started to gain interest in the food industry as a way to introduce a more heterogeneous texture to the currently often homogenous plant-based meat analogues (Ghazali et al., 2023). 3D-printing, for instance, has been acknowledged for its potential to improve the sensory, nutritional, and sustainability aspects of foods (Zhong et al., 2023)

In comparison to red meat, seafood is considered to have a significantly smaller carbon footprint (Sustainable Fisheries, n.d.). Consequently, there tends to be less focus on mitigating the environmental effects of seafood, especially in light of the more substantial impact associated with red meat production. Incorporating the voice of the consumer in the early stages of product development maximizes the opportunity for identifying product design opportunities and is thus critical for product success (Devrix, 2021). Regarding seafood alternatives one can argue for the importance of understanding what different consumer segments expect or want from a plant based alternative in terms of sensory, environmental and functional attributes.

Not only the attributes of the product itself but also consumer characteristics such as food technology neophobia which is the fear of food made with novel processing techniques (Wendt & Weinrich, 2023), should be taken into account as it may pose a potential barrier to the acceptance of 3D-printed foods and should therefore be considered when incorporating the voice of the consumer in product design.

1.2 Aim

The aim of the study was to design a 3D-printable analogue based on the results from a qualitative consumer study to help alleviate future attempts of introducing more environmentally friendly protein-based food alternatives to the general public.

1.3 Limitations

The project did not involve the development of the meat analogue materials themselves or encompass the actual consumption of the meat analogues. In depth decision-making regarding all ingredients of a final design was not possible at this stage of development. While aiming for a representative sample, practical considerations dictated a specific sample size for the consumer study, taking into account available resources and time.

1.4 Thesis outline

The study began on the 4th of September 2023 by creating and eventually releasing a screening survey to find potential participants for focus groups. The focus groups were recorded and transcribed and a thematic analysis was performed on the data with the help of a qualitative data analysis tool (Braun & Clarke, 2006). The codes and themes found were used to develop a list of functional design requirements which served as the foundation for the concept development which led to a final design proposal. See Figure 1 for a brief project outline.

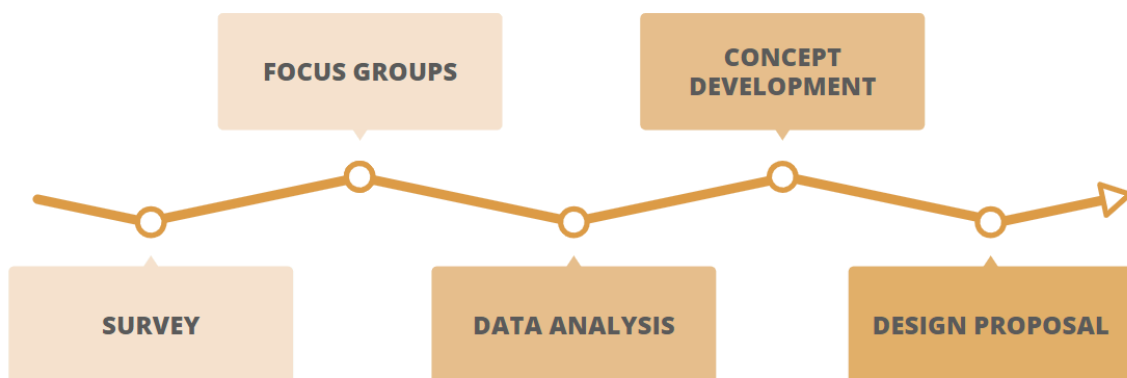


Figure 1: Brief project outline (own illustration)

1.5 Research questions

In order to align with the project's aim, the research questions were refined to provide clarity and direction. These questions guided the investigation and aided in achieving the project's mission to produce a design proposal:

- What are the consumers' concerns and preconceived assumptions when it comes to seafood analogues?
- What qualities or attributes does the consumer value in traditional seafood products in terms of taste, texture, and appearance?
 - How can we mimic these attributes in a 3D-printed analogue?
- What level of similarity to seafood texture is necessary for an alternative to be appealing to consumers?
- How does knowledge of sustainability problems that the seafood market struggles with affect consumers' feelings of analogues?
- How can we combat the barriers that are related to different levels of food technology neophobia?
- What can be done to encourage more people to partake in seafood analogues?

2. Design proposal - short description

The design proposal, see Figure 2 and 3, is a smaller sized triangular shaped vegan fish analogue. We named these triangular creations “Havsuddar,” a playful fusion of the Swedish words for “Hav” -meaning “ocean” and “uddar” - meaning “cape”. The full name then means “cape of the ocean”. Our design, “Havsuddar” is not just a name; it is a simple yet evocative link to sustainable dining, emphasizing our connection to the ocean.

The design choice aligns with principles of sustainability, conveying a message of doing more with less. While the triangular shape itself does not overtly communicate eco-friendliness, it can become a part of the broader narrative when coupled with other elements, such as the sustainable choice of ingredients, the product's name, and its visual presentation.

Havsuddar - /^hɑːvs|ədar/

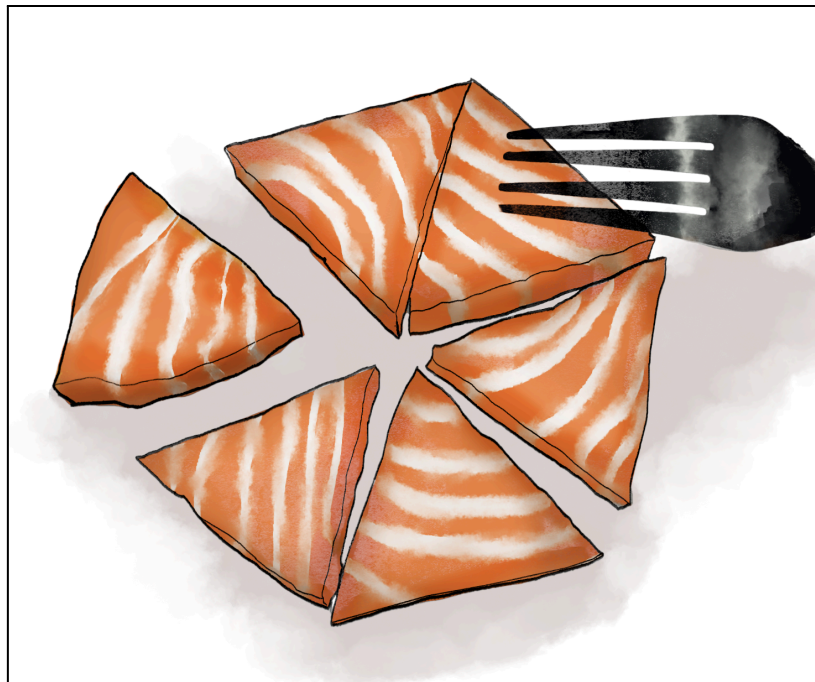


Figure 2: Illustration of the design proposal (own illustration)

The name brings a touch of Swedish charm, adding a unique cultural flair that can resonate with a global audience. In the world of culinary exploration, diverse cultural influences often enhance the appeal of a product. While uniquely Swedish, the name is surprisingly easy for English speakers to pronounce, ensuring it can be comfortably integrated into conversations without losing its charm. The name is evocative of sea elements that connects consumers to the ocean while emphasizing sustainable eating choices.

This distinct design not only makes it visually appealing but also sets it apart from other vegan fish analogues in the market. The design presents an equilateral triangle with each side

measuring around 55 millimeters and with a uniform thickness of 20 millimeters, thus aiming to be not too large nor too small. It has an irregular marbling to mimic that of real fish and has the color light orange.

Our “Havsuddar” has high versatility in various dishes and aims to make it simple for consumers to include it in daily eating habits. Its size and shape make it an ideal ingredient for creative culinary applications, it can be used as a substitute to fish filets or other commonly used protein based products. A consumer should be able to prepare it as they usually would prepare a fresh piece of fish. It can be found in the refrigerated isles of stores, but may also be frozen when not needed for longer periods of time. Further in the future, perhaps both frozen and refrigerated variants could be sold. The fact that “Havsuddar” can be found refrigerated, makes it convenient for consumers to easily bread the product themselves, if they want to.

With growing awareness about the environmental impact of traditional seafood and the ethical concerns surrounding it, “Havsuddar” presents an eco-friendly alternative that resonates with many consumers. It is free from pollutants often found in seafood, and ultimately it should contain an equal amount of proteins, vitamins and omega-3/6 fatty acids as real seafood.

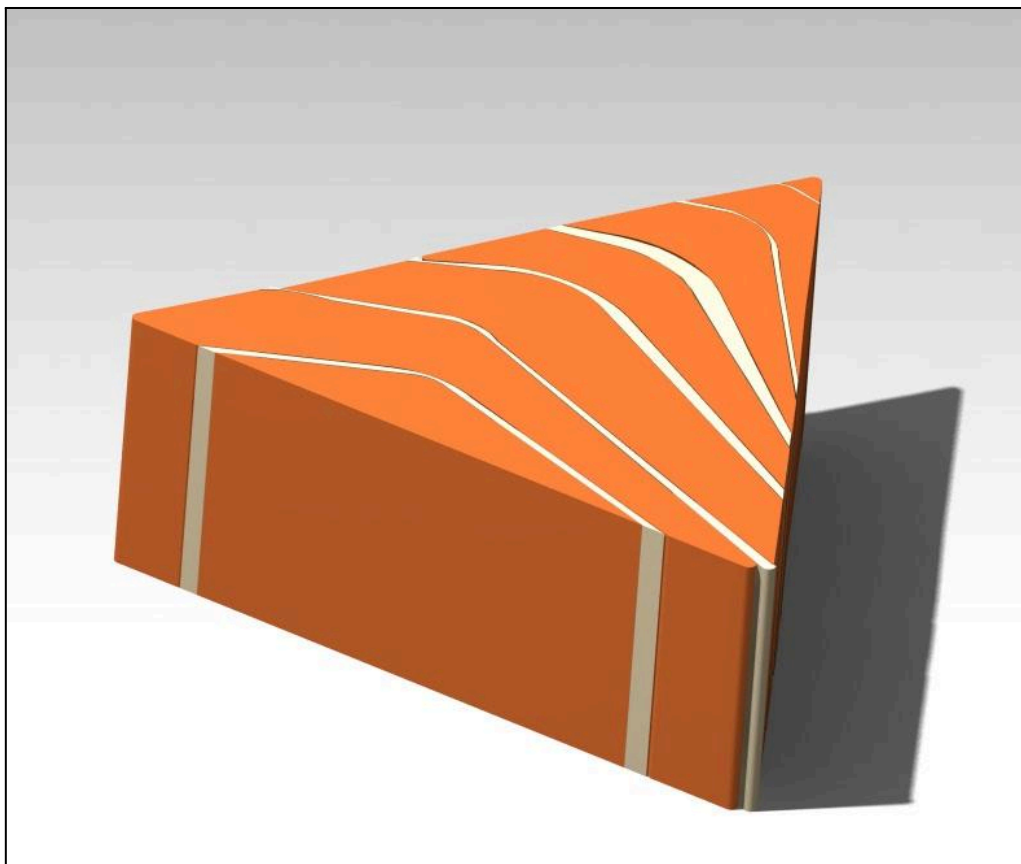


Figure 3: CATIA Rendering of design proposal

3. Literature review

The literature used in this project supported an understanding of important concepts related to 3D-printing within the food industry, food technology neophobia, seafood consumption and incorporating the voice of consumers into the design process.

3.1 3D-printing

3D-printing is an additive manufacturing technique developed in 1986 that consists of printing successive layers of materials on top of each other (Ngo et al., 2018). It is a process that can be used to fabricate a range of complex geometries from three dimensional model data. The method has been utilized in different industries, including construction, prototyping and biomechanical. The first concept of a 3D-printer for food was patented by Nanotek Instruments Inc in 2001 but it suffered from several technical shortfalls and the first functional and replicable 3D printing system compatible with food was presented in 2007 by two researchers from Cornell University (Brunner et al., 2018). The technique has since then been evolved and some examples of commercial products available are 3D-printed vegan steak produced by the company Redefine Meat that can be found on the menu of Pinchos restaurants in Sweden (Go:teborg&co. n.d.) and Revo Foods' 3D-printed vegan fish filet based on mycoprotein that was released in October 2023 for the public (Burgos, 2023).

3.2 Food Neophobia and Food Technology Neophobia

Food neophobia can be defined as the reluctance to eat and/or avoidance to eat novel foods and human traits of food neophobia can be measured using the Food Neophobia Scale (FNS) (Pliner & Hobden, 1992). The fear or hesitancy of consuming food made using novel technologies is referred to as Food Technology Neophobia and can be measured using the Food Technology Neophobia Scale (FTNS) (Cox & Evans, 2008). It specifically addresses the apprehension towards food that has been produced or processed using new technologies (Wendt & Weinrich, 2023).

The Food Technology Neophobia scale is a specialized tool that can provide valuable insight into consumer attitudes towards new food technologies (Wendt & Weinrich, 2023). This insight can play a significant role in guiding product development, marketing strategies and policy making in the food industry. The ability to identify different population segments with various levels of food technology neophobia can also be deemed useful when trying to identify early adopters of innovative products (Evans et al., 2010).

Someone's FTNS is calculated by having them rank 13 statements that relate to new foods, the future and new technology (see appendix A) from 1-7 where 1 is “strongly disagree” and 7 “strongly agree” (Wendt and Weinrich, 2023). For the last three questions, the researchers reverse the score when calculating the final result. The result will be a rating between 13 and 91 where a higher score means a more negative approach to novel food technology.

3.3 Seafood consumption

The Swedish food agency emphasizes the health benefits of consuming fish two to three times a week, noting its rich content of nutrients that are often hard to obtain in sufficient amounts (Livsmedelsverket, 2023). Fish, a common dietary choice in Sweden, is an excellent source of selenium, iodine, protein, vitamin D, and vitamin B12. However, the levels of these nutrients vary across different fish species, thus it is advised to consume a variety of fish and seafood. Fish is particularly noted for being a primary natural source of vitamin D, which is rare in other foods. This vitamin is present in all fish, regardless of their fat content, including herring, char, and salmon. Fatty and medium-fat fish like herring, salmon, and mackerel are also crucial for providing omega-3 fatty acids (DHA and EPA), which may reduce the risk of heart and cardiovascular diseases. These fats are especially important for children's brain and vision development. Shellfish and mussels, being lean, are often sources of protein, vitamin B12, iodine, selenium, and vitamin E.

3.4 Environmental impact of seafood

At the same time as government organizations are encouraging citizens to eat more seafood, overfishing, defined as catching fish faster than stocks can replenish, poses a significant threat to ocean wildlife populations (WWF, n.d.). Perhaps, this can create confusion about whether and how much seafood one should consume? Although catching fish is not in of itself bad for the ocean, several fishing methods often result in “bycatch”, where unintended sea life, including sea turtles and cetaceans, are caught along with the wanted sea life, leading to the unnecessary loss of marine animals (WWF, n.d.).

Several environmental labels are employed for seafood in Sweden, including MSC (Marine Steward Council), ASC (Aquaculture Steward Council), and KRAV, certifying fish from stable populations fished sustainably with minimal environmental impact (Livsmedelsverket, 2023), these certifications are endorsed by WWF (Världsnaturfonden WWF, n.d.). However, Naturskyddsföreningen highlights the importance of reducing fish and seafood consumption to alleviate pressure on the oceans (Naturskyddsföreningen, 2022). Despite certifications, Naturskyddsföreningen criticizes MSC for certifying fish caught using destructive methods like bottom trawling, associated with high levels of bycatch. They recommend opting for KRAV or MSC-certified fish caught without trawling to promote sustainable practices. A concerning statistic shows that 90% of the world's fish stocks are maximally fished or overfished. Destructive fishing methods contribute to negative impacts on the climate and biological diversity of oceans. Naturskyddsföreningen identifies five key problems in the fishing industry, including excessive fishing, the use of destructive tools, unfair resource distribution, fish diversion for fodder, and industrial fishing near coasts. To try to address some of these issues, Naturskyddsföreningen proposes measures such as reducing fishing pressure to allow fish stocks to recover, discontinuing destructive methods, and promoting equitable resource distribution and small-scale fishing.

According to the Environmental Defence Fund (n.d), overfishing remains the most severe threat to oceans and approximately one-third of the world's fisheries are currently in trouble. In summary, the environmental impact of seafood consumption, particularly overfishing, underscores the urgent need for sustainable fishing practices and consumer awareness of certifications to mitigate detrimental effects on ocean ecosystems.

3.5 Incorporating the voice of the consumer into the design

Understanding what consumers expect from seafood analogues in terms of taste, texture, and appearance is essential for this project. Since 3D-printing allows for precise control over these aspects, knowing consumer preferences can guide the creation of more appealing products (Zhong, 2023). Products designed with consumer input are more likely to be accepted in the market (Devrix, 2021). This is because if consumers feel that their preferences and concerns are addressed, they are more likely to try and continue purchasing these products. Different consumers have varied nutritional needs and health concerns. By incorporating consumer feedback, manufacturers can tailor their products to meet these specific needs, such as adjusting protein content, reducing allergens, or enhancing with specific nutrients. Many consumers are turning to plant-based or alternative seafood due to ethical and environmental concerns (Kalantari et al., 2023). Understanding these motivations could help in designing products that align with these values, potentially reducing the impact on marine ecosystems. Consumer insights can drive innovation. Understanding the gaps in current offerings or specific desires of consumers can lead to the development of novel products that better meet market demands. Engaging consumers in the design process can also be an educational tool, increasing awareness about sustainable eating practices and the potential of new food technologies like 3D-printing (Zhong, 2023).

In summary, incorporating consumer feedback into the design of 3D-printed seafood analogues ensures that the products are not only technically feasible but also desirable, marketable, and aligned with consumer values and needs.

4. Method and Implementation

This chapter will describe the methods used and overall implementation in the project. A survey was released to find potential participants for focus groups and using the survey responses, the respondents were divided into groups based on their levels of seafood consumption and food technology neophobia. The focus groups were recorded and transcribed and the data was thematically analyzed with a Qualitative Data Analysis tool. The codes and themes found were used to develop a list of functional demands which lay the foundation for a concept development which further led to a design proposal.

4.1 Qualitative and quantitative research

Qualitative research is a method that produces descriptive data, such as observations of behavior or personal accounts of experience where the goal is to examine how individuals can perceive the world from different views (American Psychological Association, n.d.). There are several methods labeled as qualitative research including focus groups, in depth interviews and participant observations.

In contrast to qualitative research, quantitative research relies on measuring variables using a numerical system, for example test scores or measurements of reaction time (American Psychological Association, n.d.). Examples of techniques included in the term quantitative research are experiments and surveys.

4.1.1 Survey/Screening

A survey was sent out to connections that RISE had access to through discussion panels, to find participants for the study. Through the survey we asked respondents to rate their intake of seafood and to rank their thoughts and feelings about new foods and technology by answering 13 previously mentioned questions (see appendix A) to determine each respondent's FTN score (Wendt & Weinrich, 2023). Respondents of the survey were also asked to provide information about when and if they would be available to participate in focus groups. Respondents who had any allergies or had inconclusive answers were excluded from the list of possible participants for focus groups. The decision to exclude people with allergies was based on convenience when putting the focus groups together.

4.1.2 Grouping

From the survey we arrived at a list of available respondents of varying ages. The 203 respondents who answered the survey were between the ages of 18 and 76, with the average age of the survey respondents being 48.3. Of them, 30% defined themselves as men, 69.5% as women and 0.5% defined themselves as other. The focus groups were conducted to have participants with the same FTNS and seafood consumption in the same groups. Choosing focus group participants from the respondents was intricate and precise work since the time availability was another criteria that had to be accounted for. The choice of participants were semi-random since we attempted to have a similar percentage of age and gender in the

groups, but besides that, the participants were picked without any other knowledge about them.

Sim (1998) states that “... the more homogeneous the membership of the group, in terms of social background, level of education, knowledge, and experience, the more confident individual group members are likely to be in voicing their [own] views”, thus the idea is that similar thinking individuals perhaps could delve deeper into the nuances of their shared preferences or experiences, that could lead to more detailed and focused feedback on specific aspects of a product. Our two grouping criterias, high to low FTNS and seafood consumption were still broad enough and the differences between the participants were large enough to still encourage a good discussion.

The initial plan was to have the respondents sectioned into three groups of low (Once per week or less), medium (2-3 times per week) and high consumption (more than 3 times per week) of seafood, however the results from the survey made it clear that an even group constellation was not possible since only 6 participants reported eating seafood more than 3 times per week, see Figure 4. The solution was to combine the medium consumption group with the high consumption group resulting in 2 groupings: low consumption (once per week or less) and high consumption (2-3 times per week or more). To decide the limits for the low, medium and high FTNS, a histogram of the participants FTNS were used, see Figure 5. It resulted in the following limits for the FTN: low FTN: 17-38 FTNS, medium FTN: 39-46 FTNS and high FTN = 47-69 FTNS.

