

# **Consumer reactions to communication about innovative processing technologies in iNOBox**

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# Report

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<i>Summary/recommendation:</i> The objective of this study was to reveal the influence of information about products processed with innovative processing technology (IPT) on consumers. The focus was placed on consumer perception of various types of information about the products and how they can carry the benefits of consuming such products. Innovative food processing technologies are not in the top of mind of Norwegian consumers. Their low knowledge generates skepticism when they hear about them, in contrary to more acceptable conventional processing technologies. However, communicating benefits from the use of these new technologies has a powerful potential towards future differentiation strategies, depending on the technology and food category. Convenience related to specific food categories, potentially due to increased self-life could be used to increase acceptance of a shift towards these innovative technologies. Additionally, communicating about specific environmental benefits from the use of innovative food processing technologies could increase acceptance and willingness to pay for food as a whole. Balanced information about the justification of changes in food production and processing is a valuable tool for increasing consumer acceptance and the avoidance of emotional reactions at a later stage, when technologies are broadly available and potentially communicated in an overdramatized manner by the media.	<i>Project No.:</i> 12307
<i>Summary/recommendation in Norwegian:</i> Norske forbrukere har generelt lite kunnskap om innovative matvareteknologier, noe som kan skape skepsis når de først hører om slike teknologier. Kommunikasjon om fordeler ved bruk av ny foredlingsteknologi har et stort potensial for fremtidige differensieringsstrategier, avhengig av teknologi og matvarekategori. For noen matkategorier kan innovativ teknologi føre til forlenget holdbarhet og dermed økt bekvemmelighet. Dette kan brukes til å øke aksept for et skifte inn mot disse innovative teknologiene. I tillegg kan informasjon om spesifikke miljøgevinster ved bruk av innovative matforedlingsteknologier øke aksept og betalingsvilje hos forbrukerne. Veloverveid informasjon rundt begrunnelsen for endringer i matproduksjon og foredling er et viktig verktøy for å øke forbrukeraksept og unngå negative, emosjonelle reaksjoner i etterkant – spesielt med tanke på overdramatisering i media.	

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# 1 Summary

The main objective of this study was to reveal the influence of information about products processed with innovative processing technology (IPT) on consumers. The main focus was placed on consumer perception of various types of information about the products and how they can lead to a synergic information transfer about the benefits of consuming such products. This new knowledge will be implemented in a decision-support tool that will help companies establish a trust building communication strategy, as part of the marketing strategy, to enhance reputation & consumer acceptance after the end of the iNOBox project.

Innovative food processing technologies are not in the top of mind of Norwegian consumers. Their low knowledge about them generates some skepticism when they hear about them, in contrary to more acceptable conventional processing technologies. However, communicating benefits from the use of these new technologies has a powerful potential towards future differentiation strategies, depending on the technology and food category. Convenience related to specific food categories, potentially due to increase self-life could be used to increase acceptance of a shift towards these innovative technologies. Additionally, communicating about specific environmental benefits from the use of innovative food processing technologies could increase acceptance and willingness to pay for food as a whole. Balanced information about the justification of changes in food production and processing is a valuable tool for increasing consumer acceptance and the avoidance of emotional reactions at a later stage, when technologies are broadly available and potentially communicated in an overdramatized manner by the media.

## 2 Introduction

The main objective of this study was to reveal the influence of information about products processed with innovative processing technology (IPT) on consumers. The focus was placed on consumer perception of various types of information about the products and how they can lead to a synergic information transfer about the benefits of consuming such products. This new knowledge will be implemented in a decision-support tool that will help companies establish a trust building communication strategy, as part of the marketing strategy, to enhance reputation & consumer acceptance after the end of the iNOBox project.

Most consumers tend to be skeptical towards new food, a phenomenon commonly described as food neophobia (Tuorila *et al.*, 2001). This skepticism is even higher when it comes to food processed by use of new technologies (Frewer, 1999). Looking at innovative processing technologies in specifically, indicated that there is a potential for acceptance for some of them, depending on various factors, such as which product it is combined with, how it is communicated, etc (Cardello *et al.*, 2007; Cardello, 2003). Additionally, balanced communication, transparency and communication of benefits to the consumers, has shown a positive effect on the acceptance of such products (Verbeke, 2011; Jacobs *et al.*, 2015). This study moved one step further by combining the knowledge of previous literature in an experimental design that focused on the effect of communicating benefits to the consumers, in order to support informed decision making.

When consumers are exposed to new information, without having previous experience in order to make informed and analytical evaluations, they may resort to emotional reactions represented by changes in their mood (Köster & Mojet, 2015; 2018). Emotional reactions measured in an emotive projection test may not correlate directly with liking but can be an indication of consumer expectations and how they influence liking after the food product is consumed (Mojet *et al.*, 2015). Such emotional responses consumers have about products could be useful in identifying the effect of packaging information (Spinelli & Niedziela, 2016). Emotional reactions could also lead to top of mind associations consumers make with information stimuli they are exposed to, which can be captured using open-ended questions (OEQs) (Altintzoglou *et al.*, 2018). This study aimed at capturing these free associations consumers make, within an emotional frame of mind, but also as free associations that could provide insights that researchers could not expect only based on previous research and theory.

The appropriateness of information to describe food processing benefits and its suitability for various food categories may also influence the consumers' attitudes, willingness to try, pay and eat such products (Oliver, 1980; Schutz, 1994; Wilks & Phillips, 2017). However, consumers are individuals, with abundant diversity which can influence how information is perceived and interpreted. For example, subjective knowledge, social consumption based on brands and perceived consumer effectiveness could influence how consumers choose to adopt food processed with new technologies (Park, 1994; Moschis, 1981; Fitzmaurice & Comegys, 2006; Ellen *et al.*, 1991; Honkanen & Young, 2015). Perceived consumer effectiveness is often associated with environmentally friendly behaviour, which could also be related to involvement with food waste reduction in combination or competing with convenience orientation (Pieniak *et al.*, 2008; Olsen *et al.*, 2007). However, an important starting point for consumers to start considering the choice for food processed using new technology, there is probably a need for them to trust governmental control of food production and processing, as well as the companies that produce the food (Holloway *et al.*, 2009). Both types of trust could be higher among

consumers that are innovative towards an effort of being unique (Tian *et al.*, 2001; Goldsmith & Hofacker, 1991; Bartels & Reinders, 2010).

### 3 Methods

This study followed a combination of methods in a consumer survey. The participants were organized in groups, following an experimental design, and after that, they responded to open ended emotive projections, emotive projections, open ended questions and classic survey questions. This approach as a whole has provided insights that secure implementation by companies in the real market.

