



Dutch consumers' knowledge, attitudes and intentions regarding the best before date on food packages

Getting to know the group that has undesirable knowledge and intentions (and therefore can and should make most improvement) in terms of socio-demographics, socio-economics and attitudes

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Summary

Background. Consumers cause food waste by throwing away edible food products after the best before date. This study investigates how well Dutch consumers know the best before date and how consumers with undesirable knowledge and intentions regarding the best before date are characterized in terms of socio-demographics, socio-economics and attitudes. When these consumers are better understood, future campaigns can be made more specific, hopefully leading to a further decrease in undesirable knowledge and intentions. **Methods.** 376 respondents participated in a questionnaire. Based on answers, respondents were divided into two groups that have either desirable or undesirable knowledge and intentions. Tests showed what differences could be found between groups. **Results.** Respondents score relatively low on whether they know campaigns about the best before date. Many heard of the best before date (98.9%), but 45.5% incorrectly thinks that the best before date is about safety instead of quality. This is in line with the fact that respondents' most mentioned reason to not use products after the best before date is 'not becoming ill' (83.0%). Dutch adult consumers with undesirable knowledge and intentions less often know both the use by date and best before date (81.3%) than those with desirable knowledge and intentions (93.4%). They score lower on the perception that throwing away products after the best before date is food waste (3.91 compared to 4.17), can be avoided (4.12 compared to 4.27) and that they feel engaged with food scarcity (3.27 compared to 3.48). Habits and image are mentioned more often as reasons to not use products after the best before date (resp. 19.7% and 9.8% for habits and 7.3% and 1.1% for image). No differences are found regarding socio-demographics and socio-economics. **Conclusion.** Campaigns should communicate that two types of expiration dates exist, the use by date being about safety and the best before date being about quality. Once consumers know that the best before date is a measure of quality, consumers hopefully become less afraid of becoming ill when they use products after the best before date. Differences between respondents with either desirable or undesirable knowledge and intentions can be used to make sure that future campaigns for the group with undesirable knowledge and intentions are more specific, reaching the target group better and thus, hopefully becoming more effective. Respondents with undesirable knowledge and intentions should become more aware that throwing away food products after the best before date leads to food waste and can be avoided. Since these consumers feel less engaged with food scarcity, talking about scarcity might not be effective, but providing education about food waste in relation to scarcity might be beneficial to aim to increase engagement. Campaigns should target one's image and tell how to change habits, since these aspects are more often mentioned as reasons to not use products after the best before date by respondents with undesirable knowledge and intentions.

KEY WORDS: food waste; household consumer behavior; expiration dates; the best before date; demographics; clustering

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1 Introduction

1.1 Background

In developed countries, much food is wasted at the consumer level (Beretta, Stoessel, Baier, & Hellweg, 2013; Griffin, Sobal, & Lyson, 2009; Gustafsson, Cederberg, Sonesson, & Emanuelsson, 2013; Jörisen, Priefer, & Bräutigam, 2015; Koivupuro et al., 2012; Kummu et al., 2012; Parfitt, Barthel, & Macnaughton, 2010; Silvennoinen, Katajajuuri, Hartikainen, Heikkilä, & Reinikainen, 2014; Timmermans, Ambuko, Belik, & Huang, 2014). Food waste is defined as: 'Part of food loss and referring to discarding or alternative (non-food) use of food that is safe and nutritious for human consumption along the entire food supply chain, from primary production to household level. Food waste is recognized as a distinct part of food loss because the drivers that generate it and the solutions to it are different from those of food losses' (FAO, 2014). In Europe, 123 kilograms per person per year are wasted (min 55-max 190 kilograms). This means that 16% of all food that reaches the consumer, is thrown away. Of this amount, 97 kilograms per person per year (min 45-max 153 kilograms) - 80% - is avoidable. Avoidable food waste entails that the food was edible, but not consumed (CREM waste management, 2017; Vanham, Bouraoui, Leip, Grizzetti, & Bidoglio, 2015; Waste Resource Action Programme, 2013). These numbers have also been presented for the Netherlands. In 2009, Dutch households threw away 8 to 11% of purchased foods (Thönissen, 2009). Thus, it is probable that much improvement can be made at the consumer level. The number of people that is nowadays suffering from hunger is 815 million. Good food products that are thrown away could have otherwise fed the hungry part of the population (FAO, 2017). Furthermore, the production, distribution and storage of food products has its impact on the environment. In Europe, per 1000 kilograms of food waste, 1900 kilograms of CO₂ equivalents are emitted (Monier et al., 2010). When food products are wasted, the invested energy and raw materials are lost. The environment is affected without the benefit of feeding people (Roels & Van Gijsegheem, 2011). When products are thrown away at the consumer stage, the environmental impact is larger than when products would have been thrown away earlier in the food chain. 85 to 90% of total energy costs of a product has already been invested (Voedingscentrum, 2017). Therefore, wastage in the consumer stage should be reduced as much as possible.