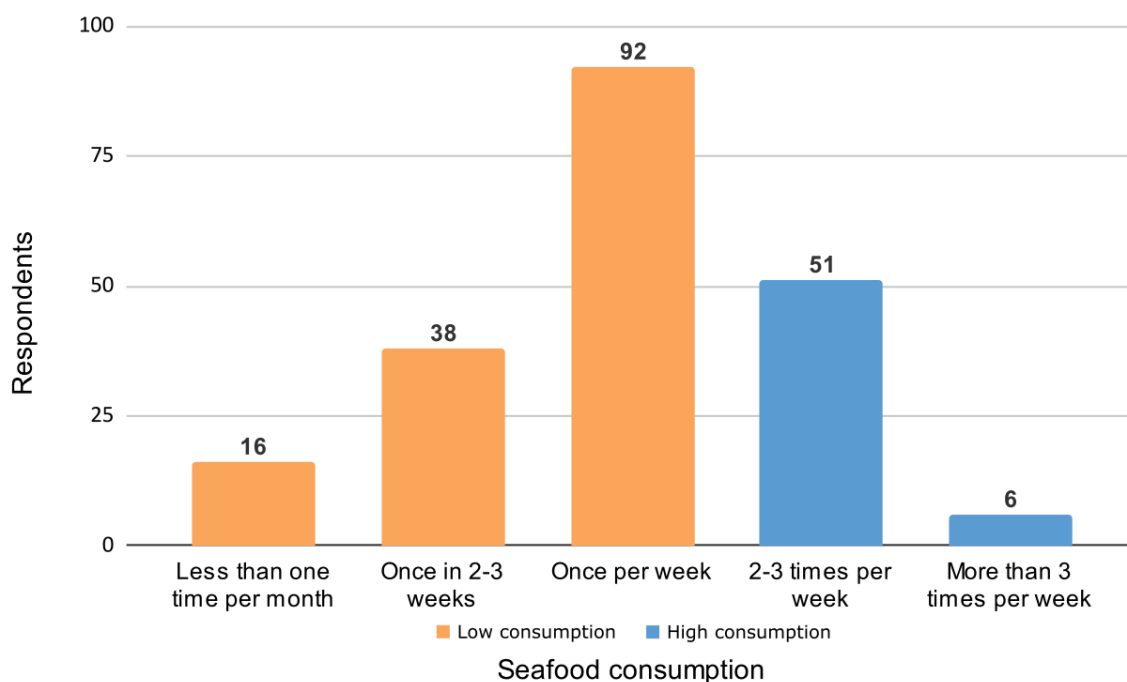


Figure 4: Survey respondents distribution of seafood consumption (own illustration)

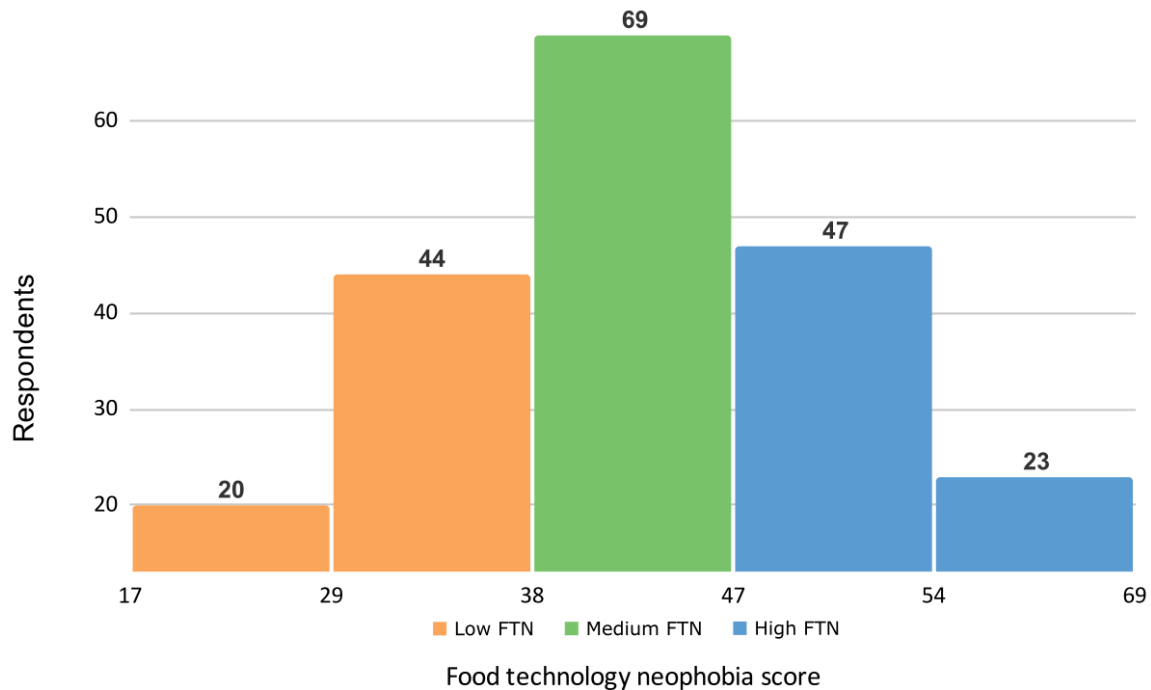


Figure 5: histogram of the number of participants and their food technology neophobia score. (own illustration)

This resulted in 6 groups (see table 1) with different seafood consumption and FTNS, the groups were named based on these attributes to easier keep track of them during the project.

	Low Food Technology Neophobia	Medium Food Technology Neophobia	High Food Technology Neophobia
High Seafood Consumption	HCLF	HCMF	HCHF
Low Seafood Consumption	LCLF	LCMF	LCHF

Table 1: final grouping, dependent on seafood consumption and FTNS (own illustration)

4.1.3 Focus groups

Morgan (1997) explains in the book “Focus groups as a qualitative research method” that a simple way to test if a focus group is an appropriate method for a project is to think about how actively and easily the participants would discuss the topic of interest. Focus groups are participant-defined which leads to the setting becoming less controlled than individual interviewing but because of pre-decided topics and the moderator who leads the talk, it is more controlled than participant observations. The goal was to conduct semi-structured focus groups with a moderator leading the conversation points (Jobber & Ellis-Chadwick, 2020).

An interview guide was created to semi structure the focus groups and to ensure that similar topics were discussed in each of the groups. It also made the data analysis process easier since the transcriptions could be divided into parts depending on the topic discussed. Since the survey did not specify the subject of the focus groups, such as 3D-printing or seafood analogues, the participants were unaware of the discussion points. The goal was to achieve as spontaneous reactions as possible to the questions. The plan was as follows:

The moderator, participants, and others in the room briefly introduced themselves. If a third party was connected via a link to listen, it was declared to the participants. The purpose of the focus groups were discussed, emphasizing sustainability in the food system and various ways product design could contribute from the participants' perspectives. Formalities included mentioning the recording of the session, signing consent forms for participation, informing of their rights according to GDPR, followed by simple rules like one person speaking at a time, no right or wrong answers, and keeping mobile phones silent. After the introduction the four following categories were discussed:

General Consumption of Seafood: Participants discussed perceptions of fish and seafood, including algae, squid, sea cucumber, seaweed, mussels, etc. They explored current consumption habits, reasons for choices, opinions on the pros and cons, and experiences with unusual seafood types. Health and sustainability aspects were probed for if not spontaneously mentioned.

Preconceptions About Alternative Seafood: Awareness and experiences with fish and seafood alternatives were examined, including plant-based sources like legumes and mycoprotein. Sensory expectations and preferences, target consumers, nutritional concerns, and cooking methods for these alternatives were discussed.

Processing and 3D-printing: 3D-printing technology and its application in food, specifically seafood alternatives, were introduced. Participants explored thoughts on 3D-printed food, similarities and differences with traditional processed seafood, and expectations about appearance, taste, and texture. This part of the session also involved showing images of examples of vegan, and/or 3D-printed “seafood” and discussing sensory expectations and willingness to try these products.

Ideal 3D-Printed Seafood: Open brainstorming about the ideal 3D-printed seafood alternative took place, considering appearance, storage, preparation, taste, texture, and nutritional content. Preferences in size, form, and the balance of ingredients like proteins and fibers were also discussed.

Roughly 9 participants were invited for each focus group with the goal of having a minimum of 5 showing up. However due to availability responses in the survey, some groups had fewer initial participants invited. On one occasion, due to cancellations, one group had only 3 participants show up but despite this, the discussions were good even with fewer participants

than preferred. The distribution between genders can be seen in Table 2, along with average age and FTNS for each group.

Group	Number of participants	Male	Female	Average age	Average FTNS
HCLF	9	3	6	45.7	27.2
HCMF	5	0	5	56.4	43.2
HCHF	7	2	5	48.9	55.1
LCLF	3	2	1	47	31
LCMF	6	5	1	49.3	42.8
LCHF	5	2	3	52.2	54.2
All groups	35	14	21	49.9	42.3

Table 2: Statistics from the different group

4.2 Data Analysis

This section describes how the data from the focus groups was handled through transcription and thematic analysis.

4.2.1 Transcription

The 14 hours of recorded material from the focus groups were transcribed using the open-source model Whisper, an automatic speech recognition system (OpenAI, n.d.) written in the coding language Python (*Whisper*, 2022/2023). The model were run locally and the transcripts were further corrected and refined by manually listening through the audio files and cross-checking with the transcript.

Whisper was run using the medium model, it showed to give accurate enough results and the small difference in quality between the large model and the medium model did not justify the difference in time consumption. However, using the medium model instead of the base model showed to speed up the process when cross-checking and the difference in time consumption between the two models was not too significant.

4.2.2 Thematic Analysis

Thematic analysis is a qualitative research method used for identifying, analyzing, and reporting patterns (themes) within data (Braun & Clarke, 2006). It organizes and describes your data set in rich detail and goes further to interpret various aspects of the research topic. Each focus group transcription was firstly analyzed separate from one another. A combined analysis of all 6 groups was then performed based on the codes and themes found in each one. The different themes we found were sustainability, target audience, information,

contents, positive and negative similarities to seafood and positive, negative and neutral sensory aspects. A computer tool called RQDA was used to simplify the process of analyzing the transcriptions, that is a qualitative data analysis software application (Huang, 2016). RQDA simplified the coding of the transcriptions and made it easy to find and categorize quotes. The final codes can be seen in the table below, table 3.

Final codes and themes		
Themes	Codes	Description
SUSTAINABILITY	Transport	The logistics of seafood transportation and the value of locally sourced products.
	Shelf life	Concerns about the longevity and proper storage of seafood products.
	environment	Addresses sustainability issues, including overfishing and the presence of harmful substances.
	ethics	Evaluates the ethical implications of seafood consumption.
	freshness factor	Differences in quality and storage between fresh and frozen seafood.
TARGET AUDIENCE	social and cultural	The cultural and social aspects associated with seafood consumption.
	Price	How price affects consumer choices, categorizing seafood as either luxury or staple food.
	marketing	Consumer perceptions on product naming and placement in stores.
INFORMATION NEEDS	content description	Importance of knowing the contents and production processes of seafood products.
	Product semantics	How the look of a product influences expectations about its preparation.
	Guide	The need for clear cooking instructions and convenience in preparation.
CONTENTS	food stuffs	Concerns over potential allergens and unwanted ingredients in seafood products.
	health	How closely alternatives should resemble traditional seafood in taste, appearance, and texture.
	nutrients	nutrient content like omega 3, proteins, wanted and unwanted
POSITIVE SIMILARITIES TO SEAFOOD		“Discuss the similarity of analogs to fish and shellfish, how similar it should be, to what degree, should look like... this should be included. This is good with fish and shellfish.”
NEGATIVE SIMILARITIES TO SEAFOOD		Should not look like.... Must taste differently to... do not want to be deceived. Do not want this.
POSITIVE SENSORY ASPECTS	Positive taste	Talking about it being delicious, tastes good, likes the taste of..
	Positive smell	Talking about something smelling good, like the smell of...

	Positive consistency	Talking about good texture, the 'right' texture
	Positive look	Looks appetizing, looks 'correct'
	Positive shape	Good shape, want smaller/larger pieces
	Positive color	The color looks good, like the color, should be this color
NEGATIVE SENSORY ASPECTS	Negative taste	Talking about what tastes disgusting.
	Negative smell	Mentions disliked smells, or a smell that is expected to be disgusting.
	Negative consistency	Mentions the texture of both the analog and the real thing in a negative sense.
	Negative look	Does not like how something looks, looks repulsive.
	Negative shape	The shape is wrong, too big too small
	Negative color	Wrong color, does not look right, wrong saturation
NEUTRAL SENSORY ASPECTS	Neutral taste	Mentions taste but does not place importance on whether it is good or bad.
	Neutral smell	Mentions smell in a neutral manner
	Neutral consistency	Mentions texture in a neutral manner
	Neutral look	Mentions appearance in a neutral manner
	Neutral shape	Mentions shape in a neutral manner
	Neutral color	Places no importance on whether it is positive or negative that something is x color

Table 3: Final codes and themes

4.3 Functional design requirements

A list of functional design requirements express what a final design is supposed to achieve and do. The goal is to translate wishes and ideas from potential users and/or consumers into more concrete design requirements (Meijers, 2009). It helps in prioritizing which features to include, based on their importance and the resources available. It is a foundational tool that can guide the whole lifecycle of a product, from conception to market launch, and beyond, into product assessment and iteration. It helps ensure that a product is designed with a clear understanding of what is required to succeed in meeting the user's needs and the market's demands.

The purpose of creating a functional design requirement list is to express the product in terms of functions, rather than presenting it as finalized ideas (SVID, n.d.). A verb and a noun is used to describe each function in a refined way. The refined functions are categorized as main function, secondary function or supporting function to clarify the role of each function. The secondary function is necessary for the main function to be achieved while the supporting function can help achieve the main function but it is not necessary for it to work.

To further categorize the different functions, they were marked as necessary, desirable, thinkable or unnecessary. Where necessary functions are those deemed most important, desirable functions are functions aimed to be included while thinkable functions are not as desirable as desirable functions, but they are functions worth exploring. Unnecessary functions are functions that might have come up but that are decided to be unnecessary or irrelevant for the potential design.

4.4 Ideation process

Brainstorming, PNI and prototyping were the three main methods used during the ideation process. The ideas from the brainstorming were evaluated using the PNI to decide which ideas to continue to develop and further create prototypes off. The implementation will be presented in chapter 6: Concept development.

4.4.1 Brainstorming and Brainwriting

Brainstorming is a creative technique used to generate a large number of ideas, typically used in group settings but also applicable individually (Österlin, 2016). Criticism or evaluation of ideas is postponed, encouraging free-flowing thoughts and open expression of unconventional ideas (Vizologi, n.d.). The focus is on quantity over quality and thus it fosters a creative environment. Brainstorming encourages participation from all members, valuing diverse perspectives and increasing engagement (Österlin, 2016).

Brainwriting is a structured approach to idea generation (MindManager, 2023). It involves parties writing down their ideas independently before sharing with the group. This helps diversify ideas but minimize influence from the other participants' suggestions, focusing more on one's own thoughts, ideas and perspectives.

4.4.2 PNI

PNI, also referred to as PMI, is an easy way to evaluate ideas by focusing on what is positive, negative and interesting for each idea that is being evaluated (Österlin, 2016). A common way to use this method is to create a diagram with columns for positive, negative and interesting and go through the ideas one by one discussing these 3 talking points. The advantage of using PNI is that one is forced to think outside the box, when one's natural instinct is to stop or move on (deBono, n.d.). For example, if someone likes an idea, it is unlikely that they will look for the negative aspects. The interesting points are aspects which are neither good nor bad, but are worth noting. PNI simply helps expand the view of each idea.

4.4.3 Prototyping

Creating prototypes and models is an important part of the design process (Öresund Strategy & Design, n.d.). Models in CAD or 3D-software makes it easy to test different shapes, colors and materials but physical models help with understanding and feeling the size and shape of a product. Simple materials such as clay, styrofoam, cardboard are materials that are

frequently used to create three dimensional sketch models which allows the designer to explore and find solutions that might not have been found if the sketching was done on the computer or on paper (Österlin, 2016).

4.4.4 3D-modeling

We used the 3D-modeling software “CATIA” by Dassault Systèmes to create a first draft of the prototype in an STL format. (Patel, n.d.) The STL file describes the surface geometry of the three-dimensional object without representing color, texture, or other attributes (Adobe, n.d.). It contains a series of triangular facets, each represented by its normal and the coordinates of its three vertices.

5. Findings

The focus groups were conducted in Swedish but the quotes presented in the subchapters of chapter 5 are translated from Swedish to English by the writers of this report. The quotes in the original language can be found in appendix B. The quotes in the following chapters are particular statements that represent the themes and codes that were interpreted from 14 hours of recorded conversations with 35 participants. A summary of the themes and codes can be found in chapter 5.7.

5.1 Sustainability

The overarching opinion when discussing sustainability in the different focus groups was that seafood, particularly fish, is more environmentally friendly than meat. However, it was noticeable that the knowledge behind why it would be more environmentally friendly varied and some participants expressed it in a sense of “it is common knowledge” or something “you just know”. Some participants also made a point in differentiating between fish from fish farms and fish caught in the wild, expressing skepticism regarding environmental impact and ethics in regards to farmed fish.

Participant 4: *“Then one probably also imagines that it is more environmentally friendly to eat fish than meat. But I can not really say why. Fish are more naturally available, cows and pigs have to be bred.”*

Participant 1: *“But what about farmed salmon?”*

Participant 4: *“I do not like that. I feel stressed, a bit like the chicken industry, I think.”*

LCMF

“But we spoke before about how it is better for the environment to eat fish instead of meat. I agree, but I also think that maybe not always because we are fishing in the ocean, which is good, but there are also places where they make space to grow fish, that is not so good. We have to use water and feed the fish. it is not so good for the environment if we do it this way.”

HCLF, participant 2

Even if people might have questions or worries, one participant expressed that even if it might be bad in some way, red meat still has a higher climate footprint and thus buying fish is seen as doing something good for the environment.

“I do not know if it is correct or good to think this way, but that is usually how I think - that it [the fish] is probably luminescent and super bad, but maybe it has a lower climate footprint than meat or something else.”

HCLF, participant 3

Therefore it seems participants are aware of some of the environmental impact of seafood, yet still argue that fish overtake red meat in environmental friendliness. There were, however, concerns about vegetarian alternatives as well. Content such as soybeans was brought up as something that, if possible, should be avoided due to its supposed large carbon footprint. One participant especially noted that just because something is vegetarian or vegan it will not automatically mean that it is more environmentally friendly than meat or seafood.

“Soybeans also require quite a lot of the Earth's resources. It is not automatically more environmentally friendly just because you choose a different product. It is also about the consumer's knowledge to understand what is in it. The whole lifecycle. But absolutely. If it had been another product that I know has less environmental impact.”

LCHF, participant 1

When it came to new technology for sustainable food, some participants considered the potential of 3D-printed food to be more efficient in terms of how it uses resources, possibly implying that it could be produced using less environmental impact compared to traditional methods. Some were more skeptical.

“Another thing that I just thought of now, while sitting here, is that it can benefit, like, can it make the food last for more people, it is controlled as well as possible, and I want, I mean I love red meat, I do too, if I then can get a 3D-printed entrecôte that I know is made from really fine ingredients, the price is about the same, and it benefits the environment and so on, then 100% yes to that.”

LCMF, participant 4

In conclusion, even if participants did express knowledge about seafood and the possible impact it has on the environment, one can easily see a theme where the overarching consensus is that seafood is better for the environment than red meat. The idea of making food “last for more people” points to a need for sustainable food solutions that can address food scarcity and ensure broader distribution. The thoughts reflect a desire for food in general to be sustainable, accessible, high-quality, environmentally friendly, palatable, and cost-effective.

5.2 Information needs

Participants in the different focus groups expressed several different types of information needs they would deem important to have access to when buying a food product.

5.2.1 Ingredients

Participants in the focus groups expressed the importance of knowing the ingredients of a product on several occasions. It was mentioned as a way to increase motivation for people to

buy a product, especially in regards to replacing current similar products but also in terms of evoking a positive feeling about the product and thus increasing the motivation to try it.

“People usually look at the contents, if it contains the right vitamins, minerals, and substances, you get even more motivated [to buy it].”

HCLF, participant 7

Regarding the production method it became clear on several occasions that knowing the ingredients can be more important than knowing how the product is made. One participant expressed that understanding the ingredients in a product increases their positivity towards the product, regardless of production method.

“For me, it is probably about knowing the content. If I have good and extensive knowledge about the content of the products regardless of whether I am the one making it or someone else is making it, then I am more positive about it.”

LCHF, participant 1

Another participant expressed that it is fine if the contents of the product differ from the contents of the product it aims to replace. However, if that is the case, it has to be communicated in a way so that the consumer is aware and can compensate for the missing content.

Participant 1: *“... one needs to know; it is about communicating that ‘this does not contain omega-3; you will have to find it another way’. Fine, then I know.”*

Participant 5: *“Exactly.”*

Participant 3: *“Mm, if it is not added [to the product] then you have to find a different source.”*

LCMF

It can be concluded that potential customers find information about ingredients important both to increase their knowledge about how the product can be implemented in the daily routine but also to make sure that they get the nutrients they expect.

5.2.2 Environmental

As mentioned before, participants indicated a concern about the ethical treatment of the fish and the environmental impact of fish farming. This suggests a need for information about potential farming practices, including space, conditions of the farm, and the overall sustainability of these practices.

Participant 4: *“... because I do not think a farmed salmon feels particularly healthy. It might be healthy in itself, but the fact that they just feed these poor fish in a small pool*

and stuff them with a lot, as you said, with antibiotics and a lot for them, it becomes so much strange stuff.”

Participant 5: *“and they have no muscles.”*

LCMF

Some participants did show awareness of varying recommendations, from authorities like The Swedish Food Agency, based on the origin of the seafood, but find it challenging to consider these details while shopping. This might reflect a need for straightforward, easily understandable information at the point of purchase.