#### 3.1 Recruitment

Recruitment for the survey was subcontracted to YouGov, after following the procedure of requesting quotes from at least three providers. YouGov offered the best quality for the lowest price and was chosen. Ensuring that YouGov followed the required GDPR procedures, the project was submitted to NSD to receive an approval and was sent out to Norwegian participants in September 2019. The screening questions, while keeping the sample representative, were: a) Do you have food allergies? And b) are you responsible for at least 50% of the purchase or preparation of food in your household during the last month? The correct answers being no to allergies and yes to the 50% responsibility meant that the participants were eligible to participate in the iNObox survey. This led to the recruitment of at least 1200 participants.

#### 3.2 Experimental design

The experimental design followed in this survey was based on 6 conditions with 200 participants in each (Table 1). The participants of each group were similar in terms country representation. The participants in each of the six conditions only received information related to the condition they were grouped into, described in Table 2.

Table 1 Experimental conditions

Experimental contition		Number of participants
Control		200
Innovative Processing Technology (IPT)		200
IPT + benefit	Convenience	200
	Health	200
	Sustainability	200
	Quality	200
Total		1200



Table 2 Information given to participants in each of the experimental conditions

Experimental condition		Information given to the participants
Control		Food product processed as usual
Innovative Processing Technology (IPT)		Food product processed using innovative processing technologies
IPT + benefit	Convenience	Food product processed using innovative processing technologies for increasing convenience in your daily life
	Health	Food product processed using innovative processing technologies for improving the effect food has on your health
	Sustainability	Food product processed using innovative processing technologies for improving environmental sustainability
	Quality	Food product processed using innovative processing technologies for improving the quality

The participants received information about participating in a study related to one of the conditions described above, followed by basic guidelines on how to use the various parts of the survey, anonymity, etc. A manipulation check was used to ensure that the participants were aware of the condition they were assigned to. All participants responded correctly to the manipulation check.

### 3.3 Survey (also in Appendix, in Norwegian)

The survey started with an Emotive projection task, where participants were asked to judge the mood of persons that were shown to them in four pictures (Figure 1; Adams *et al.*, 2016). The pictures were shown to participants in random order and they were first asked to reply in three open fields for each of the pictures (Altintzoglou *et al.*, 2018). After that, they were asked to evaluate four moods of the pictured persons: a) open, b) suspicious, c) cheerful and d) stressed, on seven-point scales from 1= very little to 7= very much (Mojet *et al.*, 2016; Vermeer *et al.*, 2009)



Figure 1 The four pictures shown to participants

The survey continued with an open-ended question that requested the participants to imagine that they were at a shop/supermarket to buy food for dinner where they you saw a product that was processed using one of the experimental conditions in which the participants belonged in. Then the participants were asked to write the first three thoughts that came to their mind, using one or two words (Altintzoglou *et al.*, 2018).

The part that followed, focused on the suitability of various food categories to each of the experimental conditions. The food categories were: Ready to eat salads, Ready to eat dressings/soups/vegetables/potatoes, Salads, Vegetables, Frozen vegetables, Milk, Milk based products, Juice/Smoothies and Potatoes, rated on seven-point scales from 1= not at all suitable to 7= very suitable (Schutz, 1994).

Participants then rated the products of their experimental condition on willingness to try, willingness to eat and willingness to pay (Wilks & Phillips, 2017). Both willingness to try and willingness to eat were rated on five-point scales: Definitely yes, Probably yes, Unsure, Probably no and Definitely no. Willingness to pay was rated on a five point scale: Much more, Somewhat more, Neither more nor less, Somewhat less and Much less.

Consumer attitudes towards products belonging to each of the experimental conditions were measured using seven-point scales from 1= negative attitude to 7= positive attitude (Oliver, 1980). The attitudes measured were Foolish-Wise, Safe-Risky, Good for me-Bad for me and Harmful-Beneficial. After that, participants were asked to rate the appropriateness of various benefits for the products in their experimental condition. These were: Stays fresh longer, Easy planning, No wasted product, Better taste, Healthier, More vitamins, Less sugar and Sustainable, rated on seven-point scales from 1=never appropriate to 7= always appropriate (Schutz, 1994)

The survey then shifted focus towards the personality characteristics of the participants, starting with social consumption based on brands (Moschis, 1981; Fitzmaurice & Comegys, 2006). The items used were: "Before I buy a product, it is important for me to know what others think about the different products or brands", " Before I buy a product, it is important for me to know what kind of people buy these products or brands", "Before I buy a product, it is important for me to know what others think about people who use these products or brands" and "Before I buy a product, it is important for me to know what brands or products I should buy to make a good impression on others", rated on seven-point scales from 1= Strongly disagree to 7= Strongly agree.

Subjective knowledge about food processing and food quality were measured using the items: "I feel very knowledgeable about ...", "Compared to my friends, I know a lot about ..." and "Compared to experts, I know a lot about ...", rated on seven-point scales from 1= strongly disagree to 7= strongly agree (Park, 1994). Perceived consumer effectiveness was measured using the items adapted to the surveys goals: "There is not much that only one individual can do about food waste reduction", "The efforts of one person about food waste reduction are useless as long as other people don't act in a similar way" and "As one person has no effect on food waste reduction, there is no point in me attempting to do so", rate on seven-point scales from 1= strongly disagree to 7=strongly agree (Ellen *et al.*, 1991; Honkanen & Young, 2015). Participants were then asked to reply with a yes or a no to the question "Have you actively sought information about food processing technologies during the last year?".

Involvement with food waste reduction and health were measured using three items for each: "... means a lot to me", "I care a lot about ..." and "... is very important to me", rated on seven point scales from 1= strongly disagree to 7= strongly agree (Pieniak *et al.*, 2008). Convenience orientation was measured using the items: "I prefer meals that are easy to plan, buy (provide), prepare and cook", "The less physical effort (work, energy) I need to buy and prepare a meal, the better", "I prefer meals that are quick to plan, buy (provide), prepare and cook" and "I prefer meals that can be prepared and cooked quickly", rated on seven point scales from 1=totally disagree to 7= totally agree (Olsen *et al.*, 2007).

Trust in governmental control and trust in producers was measured using six items for each: "... of processed food products can generally be trusted", "... of processed food products are honest and truthful", "... of processed food products are trustworthy", "... of processed food products can be counted on to do what is right", "I have great confidence in ... of processed food products" and "... of processed food products have high integrity", rated on seven-point scales from 1=strongly disagree to 7= strongly agree (Holloway *et al.*, 2009). Need for uniqueness and domain specific innovativeness were measured using the items: "I often try to avoid products that are bought by the general population", "The more common a product is among the general population, the less interested I am in buying it", "When products I like become extremely popular, I often lose interest in them", "Products that everybody buy, have less value to me", "I buy new types of food earlier than other people", "Normally I'm one of the first among my friends to buy new types of food", "Normally I'm one of the first among my friends to know about new types of food" and "I like to buy new and different types of food even if I have not tasted it before", rated on seven-point scales from 1= Strongly disagree to 7=Strongly agree (Tian *et al.*, 2001; Goldsmith & Hofacker, 1991; Bartels & Reinders, 2010).

Finally, the survey covered Environment related behaviour, social and demographic characteristics. Participants' behaviour related to the environment was covered by the questions "Are you a member of an environmental organization?" and "Do you financially support any environmental organization?" Social and demographic characteristics of the participants, including: Age, Gender, Latest completed Education level, Occupation, Monthly household income, Current household situation and Number of children in household.

### **3.4 Statistical analysis**

Correspondence analysis, using Past 3, was used to analyse the content of the open-ended questions. Analysis of variance (ANOVA) was used to analyse the effect of the different experimental conditions on the consumers. SPSS 26.0 software was used for conducting the ANOVA.

## 4 Results

In the sections below, the results from the consumer survey are described, starting with a sample description, and followed by the rest of the results following the order that they appeared in the survey.

### 4.1 Sample

Social and demographic characteristics of the study population indicated a balanced sample, representative of the population of Norway (Table 3).

*Table 3 Social and demographic characteristics of the representative Norwegian sample population (n=1206).*

		%			%
Region	Oslo/Akershus	23.9	Mean age	48.66	
	Rest Østland	19.2	Gender	Female	49.2
	Sørlandet	13.6		Male	50.8
	Vestlandet	26	Personal yearly income (NOK)	< 100 000	5.6
	Trøndelag/Nord-Norge	17.2		100 000–99 999	5.6
Lifecycle situation	Pre family	25.7		200 000–299 999	11.4
	Young family	10.9		300 000–399 999	13.6
	Adult family	18.5		400 000–499 999	18
	Active Empty Nesters	25.8		500 000–599 999	11.5
	Senior Citizens	19.2		600 000–699 999	6.6
Family situation	Living with parent(s)	4.1		700 000–799 999	4.5
	Single parent	4.6		800 000–899 999	2.2
	Single	31.3		900 000–999 999	1.2
	Couple with child(ren)	24		> 1 000 000	2
	Couple without child(ren)	32	Prefer not to report	13.8	
	Other with child(ren)	0.8	Don't know	3.9	
	Other without child(ren)	3.2	Household yearly income	< 100 000	3
Marital status	Divorced	7.3		100 000–199 999	2.9
	Registered couple	0.7		200 000–299 999	6.8
	In relationship, living alone	7.5		300 000–399 999	8
	Cohabiting	19.5		400 000–499 999	9.3
	Married	37.6		500 000–599 999	8.3
	Separated	1.9		600 000–699 999	6.6
	Single	23.5		700 000–799 999	9
	Widow(er)	2.2		800.000–899.999	7
Number of children in household	0	74.5		900.000–999.999	6.6
	1	11.4		> 1.000.000	12.9
	2	10	Prefer not to report	14.5	
	3	3.2	Don't know	5.1	
	4	0.6	Household size	1	29.9
	5 or more	0.3		2	38.8
Education	Primary	7.5		3	12.9
	Highschool	36.8		4	12.7
	University etc. (1-3 years)	29.9		5	3.5
	University etc. (4 or > years)	25.2		6	1.3
	Prefer not to report	0.7		7	0.6
Occupation	Pensionist	20.7		8 or more	0.2
	Unemployed	11.9	Residential area size (number of residents)	Capital area	16.2
	Homemaker	3.2		> 50.000	30.1
	Student	9.3		5.000 - 49.999	29.9
	Employed (Office)	23.2		< 5.000	23.1
	Employed (Skilled)	23.8		Don't know	0.7
	Self-employed	4.6			
	Other	3.3			

The distribution of social and demographics among the experimental conditions indicated the lack of significant differences, which implied comparable groups for the experiment (Table 4).

*Table 4 Social and demographic characteristics of the representative Norwegian sample population per experimental condition*

	Experimental contition						Total	F	Sig.
	Control	IPT	Convenience	Health	Sustainability	Quality			
N	201	200	202	201	201	201	1206		
Gender	1.53	1.51	1.49	1.5	1.52	1.51	1.51	0.2	0.963
Age	49.13	47.65	49.47	49.53	47.21	48.95	48.66	0.7	0.619
Region	2.92	2.92	2.95	3.03	2.93	2.87	2.94	0.3	0.918
Lifecycle situation	3.07	2.94	3.07	3.06	2.91	3.05	3.02	0.5	0.762
Family situation	3.89	3.88	3.95	4.05	3.93	3.75	3.91	1.3	0.244
Marital status	4.94	4.84	4.93	4.93	4.86	4.9	4.9	0.1	0.986
Number of children in household	0.34	0.5	0.49	0.51	0.47	0.38	0.45	1.3	0.273
Education	2.8	2.78	2.77	2.67	2.83	2.65	2.75	1.2	0.313
Occupation	4.06	4.14	3.98	4.16	4.12	4.06	4.09	0.2	0.963
Personal yearly income	6.31	6.52	5.93	6.39	6.2	5.69	6.17	1.6	0.162
Household yearly income	8.06	8.39	7.54	7.99	7.79	7.44	7.87	2.1	0.063
Household size	2.21	2.37	2.29	2.33	2.25	2.26	2.29	0.4	0.846
Size of Residential area size	2.58	2.57	2.59	2.68	2.61	2.7	2.62	0.5	0.745

## 4.2 Emotive projection tests

The new approach of open-ended emotive projections led to results of limited usefulness. The participants showed the ability of coming up with emotions to report, but the distribution of the words in the analysis did not indicate particularly clear separation between the six experimental conditions (figure 2).