“I think it is a bit tricky when you buy some kind of pre-packaged fish and the same product can have several different origins. And then in the corner, there is a little A or B, and they are completely different parts of the sea. And if you go to Livsmedelsverket's website, it is completely different whether the fish is recommended or not depending on where in the same sea it is. But I do not think about that when I am in the store, whether it is this A or B.”

LCMF, participant 2

It became clear that for some people it is very important that the labelings on the packaging of frozen seafood show certification of environmental friendliness. In the low consumption, high food neophobia group several participants implied that there can be uncertainties when buying fish, even if one looks for the certifications.

“As a consumer, I find it difficult, if we take two frozen fish blocks, if we are going to simplify it. And both are MSC certified. I have no- Then you are supposed to read the ingredient list. Where are they caught? And then I am supposed to consider how it has been transported, how far is it? How and for how long? Has it passed through other countries to be gutted somewhere, only to be sent back? It is impossible for a consumer to make this assessment, what is valuable.”

LCHF, participant 1

The act of finding or asking store staff about certification of environmental friendliness seemed to occur more often in regards to frozen seafood than fresh seafood from the fish counter. Some participants mentioned that they are always making sure that they ask where the fresh fish comes from while some expressed that they take it for granted that fresh fish is good fish.

“If it is fresh [fish], one might assume that ‘this is good fish’. But you can not really take that for granted. Not really. So that is true, one should ask.”

LCHF, participant 2

An interesting aspect is that most participants felt that fresh fish was superior in quality to frozen fish, and referred to it as “good fish”, and this inhibited their need to ask questions

regarding certification of environmental friendliness despite no guarantee that fresh fish is more environmentally friendly than frozen fish. However, some participants expressed that they do in fact ask, but it seemed not to be the case for the majority of participants. The uncertainties regarding product origin should be possible to address to ensure that consumers can easily access information about origin and how a certain product has traveled.

However, it is an important aspect which points to labeling/certification being something that could increase the interest from consumers from an environmental perspective. Thus one can conclude that knowledge about a product's environmental impact might affect willingness to buy.

5.2.3 Cooking

Most participants expressed that they want to be able to cook a seafood analogue. If they are not able to, or the analogue comes precooked to a point where additional cooking is detrimental, participants within the high level and even medium level of food technology neophobia groups showed high discomfort.

“I think it [the cooking] will be hard to get rid of, at least for my generation, but then again, like everything new, the others will have to take it up; it will become more natural for them, you know, but for us, it is hard, it is almost genetic, it is ingrained like this is how we do it, and then the reptilian brain kicks in right away.”

LCMF, participant 5

On several occasions participants spoke about expectations on substitutes based on their appearance.

“... the constructors should have considered that people expect it [the substitute] to be cooked in the same way [as real fish] since it looks the same.”

HCMF, participant 1

This statement is something that summarizes other discussions very well. When discussing specifically how a potential fish substitute would be cooked, it was often mentioned that the expectations or first instinct would be to cook it based on what it looks like.

“I will cook it the same way [as the real counterpart]”

LCMF, participant 6

“That is the thing, if it looks the same or resembles it [fishsticks], you will cook it the same way as fishsticks.”

LCHF, participant 2

It became clear that if a potential seafood analogue reminds the participants of something they know, they will either expect it to be cooked the same way, or they will want clear

instructions. One can argue that if it is simple to understand how to cook something, it might increase willingness to buy, since it won't make everyday cooking more complicated.

One participant pointed out that if it looks like something people are familiar with and they expect it to be cooked in a certain way, but the product is supposed to be cooked differently, then it is important to make this very clear, to avoid failure.

“So if it is not meant to be [cooked] the same way [as its real counterpart] one has to be quite explicit about that.”

LCMF, participant 2

Needing to read the instructions for a new product was something participants were not against, and some expressed that it was to be expected.

“[if it was something new] I would probably be a bit more cautious and read the packaging”

LCHF, participant 2

Some pointed out that breading helps to prevent the fish from falling apart during cooking, a common occurrence with fish filets. Overall, participants had a lot of thoughts regarding the practical considerations and techniques of cooking fish, particularly in relation to breading and maintaining the integrity of the fish during cooking.

“... I do not always bread it. But then it is a bit when it starts to fall apart. That is why it is so good to bread it because then it does not fall apart. If you have a filet, it usually falls apart.”

LCLF, participant 2

Based on these expressed thoughts, one can conclude two different ways to go about information about cooking. Either have a product look similar to something so that consumers know how to cook it based on previous experiences, or make something look different if cooking is different to ensure that consumers read the instructions. One can also argue that having instructions for cooking is good even if it may be expected that a consumer “should know” how to do something. If a new product looks like a familiar product, that they know how to prepare, but the new product is prepared differently, it is extra important to be clear about it on the packaging to ensure mishaps do not happen. The participants want to feel comfortable cooking.

5.3 Contents

Below describes the findings regarding the wanted and unwanted ingredients of seafood analogues due to health and nutritional needs of the participants.

5.3.1 Foodstuffs

Some participants said that if a seafood analogue is made from fish, it defeats the purpose of choosing it as an alternative, as they might as well just eat regular fish, even if the analogue is made from leftovers that have been taken care of from the fish industry. This perspective suggests a desire for alternatives that are distinct from the original in terms of ingredients.

“I do not want it to be made of fish, because then I might as well just eat fish.”

LCMF, participant 1

Though, some participants had a different view of it, that we should take advantage of everything, including leftovers, from the processes we already have in use. Some participants thought that using fish trimmings as the main ingredient in seafood analogues could be beneficial.

“Yes, I think like this: if you can produce something that is tasty from fish trimmings, if I may say so. Something that attracts the customer with something that is otherwise discarded, and it has good content in it and also tastes good.”

LCLF, participant 2

Some have a forward-looking perspective on the contents and ingredients of future seafood analogues suggesting that we should have a focus on creating alternatives that are free from allergens, for individuals with food allergies. There is a desire to develop ways to accommodate these needs in future seafood analogues. The participants mention that society is “very allergic”, which underlines the growing importance of creating inclusive food options that are safe and appealing to a broader range of consumers.

“It has become very delicate if you discuss such things with younger people today. And then considering that many families cook... can make five different meals. This could be a thing! For example, you can remove all allergenic things for some people. And they can still eat an alternative that looks something like the same and has a good taste and texture. Then it can also be an alternative. Our society is very allergic.”

HCHF, participant 6

Thus one can conclude that fish or no fish in an analogue is something participants had different views on. Providing replacements or equivalents of common foods to people with allergies was viewed in a positive light.

5.3.2 Health

The participants reflected on a concern about the contents of a potential seafood analogue, particularly regarding its safety and naturalness. Some participants emphasized that the process of creating the product itself is not a primary concern, but rather the raw materials and ingredients used in it. Some participants expressed a heightened sense of caution, noting the product's unnatural appearance and unknown processing methods, leading to worries about potential carcinogenic effects. This hesitancy is especially pronounced in the context of children or grandchildren consuming the product, indicating a lack of trust in the safety of its composition.

Participant 1: *“But the process itself cannot be carcinogenic, the question is what raw materials, what is in it, that is what is interesting, not how it has been mixed together.”*

Moderator: *“Do you think the process is carcinogenic, or is it the content itself?”*

Participant 3: *“Well, you know, it is so, it is very, very clear that it is unnatural and you do not know what process it has actually gone through to end up like this, and of course, it makes you very curious. It might be carcinogenic, I do not mean that it is carcinogenic, but one can imagine, aha, if I have a small child or my grandchild, I do not want them to taste it, maybe I might taste it.”*

HCMF

Concern for the unknown is understandable, and hesitancy for new foods made by new technology is a hurdle. At the same time, there were participants who claimed they would not react much differently to something being part of a 3D-printing process versus something produced with a more conventional process. Nevertheless, the veracity of this opinion remains uncertain until it is put into practice.

“I am no more or less scared of a 3D-printed food, than I am of a sausage.”

LCMF, Participant 1

5.3.3 Nutrition

The participants spoke of the importance of keeping the nutritional values as equivalent to real seafood as possible to allow direct substitution without worrying about having to add additional items to reach the same nutrients.

“It ideally should have the same amount [as salmon] because if one intends to buy it instead of real salmon, it must contain the same vitamins and provide an equivalent amount of nutrients.”

LCHF, participant 3

Specifically fish is understood by participants to be very nutritious. Omega 3 and Omega 6 were two ingredients with high health benefits that were mentioned in almost every group.

Participant 4: *“Then I think fish is healthy.”*

Moderator: *“How do you figure that?”*

Participant 4: *“That it contains omega 3, omega 6, and all that. Then you become very smart from fish and herbs. I do not know.”*

LCMF

Breading was a concern to some participants when used in seafood products, like fish sticks. An individual acknowledged enjoying such products but pointed out that the breading is problematic because it absorbs a lot of fat, which can lead to weight gain. While the taste of these breaded products are appreciated, there is an awareness and caution about their nutritional profile, particularly regarding fat content. This concern showed more of a preference for less fattening, healthier options in the preparation of seafood and its analogues. It could be important to aim to appeal to health-conscious consumers, suggesting a demand for tasty yet healthier alternatives, perhaps with less fat-rich breading.

“No, no, no, I eat everything, including those regular fish sticks and such. It is the breading that is not so good because it absorbs a lot of fat, and then you get fat. That is the part that is a bit concerning, but otherwise, they are very tasty, so I eat most things that are not complicated.”

HCMF, participant 1

However, it would be miscalculated to not take into account the warm feelings some participants had regarding making and eating breaded seafood at home. Homemade breading was perceived to absorb more butter, resulting in a richer, buttery flavor. In contrast, pre-made breading or commercial breaded products were described as being primarily about crispiness with less emphasis on flavor. Perhaps some consumers prefer the crisp texture of commercial breading, others might be more inclined towards homemade breading for its ability to absorb and enhance flavors in a final product.

“I think the homemade breading absorbs more of the butter, so it gets more of a buttery taste. The other one is just crisp and not so much flavor in it. The breadcrumbs kind of soak up-”

LCLF, participant 2

If a new seafood analogue is presented and it does not resemble anything currently on the market for seafood, it still seems likely that participants would prefer to use the same accompaniments they currently use in their daily meals for seafood. This simplifies the inclusion of an analogue in a routine. A consumer will not have to worry about changing more than one item in a meal, because the suitable accompaniment is kept the same, in regards to nutrients. The sensory aspects in a new product, such as taste, must work with commonly used accompaniments for seafood.

“I do eat meat, and sometimes I eat vegetarian, but we usually make two different dishes, so then you still have the same [accompaniments to the dishes]. If you have to change that [accompaniments] too, it just becomes, well, it gets complicated. You want- if it is potatoes, you need to have it both and it should be equal.”

HCLF, participant 5

5.4 Target consumer

Below describes the participants thoughts about social aspects, pricing and marketing that may affect a future seafood analogue.

5.4.1 Social & cultural aspects

When participants were asked about seafood, most responded with thoughts of the social aspect of seafood consumption. Eating out, particularly seafood, is often associated with social gatherings and experiences. This may suggest that seafood is not just food, but also part of a social experience. The participants highlight the cultural connection between seafood and the natural environment. It shows how seafood is often culturally linked to the sea, evoking imagery and associations with the natural source of the food. The participants point to regional cultural associations with seafood. The “West Coast” may be known for its specific seafood traditions and practices, indicating how geographic location influences seafood consumption and perception.

Participant 2: *“I am thinking about restaurant visits.”*

Participant 3: *“I think of the sea.”*

Participant 5 *“Typical West Coast.”*

Participant 1: *“And socializing.”*

LCHF

The participants reflected on the cultural and social dynamics of dietary choices, particularly in group settings. They discussed how personal dietary choices, like vegetarianism, interact with broader social and cultural eating habits, and that they influence one's sense of belonging in a group. Many of the participants were however close to a family member who chooses to not consume meat, including fish and it was brought up that for those people, a potential substitute could bring a sense of inclusion.

“For those who are vegetarians and who eat with others who are not, sometimes there might be situations where one eats vegetarian but not everyone does, then it could be about a sense of belonging.”

LCMF, participant 2

Cultural background, tradition, and habitual practices seemed to play a significant role in shaping one's dietary preferences, including seafood. Cultural habits and traditions appear deeply ingrained in determining what is considered normal or strange in terms of eating habits.

“Yes, I think it is a lot about where one comes from, tradition, and culture, what one is used to... For example, in my case. We eat meat almost every day. It is normal, you know. A meal without meat for one day... That is strange, it is like you have not eaten at all. So for me... I realize... when you say it like that. We maybe ate too much meat, so maybe it will be necessary to... force to eat fish instead...”

HCHF, participant 7

There is a resistance to change in traditional eating habits and skepticism about adopting new food trends or habits. Some participants were very resistant to change when it came to personal and cultural food preferences.

“So I feel that maybe it is for the future. something that will become relevant. But I am more for other traditions and other food and stuff. It just does not feel so good and appealing to me.”

HCHF, participant 7

There is an influence of early cultural conditioning on dietary habits that shows how cultural norms and family traditions can shape lifelong eating habits, including the frequency of seafood consumption. Some participants talked about how they experienced an everyday where cod liver oil was included as a mandatory supplement in schools. Cod liver oil contains among other things omega 3 and 6. Perhaps this shaped participants' perceptions of how important seafood derived fatty acids are.

“You have been brought up since you were a child with the idea that it is good to eat fish at least once or twice a week. Or something like that.”

HCHF, participant 7

“We had it [fish] once a week when I was a child. But of course, we also had it in school. It was standard, you were supposed to eat fish. And then when I was a child in the 60's, we also got cod liver oil. So they forced us to take a spoonful every morning...”

HCHF, participant 6

Participants described a shift in consumer awareness about the content and origin of their food and a growing cultural trend towards more conscious and informed eating habits, where consumers are more concerned about what they eat and its impact.

“I never used to think about such things before. But now, one thinks more about what it contains, or what it was made of. What it has absorbed. I never had that thought before. Instead, one just ate what was tasty. It is frightening.”

LCHF, participant 2

However, when probed regarding why the participants eat seafood, if it is for sustainability, health, culture, tradition, or simply tasty, some groups focused way more on ingredients than tradition.

“It contains a lot of protein. It has great content for vision and so on. It is nutritious.”

LCLF, participant 1

Why people eat seafood can be based on different things, but a theme that was brought up in several different focus groups was tradition, which points towards it being an important factor in the participants' seafood consumption together with presumed health advantages.

5.4.2 Pricing

The focus groups described how the rising cost of seafood affects consumer behavior. The participants mention reducing fish consumption due to higher prices, indicating that price is a significant factor in their purchasing decisions. Some participants valued quality, as indicated by their preference for white fish and purchasing from fish stores or counters for freshness. This shows a trade-off between price and quality that consumers often have to make.

“I used to prepare fish more often before. I think the price has become so high, so now I partly choose to avoid it. But when I do buy it, I prefer white fish. I like to buy in a fish store or at a counter so I can have fresh fish.”

LCHF, participant 1

Financial constraints can affect what people feel comfortable buying. The high cost of buying from a fish stand led some participants in one group to opt for less expensive options from regular stores. It highlights how price can be a barrier to accessing higher-quality seafood, like that available at fish stands, and forces some consumers to seek more affordable alternatives. The willingness to buy at a fish stand “if I can afford it” shows the importance of price in determining where and what kind of seafood consumers purchase.

“If you buy at a fish stand, it is very expensive, and you can not always afford to do that anymore. Then you have to get something from the store. It is also about the money. It is really expensive to eat only from a fish stand. You have to buy some cod [and salmon] from the store occasionally. If I can afford it, I buy at such a fish stand.”

HCLF, participant 8

For 3D-printed vegan seafood to be a viable alternative for consumers, it must not only match the taste of traditional seafood but also be offered at a comparable price. What one can take from this is that consumer acceptance of innovative food products is closely tied to their ability to deliver a familiar sensory experience and a perceived value for money.

“If this would taste like a salmon filet and the price is not more expensive, then I could very well imagine eating it.”

LCLF, participant 2

The price can thus be interpreted to be a big factor when people decide what seafood to buy.

5.4.3 Marketing

How the participants viewed naming and placement of a new product that is 3D-printed or vegetarian/vegan were relatively unified. A product replacing another product cannot be called something it is not.

“It can not be called fish if it is not fish.”

LCHF, participant 3

When asked about where they would like to see the food positioned in the stores, most participants responded more positively towards having it refrigerated compared to frozen.. They are, however, more accustomed to vegetarian options being found in the frozen isles of stores.

“Often, these kinds of things are frozen. I think that if it had been marketed as fresh instead, it would have performed a bit better compared to being frozen.”

HCLF, participant 7

“That is because they are made of something, and that if you freeze them, maybe they become a bit drier or something like that, maybe something like that happens to it.”

LCLF, participant 2

When asked about what group of people the participants think fish and shellfish analogues are for, their answers varied. Some participants thought that seafood analogues should only be marketed towards vegans or vegetarians. Others thought analogues should be marketed towards people who eat meat or seafood, but want to eat less. Some thought that it should not be targeting children, because of the belief that whatever the product contains, it cannot possibly replace the nutrients from the original product.

Participant 5: *“I would say definitely not for children, at least.”*

Moderator: *“Not for children?”*

Participant 5: *“Who are growing and developing. Because I do not believe the technology exists to replace all trace elements, all fats, everything. The consistency needed for the development of the heart and nervous system, and brain, and everything in a proper way. For one to receive as much of the small stuff as needed. I do not think, I think they need a lot that we cannot manufacture in a good combination and dose.”*

LCHF

One can conclude that where the product is found in the store can affect consumers interest in buying it, and since the overall idea expressed by the participants in the focus groups was that fresh fish is seen as more appealing, one can assume that a substitute not being frozen may be appealing as well.

5.5 Negative and positive similarities to seafood

In this segment, we delve into the nuanced considerations surrounding the design and perception of fish and seafood analogues. A pivotal aspect of our exploration is the degree of similarity these analogues should bear to their traditional counterparts.

The participants in the focus group spoke about the positives and negatives aspects related to seafood analogues that are similar to existing seafood. It was declared on several occasions that a product should not trick the customer and the importance of being honest about analogue products was rated high. There was a trend of worry about being tricked, and the participants wanted that any new product imitating another should communicate differences clearly.

“The risk with imitation is that the consumer can be deceived. Play fair with it.”

LCHF, participant 1

“I want it [the substitute] to differentiate [from the original] so one does not get deceived.”

HCMF, participant 3

Thus, to succeed and satisfy customers with a seafood analogue, it is important to be open about its content, way of production and that it is a substitute.

“Well, if it is already something 3D-printed, then it is already artificial in a way and then I am probably going to accept that it is too perfect. Then I buy the product because I am aware of it. But if it is served to me without information about it [being 3D-printed], then I would really feel deceived.”

LCHF, participant 1

The part that was crucial to most participants of the focus group was that if one is to attempt to imitate a food product like salmon, then it has to check all the metaphorical boxes for identical taste and nutrition.

“If it looks like salmon, but does not taste like salmon nor contain the same ingredients as salmon, then I probably do not understand why I should eat it.”

HCLF, participant 4

However, some participants wanted a clear visual distinction between, what was described as, real and fake seafood, while others thought it was important for a product to look identical to the original.

Participant 3: *“I do not want it [the substitute] to look identical, I want to be able to tell the difference, it should be visible so that I am aware of it. It feels like you get deceived if it looks the same [as the real counterpart]”*

Participant 2: *“But how should it look if it is not identical? Should it look like a freak of fish? Nah, it should look identical, otherwise it becomes...”*

HCMF

Salmon filets were the type of seafood that was talked about the most, and seemed to be the go-to fish for most participants. It is possible that the color change that occurs when preparing salmon helps the consumer know when it is cooked enough for it to be safe to eat.

“It [salmon] is very convenient, it is very easy to prepare, that is the biggest advantage with it, you do not have to do much with filets and such.”

HCMF, participant 3

Some participants expressed interest in the possibility of improving upon the original seafood.

“If it could make boneless fish, that would be great.”

LCLF, participant 1

While others wanted the full experience of seafood, even with the parts they do not care for, like the gray piece at the top of the filets.

Participant 5: *“The little gray at the top of the filet is a bit softer than the rest [of the filet]. So if it is supposed to mimic a salmon then it should be like that.”*

Participant 2: *“It should be identical.”*

Participant 5: *“With the skin and maybe the fat around it.”*

Participant 2: *“then you want it to look as identical as possible, does not everyone want that? You do not want to see that it is some [expletive] 3D-printed fish, it should be as identical as possible I think.”*

HCMF

The people who want an analogue to look like fish and the people who do not, felt strongly about their views. This duality could possibly make a design process of a seafood analogue a little tricky. Thus the question remains, should a seafood analogue be a direct copy or completely different?

5.6 Sensory aspects

In this section, we present our sensory evaluation. Due to the fact that this project did not involve a taste test, below is a description of consumer preferences over shape, size, thickness, color, and texture that was tackled in this project. These were the essential attributes influencing the appeal of the product.

5.6.1 Shape

The shape can determine both how people assume it is supposed to be cooked but also the expectations of taste. If something has the same shape as a fish filet, then people are likely going to assume that it tastes like it and behaves like it. It was brought up that it might be a good idea to aim for more natural shapes to allow people to get used to it before looking to make more complex and unnatural shapes.

Participant 3: *“At the start, it should be more natural, but then, maybe if there is no danger [you can make it more unnatural], but in the beginning, absolutely not. It is very scary.”*

Moderator: *“So it should be something recognizable at first?”*

Participant 3: *“Yeah, exactly.”*

Participant 2: *“Mm.”*

HCMF

The definition of what participants meant with “natural” was more of a vague concept, and deciding what is a “natural shape” would need further exploring. Fish filet analogues were described as something familiar and natural looking, but if the filet were perceived to be too perfect, there was a feeling of the uncanny valley.