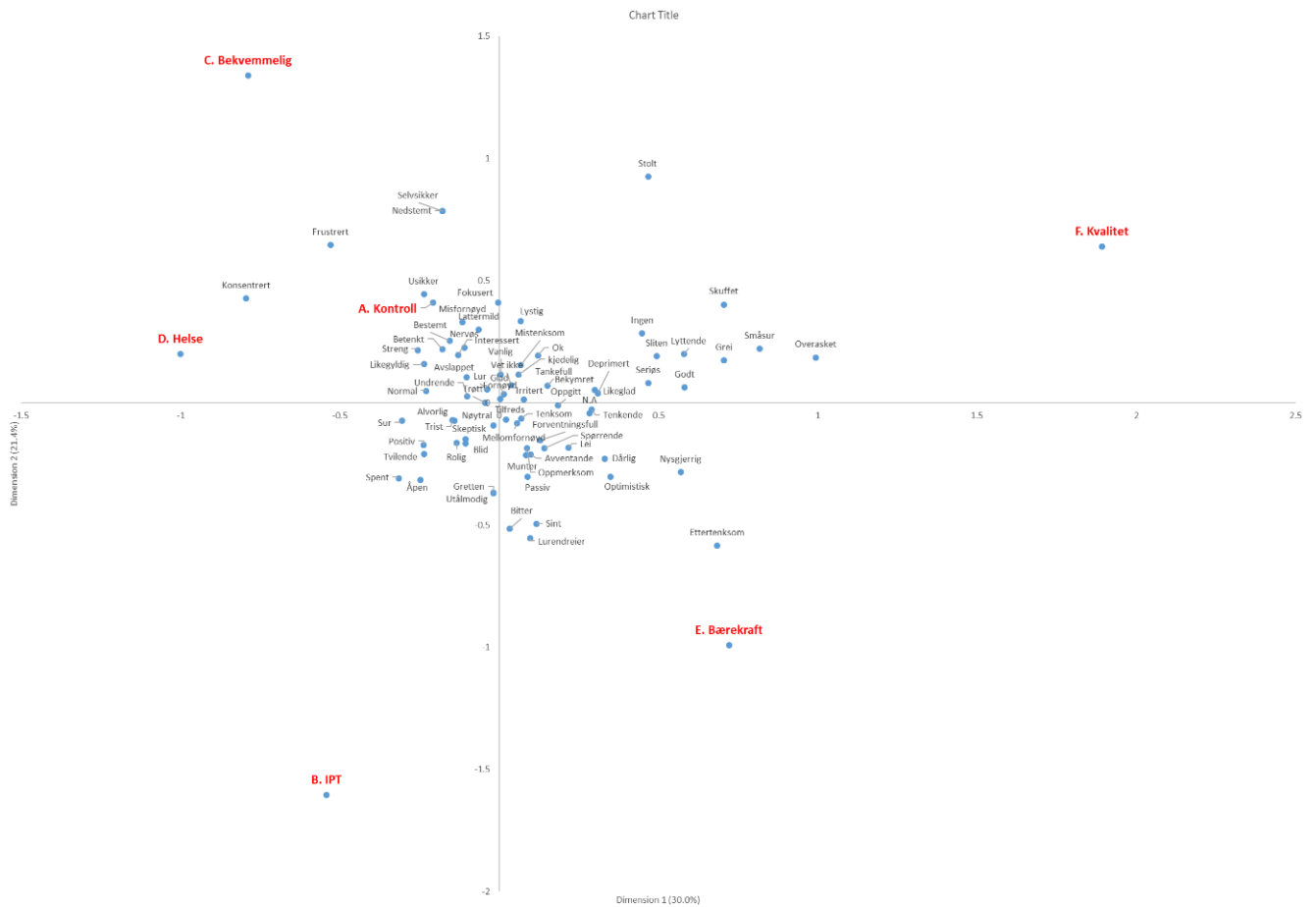


Figure 2 Open-Ended Emotive Projection results (Larger in appendix)

Emotive projections resulted in no significant differences between the experimental conditions (Table 5).

Table 5 Emotive projections per experimental condition

	Experimental contition							F	Sig.
	Control	IPT	Convenience	Health	Sustainability	Quality	Total		
Open	3.7	3.6	3.5	3.7	3.7	3.8	3.7	1.6	0.166
Suspicious	3.8	3.8	3.8	3.9	3.88	3.8	3.8	0.2	0.953
Happy	3.6	3.6	3.5	3.6	3.6	3.6	3.6	0.5	0.762
Stressed	3.0	3.1	3.1	3.0	3.0	3.1	3.1	0.2	0.958

4.3 Top of mind consumer reactions (OEQ)

Consumers’ top of mind reports led to the results in figure 3 (also larger in appendix). It is apparent that the control condition, based on the communication that the food products were processed as usual was significantly different than the other conditions, leading to its placement on the very left of the figure, together with words like natural, safe, good and quality. On the other end, and the furthest away was the condition about innovative processing technologies (IPT), together with words such as suspicious, sceptic, genetically modified etc. on the same side, but spread along the y axis, were the other experimental conditions, with a clear divide between convenience communication which was opposite health and sustainability. Convenience was near words like easy, smart and new, while health

and sustainability were near words such as positive, environmentally friendly, processed and doubtful. These results indicated how consumers think without any limitation from questionnaire items that frame the area where they can report their opinions, therefore will be very useful when interpreting the results as a whole and concluding.

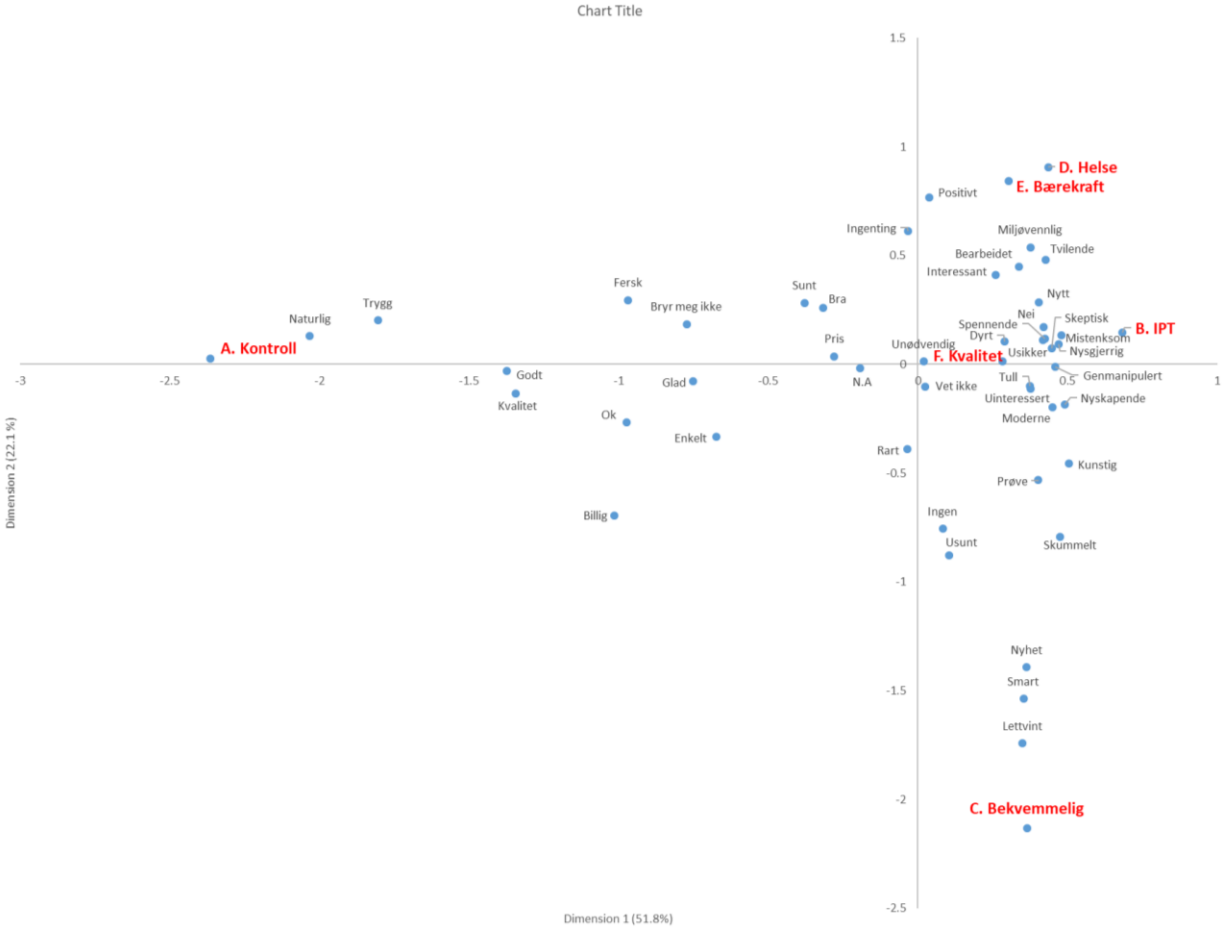


Figure 3 Consumers' impressions about information regarding food processed using IPT (Larger in appendix)

#### 4.4 Suitability of (IPT, IPT with benefits and control) to different product categories

Table 6 shows the suitability of innovative processing technology (IPT), IPT with benefits and control group (food processed in the usual way) to different product categories

Table 6 Suitability of IPT, IPT with benefits and control to different product categories (Different letters within the same row indicate significant differences ( $p < 0.05$ ))

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Ready to eat salad mix	4,68a	4,10b	4,33ab	4,79a	4,37ab	3,92b
Ready to eat dressings, soup, vegetables and potatoes	4,25bc	4,74ab	4,28bc	4,90a	4,59ab	3,93c
Salads	4,88a	3,61c	4,14bc	4,34ab	4,07bc	4,02bc
Vegetables	5,14a	3,53c	4,00bc	4,03bc	4,05bc	4,21b
Frozen vegetables	4,79a	4,11b	4,44ab	4,69a	4,49ab	4,36ab
Milk	5,21a	3,60c	3,87bc	3,77bc	4,20b	3,89bc
Milk based products	4,79a	4,26ab	4,21b	4,20b	4,52ab	3,99b
Juice/Smoothies	4,64a	4,50ab	4,39ab	4,52ab	4,48ab	3,98b
Potatoes	4,91a	3,03c	3,41bc	3,49bc	3,62bc	3,85b

The control group received the highest consumer rating for all product categories except ready to eat dressings, soup, vegetables and potatoes. The innovative processing technology (IPT) group received the lowest rating for 5 of 9 product categories (salads, vegetables, frozen vegetables, milk and potatoes). The IPT group with the benefit improving environmental sustainability was given the lowest rating for the 4 of 9 product categories (both ready to eat product categories, milk-based products and juice/smoothies). The results show that IPT with benefit information receives a significantly lower evaluation than food produced in the usual way in the following product categories:

- Ready to eat salad mix; IPT and sustainability benefit
- Salads; IPT and sustainability, quality and health benefits
- Vegetables; All IPT with benefits
- Milk; All IPT with benefits
- Milk based products; IPT and sustainability, convenience and health benefits
- Juice/Smoothies; IPT and sustainability benefit
- Potatoes; All IPT with benefits



## 4.5 Willingness to try, eat and pay

Table 7 shows the willingness to try, eat and pay for IPT, IPT with benefits and control group.

Table 7 Willingness to try, eat and pay (Different letters within the same row indicate significant differences ( $p < 0.05$ ))

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Willingness to try	4,16a	3,47b	3,39b	3,43b	3,38b	3,52
Willingness to eat	4,00a	3,53b	3,51b	3,48b	3,51b	3,62b
Willingness to pay	3,08a	2,71b	2,92ab	2,83ab	2,86ab	2,98a

The consumers were significantly less interested in trying and eating food products with IPT and IPT with benefits. There was no difference in willingness to pay between the control group and food products with IPT and benefits. However, a significantly lower willingness to pay was found for IPT compared with the control group.

## 4.6 Attitude

Table 8 shows the attitude for IPT, IPT with benefits and control group.

Table 8 Attitudes (Different letters within the same row indicate significant differences ( $p < 0.05$ ))

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Attitude	5,32a	4,35b	4,47b	4,29b	4,56b	4,80b

Consumers has a significantly less positive attitude to IPT and IPT food products.

## 4.7 Appropriateness of communication

Table 9 shows the appropriateness of different types of information for IPT, IPT with benefits and control group.

Table 9 Appropriateness of communication (Different letters within the same row indicate significant differences ( $p < 0.05$ ))

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Keeps fresh for longer time	4,79b	5,27ab	5,21ab	5,27ab	5,37a	4,98ab
Easy to plan	5,00ab	4,96ab	4,79ab	5,15a	4,85ab	4,64b
Avoids food waste	5,00	4,96	4,96	5,09	5,24	5,24
Better taste	4,93	4,58	4,87	4,47	4,96	4,67
Healthier	5,01	4,81	5,12	4,77	4,87	4,99
More vitamins	4,86	4,84	4,92	4,78	4,78	4,88
Less sugar	4,92	5,14	5,34	4,92	5,10	5,09
Sustainable	4,97	4,84	4,97	4,84	4,95	5,25

The results show small or no differences for the appropriateness of different types of information for IPT, IPT with benefits and control group. There is a clear tendency that the corresponding benefit of the communication receives the highest score. For example, when the information is easy to plan, IPT and convenience benefit has the highest score and when the information is healthier, more vitamins and less sugar IPT and health benefit scores highest.

#### 4.8 Individual characteristics and behavioral indicators

No significant difference was found for social norms between IPT, IPT with benefits and control group.

Table 10 shows knowledge about food production and quality for IPT, IPT with benefits and control group.

*Table 10 Knowledge about food production and quality (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Knowledge production	3,75	3,43	3,66	3,58	3,76	3,72
Knowledge quality	3,79	3,67	3,83	3,78	3,96	4,00

No significant difference was found for knowledge about food production and quality between IPT, IPT with benefits and control group.

Table 11 shows consumer empowerment for IPT, IPT with benefits and control group.

*Table 11 Consumer empowerment (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Consumer empowerment	2,82	3,14	3,07	3,14	3,34	3,20

No significant difference was found for consumer search for information between IPT, IPT with benefits and control group (Table 12).

*Table 12 Consumer search for information about food processing technology*

		Experimental condition					
		Control	IPT	IPT+health	IPT+convenience	IPT+sustainability	IPT+quality
Consumer search for information	Yes	29	21	26	20	34	43
	No	172	179	176	181	167	158

Table 13 shows involvement in food waste and health for IPT, IPT with benefits and control group.