Moderator : *“Would it have looked nicer if it looked like a butterfly salmon filet compared to this [shows an image of a 3D-printed salmon], for example?”*

Participant 2: *“Yes, but the salmon looks good.”*

Participant 5: *“It does not feel like a butterfly salmon filet can look as natural as that, because it looks very natural, but surely it can, because they obviously can make it like that.”*

HCMF

One participant pointed to the tension between making an analogue look like real seafood (high authenticity) and innovation, in terms of design (originality). Ultimately, whether it is more valuable for a product to mimic traditional seafood or to present something different varied a lot between participants.

“Even if it is fake. Why can it not just BE fake? Why try to make it resemble something it is not?”

HCHF, participant 1

However, a lot of participants brought up that an analogue with a simple shape would feel less intimidating than something complicated like a full replica.

“I think I would feel more comfortable if they were 3D-printed in a square shape.”

HCHF, participant 1

“Yeah, I mean, it could be in the shape of a slice, like a cheese almost. I do not think having it shaped as a ball, you know I do not think [is a good idea]. Taking an odd shape would be a bit strange.”

LCLF, participant 1

Therefore, having a shape that is recognizable can be seen as a good starting point when designing an analogue.

5.6.2 Size

Regarding the size of the product, people argued that they prefer to buy a side of salmon instead of pre-cut pieces and when talking about fish analogues they mentioned that they probably would prefer smaller pieces.

When talking about why they prefer to buy larger pieces of fish, participants mentioned how a bigger piece feels fresher and more recently fished. They also mentioned that they sometimes cut the fish into filets themselves rather than buying pre-cut filets.

Participant 2: *“... I have also bought a lot of these small frozen [filets], but nowadays I rather buy large filets and cut them into pieces myself. Then, I can freeze the leftovers myself, and it ends up like frozen fish anyway.”*

Moderator: *“How come?”*

Participant 2: *“Because it feels fresher and more recently fished. I think the whole consistency of a side of salmon is better than these small ones. As someone else may have mentioned, these small - I do not know, they feel more dry. It simply is better quality when it is a larger piece of fish.”*

LCLF, participant 2

Buying the salmon side instead of pre-cut pieces was also seen as convenient because it will last for longer, since it is a bigger piece. You can also cut it into filets and store it in the freezer if you will not cook and eat it all on the same day as you buy it.

“Yeah, [I buy a side of salmon] once a month or so, that is what I usually do. It is convenient. So, you buy these small pieces, then it lasts for one occasion. But with the side of salmon, I use it two or three times. It is just convenient. it is good to pack, like in the freezer, it is just the right amount.”

LCHF, participant 5

This gives the impression that having conveniently small sized pieces is desirable, but also having the opportunity to buy bigger pieces can be good. Something participants saw as a positive aspect of 3D-printing fish was that the size of each filet can be the same and they can be printed in portion sizes. It can be assumed that this is convenient for people who want to make sure they get the nutrients they need, since each piece will have the same ingredients.

“It [the 3D-printer] can make every piece exactly the same. Sometimes it might be that one piece is a bit smaller than what is actually stated in the ingredients. I think it can be really good.”

LCLF, participant 1

“If you have the chance to 3D-print them and shape them, you can make them in portion sizes. That is practical.”

HCMF, participant 1

However it was also brought up that smaller pieces probably are better in the introduction phase when people are getting used to the product.

“I think that in the beginning before you know exactly what it is, then it depends on the price, but it is better with smaller pieces.”

HCLF, participant 5

Having smaller pieces can be seen as less intimidating and also simplify for those skeptical to the food since it is probably less overwhelming with a small piece of fish, compared to a side of salmon, for example. A participant expressed clearly that a bigger piece was a big nono.

“Preferably a smaller [piece] rather than a big [piece], no - no not a big [piece].”

HCMF, participant 5

However, the participants saw opportunities with the 3D-printer and suggested that there could be smaller pieces or bigger pieces, just like it is today with fish.

Participant 4: *“I might want to make a whole baked 3D-salmon filet in the oven, or I might want pieces. So there could be alternatives.”*

Participant 1: *“Agreed.”*

LCMF

The size is an aspect that matters to participants and one of the findings is that the ability to choose is important.

5.6.3 Thickness

Problems around uneven cooking arose when discussing cooking salmon. It was explained that a filet being different in thickness resulted in uneven cooking times, which can be understood to result in parts of it being overcooked or undercooked.

“When it is like that [uneven thickness], it can become a problem when pan frying. The thin side cooks quickly, while the other thick side may take some time.”

LCLF, participant 3

One participant suggested that maintaining even thickness serves as a solution to the issue of uneven cooking for filets.

“Well, I am thinking, if you say side of salmon, the smartest thing would probably be, sure you might want it to be like a side of salmon, but you want it to be equally wide and thick all the way.”

LCMF, participant 4

Besides the struggles with uneven thickness, uncertainty about when fish is cooked through was brought up. Mainly cooking using a frying pan was mentioned in relation to knowing when something is done, but it was also mentioned that cutting into the thickest part of the fish is an easy way to determine if it is done or not. Regarding cooking fish in the oven, it was mentioned that recipes usually are accurate regarding the time and thus good to follow if one is uncertain.

“Yeah, you can see when it is done, and if you cut into the thickest part you can tell if it is ready or if it requires five more minutes.”

LCHF, participant 2

“If you have a recipe that specifies exactly how long the fish should be in the oven, I find that it usually is correct. But otherwise, if you just cook it in a frying pan, then it

can be a bit... You have to cut into the fish to see if it is done, but that way, you break the fish piece.”

LCHF, participant 3

Noting the emphasis on food presentation, it was observed that appearance mattered more when cooking for guests than when eating alone.

“If I am cooking for myself, I do not care that much about the shape. I just want it to taste good. But If I am cooking for others as well, then I need to care about how it looks.”

LCLF, participant 3

Equal pieces of meat or fish was said to be important to some participants, because of ease of cooking.

“... when cooking meat or fish or whatever it is, you want the pieces to be quite equal-equal in size so that everything is ready at the same time.”

HCHF, participant 6

Over all, even thickness was appreciated by participants due to it simplifying the cooking experience.

5.6.4 Color

How our choices are guided by what we see were brought up on several occasions when discussing the color of fish or fish substitutes. A positive aspect that was brought up regarding salmon is that its color makes it pop and thus makes the food more appealing and interesting compared to white fish.

“You also eat with your eyes, and I think salmon looks more appealing [than white fish]. If you make a cream-based sauce and have white fish with it, it does not stand out. Salmon color pops and you go ‘I want that one’.”

LCMF, participant 2

However the color might also depend on the product, it can be expected that if people want something that should be a copy of a fish, it should also have the same color. It was shown in the low consumption, medium food technology neophobia group that slightest nuance difference from the “real thing” might make the food unappealing and feel unnatural. When discussing an image of a 3D-printed salmon, concerns were made over its overly saturated red and thus can look a bit scary. They also mentioned it having a close resemblance to minced meat rather than fish.

Participant 2: *“... normally the salmon in the store is colored, but that one [image of 3D-printed salmon] is almost more red than the one in the store.”*

Participant 1: *“Yes, that one [picture of 3D-printed salmon] looked a bit scary I think, almost like minced meat.”*

Participant 4: *“It almost looks like meat, more like meat actually- yes. Minced meat.”*
LCMF

Some participants pointed out how a white fish analogue that was shown was transparent in the wrong way. Thus it is not only the actual color but also the way it is colored that people react to when looking at something.

“When I am looking at this [white fish without cover], I think of the grain of a piece of wood, the annual rings, more than than the transparency of the ribs of a fish. it is translucent in the wrong way.”

LCHF, participant 5

There was a discussion around whether consumers would take notice of or be bothered by the unnaturally perfect or weirdly transparent appearance of an analogue when buying it from a store.

“But the question is, if I had been standing in the store and no one had said anything, would I have been looking for it? The question is, if the consistency had been the same [as a real fish], I probably would not have reacted.”

LCHF, participant 1

Preconceived expectations of a product's color might affect whether a consumer will find it appealing or not. If someone gets told it should look like a specific fish, people might be more likely to find potential negative differences. Regarding specific coloring, there were a few ideas brought up - such as which color to avoid or what might be a good color and why. It was mentioned that a beige or brown color would make people less tempted to eat it.

“Can not make it beige or brown. A poop-brown color. Then you might not be tempted by it. After all, we eat with our eyes, and our choices are often guided by what we see.”

LCLF, participant 2

An interesting thought related to colors to avoid was that there are a lot of different types of food that might not be appealing but that are still eaten because people are used to it. Specifically black pudding or different types of mixtures such as coleslaw was mentioned as examples of non-appetizing food that people still eat because they know it tastes good even though the food might not look appetizing, according to some.

“We eat quite a few ugly looking dishes that we know taste good, almost everything on the christmas table or all kinds of mixes [swe: röror] look quite unappetizing, but

coleslaw, very tasty! Even if it is slimy and gray, perhaps you just need to try it so that it will become a part of it.”

LCMF, participant 1

Thus the color might help with introducing consumers to food and something that looks appetizing most likely will be what people look for. If it is something people can compare to a real counterpart, they will look for differences and it might make them more skeptical.

5.6.5 Texture and Consistency

The consensus about the consistency of a perfectly cooked fish was that it should flake easily and thus it is expected that a substitute that aims to replace fish should do the same.

“It should easily flake. Because if you take salmon, overly-cooked salmon, it holds together in a different way. Then it just becomes stringy to eat.”

LCHF, participant 1

“It [the substitute] should look like that. Then, when you take a fork, it should fall apart easily in the same way [as its ‘real’ counterpart].”

HCMF, participant 5

“... the consistency, it just falls apart, and it should be moist enough; it should not be dry.”

LCMF, participant 4

Most participants stated that they enjoy the consistency of fish. Whether the participants enjoyed the consistency of oysters varied way more. Some participants explained that the slimy consistency was unpleasant. Most participants in the low consumption and high food neophobia group expressed their disliking towards the consistency of oyster.

Participant 2: *“[Oysters have] a slimy consistency.”*

Participant 4: *“it is not something I fancy.”*

Participant 3: *“Me neither.”*

LCHF

Something being slimy was often mentioned in combination with things participants disliked or with things they would prefer not to eat.

Participant 8: *“I think it [seaweed] sounds a bit slimy actually.”*

Moderator: *“So you are not so keen to taste it?”*

Participant 8: *“No, definitely not.”*

Something being rubbery was also a consistency often mentioned in relation to things being disliked. It was explained that deep fried squid is fine because of the contrast between the rubbery consistency and the breading.

“... [the rubbery consistency] is quite nice together with the breading.”

Participant 2, LCLF

However, rubbery consistency was also brought up as something negative and it can be concluded that it comes down to personal taste or depending on what food it is that is rubbery.

“I had only tried rubbery octopus previously that was not good, but this one was soft and tender, buttery and amazing.”

Participant 1, LCMF

When discussing the expectations of the consistency of a seafood analogues or real, the participants worry about it being dry. Participants expressed that they were almost expecting it to be dry, or at least that it would be hard to cook to not make it dry.

5.7 Summary of findings

Based on the findings several conclusions were drawn that helped the project move forward. Since fish was the most commonly eaten seafood and something most focus group participants enjoyed in one way or another we decided to focus on creating an analogue for fish. The reason for this was based on how frequently fish were mentioned when asking about seafood, it was also mentioned as something most people were enjoying and that were regarded as quite simple to cook and thus convenient to include in the everyday routine. When showing the images of the different 3D-printed seafood products, a key issue with shellfish were discovered, people spoke about how shelling shrimp, crayfish, lobster or crab is part of the experience the participants expressed that they enjoy with shellfish, which most likely would be hard to achieve if they were to be 3D-printed. When talking about printing something that usually is meant to be peeled with edible shells, the reactions were quite skeptical and it was not something people seemed that interested in. Regarding squid or octopus, those species were mentioned as something appreciated but not as everyday food.

Sustainability

- ❖ Seafood, particularly fish, is seen as more environmentally friendly than red meat.
- ❖ Fish from fish farms is seen as less environmentally friendly than wild fish.
- ❖ Knowledge about labeling varies, some participants were very educated while some had more limited knowledge and expressed difficulties with knowing how to choose the more environmentally friendly product if they had interest in doing so.

- ❖ There was talk about how just because something is vegan or vegetarian it will not automatically mean that it is better for the environment.
- ❖ Knowledge about environmental impact might affect willingness-to-buy and make consumers choose one product over another.

Information needs

- ❖ Knowledge about the ingredients of a product as well as the nutritional values were mentioned as a decisive factor when deciding to buy a product.
- ❖ Communicating potential nutrient differences between a substitute and its real counterpart was mentioned as important.
- ❖ Labeling and such should be easy to understand to help the customer make choices comfortably.
- ❖ Recommendations from authorities about the environment and which fish to choose were mentioned as something rarely thought about when buying fish in the store.
- ❖ Preference for an analogue to be preparable through cooking.
- ❖ A substitute will be expected to behave like its real counterpart when being cooked.
- ❖ If a substitute is expected to be cooked differently from its real counterpart, this has to be communicated.
- ❖ Information about how a product is supposed to be cooked is expected to be found on the package.

Contents

- ❖ The substitute should aim to contain the same amount of nutrients as its real counterpart.
- ❖ The substitute should work with the same commonly used accompaniments as similar fish-based products.
- ❖ The substitute should be vegan or vegetarian.

Target consumer

- ❖ Traditions were concluded to play a significant role when shaping one's dietary preferences.
- ❖ Substitutes were met with a feeling of “not for now - but for the future”.
- ❖ The ingredients of foods were explained as something people worry more about nowadays compared to in the past.

- ❖ The price is important when people decide what to buy.
- ❖ Fish from fish stands were spoken about as more expensive than frozen fish.
- ❖ The name of an alternative product should be different from the name of the original.
- ❖ Mentions about not targeting kids with alternatives since there is a worry that there will be nutrients they need but that will not be present in alternatives.

Positive and negative similarities to seafood

- ❖ Being able to differentiate between an alternative and the real counterpart were seen as important.
- ❖ Some participants were keen on having the alternative as similar as possible, possibly to avoid having it in the uncanny valley category.
- ❖ Boneless fish was seen as something positive.
- ❖ Salmon was seen as convenient and this is something an alternative should be as well.

Sensory aspects

Shape

- ❖ Simpler shapes were regarded as better and less intimidating.
- ❖ Recognizable shapes were preferred as an introduction, before eventually making things more unnatural or experimental.

Size

- ❖ The possibility to choose between different sizes was seen as advantageous.
- ❖ Having identical pieces of the same size would be good.
- ❖ Preference for smaller pieces, not something big.

Thickness

- ❖ Having an even thickness is good when cooking, since it allows the whole piece to be done at the same time.

Color

- ❖ Salmon can be seen as more appealing than white fish, since the color makes it stand out.
- ❖ Slight variations of the same color can turn food from appealing to unappealing.

- ❖ An appealing color might make it look tasty, but a food you know tastes good might not have to look appealing to still be eaten, such as black pudding. It might be something one can get used to.

Texture and Consistency

- ❖ If it is meant to be a fish filet it should have the same consistency as a fish.
- ❖ A slimy consistency was regarded as quite unappealing.

5.7.1 Initial functional design requirements - Map of needs

A map of needs, see Figure 6, were created based on the findings, it served as a baseline for the list of functional demands and helped structuring and getting an overview of the findings.

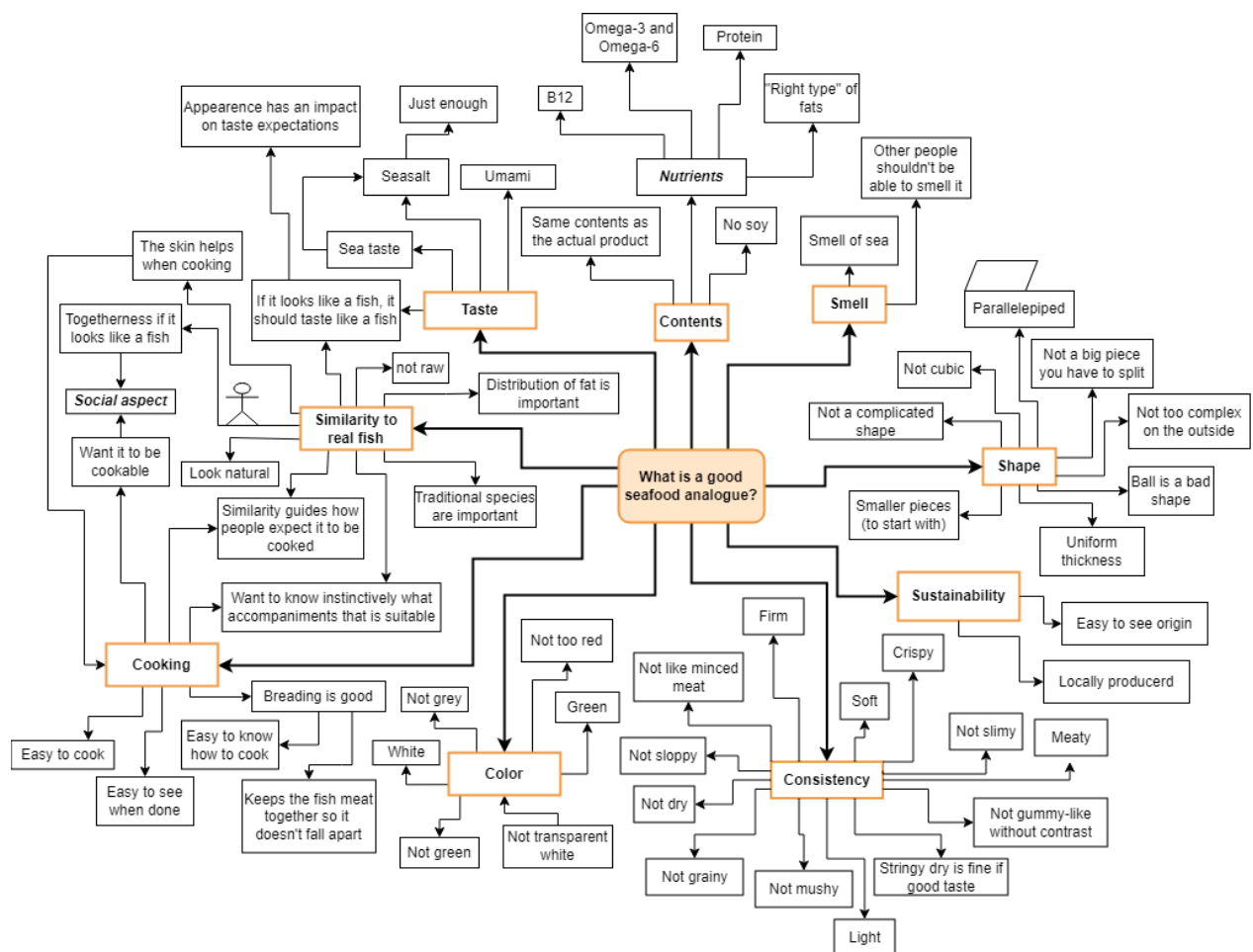


Figure 6. Map of needs (own illustration)

5.7.2 Final functional design requirements

Based on the analysis of the focus group data and the map of needs, a functional list, see Table 4, were created. The functional demands were divided into categories to easier distinguish the ones particularly important for the visual of the analogue and therefore the design. The categories were based on those used during the RQDA analysis: content,

information, sensory aspects, sustainability and target consumer. Production was also added since some requirements were closely connected to the production of the product.

The main function is to enable edibility, since it is food and the main goal is for people to eat it. Besides the secondary functions related to content, express trust and grant pleasure were seen as important functions since for people to ingest something, they most likely need to trust it and it should grant pleasure, to encourage them to eat it again.