*Table 13 Involvement in food waste and health (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Involvement food waste	5,60	5,36	5,28	5,41	5,47	5,38
Involvement health	5,82	5,87	5,74	5,75	5,60	5,76

No significant difference was found for involvement in food waste and health between IPT, IPT with benefits and control group.

Table 14 shows convenience orientation for IPT, IPT with benefits and control group.

*Table 14 Convenience orientation (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Convenience orientation	4,75	4,95	4,77	4,75	4,88	4,74

No significant difference was found for convenience orientation between IPT, IPT with benefits and control group.

Table 15 shows trust towards controlling authorities and food producers for IPT, IPT with benefits and control group.

*Table 15 Trust towards controlling authorities and food producers (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Trust authorities	4,81	4,48	4,38	4,65	4,74	4,53
Trust food producers	4,35	4,08	3,89	4,18	4,34	4,15

No significant difference was found for trust towards controlling authorities and food producers between IPT, IPT with benefits and control group.

Table 16 shows need for uniqueness and innovativeness for IPT, IPT with benefits and control group.

*Table 16 Need for uniqueness and innovativeness (Different letters within the same row indicate significant differences ( $p < 0.05$ ))*

	Experimental condition					
	Control	IPT	IPT+health	IPT+convenience	IPT+quality	IPT+sustainability
Uniqueness	2,78	2,76	2,76	2,91	3,19	2,80
Innovativeness	3,62	3,71	3,56	3,58	3,68	3,76

No significant difference was found for need for uniqueness and innovativeness between IPT, IPT with benefits and control group.

5,7% of the participants was a member of an environmental organization. There was no significant difference between the experimental groups in the number of members of environmental organizations.

## 5 Discussion

The main general finding in this study is that when Norwegian consumers are informed about food products being processed by use of innovative technologies, they become less positive than when informed about food processing being done as usual. Adding potential benefits from using innovative processing technologies, such as improved health, increased convenience, improved quality and increased sustainability seem to have a positive effect on consumer responses, yet this effect is limited. The benefit that as a whole seems to result to the most positive effect is increased convenience, which is potentially associated with increased self-life. Sustainability, quality and health were also considered relevant benefits, leading to increased willingness to pay. However, this positive effect was only observed when reporting on food on a general level, and not when the focus was on food categories and example products. In the latter situation, convenience was the main driving force for increased acceptance of innovative food processing technologies. These results were also confirmed by the additional measurement method that employed one-ended questions. On a product specific level, the results showed variation in suitability of benefit communication, but with the traditional processing methods always leading the highest scores.

The consumer sample showed little variation between experimental groups when it comes to personality and behavioral characteristics. This meant that these variables could not be used to directly support the results from the experimental part of this study. A potential challenge when evaluating information about innovative food processing technologies is that consumers are not knowledgeable enough in order to differentiate themselves and take a position for or against specific details and benefits that are related to the technologies. What was observed in this study was that most consumers had a relatively low level of knowledge about food production and quality, a low level of consumer empowerment and also a low level on information search about new food processing technologies. This may appear that the participants are not engaged in this issue, but due to the fact that it is a representative sample, we can conclude that the topic of innovative food processing technologies is of low interest for most consumers in Norway.

A representative Norwegian consumer sample successfully completed an open-ended emotive projection task, reporting several words describing their emotions. However, these emotions did not indicate a particular or significant differentiation among the experimental conditions. This result was confirmed by the Emotive projection task with predetermined questions, where no significant differences were found between the experimental and control conditions. These results may indicate the lack of differences between conditions, on an emotional level, or the weakness of the method for this particular type of stimuli. The Emotive Projection Test method has been previously used to evaluate food products, while in this study it was employed to reveal emotional differences in the consumer reactions to information about innovative food processing technologies (Mojet *et al.*, 2016). The higher level of abstraction in focusing on information about technologies may have created enough distance for the consumers to find it difficult to emotionally relate to one or the other approach and benefit. A potential improvement in future tests using this new approach would be to expose consumers to real food product that carry the various experimental conditions in terms of information. In conclusion, we consider the use of open-ended emotive projection tests useful and feasible, with the additional recommendation of using stimuli that generate larger contrast in consumer responses.

## 6 Conclusion

Innovative food processing technologies are not in the top of mind of Norwegian consumers. Their low knowledge about them generates some skepticism when they hear about them, in contrary to more acceptable conventional processing technologies. However, communicating benefits from the use of these new technologies has a powerful potential towards future differentiation strategies, depending on the technology and food category. Convenience related to specific food categories, potentially due to increase self-life could be used to increase acceptance of a shift towards these innovative technologies. Additionally, communicating about specific environmental benefits from the use of innovative food processing technologies could increase acceptance and willingness to pay for food as a whole. Balanced information about the justification of changes in food production and processing is a valuable tool for increasing consumer acceptance and the avoidance of emotional reactions at a later stage, when technologies are broadly available and potentially communicated in an overdramatized manner by the media.

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# Appendix

## 1.1 Appendix 1: Full consumer survey in Norwegian

### YouGov's GDPR procedures described to participants during recruitment.

#### Screening questions, while keeping the sample representative

1. Har du noen matallergier? (ja/nei)
2. Har du vært ansvarlig for minst 50 % av innkjøp eller tilberedning av mat i ditt hushold den siste måneden? (ja/nei)

### iNObox survey

Survey performed in Norway. Delivered clean and organised raw data in SPSS format.

Recruitment of 1200 participants (6 groups of 200 participants each), randomly allocated to 6 versions of the survey as described below.

Experimental design for the 6 groups of 200 participants each is:

<b>Control</b>		200p
<b>IPT</b>		200p
<b>IPT + benefit</b>	<b>Convenience</b>	200p
	<b>Health</b>	200p
	<b>Sustainability</b>	200p
	<b>Quality</b>	200p
<b>Total</b>		<b>1200p</b>

Please screen participants for not having food related allergies and for being at least 50% responsible for the shopping and preparation of food in their household, while maintaining a balanced sample between the six groups, which is also as representative as possible for the Norwegian population. Within question (e.g. 1, 2, 3) please program randomization of the items (e.g. a, b, c) for each participant.