Category	verb + noun	Limitations	Class	N/D/T/U
Content	<i>preserve</i> nutrition	Nutrition should not be lost in processing before consumption	supporting function	<i>desirable</i>
	<i>enable</i> edibility	The product must be edible for a variety of people	Main function	necessary
	<i>contain</i> fluid	To the extent that the product is not dry to consume	<i>secondary</i> function	<i>desirable</i>
	<i>contain</i> protein	Similar amount to fish	<i>secondary</i> function	<i>desirable</i>
	<i>contain</i> omega-3	Similar amount to fish	<i>secondary</i> function	<i>desirable</i>
	<i>contain</i> natural ingredients	Contain as low amount of highly processed foods as possible due to traceability	supporting function	<i>desirable</i>
	<i>contain</i> fat	Similar amount to fish	<i>secondary</i> function	<i>desirable</i>
Information	<i>contain</i> collagen	Similar amount to fish	<i>secondary</i> function	thinkable
	<i>express</i> truthfulness	Clear information without withholding of specifics	supporting function	necessary
	<i>express</i> trust	Product should give the impression that it is a trustworthy product and producer to consumer/buyer	<i>secondary</i> function	necessary
Production	<i>convey</i> authenticity	The information related to contents of the product being as "natural" as possible	supporting function	necessary
	<i>avoid</i> contamination	Be able to account for specifically HOW the product is made and what processes are implemented for safety and hygiene	supporting function	necessary
Sensory aspects	<i>enable</i> printing	The product should be 3D printable, using STL format.	<i>secondary</i> function	necessary
	<i>simplify</i> shape	Make something new into a shape that is recognizable for consumers	supporting function	necessary
	<i>grant</i> pleasure	Through all parts of use	<i>secondary</i> function	necessary
	<i>express</i> ocean	Remind the consumer/buyer of the context of the product and how to prepare it	supporting function	thinkable
	<i>express</i> rawness	Related to natural contents	supporting function	thinkable
	<i>express</i> good flavor	Be perceived as tasty to consumer	<i>secondary</i> function	<i>desirable</i>
	<i>express</i> freshness	Similar to seafood, where freshness is paramount	supporting function	<i>desirable</i>
	<i>define</i> marbling	Marbling should be clear and crisp	supporting function	<i>desirable</i>
	<i>communicate</i> naturalness	Related to natural contents	supporting function	thinkable
Sustainability	<i>be</i> marbled	Marbling is very important	supporting function	necessary
	<i>avoid</i> dryness	Texture is important	supporting function	<i>desirable</i>
	<i>simplify</i> tracing the product's origin	Make the new product relatable to buyer and consumer	supporting function	<i>desirable</i>
Target consumer	<i>simplify</i> good environmental decisions	Make it easy to purchase instead of less environmentally friendly products	supporting function	<i>desirable</i>
	<i>encourage</i> environmental friendliness	Product should actively support environmentally friendly causes	supporting function	thinkable
	<i>specify</i> portions	Show clearly how much of the product should be consumed for an (to seafood) equivalent nutritional benefit	supporting function	thinkable
	<i>simplify</i> portioning	Make portioning as easy as possible	supporting function	<i>desirable</i>
	<i>simplify</i> integration	Should easily be integrated into the daily food routine.	supporting function	necessary
	<i>simplify</i> cooking	may not take more time to prepare than "regular" seafood	supporting function	<i>desirable</i>
	<i>express</i> tradition	Be able to be used in a traditional context	supporting function	thinkable
	<i>express</i> easy digestion	Through appropriate size and content	supporting function	<i>desirable</i>
	<i>encourage</i> togetherness	Be able to be used in a traditional context	supporting function	thinkable
	<i>clarify</i> suitable accompaniments	Should be easy to identify suitable accompaniments.	supporting function	<i>desirable</i>
Target consumer	<i>be</i> vegetarian	Contain no animal products where any animal is hurt in the process	<i>secondary</i> function	<i>desirable</i>
	<i>be</i> vegan	Contain no animal products	<i>secondary</i> function	thinkable

Table 4: List of functional design requirements

6. Concept development

The concept development phase and methods were mainly based on the previous analysis phase and the concluded list of functional demands. Brainstorming, PNI and prototyping were the main methods used during the concept development phase. The concept development phase was done in a closed environment where the conclusions were based on our own design expertise without external user input.

6.1 Brainstorming and brainwriting

To start off the creative process there was an initial brainstorming session. We had a discussion so that a general consensus was reached about the important design requirements from the previous chapter that should be implemented in a final design. A few general designs were created. The process consisted of 40 minutes of individual idea generation (sketching and writing), the ideas were then presented and brainstormed together before repeating the process again. Initially the range of ideas was quite narrow but after discussing ideas and performing another round, the range expanded and the ideas became more varied and outside of the box. The process was repeated until the amount of ideas were concluded to be enough to continue the development process, see Figure 7 for some of the ideas.

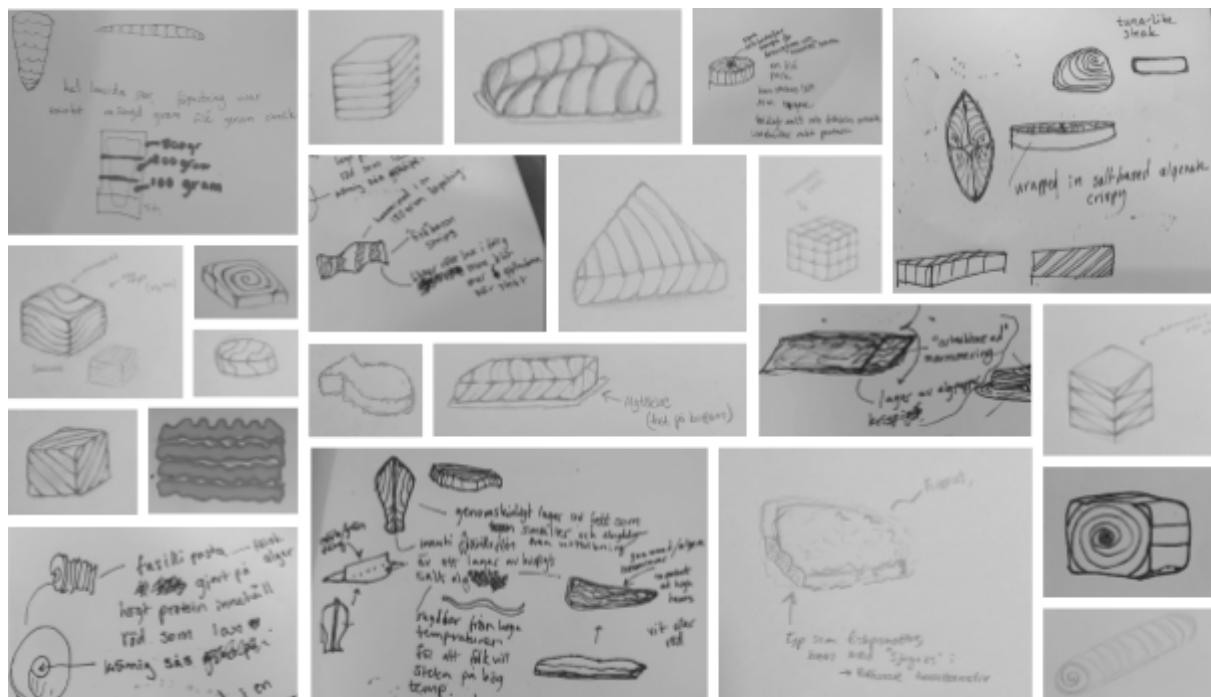


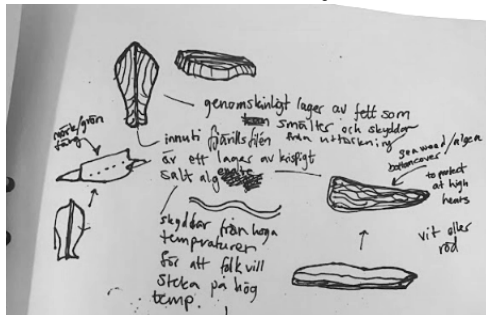
Figure 7: Result from brainstorming (own illustrations)

6.2 PNI

The ideas from the brainstorming session were evaluated using the PNI method. Each idea was evaluated and resulted in five ideas, see the list of ideas below, that qualified for further

development. These ideas were further iterated and evaluated before there was a final decision on a concept design that fulfilled the list of functional design requirements.

Idea 1: Salmon butterfly

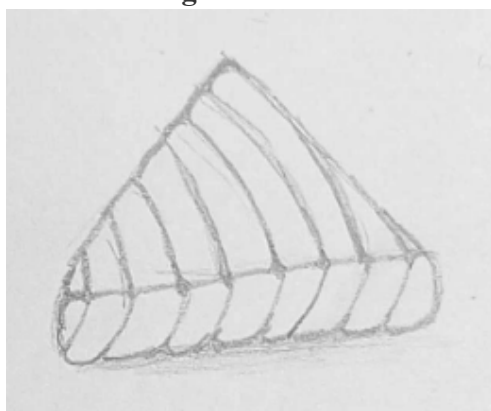


Positive: Salmon butterflies give a luxurious feeling. Possible to pan fry on top of the crispy part.

Negative: Complicated shape. Unclear if everything is edible. Might trick the customer.

Interesting: Protective layer when cooking.

Idea 2: Triangle

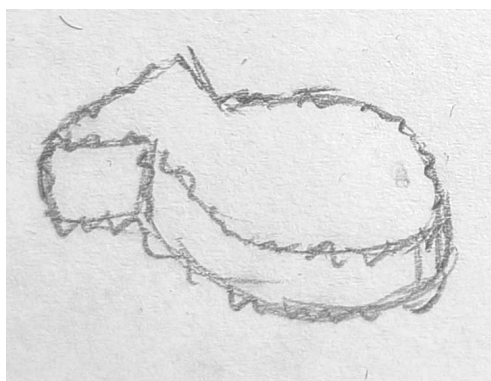


Positive: Uniform thickness. Should be easy to print. Cute. Different sized flakes. Not too similar to real fish. Interesting packaging alternatives. Easy to portion. Most likely won't trick the customer.

Negative: Risk that the marbling makes it too similar to fish.

Interesting: Interesting shape even if it is an easy shape.

Idea 3: Cartoon fish

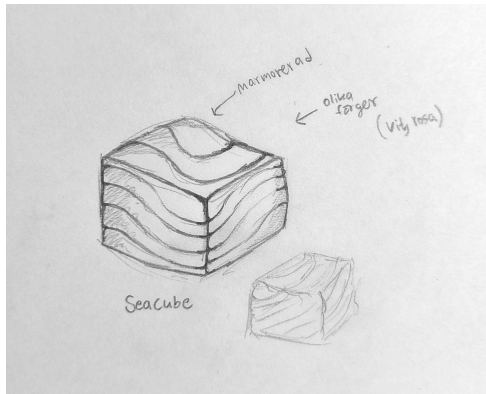


Positive: Fun shape, happening. People like breeding, easy to cook. Good for kids.

Negative: Bit unclear. Can be perceived as not serious. Can be perceived as fake. Breeding may make it seem more unhealthy.

Interesting: Caricature of fish, how does that affect the perception, is it seen as tricking or not?

Idea 4: Small Cube

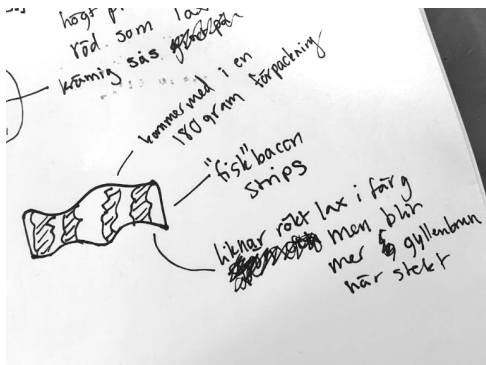


Positive: Shape that can be used in several different types of food. Focus on the consistency instead of the shape (good introduction to the food). Easy shape, like stew pieces.

Negative: How is it supposed to be used? Soup, stew, pan fry? Small pieces can make it hard to portion.

Interesting: Versatility, good for variation.

Idea 5: Fish bacon



Positive: Can replace bacon. Pleasure before being healthy. Something new.

Negative: Might trick the customer (they might think it is bacon or gravlax). Might have people use higher temperatures - which makes the "good" ingredients disappear.

Interesting: Something new. Not focus on being healthy, rather focus on tasting good.

The idea that was ultimately chosen was the triangle. It had many positive aspects. It had a friendly impression, was not too complicated in structure and was thought to be a great candidate for 3D-printing on a large scale. When the generalized shape was chosen, we iterated to find a suitable size and shape of the marbling, which was critical to the design, see Figure 8 and Figure 9.

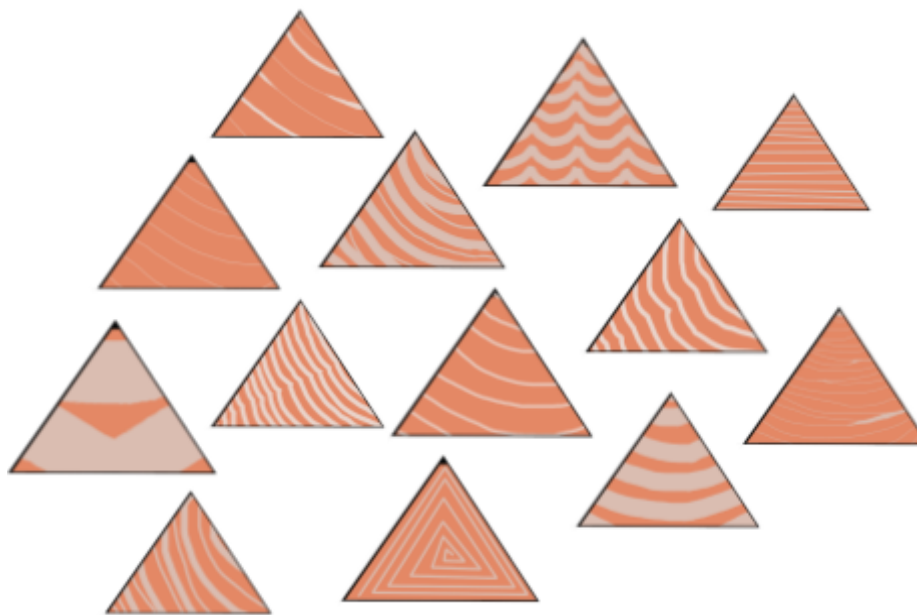


Figure 8: Different iterations of marbling designs (own illustration)

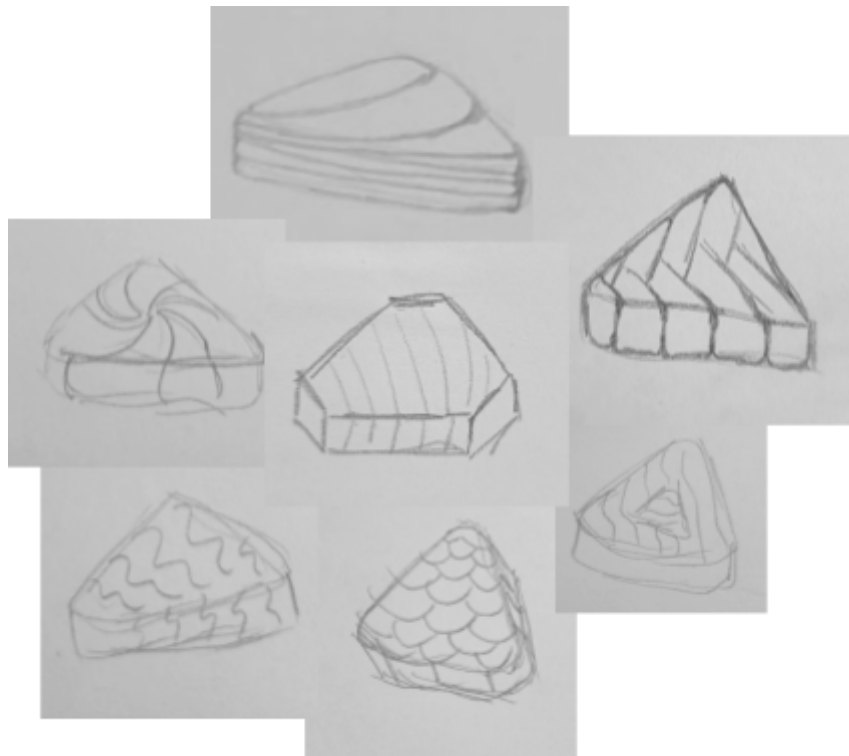


Figure 9: Different alterations of the triangle (own illustration)

6.3 Prototyping

When a rough understanding of the shape was achieved during the brainstorming process, iterating the size and marbling design became a bit difficult. It became clear that the size of the product and the marbling were hard to form an impression of, without creating an actual mockup. Using clay and styrofoam, several models were created in various sizes and shapes with different types of marbling, see Figure 10 and Figure 11. Using a plate, knife and fork for scale, see Figure 12, helped with deciding the size of the product and it also became clear that the type of marbling was dependent on the shape of the product.

The plate was used to visualize how it might look on a dining table. The knife and fork were important props to “mimic” the feeling of actually cutting or having the pieces fall apart. It became obvious that a piece that was too big felt overwhelming and not appetizing at all. By thinking of what potential foods it might replace, possible accompaniments were used as a way to decide the size of the product. Filets, fish sticks or meatballs were possible food items to be replaced and the size were therefore inspired by theirs.

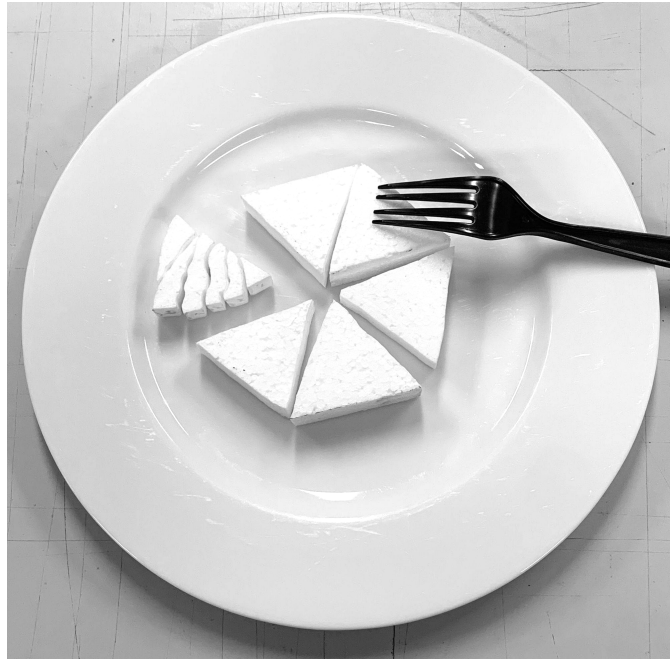


Figure 10. Prototype size in relation to fork and plate (own photo)



Figure 11. Different types of marbling (own photo)

To get a rough understanding of appropriate colors of the product, the Natural Color System, NCS, were used, see Figure 12. Different colors were compared and discussed but mainly different nuances of orange were evaluated since it associates with salmon, a fish that was often mentioned as a favorite or “likable”.



Figure 12. Color study (own photo)

Illustrations with the different nuances of orange were used to pick the most suitable color for the product. It was discovered that just a slight change in nuance could have a large impact on how appetizing something looked. In Figure 13, different nuances can be seen where the first one was decided to be too red, and more similar to tuna, the second one was more pale but felt unnatural, the third one was too saturated and it was assumed that consumers might associate it with having a lot of unnatural coloring added. The fourth one was determined to be the color most associated with salmon and also the most appetizing color. To broaden our design horizons we made sure to investigate other color options deviating from the colors similar to salmon, see Figure 14.

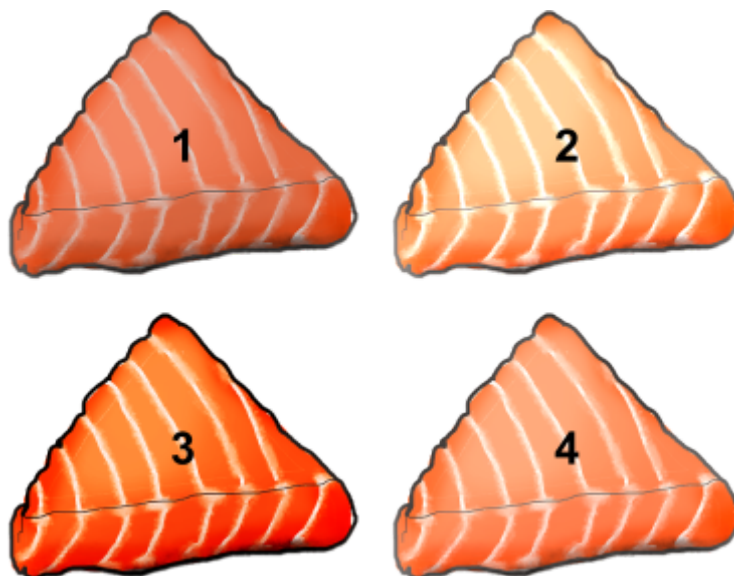


Figure 13. Different nuances (own illustration)

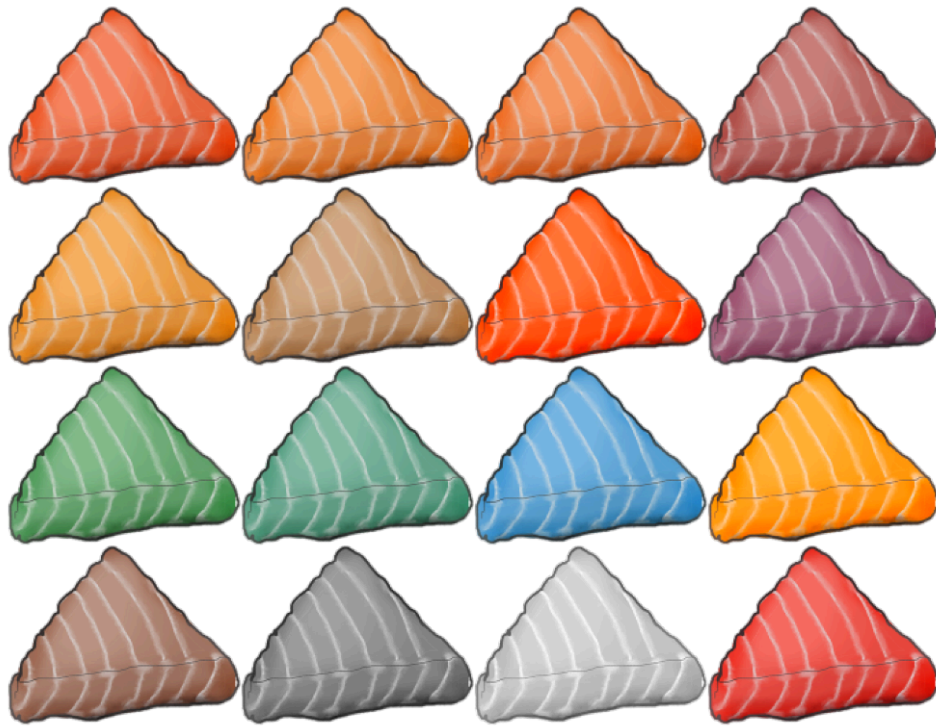


Figure 14. Many different nuances (own illustration)

6.4 3D-modeling

A 3D-model was crafted using CATIA V5 to enhance the conceptual visualization, as illustrated in Figure 15 and Figure 16. Subsequently, this model was forwarded to RISE to serve as a foundation for their continued efforts in developing future physical prototypes through 3D printing. This collaborative effort ensures the seamless translation of our conceptual design into a tangible model. The design was considered by the project group to be a good model to use for potential mass-production because of the stackability of many triangles in one 3D-printing process.

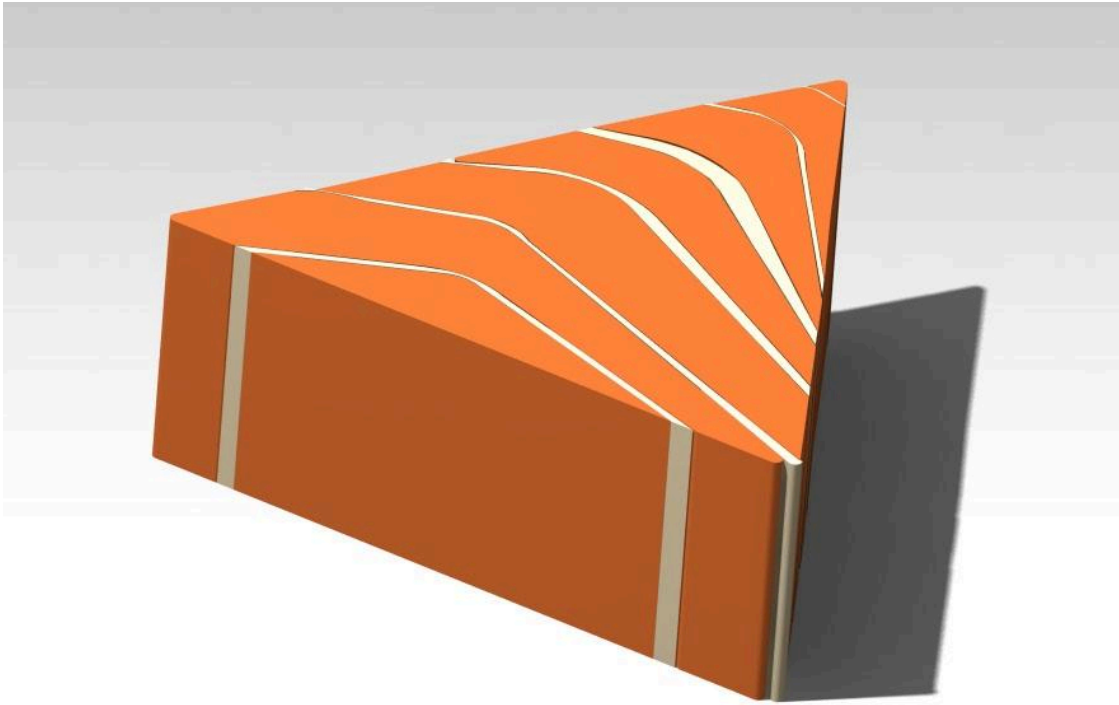


Figure 15: Rendering of prototype full-body in CATIA V5

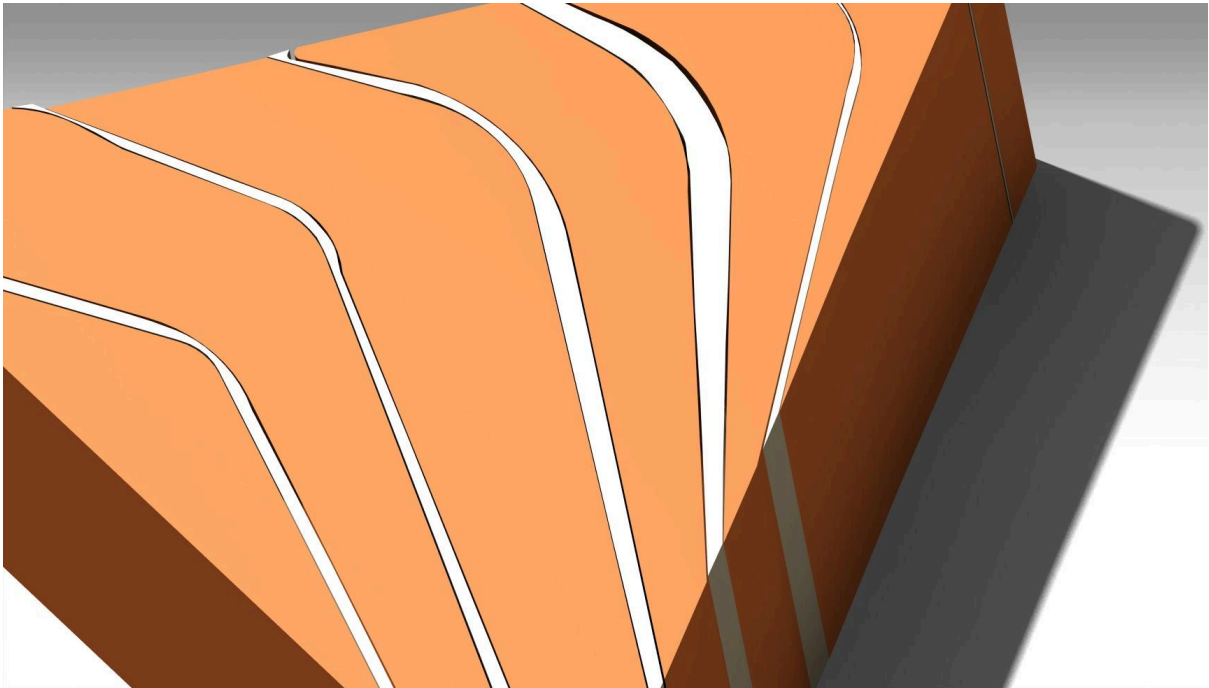


Figure 16: Rendering of prototype full-body in CATIA V5

7. Design proposal

As previously mentioned in chapter 2, the design of the final product “HAVSUDDEN” is a triangular shaped fish analogue, see Figure 17. The design choices are based on the functional design requirements list, which are based on the findings from the focus groups and thus the proposal should fulfill the needs and wishes from the potential consumers. This distinct design not only makes it visually appealing but also sets it apart from other vegan fish analogues in the market.

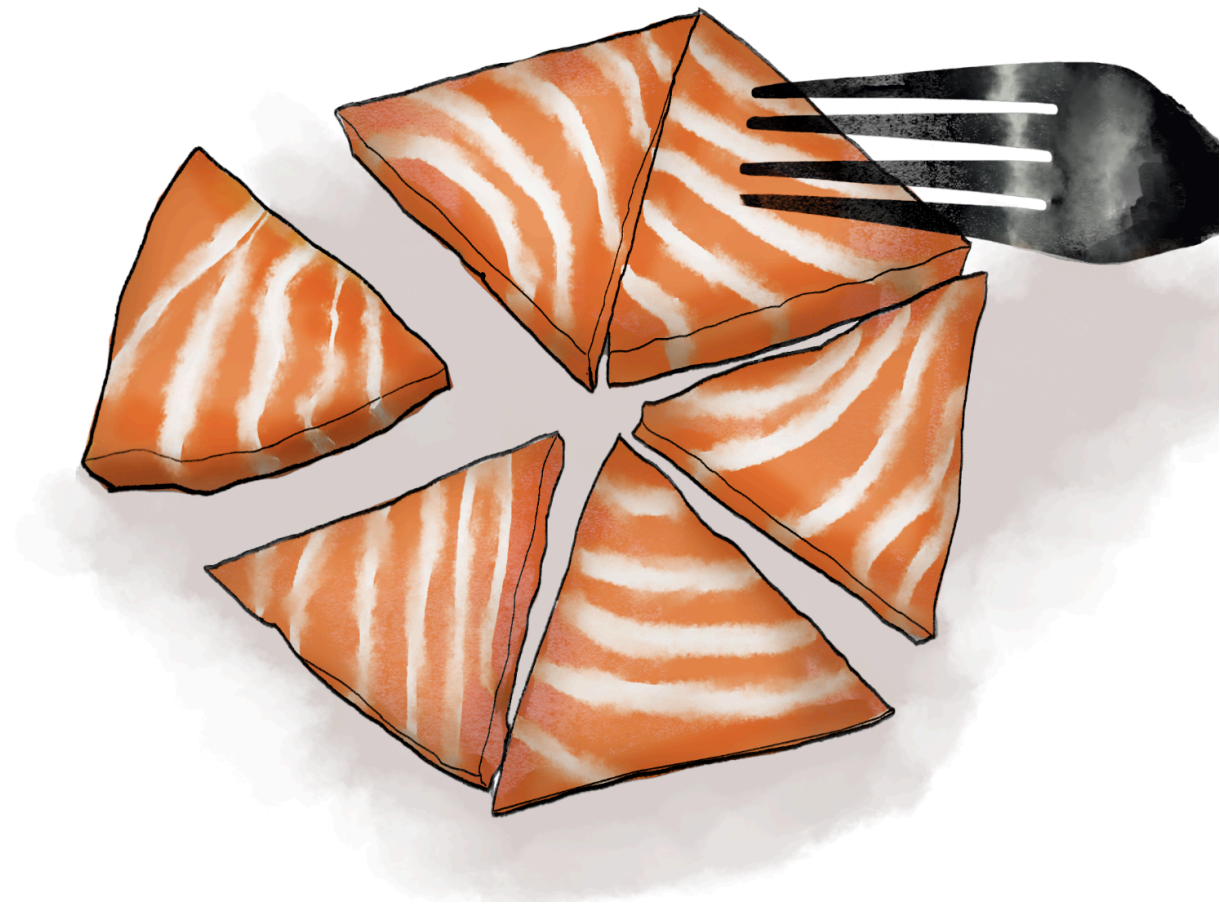


Figure 17: The design proposal

7.1 Shape

The shape of the design is an equilateral triangle which provides several interesting palatability alternatives and packaging options, see Figure 18.

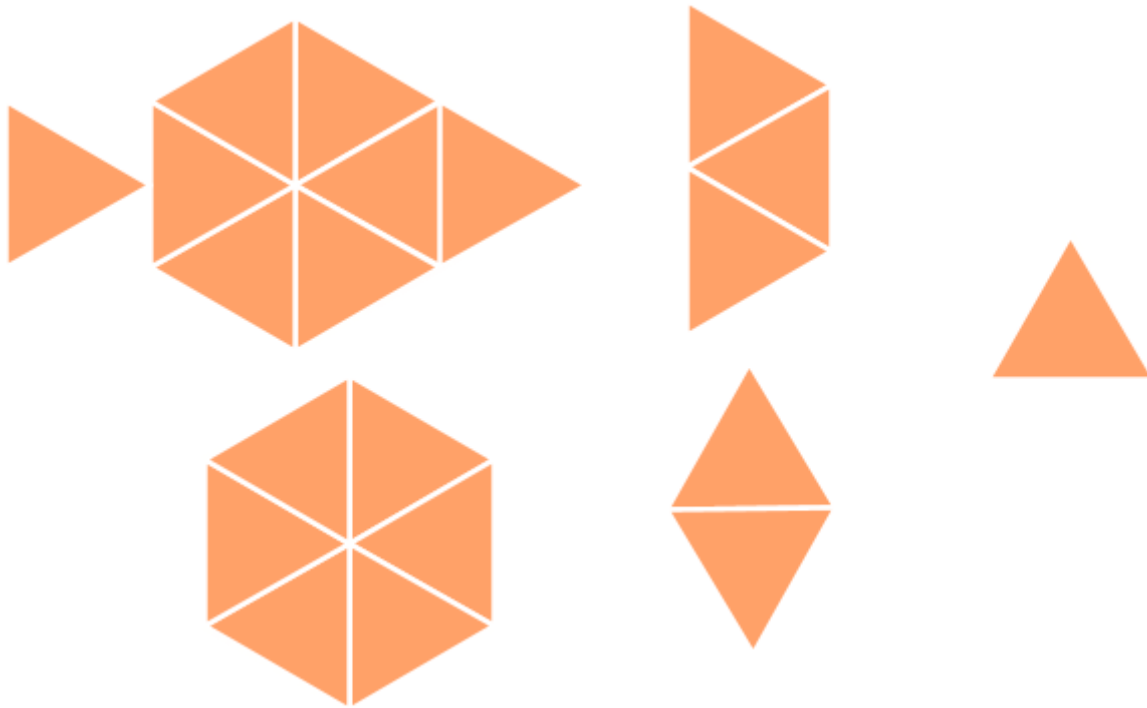


Figure 18. Shapes (own illustration)

A fish filet is usually rectangular and stew pieces are more cubical, a triangle on the other hand is a shape that is not directly associated with fish or current fish products. Fear of being deceived was brought up on several occasions in the focus groups and by choosing a shape not commonly used for fish today it should help with distancing the substitute from the real fish.

Having a shape that is rarely used for fish may also lower the expectations on taste and consistency since the consumer has less products to compare it with and therefore should have less preconceived expectations. This is advantageous since with less expectations it is harder to be disappointed and therefore gives the product some leeway to not be perfect.

The triangle is also a shape that is not too unfamiliar in the food industry and some common food items such as pizza slices and nachos, thus a shape that is not completely new in the food industry which might make it less scary. Using a shape that is well known adds to the safety feeling since people are not unfamiliar with it - it is just used in a new context. The shape itself can be associated with stability and thus one can argue for it to be expressing safeness.

7.2 Size and thickness

The sides of the triangle are around 55 millimeters in length and the thickness is 20 millimeters, see Figure 19. It is something that can be varied, but as a standard product, the preferred size of our product should be smaller than a regular filet but bigger than a tiny bite.. This decision was based on the trend that smaller pieces are more desirable than bigger, since it both allows for consumers to choose their preferred amount to plate up and to prepare, but also makes it less overwhelming for people who might be skeptical of new foods, see Figure 20. The thickness of the piece is uniform to simplify cooking and allow the product to be ready at the same time.

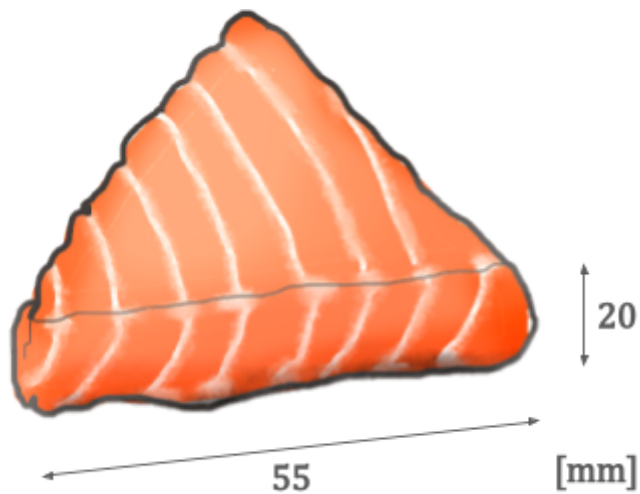


Figure 19. Size of design (own illustration)



Figure 20. Size of design in relation to a plate (own picture)

7.3 Marbling

Choosing to have a marbled product was fairly easy since it was mentioned several times in the focus groups as something that made fish desirable, and therefore something that people most likely would appreciate in a fish substitute. The marbling however does depend on the size of the product and it is something that can only be briefly explored using mockups and drawings and therefore a final decision on the gap between the fat and how the marbling is shaped has to be explored further with the actual material and proper taste testing.

However the marbling decided on in this iteration of the final concept is mimicking the marbling of a salmon or white fish, and has several layers of fat that is roughly 3 millimeters, see Figure 21, to hopefully provide a baseline for a good flakiness.

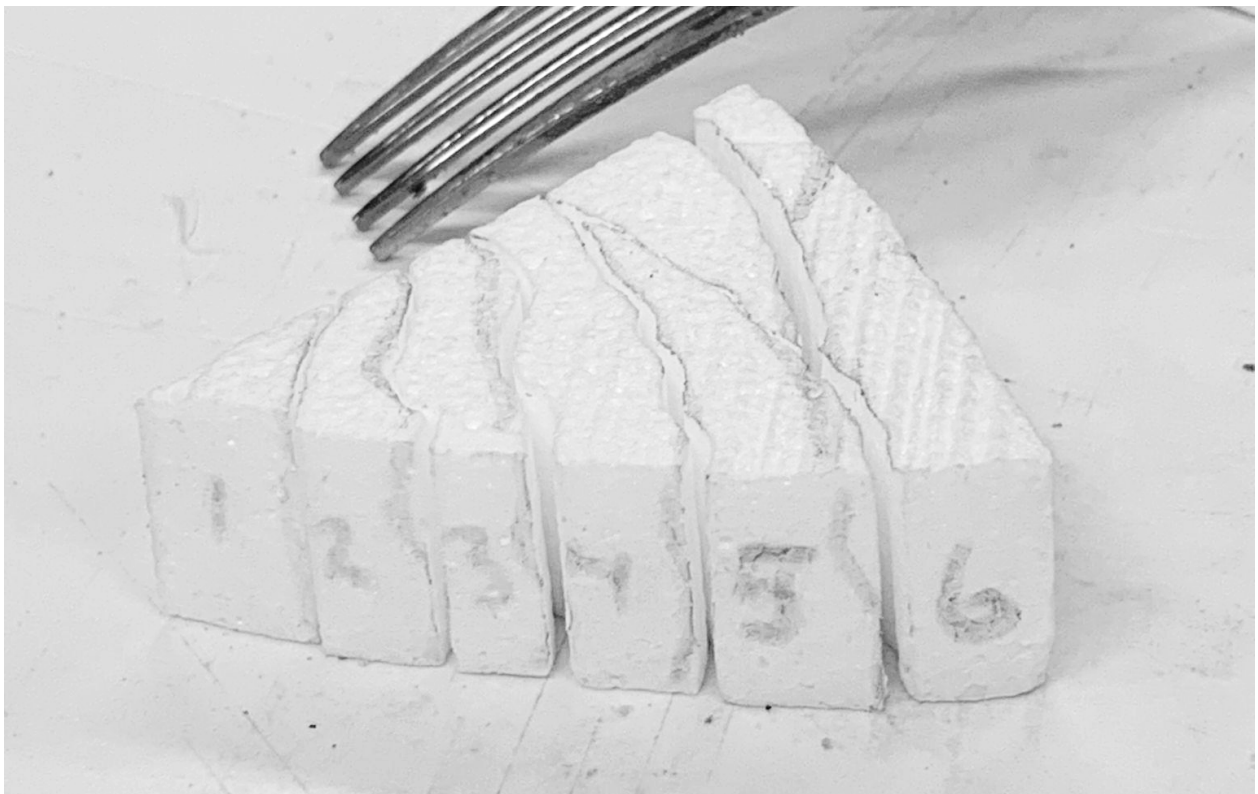


Figure 21. Preferred marbling style, numbered for ease of assembly (own picture)

7.4 Color

The color used in the illustrations for this concept is similar to the main color of salmon, as salmon was a fish mentioned frequently and many are familiar with it. It also provides some color to the plate when serving, compared to a white or gray fish, which can improve the visual and thus fulfill the requirements of making it more appetizing.

The color that was chosen using the NCS system for “Havsudden” was NCS S 0550-Y50R, see Figure 22. With the caveat that there could be big variations in color in reality, because of differing ingredients and color changes that could come with cooking, and thus lighter and darker parts could be present.



Figure 22. Base color (own illustration)

7.5 Ingredients and Nutrients

The amount and kinds of nutrients that should be included in the final product should be equivalent or near equivalent to real seafood, more specifically, rich in omega-3, omega-6 and protein. If consumers want to replace traditional seafood with the analogue, replicating the nutrient profile of real fish would simplify the substitution process for the consumer, according to participants. The inclusion of similar nutrient levels is not only a matter of convenience but also a strategic consideration in the product design based on the focus group data.

Keeping the nutrients similar to real fish also simplifies direct substitution since the consumer will not have to add something else to get the needed nutrients, which also fulfills the task of making it easy to include in the daily routine. Furthermore, the move towards a vegan formulation of the product broadens its appeal. The focus group data showed that this is not only pertinent to the growing demographic of vegans and vegetarians but also caters to those who are seeking to reduce their seafood consumption for various reasons.

8. Discussion

This chapter discusses important topics that concerned the focus groups, screening, color, texture and ingredients that were brought up during the project but were ultimately considered beyond scope. The chapter includes a final project conclusion with hope for future study.

8.1 Focus groups

Regarding diet discrepancies, the findings from the screening survey was an eye-opener. Initially, we made the assumption that most people meet the general dietary guidelines of eating seafood 2-3 times per week. The reality, however, showed us a different picture where only a fraction of the respondents met the recommendations. By looking at the answers the most logical way for us to split the groups was to simply have 2 categories of seafood consumption, high and low, where high included the recommended intake. This most likely did not make a big difference in the study since the project would end up being focused on the overall consensus instead of the differences between the focus groups.

At the start we assumed the differences would be big, but after the first few focus groups it became obvious that the differences were smaller than expected and difficult to distinguish so therefore, even if the project had an intention to look for differences, it became clear that focusing on the overall consensus were more important for the design process. If we had instead focused on differences, it would have been a possibility that we came up with one design for each focus group, while in reality, would rarely be the case for a food product and thus trying to combine the groups demands and thoughts into one design was decided to be more advantageous.