Velkommen til denne undersøkelsen hvor vi ønsker å vite din oppfatning av [plural form of text in table 1]:

		<b>Tekst</b>
<b>Kontroll</b>		Matvarer bearbeidet på vanlig måte
<b>IPT</b>		Matvarer bearbeidet ved bruk av nytt teknologi
<b>IPT + utbytte</b>	<b>Bekvemmelig</b>	Matvarer bearbeidet ved bruk av nytt teknologi som gjør dagliglivet mer lettvent
	<b>Helse</b>	Matvarer bearbeidet ved bruk av nytt teknologi som gir sunnere produkter
	<b>Bærekraft</b>	Matvarer bearbeidet ved bruk av nytt teknologi som bidrar til bærekraftig miljø
	<b>Kvalitet</b>	Matvarer bearbeidet ved bruk av nytt teknologi som gir bedre produktkvalitet

Vi setter pris på at du deltar og at du vil dele dine personlige meninger om dette temaet. Vi vil analysere resultatene grundig for å få frem viktig kunnskap om dette og nærliggende forskningsfelt. Denne undersøkelsen består av spørsmål hvor du enten skal svare med fritekst, rangere på en gitt skala, velge ja/nei eller velge et alternativ fra en liste. Svar ærlig på alle spørsmål, og svar det du først

tenker på. Det finnes ikke noe rett eller galt svar. Alle svar blir anonymisert, og du kan når som helst avslutte undersøkelsen eller be om at ditt svar blir slettet.

**new page/screen**  
**Manipulation check.**

Her skal du svare det du tror er riktig.  
Denne undersøkelsen er om produkter som er:

**Choices:**

- a. Matvarer bearbeidet på vanlig måte
- b. Matvarer bearbeidet ved bruk av nytt teknologi
- c. Matvarer bearbeidet ved bruk av nytt teknologi som gjør dagliglivet mer lettvint
- d. Matvarer bearbeidet ved bruk av nytt teknologi som gir sunnere produkter
- e. Matvarer bearbeidet ved bruk av nytt teknologi som bidrar til bærekraftig miljø
- f. Matvarer bearbeidet ved bruk av nytt teknologi som gir bedre produktkvalitet

**new page/screen**

På de neste sidene viser vi deg bilder av personer og ber deg svare på hvilket humør/sinnsstemning du tror disse menneskene er i. Se på bildene og gi ett svar per bilde.

**Show one picture per page and randomize the order in which the pictures appear per participant**

1. Hvilket humør/sinnsstemning tror du denne personen er i?



- a.....
- b.....
- c.....

**new page/screen**

2. Hvilket humør/sinnsstemning tror du denne personen er i?



- a.....

b.....

c.....

new page/screen

3. Hvilket humør/sinnsstemning tror du denne personen er i?



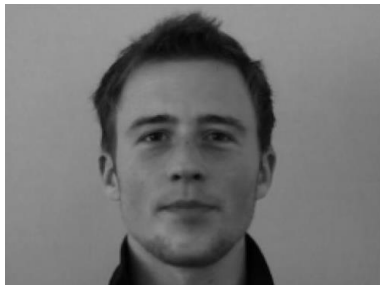
a.....

b.....

c.....

new page/screen

4. Hvilket humør/sinnsstemning tror du denne personen er i?



a.....

b.....

c.....

new page/screen

Show one picture per page and randomize the order in which the pictures (5-8) and emotion items (i-iv) appear per participant

Skala

1. Veldig litte

2.

3.

4.verken/eller

5.

6.

7. Veldig mye

8. Vet ikke

5. Hvilket humør/sinnsstemning tror du denne personen er i?



- i. Åpen
- ii. Mistenksom
- iii. Glad
- iv. Stresset

new page/screen

6. Hvilket humør/sinnsstemning tror du denne personen er i?



- i. Åpen
- ii. Mistenksom
- iii. Glad
- iv. Stresset

new page/screen

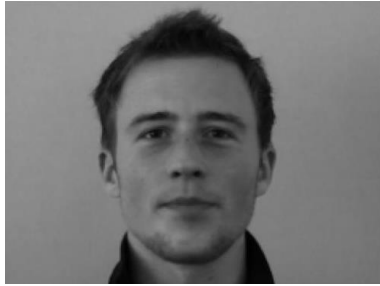
7. Hvilket humør/sinnsstemning tror du denne personen er i?



- i. Åpen
- ii. Mistenksom
- iii. Glad
- iv. Stresset

new page/screen

8. Hvilket humør/sinnsstemning tror du denne personen er i?



- i. Åpen
- ii. Mistenksom
- iii. Glad
- iv. Stresset

new page/screen

1. Forestill deg at du er i butikken for å kjøpe matvarer til middag. Du ser et produkt som er [text in table 1]. Skriv inn de tre første tankene dine om denne matvaren, bruk ett eller to ord.
  - a.....
  - b.....
  - c.....

new page/screen

2. Vi vil gjerne vite hvor godt matvarene under passer til [text in table 1]. Kryss av på skalaen
  - a. Spiseklare salatblandinger
  - b. Spiseklare dressinger/supper/grønnsaker/poteter
  - c. Salater
  - d. Grønnsaker
  - e. Frosne grønnsaker
  - f. Melk
  - g. Melkebaserte produkter
  - h. Juice/Smoothies
  - i. Poteter

Skala

- 1. Passer veldig lite
- 2.
- 3.
- 4. verken/eller
- 5.
- 6.
- 7. Passer veldig mye
- 8. Vet ikke

new page/screen

Les spørsmålene nedenfor og svar på hvert enkelt av dem ved å bruke skalaen.

3. Er du villig til å prøve [text in table 1]?
  - a. Definitivt ja
  - b. Sannsynligvis ja
  - c. Usikker
  - d. Sannsynligvis ikke
  - e. Definitivt nei
4. Er du villig til å spise [text in table 1] jevnlig?
  - a. Definitivt ja
  - b. Sannsynligvis ja
  - c. Usikker
  - d. Sannsynligvis ikke
  - e. Definitivt nei
5. Hvor mye er du villig til å betale for [text in table 1]?
  - a. Mye mer
  - b. Litt mer
  - c. Hverken mer eller mindre
  - d. Litt mindre
  - e. Mye mindre

new page/screen

6. Vi vil nå fokusere på dine holdninger til [text in table 1]. Kryss av på skalaen. Å kjøpe [text in table 1], er:

a. 1= Uklokt	7= Klokt
b. 1= Trygt	7= Utrygt
c. 1= Bra for meg	7= Ikke bra for meg
d. 1=Ufordelaktig	7=Fordelaktig

new page/screen

7. Hvor godt tenker du det passer å ta med opplysninger om følgende fordeler på emballasjen? [text in table 1]?
  - a. Holder seg fersk lengre
  - b. Enkel å planlegge
  - c. Unngår matsvinn
  - d. Bedre smak
  - e. Sunnere
  - f. Mer vitaminer
  - g. Mindre sukker
  - h. Bærekraftig

Skala

1. Passer aldri
- 2.
- 3.
- 4.verken/eller
- 5.

- 6.
7. Passer alltid
8. Vet ikke

new page/screen

Vi går over til spørsmål om deg. Les spørsmålene nedenfor og svar på hvert enkelt.