But there are definitely some interesting things to investigate in the future. For example, our assumption at the project's outset was that skepticism towards new seafood analogues would predominantly reside in groups with high food technology neophobia, however, the skepticism was shown to be present more or less in every focus group. This was surprising and showed us that it was very important that we worked hard to not accidentally disregard the opinions of those with more negative perspectives.

8.2 Color, texture and ingredients

Regarding the design itself there are several factors consumers evaluate when buying or consuming an analogue, color and marbling were the aspects found most complicated to design and evaluate.

The color of an analogue product matters significantly to consumers. When showing images of current 3D-printed seafood analogues during the focus groups, the importance of color and saturation was made clear. It was interesting to see how the participants reacted and spoke about colors and saturation and how it impacted their view on the different analogues. For

example, an image of a salmon was sometimes explained as too red which made participants feel that it was unnatural, some participants however barely mentioned the color and seemed happy with it. When we were creating prototypes, we discussed colors and it was quite clear that only a tiny change in nuance gave a totally different impression and could change something from looking appetizing to looking unappetizing. The color is therefore something that has to be studied further and finding a color that consumers appreciate and find appetizing would be crucial to succeed with satisfying the customers demands.

Mouthfeel is closely related to marbling and texture which on several occasions was brought up as an important part of why people enjoy fish. Participants in the focus groups described how “the perfect fish consistency” should be, not only regarding mouthfeel but also how it should feel when cutting into it using cutlery. However, in this project we have only been able to briefly describe how the marbling should be based on the data from the focus groups but further exploration and evaluation of different variations of marbling and texture is needed to ensure satisfaction.

Regarding ingredients in a seafood analogue one can argue that there are two ways to go, either have it as close to or the same as the product that it aims to replace OR it has to be very clear what the differences might be if it does not contain the same as the real counterpart. The key is to be transparent with the consumer so that they can make their own choice without being worried about missing out on important nutrients. Since the specific contents in the analogue have not been focused on in this project we have not gone deeper into the environmental impact of analogues either. Regarding the impact of 3D-printed food versus real fish, it is something that would need to be investigated further when there is a more final decision about the contents of the analogue and how the 3D-printing process is laid out.

8.3 Conclusion

Reflecting on our journey, participant one from group LCMF aptly said, “I am no more or less scared of a 3D printed food than I am of a sausage.” This sentiment encapsulates the shift in perception and acceptance that our project, “Havsudden,” could catalyze. As our initial assumptions and expectations were challenged and evolved, “Havsudden” emerged as a product offering diverse options for consumers. Looking ahead, we acknowledge the challenges and opportunities that lie before the seafood analogue market, yet we are confident that “Havsudden” can pave the way for a future where seafood alternatives are celebrated.

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Appendix

APPENDIX A: SURVEY QUESTIONS USED TO CALCULATE FOOD TECHNOLOGY NEOPHOBIA SCORE FOR EACH RESPONDENT

- 1. *There are plenty of tasty foods around so we do not need to use new food technologies to produce more.*
- 2. *The benefits of new food technologies are often grossly overstated.*
- 3. *New food technologies decrease the natural quality of food.*
- 4. *There is no sense trying out high-tech food products because the ones I eat are already good enough.*
- 5. *New foods are not healthier than traditional foods.*
- 6. *New food technologies are something I am uncertain about.*
- 7. *Society should not depend heavily on technologies to solve its food problems.*
- 8. *New food technologies may have long term negative environmental effects.*
- 9. *It can be risky to switch to new food technologies too quickly.*
- 10. *New food technologies are unlikely to have long term negative health effects. (R).*
- 11. *New products produced using new food technologies can help people have a balanced diet. (R).*
- 12. *New food technologies give people more control over their food choices. (R).*
- 13. *Information / media (4) 13. The media usually provides a balanced and unbiased view of new food technologies. (R).*

APPENDIX B: IMPORTANT QUOTES FROM FOCUS GROUPS: TRANSLATION FROM SWEDISH TO ENGLISH

5.1 Sustainability

Participant 4: *“Then one probably also imagines that it is more environmentally friendly to eat fish than meat. But I can not really say why. Fish are more naturally available, cows and pigs have to be bred.”*

Participant 1: *“But what about farmed salmon?”*

Participant 4: *“I do not like that. It feels stressed, a bit like the chicken industry, I think.”*

LCMF

Deltagare 4: *“Sen inbillar man väl sig också att det är mer miljövänligt att äta fisk än kött. Men jag kan inte riktigt säga varför. Fisk är mer naturligt finns. Kor och gris måste man föda upp.”*

Deltagare 1: *“Men odlad lax då?”*

Deltagare 4: *“Det gillar jag inte. Det känns som det är fram-stressat som lite som kyckling branschen tänker jag.”*

LCMF

“But we spoke before about how it is better for the environment to eat fish instead of meat. I agree, but I also think that maybe not always because we are fishing in the ocean, which is good, but there is also places where they make space to grow fish, that is not so good. We have to use water and feed the fish. It is not so good for the environment if we do it this way.”

HCLF, participant 2

“Men vi pratade också förut om att det är bättre för miljön att äta fisk än kött. Jag håller med, men jag tänker också att det kanske inte alltid eftersom vi fiskar i havet, det är bra. Men det finns också platser som man gör plats för att växa fisk, det är inte så bra. Vi måste använda vatten och ge mat till fisk. Det är inte så bra för miljön om vi gör så här.”

HCLF, deltagare 2

“I do not know if it is correct or good to think this way, but that is usually how I think - that it [the fish] is probably luminescent and super bad, but maybe it has lower climate footprint than meat or something else.”

HCLF, participant 3

“Jag vet inte om det stämmer eller om det är bra att man tänker så, men det brukar i alla fall jag tänka, att den är säkert självlysande och jättedålig, men kanske lägre klimatavtryck än kött eller något annat.”

HCLF, deltagare 3

“Soybeans also require quite a lot of the Earth's resources. It is not automatically more environmentally friendly just because you choose a different product. It is also about the consumer's knowledge to understand what is in it. The whole lifecycle. But absolutely. If it had been another product that I know has less environmental impact.”

LCHE, participant 1

“Sojabönorna kräver ganska mycket av jordens resurser också. Det är ju inte per automatik bara för att du tar en annan produkt att det blir mer miljövänligt. Det är också kunskapen hos konsumenten att

förstå vad det var i det här. Hela livscykeln. Men absolut. Hade det varit en annan produkt som jag vet är mindre miljöpåverkan.”

LCHF, deltagare 1

"Another thing that I just thought of now, while sitting here, is that it can benefit, like, can it make the food last for more people, it is controlled as well as possible, and I want, I mean I love red meat, I do too, if I then can get a 3D-printed entrecôte that I know is made from really fine ingredients, the price is about the same, and it benefits the environment and so on, then 100% yes to that."

LCMF, participant 4

“En annan sak som jag bara tänkte nu när jag satt och det kan det gynna, asså kan det göra att maten räcker till fler personer det är kontrollerat så bra som det går och jag vill ha, älskar kött, det gör jag också om jag då kan få en 3D-printad antrekå som jag vet det är gjort på jättefina råvaror, priset ungefär samma och det gynnar miljön och så vidare då 100% ja på den.”

LCMF, deltagare 4

5.2 Information needs

5.2.1 Ingredients

“People usually look at the contents, if it contains the right vitamins, minerals, and substances, you get even more motivated [to buy it].”

HCLF, participant 7

"Man brukar titta på innehållen, om det finns de här rätta vitaminer och mineraler och ämnen så blir man ännu mer motiverad [att köpa]"

HCLF, deltagare 7

“For me, it is probably about knowing the content. If I have good and extensive knowledge about the content of the products regardless of whether I am the one making it or someone else is making it, then I am more positive about it.”

LCHF, participant 1

“Det handlar nog för mig om att veta innehållet i det. Om jag har bra och stor kunskap kring den innehållet i produkten oavsett om det är jag som gör den eller om det är någon annan som gör den då är jag mer positiv till det.”

LCHF, deltagare 1

Participant 1: *“... one needs to know; it is about communicating that ‘this does not contain omega-3; you will have to find it another way’. Fine, then I know.”*

Participant 5: *“Exactly.”*

Participant 3: *“Mm, if it is not added [to the product] then you have to find a different source.”*

LCMF

Deltagare 1: *“Det är väl ganska man behöver ju veta det handlar väl om att kommunicera den här innehåller ingen omega 3 det får du hitta på något annat sätt fine, då vet jag det.”*

Deltagare 5: *“A men precis”*

Deltagare 3: *“Mm, tillsätter man inte nått [till produkten] får man ta det på ett annat sätt då.”*

LCMF

5.2.2 Environmental

Participant 4: "... because I do not think a farmed salmon feels particularly healthy. It might be healthy in itself, but the fact that they just feed these poor fish in a small pool and stuff them with a lot, as you said, with antibiotics and a lot for them, it becomes so much strange stuff."

Participant 5: "and they have no muscles."

LCMF

Deltagare 4: "Jag skulle svara som jag sa innan och det beror helt på egentligen vad det var det för ingredienser och hur miljö och liksom de olika aspekterna för jag tycker inte en odlad lax känns speciellt nyttigt den kanske är nyttigt i sig men just det här att det bara göder upp stackars fiskar i en liten bassäng och får dem i sig massa och som du sa med antibiotika och massa för dem det blir så mycket konstigt."

Deltagare 5: "och inga muskler har de."

LCMF

"I think it is a bit tricky when you buy some kind of pre-packaged fish and the same product can have several different origins. And then in the corner, there is a little A or B, and they are completely different parts of a sea. And if you go to Livsmedelsverket's website, it is completely different whether the fish is recommended or not depending on where in the same sea it is. But I do not think about that when I am in the store, whether it is this A or B."

LCMF, participant 2

"Jag tycker att det är lite lurigt när man köper nån sån här färdigförpackad fisk och så att samma produkt kan ha flera olika ursprung. Och så är det nere i hörnet ett litet A eller B och så är det helt olika delar av ett hav. Och går man in på Livsmedelsverkets hemsida så är det helt olika om fisken rekommenderas eller inte beroende på var i samma hav det är. Men det tänker inte jag på när jag står i affären om det är det här A eller B."

LCMF, deltagare 2

"As a consumer, I find it difficult, if we take two frozen fish blocks, if we are going to simplify it. And both are MSC certified. I have no- Then you are supposed to read the ingredient list. Where are they caught? And then I am supposed to consider how it has been transported, how far is it? How and for how long? Has it passed through other countries to be gutted somewhere, only to be sent back? It is impossible for a consumer to make this assessment, what is valuable."

LCHF, participant 1

"Det kan jag tycka är svårt som konsument att såhär två frysta fiskblock, om vi nu ska hårdra det. Och så är båda MSC-märkta. Jag har ingen - Då ska man börja läsa på innehållsbeteckningen. Var är dom fiskade någonstans. Och så ska jag någonstans ta ett resonemang kring hur har den fraktats, hur långt är det? Hur och hur länge? Har den passerat andra länder för att den ska rensas någonstans, för att sen skickas tillbaka? Det är omöjligt som konsument att kunna göra den här bedömningen, vad värt."

LCHF, deltagare 1

"If it is fresh [fish], one might assume that "this is good fish". But you can not really take that for granted. Not really. So that is true, one should ask."

LCHF, participant 2

"Är det färsk tar man för givet att det här är bra fisk. Men det kan man ju inte ta för givet. Egentligen inte. Så det är ju riktigt. Man ska ju fråga."

LCHF, deltagare 2

5.2.3 Cooking

"I think it [the cooking] will be hard to get rid of, at least for my generation, but then again, like everything new, the others will have to take it up; it will become more natural for them, you know, but for us, it is hard, it is almost genetic, it is ingrained like this is how we do it, and then the reptilian brain kicks in right away."

LCMF, participant 5

"Det blir svårt att ta bort det [tillagningen] tror jag i alla fall för min generation men jag tror det sen är det väl som allting nytt det får väl de andra ta det blir ju mer naturligt för dem va men för oss blir det ju svårt det är ju nästan genetiskt sitter i så här gör vi och så är reptilhjärnan den går in där direkt."

LCMF, deltagare 5

"... the constructors should have considered that people expect it [the substitute] to be cooked in the same way [as real fish] since it looks the same."

HCMF, participant 1

"Det är ju enklare så om man vet hur man ska göra en vanlig fisk och så är det nånting som ser ut som en vanlig fisk och syfte att efterapa en vanlig fisk då borde ju syftet i konstruktion konstruktörerna borde ju ha tänkt på att folk förväntar sig att man tillagar den på samma sätt eftersom den ser ut på samma sätt."

HCMF, deltagare 1

"I will cook it the same way [as the real counterpart]"

LCMF, participant 6

"Jag kommer tillaga det på samma sätt"

LCMF, deltagare 6

"That is the thing, if it looks the same or resembles it [fishsticks], you will cook it the same way as fishsticks."

LCHF, participant 2

"Men det blir ju det, ser det ut likadant eller liknar det så tillagar man det på samma sätt som fiskpinnarna."

LCHF, deltagare 2

"So if it is not meant to be [cooked] the same way [as its real counterpart] one has to be quite explicit about that."

LCMF, participant 2

"Så om det inte ska vara på samma sätt så får man vara ganska tydlig med det."

LCMF, deltagare 2

"[if it was something new] I would probably be a bit more cautious and read the packaging"

LCHF, participant 2

"Skulle nog skärpa mig lite och läsa på förpackningen."

LCHF, deltagare 2

"... I do not always bread it. But then it is a bit when it starts to fall apart. That is why it is so good to bread it because then it does not fall apart. If you have a filet, it usually falls apart."

LCLF, participant 2

"Jag tror att när man panerar den så tenderar man att gå och översteka den lite. Det är svårt att veta. Men ibland så vet jag torsk och lite sådana... Jag panerar ju inte alltid. Men då är det lite när den börjar falla isär. Det är därför det är så bra att panera för då faller den inte isär. Har man en filé så faller den ju isär oftast."

LCLF, deltagare 2

5.3 Contents

5.3.1 Foodstuffs

"I do not want it to be made of fish, because then I might as well just eat fish."

LCMF, participant 1

"Jag vill inte att den ska bli gjord av fisk då kan jag lika gärna att äta en fisk."

LCMF, deltagare 1

"Yes, I think like this: if you can produce something that is tasty from fish trimmings, if I may say so. Something that attracts the customer with something that is otherwise discarded, and it has good content in it and also tastes good."

LCLF, participant 2

"Ja, jag tänker så här att om man kan producera någonting som är gott av fiskrenset om man nu får säga så. Som attraherar kunden av någonting som man ändå slänger och det är gott innehåll i det och dessutom bra innehåll och dessutom smakar gott."

LCLF, deltagare 2

"It has become very delicate if you discuss such things with younger people today. And then considering that many families cook... can make five different meals. This could be a thing! For example, you can remove all allergenic things for some people. And they can still eat an alternative that looks something like the same and has a good taste and texture. Then it can also be an alternative. Our society is very allergic."

HCHF, participant 6

"Det har blivit väldigt skört att diskuterar såna här saker med ungdomare idag. Och sen med tanke på att många familjer tillagar... kan göra fem olika måltider. Det här kan ju vara en grej att till exempel kan man få bort alla allergena saker för vissa människor. Och de kan ändå äta ett alternativ som ser något sådana likadant ut och har en bra smakkonsistens. Då kan det också vara ett alternativ. Vårt samhälle är väldigt allergent."

HCHF, deltagare 6

5.3.2 Health

Participant 1: *"But the process itself cannot be carcinogenic, the question is what raw materials, what is in it, that is what is interesting, not how it has been mixed together."*

Moderator: *"Do you think the process is carcinogenic, or is it the content itself?"*

Participant 3: *"Well, you know, it is so, it is very, very clear that it is unnatural and you do not know what process it has actually gone through to end up like this, and of course, it makes you very curious."*

It might be carcinogenic, I do not mean that it is carcinogenic, but one can imagine, aha, if I have a small child or my grandchild, I do not want them to taste it, maybe I might taste it."

HCMF

Deltagare 1: *"Men processen i sig kan inte vara cancerframkallande, det är frågan vilka råvaror, vad är det i den det är det som är intressant inte hur man har geggat ihop det"*

Moderator: *"tänker du att processen är cancerframkallande eller är det just innehållet?"*

Deltagare 3: *"Jomen du vet det är så det är jätte jätte jätte så det är så tydlig att den är onaturlig och man vet inte vilken process den har faktiskt det blev så här och det är klart att man blir väldigt nyfiken det kan det kan hända att det blir cancerframkallande jag menar det inte så att det är cancerframkallande men man kan tänka sig aha om jag har ett små barn eller mitt barnbarn så jag vill inte ska smaka på det kanske jag kanske smakar"*

HCMF

"I am no more or less scared of a 3D printed food than I am of a sausage."

LCMF, Participant 1

"Jag är inte mer eller mindre rädd för en 3D-utskrivna matprodukt än en korv."

LCMF, deltagare 1

5.3.3 Nutrition

"It ideally should have the same amount [as salmon] because if one intends to buy it instead of real salmon, it must contain the same vitamins and provide an equivalent amount of nutrients."

LCHF, participant 3

"Det helst lika mycket för om man har avsikt att köpa den istället för den riktiga lax så den måste innehålla samma vitaminer samma lika mycket näring."

LCHF, deltagare 3

Participant 4: *"Then I think fish is healthy."*

Moderator: *"How do you figure that?"*

Participant 4: *"That it contains omega 3, omega 6, and all that. Then you become very smart from fish and herbs. I do not know."*

LCMF

Deltagare 4: *"Sen tror jag väl att fisk är nyttigt."*

Moderator: *"Hur tänker du då?"*

Deltagare 4: *"Att det innehåller omega 3, omega 6 och allt vad det är. Sen blir man väldigt smart av fisk och ört. Jag vet inte."*

LCMF

"No, no, no, I eat everything, including those regular fish sticks and such. It is the breeding that is not so good because it absorbs a lot of fat, and then you get fat. That is the part that is a bit concerning, but otherwise, they are very tasty, so I eat most things that are not complicated."

HCMF, participant 1

“Nej nej nej jag äter allt och även de här vanliga fiskpinnar och sånt där det är paneringen som inte är så bra för den suger ju upp en massa fett då blir man ju tjock det är ju den som är lite bekymmersam men annars är de jättegoda så jag äter det mesta som inte är krångligt”

HCMF, deltagare 1

“I think the homemade breadings absorbs more of the butter, so it gets more of a buttery taste. The other one is just crisp and not so much flavor in it. The breadcrumbs kind of soak up-”

LCLF, participant 2

“jag tror den egna paneringen suger upp mer utav smör så blir det mer smörsmak den andra är bara krisp och inte så mycket smak på den ströbrödet är liksom suger åt sig-”

LCLF, deltagare 2

“I do eat meat, and sometimes I eat vegetarian, but we usually make two different dishes, so then you still have the same [accompaniments to the dishes]. If you have to change that [accompaniments] too, it just becomes, well, it gets complicated. You want- if it is potatoes, you need to have it both and it should be equal.”

HCLF, participant 5

“Jag äter ju kött och jag äter vegetariskt någon gång, men vi gör ju oftast två olika rätter, då har man ju ändå det andra till. Ska man ändra det också så blir det liksom bara, nä, det blir jobbigt, man vill ju ha- ska det vara potatis måste man ha det till båda och det ska vara lika.”

HCLF, deltagare 5

5.4 Target consumer

5.4.1 Social & cultural aspects

Participant 2: *“I am thinking about restaurant visits.”*

Participant 3: *“I think of the sea.”*

Participant 5 *“Typical West Coast.”*

Participant 1: *“And socializing.”*

LCHF

Deltagare 2: *“Jag tänker ni på restaurangbesök.”*

Deltagare 3: *“Lite havet, tänker jag på.”*

Deltagare 5: *“Typiskt västkusten.”*

Deltagare 1: *“Och socialisera.”*

LCHF

“For those who are vegetarians and who eat with others who are not, sometimes there might be situations where one eats vegetarian but not everyone does, then it could be about a sense of belonging.”

LCMF, participant 2

“För de som är vegetarianer och som äter tillsammans med andra som inte är det då kanske det ibland kan uppstå situationer en äter vegetariskt men inte alla då kan det ha med samhörighet att göra.”

LCMF, deltagare 2

"Yes, I think it is a lot about where one comes from, tradition, and culture, what one is used to... For example, in my case. We eat meat almost every day. It is normal, you know. A meal without meat for one day... That is strange, it is like you have not eaten at all. So for me... I realize... when you say it like that. We maybe ate too much meat, so maybe it will be necessary to... force to eat fish instead..."

HCHF, participant 7

"Ja, jag tror det är mycket vad man kanske kommer ifrån och tradition och kultur, vad man har för... Exempelvis hos var det. Vi äter kött nästan varje dag. Det är normalt liksom. En Maträtt utan kött ett en dag... Det är konstigt, då har du inte ätit i princip. Så för mig... Jag låter...när du säger så. Vi åt kanske för mycket kött, så kanske blir det så att man... får tvinga att det här är åt fisk istället."

HCHF, deltagare 7

"So I feel that maybe it is for the future. something that will become relevant. But I am more for other traditions and other food and stuff. It just does not feel so good and appealing to me."

HCHF, participant 7

"Så känner jag att det kanske är för framtiden någonting som blir aktuellt. Men jag är mer för andra traditioner och annan mat och så. Det känns bara inte så bra och lockande för mig."