8. Hvor enig eller uenig er du i følgende påstander:
  - a. Før jeg handler er det viktig for meg å vite hva andre tenker om disse produktene eller merkene.
  - b. Før jeg handler er det viktig for meg å vite hva slags mennesker som handler disse produktene eller merkene.
  - c. Før jeg handler er det viktig for meg å vite hva andre tenker om mennesker som bruker disse produktene eller merkene.
  - d. Før jeg handler er det viktig for meg å vite hvilke produkter og merker jeg bør kjøpe for å gjøre et godt inntrykk på andre.

Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

9. Les påstandene nedenfor og vurder hvor enig eller uenig du er.
  - a. Jeg føler meg meget kunnskapsrik når det gjelder matproduksjon
  - b. Jeg føler meg meget kunnskapsrik når det gjelder matkvalitet.
  - c. Sammenlignet med mine venner kan jeg mye om matproduksjon
  - d. Sammenlignet med mine venner kan jeg mye om matkvalitet.
  - e. Sammenlignet med eksperter vet jeg mye om matproduksjon.
  - f. Sammenlignet med eksperter vet jeg mye om matkvalitet.

Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

new page/screen

10. Tenk over følgende påstander og kryss av på skalaen hvor enig eller uenig du er
- En person alene kan ikke gjøre mye for å redusere matsvinn.
  - Det er ikke verdt innsatsen om bare en person reduserer matsvinn og ingen andre gjør det.
  - Siden min innsats ikke vil påvirke det totale matsvinnet, er det ingen vits for meg å gjøre noe.

Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

new page/screen

I denne delen av undersøkelsen fokuserer vi på informasjon om bearbejdede produkter. Les spørsmålene og svar på hvert enkelt med ja eller nei eller bruk skalaen ved siden av spørsmålet.

11. Har du i løpet av siste år aktivt søkt etter informasjon om teknologi brukt i matproduksjon?  
(ja/nei)

new page/screen

12. For hver av de følgende påstandene, kryss av for hvor enig eller uenig du er.
- Å redusere matsvinn betyr mye for meg
  - Jeg bryr meg mye om å redusere matsvinn
  - Å redusere matsvinn er veldig viktig for meg
  - Helse betyr mye for meg
  - Jeg bryr meg mye om helse
  - Helse er veldig viktig for meg

Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

new page/screen

13. For hver av de følgende påstandene, kryss av for hvor enig eller uenig du er.



- a. Jeg foretrekker måltider som er lette å planlegge, kjøpe inn og tilberede.
- b. Jo mindre krefter jeg trenger å bruke på innkjøp og tilberedning av et måltid, jo bedre
- c. Jeg foretrekker måltider som er kjappe å planlegge, kjøpe inn og tilberede
- d. Jeg foretrekker måltider som kan tilberedes på kort tid

#### Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

#### new page/screen

14. Les påstandene nedenfor og kryss av for hvor enig eller uenig du er.
- a. **Offentlig kontroll** av bearbeidede matvarer kan man generelt stole på
  - b. **Offentlig kontroll** av bearbeidede matvarer er ærlig
  - c. **Offentlig kontroll** av bearbeidede matvarer er troverdig
  - d. Man kan stole på at **offentlig kontroll** av bearbeidede matvarer gjøres riktig
  - e. Jeg har stor tiltro til **offentlig kontroll** av bearbeidede matvarer
  - f. **Offentlig kontroll** av bearbeidede matvarer har høy integritet
  - g. **Produsenter** av bearbeidet mat kan man generelt stole på
  - h. **Produsenter** av bearbeidet mat er ærlige
  - i. **Produsenter** av bearbeidet mat er troverdige
  - j. Man kan stole på at **produsenter** av bearbeidet mat gjør det som er riktig
  - k. Jeg har stor tiltro til **produsenter** av bearbeidede matvarer.
  - l. **Produsenter** av bearbeidet mat har høy integritet

#### Skala

1. Helt uenig
- 2.
- 3.
4. verken/eller
- 5.
- 6.
7. Helt enig
8. Vet ikke

#### new page/screen

15. Nå skal vi spørre om dine vaner i forhold til produkter generelt. Les påstandene nedenfor og kryss av for hvor enig eller uenig du er.

- a. Jeg prøver å unngå produkter som alle kjøper
- b. Dess vanligere et produkt er (i befolkningen)?, jo mindre interessert er jeg i å kjøpe det
- c. Når produkter jeg liker blir veldig populære, mister jeg ofte interessen
- d. Produkter som alle kjøper har mindre verdi for meg
- e. Jeg kjøper nye typer mat før alle andre
- f. Normalt er jeg den første i vennegjengen som kjøper nye typer mat
- g. Normalt er jeg den første i vennegjengen som får kjennskap til nye typer mat
- h. Jeg liker å kjøpe nye og forskjellige typer mat selv om jeg ikke har smakt dem tidligere

#### Skala

- 1. Helt uenig
- 2.
- 3.
- 4. verken/eller
- 5.
- 6.
- 7. Helt enig
- 8. Vet ikke

#### new page/screen

16. Hva er ditt forhold til miljøvern? Velg ja eller nei på spørsmålene nedenfor.
- a. Er du medlem av en miljøvernorganisasjon? (yes/no)
  - b. Gir du økonomisk støtte til en miljøvernorganisasjon? (yes/no)

#### new page/screen

#### 17. Socio-demografi

- a. Alder (tall)
- b. Kjønn
  - a. Kvinne
  - b. Man
  - c. Vil ikke rapportere
- c. Siste fullførte utdanning
  - a. Videregående eller lignende
  - b. Teknisk videregående/Yrkesrettet eller lignende
  - c. Videre teknisk utdanning eller lignende
  - d. Bachelorgrad (BSc) eller lignende
  - e. Mastergrad (MSc) eller lignende
  - f. Doktorgrad (PhD) eller lignende
- d. Til daglig er jeg...
  - a. I full jobb
  - b. I deltidsjobb
  - c. Hjemmeværende

- d. Arbeidsledig
  - e. Student
  - f. Pensjonist
  - g. Vil ikke rapportere
- e. Husholdningens månedlige inntekt
- a. <20 000 nok
  - b. 20 000-30 000 nok
  - c. 30 000-40 000 nok
  - d. 40 000-50 000 nok
  - e. 50 000-60 000 nok
  - f. 60 000-70 000 nok
  - g. 70 000-80 000 nok
  - h. 80 000-90 000 nok
  - i. 90 000-100 000 nok
  - j. >100 000 nok
  - k. Vil ikke rapportere
- f. Sivilstand
- a. Gift
  - b. Bor sammen med partner
  - c. Bor i kollektivet
  - d. Singel
  - e. Skilt
  - f. Enke
- g. Antall barn i husholdningen (tall)

new page/screen

Tusen takk for din deltakelse i denne undersøkelsen! Vi setter stor pris på det.



### 1.3 Appendix 3: Open Ended Questions results