HCHF, deltagare 7

"You have been brought up since you were a child with the idea that it is good to eat fish at least once or twice a week. Or something like that."

HCHF, participant 7

"Man har ju fått med sig sedan man var barn. Att det är bra att fisk är åtminstone en, två gånger i veckan. Eller någonting sånt där."

HCHF, deltagare 7

"We had it [fish] once a week when I was a child. But of course, we also had it in school. It was standard, you were supposed to eat fish. And then when I was a child in the 60's, we also got cod liver oil. So they forced us to take a spoonful every morning..."

HCHF, participant 6

"Vi åt [fisk] en gång i veckan när jag var barn. Men det klart, man åt ju skolan också. Det var ju standard, man skulle ha fisk. Och sen så när jag var barn på 60-talet fick man ju fiskleverolja också. Så det tvingade de ju i en en sked varje morgon..."

HCHF, deltagare 6

"I never used to think about such things before. But now, one thinks more about what it contains, or what it was made of. What it has absorbed. I never had that thought before. Instead, one just ate what was tasty. It is frightening."

LCHF, participant 2

"Jag har aldrig tänkt på såna saker tidigare. Men nu tänker man ju mer på vad det innehåller eller vad det va, bestå av. Vad det har tagit till sig. Den tanken hade man aldrig förr. Utan man bara åt det som var gott. Det är skrämmande."

LCHF, deltagare 2

"It contains a lot of protein. It has great content for vision and so on. It is nutritious."

LCLF, participant 1

"Det är mycket protein i det. Det är mycket bra innehåll för synen och så vidare. Det är näringsrikt."

LCLF, deltagare 1

5.4.2 Pricing

"I used to prepare fish more often before. I think the price has become so high, so now I partly choose to avoid it. But when I do buy it, I prefer white fish. I like to buy in a fish store or at a counter so I can have fresh fish."

LCHF, participant 1

"Jag tillagade nog mer fisk förr. Jag tycker att priset har blivit så pass högt, så nu väljer jag bort det till viss del. Men då är det gärna vit fisk. Jag köper gärna i en fiskaffär eller i en disk så man har färsk fisk."

LCHF, deltagare 1

"If you buy at a fish stand, it is very expensive, and you can not always afford to do that anymore. Then you have to get something from the store. It is also about the money. It is really expensive to eat only from a fish stand. You have to buy some cod [and salmon] from the store occasionally. If I can afford it, I buy at such a fish stand."

HCLF, participant 8

"Om man köper i ett fiskstånd så är det väldigt dyrt och man har inte alltid råd att göra det längre. Då får man ju ta någonting från affären. Det har ju med pengar att göra också. Det är ju jättedyrt att äta bara från ett fiskstånd. Man får ju köpa lite torsk och lax från affären emellanåt. Har jag råd så köper jag i ett sådant fiskstånd."

HCLF, deltagare 8

"If this would taste like a salmon filet and the price is not more expensive, then I could very well imagine eating it."

LCLF, participant 2

"Om det här skulle smaka som en laxfile och priset inte är dyrare så skulle jag nog mycket väl kunna tänka mig och äta det."

LCLF, deltagare 2

5.4.3 Marketing

"It can't be called fish if it is not fish"

LCHF, participant 3

"Men det kan inte heta fisk om det inte är fisk."

LCHF, deltagare 3

"I think that if it had been marketed as fresh instead, it would have performed a bit better compared to being frozen."

HCLF, participant 7

"Jag tror att den hade, om man hade marknadsfört att ta som färsk då så hade det gått lite bättre jämfört med ett fryst."

HCLF, deltagare 7

"That is because they are made of something, and that if you freeze them, maybe they become a bit drier or something like that, maybe something like that happens to it."

LCLF, participant 2

"Det är för att de är ju gjord på någonting och fryser man så kanske det blir lite torrare eller någonting sånt, det kanske sker något sånt med det."

LCLF, deltagare 2

Participant 5: *"I would say definitely not for children, at least."*

Moderator: *"Not for children?"*

Participant 5: *"Who are growing and developing. Because I do not believe the technology exists to replace all trace elements, all fats, everything. The consistency needed for the development of the heart and nervous system, and brain, and everything in a proper way. For one to receive as much of the small stuff as needed. I do not think, I think they need a lot that we cannot manufacture in a good combination and dose."*

LCHF

Deltagare 5: *"Jag skulle säga absolut inte till barn, i alla fall."*

Moderator: *"Inte till barn?"*

Deltagare 5: *"Som växer upp och utvecklas. För jag tror inte att teknologin finns för att ersätta alla spårämnen, alla fetter, allting. Konsistensen som man behöver för att utveckla hjärt- och nervsystem och hjärna och allt på ett bra sätt. För att man ska få till sig så mycket smått som behövs. Jag tror inte, jag tror att de behöver mycket som vi inte kan tillverka i en bra kombination och dos."*

LCHF

5.5 Negative and positive similarities to seafood

"The risk with imitation is that the consumer can be deceived. Play fair with it."

LCHF, participant 1

"Risken med att efterlikna är ju att man blir lurad som konsument. Kör ärliga kort med det."

LCHF, deltagare 1

"I want it [the substitute] to differentiate [from the original] so one does not get deceived."

HCMF, participant 3

"Jag vill att det ska bli lite skiljer sig att man inte ska bli lurad."

HCMF, deltagare 3

"Well, if it is already something 3D-printed, then it is already artificial in a way and then I am probably going to accept that it is too perfect. Then I buy the product because I am aware of it. But if it is served to me without information about it [being 3D-printed], then I would really feel deceived."

LCHF, participant 1

"Amen. Är det en 3D-print då är den ju redan konstgjord på ett sätt. Då kommer jag nog att acceptera att den är för perfekt. Då går jag dit och köper den produkten för att jag är medveten om det. Men om jag blir serverad utan att få veta det så skulle jag verkligen känna mig lurad."

LCHF, deltagare 1

"If it looks like salmon, but does not taste like salmon nor contain the same ingredients as salmon, then I probably do not understand why I should eat it."

HCLF, participant 4

"Den ser ut som en lax sen har den inte smakat som en lax och den innehåller inte något liknande så förstår jag kanske inte varför jag ska äta den."

Participant 3: *"I do not want it [the substitute] to look identical, I want to be able to tell the difference, it should be visible so that I am aware of it. It feels like you get deceived if it looks the same [as the real counterpart]"*

Participant 2: *"But how should it look if it is not identical? Should it look like a freak of fish? Nah, it should look identical, otherwise it becomes..."*

HCMF

Deltagare 3: *"Jag tycker att det jag vill inte att det blir likadant jag vill se skillnader jag tycker att synlig jag får veta det nä jag tycker att det känns att man blir lurad om det ska se likadant ut."*

Deltagare 2: *"Men hur ska det se ut annars om det inte ser likadant ut ska det ser ju ut som ett missfoster av fisk nämen det ska se identiskt ut annars blir det..."*

HCMF

"It [salmon] is very convenient, it is very easy to prepare, that is the biggest advantage with it, you do not have to do much with filets and such."

HCMF, participant 3

"Det är verkligen smidigt det är jättelätt att laga det här är det största fördelen med det man behöver inte göra så mycket så filé o sånt."

HCMF, deltagare 3

"If it could make boneless fish, that would be great."

LCLF, participant 1

"Om den kan göra fisk utan ben hade ju det varit jättebra."

LCLF, deltagare 1

Participant 5: *"The little gray at the top of the filet is a bit softer than the rest [of the filet]. So if it is supposed to mimic a salmon then it should be like that."*

Participant 2: *"It should be identical"*

Participant 5: *"With the skin and maybe the fat around it"*

Participant 2: *"then you want it to look as identical as possible, doesn't everyone want that? You do not want to see that it is some [expletive] 3D-printed fish, it should be as identical as possible I think."*

HCMF

Deltagare 5: *"Den lilla gråa högst upp på färgskotletten den är lite annorlunda i den är lite mjukare än vad resten är; Aa om det ska vara efterapa en lax så ska det vara det."*

Deltagare 2: *"Så ska det vara exakt"*

Deltagare 5: *"med skinnet kanske och det fettat runtomkring där."*

Deltagare 2: *"Då vill du ju ha det identiskt ut som möjligt, det vill väl alla, vill du inte se att det där är någon jävla 3D-printa fisk då ska det se så identiskt ut som möjligt jag tror det."*

HCMF

5.6 Sensory aspects

5.6.1 Shape

Participant 3: *"At the start, it should be more natural, but then, maybe if there is no danger [you can make it more unnatural], but in the beginning, absolutely not. It is very scary."*

Moderator: *"So it should be something recognizable at first?"*

Participant 3: *"Yeah, exactly."*

Participant 2: *"Mm."*

HCMF

Deltagare 3: *"I början vi ska vara så mer naturligt men sen, sen kanske om det blir ingen fara men i början absolut inte det är väldigt skrämmande."*

Moderator: *"Det ska vara något man känner igen först liksom."*

Deltagare 3: *"Aa exakt"*

Deltagare 2: *"Mm"*

HCMF

Moderator : *"Would it have looked nicer if it looked like a butterfly salmon filet compared to this [shows image of 3D-printed salmon], for example?"*

Participant 2: *"Yes, but the salmon looks good."*

Participant 5: *"It does not feel like a butterfly salmon filet can look as natural as that, because it looks very natural, but surely it can, because they obviously can make it like that."*

HCMF

Moderator: *"Ja hade det varit en finare utseende om det såg ut som en laxfjäril jämfört med den [bild på utskrivna lax] till exempel"*

Deltagare 2: *"Aa, men laxen ser ju bra ut"*

Deltagare 5: *"Det känns inte som en laxfjäril kan se så naturligt ut som den, för den ser ju väldigt naturlig ut, men det gör den säkert för de kan ju göra det."*

HCMF

"If it is fake. Why can it not just BE fake? Why try to make it resemble something it is not?"

HCHF, participant 1

"Om det ändå är fake. Varför kan det inte vara fake? Varför ska man försöka få det och efterlikna någonting som det inte är?"

HCHF, deltagare 1

"I think I would feel more comfortable if they were 3D-printed in a square shape."

HCHF, participant 1

"Jag skulle nog liksom vara mer bekväm med att man printade någon fyrkantig form."

HCHF, deltagare 1

"Yeah, I mean, it could be in the shape of a slice, like a cheese almost. I do not think having it shaped as a ball, you know I do not think [is a good idea]. Taking an odd shape would be a bit strange."

LCLF, participant 1

“Jo, alltså det kan ju vara som en typ slice, som en ost typ. Att den är en boll liksom det tror jag inte. Ta en skum form, det blir lite konstigt.”

LCLF, deltagare 1

5.6.2 Size

Participant 2: *“... I have also bought a lot of these small frozen [filets], but nowadays I rather buy large filets and cut them into pieces myself. Then, I can freeze the leftovers myself, and it ends up like frozen fish anyway.”*

Moderator: *“How come?”*

Participant 2: *“Because it feels fresher and more recently fished. I think the whole consistency of a side of salmon is better than these small ones. As someone else may have mentioned, these small - I do not know, they feel more dry. It simply is better quality when it is a larger piece of fish.”*

LCLF

Deltagare 2: *“... Jag har också köpt många av de här små frysta men jag köper idag hellre de stora filéerna och skär upp bitar själv. Och sen kan jag frysa ner de som blir över själv. Så det blir ju som fryst-fisk ändå.”*

Moderator: *“Hur kommer det sig att du hellre köper i större bitar?”*

Deltagare 2: *“Därför att jag tycker den verkar färskare och fräschare. Jag tycker hela konsistensen på den hela laxsidan är bättre än de här små. Som jag tror kanske du [en annan deltagare] pratar om. dom här små.. jag vet inte.. Jag tycker att de är lite torrare. Det är bättre kvalitet när det är en stor fisk helt enkelt.”*

LCLF

“Yeah, [I buy a side of salmon] once a month or so, that is what I usually do. It is convenient. So, you buy these small pieces, then it lasts for one occasion. But with the side of salmon, I use it two or three times. It is just convenient. It is good to pack, like in the freezer, it is just the right amount.”

LCHF, participant 5

“Aa Nån gång i månaden sådär. Det brukar jag. Det är smidigt. Alltså köper man såna här små bitar och då går det åt på en gång. Men laxsida använder jag två-tre gånger. Det är smidigt helt enkelt. Det är bra att packa liksom i frysen det är lagom.”

LCHF, deltagare 5

“It [the 3D-printer] can make every piece exactly the same. Sometimes it might be that one piece is a bit smaller than what is actually stated in the ingredients. I think it can be really good.”

LCLF, participant 1

“Den kan göra varenda en så att de är exakt samma. Ibland är det så att en bit kanske är lite mindre än vad det egentligen står på innehållsförteckningen. Jag tror det kan vara jättebra.”

LCLF, deltagare 1

“If you have the chance to 3D-print them and shape them, you can make them in portion sizes. That is practical.”

HCMF, participant 1

“Om man har en chansen att 3D-printa de och formar dem så kan man göra dem i portions-size, det är ju praktiskt.”

HCMF, deltagare 1

"I think that in the beginning before you know exactly what it is, then it depends on the price, but it is better with smaller pieces"

HCLF, participant 5

"Jag tror att det är i början innan man vet riktigt vad det är sen beror ju allting på priset, det blir bättre med lite bitar."

HCLF, deltagare 5

"Preferably a smaller [piece] rather than a big [piece], no - no not a big [piece]."

HCMF, participant 5

"och nästan de mindre en stor, nej ingen stor."

HCMF, deltagare 5

Participant 4: *"I might want to make a whole baked 3D-salmon filet in the oven, or I might want pieces. So there could be alternatives."*

Participant 1: *"Agreed."*

LCMF

Deltagare 4: *"Både jag kanske vill göra en helstekt 3D-laxfilé i ugnen eller så vill ha bitar så man skulle väl kunna ha alternativ."*

Deltagare 1: *"Håller med."*

LCMF

5.6.3 Thickness

"When it is like that [uneven thickness], it can become a problem when pan frying. The thin side cooks quickly, while the other thick side may take some time."

LCLF, participant 3

"När det är så är det kan bli problem när man steker. Den tunna sidan steks snabbt medan den andra tjocka sidan kan ta lite tid."

LCLF, deltagare 3

"Well, I am thinking, if you say side of salmon, the smartest thing would probably be, sure you might want it to be like a side of salmon, but you want it to be equally wide and thick all the way."

LCMF, participant 4

"Nämen jag tänker om du säger laxsida det smartaste hade väl varit att, visst man kanske vill ha den som en lax-sida, men man vill ha den lika bred och tjock hela vägen."

LCMF, deltagare 4

"Yeah, you can see when it is done, and if you cut into the thickest part you can tell if it is ready or if it requires five more minutes."

LCHF, participant 2

"Ja, man ser ju när den är klar och om man delar lite på det tjockaste stället så ser man att den är klar. Eller att den behöver fem minuter till."

LCHF, deltagare 2

"If you have a recipe that specifies exactly how long the fish should be in the oven, I find that it usually is correct. But otherwise, if you just cook it in a frying pan, then it can be a bit... You have to cut into the fish to see if it is done, but that way, you break the fish piece."

LCHF, participant 3

"Om man har ett recept där det står exakt hur länge fisken ska vara inne i ugnen så tycker jag att det brukar stämma. Men annars om man liksom steker upp fisken så då kan det vara lite... då får man liksom dela på fisken och se om den är färdig så gör man ju sönder fiskbiten."

LCHF, deltagare 3

"If I am cooking for myself, I do not care that much about the shape. I just want it to taste good. But If I am cooking for others as well, then I need to care about how it looks."

LCLF, participant 3

"Jag kan säga också vad jag tycker om det. Om jag steker och lagar för mig själv jag bryr mig inte mycket om formen åt stället. Det är bara den som ska smaka bra. Men om jag ska göra för andra också då måste jag bry mig att den ska se ut fint ut. jag måste veta vad jag äter."

LCLF, deltagare 3

"... when cooking meat or fish or whatever it is, you want the pieces to be quite equal- equal in size so that everything is ready at the same time."

HCHF, participant 6

"När du ska steka kött eller fisk eller vad det är så ska det vara något sådana här jämnstora bitar för att allting ska bli färdigt samtidigt."

HCHF, deltagare 6

5.6.4 Color

"You also eat with your eyes, and I think salmon looks more appealing [than white fish]. If you make a cream-based sauce and have white fish with it, it does not stand out. Salmon color pops and you go 'I want that one'."

LCMF, participant 2

"Sen äter man med ögonen också och då tycker jag laxen ser mycket trevligare ut. Gör man någon sås grädd-baserad och så ser man vitfisk i då syns den liksom inte ens. Laxen poppar ut och då ser man den ska jag ha."

LCMF, deltagare 2

Participant 2: *"... normally the salmon in the store is colored, but that one [image of 3D-printed salmon] is almost more red than the one in the store."*

Participant 1: *"Yes, that one [picture of 3D-printed salmon] looked a bit scary I think, almost like minced meat."*

Participant 4: *"It almost looks like meat, more like meat actually- yes. Minced meat."*

LCMF

Deltagare 2: *"Den är väldigt röd laxen, normalt sett man färgar ju lax i butiken och den där är nästan rödare än den som är i butiken."*

Deltagare 1: *"Aa den där såg lite läskig ut tycker jag, lite färsig."*

Deltagare 4: "Den ser nästan ut som kött, den ser mer ut som kött faktiskt, färs ja"

LCMF

"When I am looking at this [white fish without cover], I think of the grain of a piece of wood, the annual rings, more than than the transparency of the ribs of a fish. It is translucent in the wrong way."

LCHF, participant 5

"När jag tittar på det här, då tänker jag på ådringen på en träbit. Årsringarna. Mer än vad genomskinlig på revben på fisk. Den är liksom genomskinlig på fel sätt."

LCHF, deltagare 5

"But the question is, if I had been standing in the store and no one had said anything, would I have been looking for it? The question is, if the consistency had been the same [as a real fish], I probably would not have reacted"

LCHF, participant 1

"Men frågan är, hade jag stått i butiken och om ingen hade sagt något, hade jag letat efter det då? Det är ju det som är frågan. Frågan är, hade konsistensen ändå varit den samma då hade jag aldrig reagerat."

LCHF, deltagare 1

"Can not make it beige or brown. A poop-brown color. Then you might not be tempted by it. After all, we eat with our eyes, and our choices are often guided by what we see."

LCLF, participant 2

"Men vill man göra en fiskbit får man göra den så att det ser ut som en fiskbit. Samma färg. Kan inte göra det en beige eller en brun. En bajsbrun färg. Då skulle man ju kanske inte lockas av det. Man äter ju med öga eller man väljer ju med ögat också. Är det ett fisksubstitut då ska det ju likna det? Om marknaden vill att jag ska få den känslan att nu köper jag en vegetarisk fisk."

LCLF, deltagare 2

"We eat quite a few ugly looking dishes that we know taste good, almost everything on the christmas table or all kinds of mixes [swe: röror] look quite unappetizing, but coleslaw, very tasty! Even if it is slimy and gray, perhaps you just need to try it so that it will become a part of it."

LCMF, participant 1

"Vi äter ju ganska många fula maträtter som vi ändå vet är goda, nästan allt på julbordet eller alla typer av röror ser ju oftast ganska oaptitliga ut men coleslaw, jättegott! även om det är slemmigt och grått så man kanske bara behöver utsätta sig för det att det ska bli en del av det."

LCMF, deltagare 1

5.6.5 Texture and consistency

"It should easily flake. Because if you take salmon, overly-cooked salmon, it holds together in a different way. Then it just becomes stringy to eat."

LCHF, participant 1

"Den ska lätt skiva sig. För tar du lax, översekt lax, så blir ju, så håller den ihop på ett annat sätt. Då blir det ju bara trådigt att äta."

LCHF, deltagare 1

"It [the substitute] should look like that. Then, when you take a fork, it should fall apart easily in the same way [as it is 'real' counterpart]"

HCMF, participant 5

"Den ska se ut så, sen ska man ta i gaffeln och se kommer den ramla isär på samma sätt."

HCMF, deltagare 5

"... the consistency, it just falls apart, and it should be moist enough; it should not be dry."

LCMF, participant 4

"Konsistensen, den trillar bara isär och den ska ju vara tillräckligt den får inte vara torr utan den är lagom blöt det behövs inte så mycket."

LCMF, deltagare 4

Participant 2: *"[Oysters have] a slimy consistency"*

Participant 4: *"It is not something I fancy."*

Participant 3: *"Me neither"*

LCHF

Deltagare 2: *"En slemmig konsistens."*

Deltagare 4: *"Inget man, inget som jag njuter av."*

Deltagare 3: *"Nej, inte jag heller."*

LCHF

Participant 8: *"I think it [seaweed] sounds a bit slimy actually."*

Moderator: *"So you are not so keen to taste it?"*

Participant 8: *"No, definitely not."*

HCLF

Deltagare 8: *"Jag tycker det låter lite slemmigt faktiskt alltså."*

Moderator: *"Du är inte så sugen?"*

Deltagare 8: *"Nej, absolut inte."*

HCLF

"... [the rubbery consistency] is quite nice together with the breeding."

Participant 2, LCLF

"Ja men det är ganska gott ändå att blanda med den här friteringen."

Deltagare 2, LCLF

"I had only tried rubbery octopus previously that was not good, but this one was soft and tender and buttery and amazing."

Participant 1, LCMF

"Jag hade egentligen bara ätit gummiaktig bläckfisk innan inte alls var så bra men den här var mjuk och mör och smörig och otrolig."

Deltagare 1, LCMF

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