In the last years, food waste became a more and more important topic that gained interest from consumers. Initiatives to reduce food waste and create a better understanding of expiration dates also increased. The year 2014 was even named as year against food waste (Adformatie, 2014). In this year, PassieVoorFood was established, an idea of Dutch supermarkets with sustainable and healthy initiatives (Centraal Bureau Levensmiddelenhandel, n.d.). Other examples of initiatives are Kliekipedia and foodbattle.nl. Kliekipedia is a Facebook page that encourages consumers to use

left-overs and throw away as little food as possible (Voedingscentrum, n.d.-b). Foodbattle.nl is a website by Milieu Centraal that helps consumers to waste less food (Milieu Centraal, n.d.). These campaigns all look at food waste in general.

One of the ways in which consumers cause food waste, is that they throw away edible food products after the best before date. The group of consumers that throws away food products when these products approach or exceed expiration dates is quite large. Looking at a country that is known for its consumerism, the United States, 37% of the population throws away food products when products approach or exceed expiration dates. The group that throws away food products every now and then, even covers 84% of the population (Leib et al., 2016). This phenomenon cannot only be found in the United States. Looking at the Netherlands, within the household, 15% of edible food is wasted because it has passed the expiration date. Of this 15%, 10% is covered by perishable products and the other 5% is covered by non-perishable products (Soethoudt, van der Sluis, Waarts, & Tromp, 2012). 48% of Dutch consumers stated that they always throw away foods that have passed the best before date. This group had a food wastage of 56 kilograms per person per year, which is much higher than people that are not that strict about the best before date. These people wasted 30 to 31 kilograms per person per year.

In 2016, the amount of food that was thrown away by consumers was lower than in 2010. In 2010, consumers wasted 48 kilograms per person per year, while in 2016, food waste was 41 kilograms per person per year (van Westerhoven & Steenhuisen, 2010). The numbers of food waste that specifically talk about avoidable food waste also decreased from 34.6 kilograms per person per year in 2013 to 32.7 kilograms per person per year in 2016 (CREM waste management, 2017). It is not known which types of household food waste led to a decrease. Therefore, it could be questioned whether the reduction was achieved by a change in behavior regarding the best before date, or that this reduction of food waste was achieved by reducing other types of food waste. Furthermore, the numbers in research of van Westerhoven and Steenhuisen (2010) were obtained by self-analysis, meaning that (lack of) reliability needs to be taken into account (Rijksoverheid, 2017). Even if the reduction of 7 kilograms was achieved completely by changed behavior regarding the best before date, there is still room – 41 kilograms – for improvement. After all, of the 48 kilograms of food waste that were measured in 2010, 14 kilograms could be prevented if consumers would be not that strict about the best before date (van Westerhoven & Steenhuisen, 2010).

Research has been done about what drives consumers to food waste (Graham-Rowe, Jessop, & Sparks, 2014; Koivupuro et al., 2012; Parfitt et al., 2010; Parizeau, von Massow, & Martin, 2015; Principato, Secondi, & Pratesi, 2015; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013), but

little research specifically investigates food waste in relation to the best before date (Brook Lyndhurst, 2008; Van Boxtael, Devlieghere, Berkvens, Vermeulen, & Uyttendaele, 2014). The importance of creating awareness and educating consumers about the best before date is seen. Awareness and knowledge could be created and improved by for example the government or companies (Canali et al., 2016). Consumers need to be educated about the meaning of the best before date, before they can make an informed decision (Canali et al., 2016). It should be avoided that consumers misinterpret the best before date or that they attach too much value to date labels or food safety. As a result, consumers might throw away food products while these are still edible. These topics should be communicated to consumers via e.g. campaigns. Many organizations educate about food waste in general and mention the expiration date as one of the causes of food waste, but a few organizations specifically highlight expiration dates. Examples are Centraal Bureau Levensmiddelenhandel (CBL), Natuur en Milieu, Voedingscentrum and Voedselbanken Nederland (Centraal Bureau Levensmiddelenhandel, n.d.; Natuur en Milieu, 2017; Voedingscentrum, n.d.-a; Voedselbanken Nederland, n.d.).

Nobody is thought to be in favor of food waste and consumers seem to have the potential to reduce food waste by using products after the best before date, but actual behavior turns out to be different. Even though organizations try to raise awareness and educate consumers, it seems like the knowledge is not seen and stored by consumers, or that consumers simply do not see the benefit of using products after the best before date. Awareness and knowledge are not the only factors influencing intentions and probably not the only way how one's approach towards the best before date could or should be influenced. Nonetheless, it is thought to be the starting point when investigating intentions regarding best before date. Without being aware of the food waste problem or possessing the right knowledge about the best before date and how to use them, consumers are not able to make an informed decision (Tsiros & Heilman, 2005). Education can be improved when it is known what kind of consumers have desirable or undesirable knowledge and intentions regarding the best before date (from now on called '(un)desirable approach towards the best before date') and what drives them to (not) use products after the best before date. It is desired to have effective campaigns that try to make sure that consumers see and store the information and that they intend to use products after the best before date. This research focuses on the persons that have an undesirable approach. It will be investigated how this group differs on socio-demographic and socio-economic aspects from the group that has a desirable approach, what are motives to (not) use products after the best before date and what these persons find important and what moves them. It is thought that the step towards awareness raising and effective education is to first understand who one is dealing with and what this person finds important. After all, consumers are known to have different knowledge and attitudes towards food waste (Parizeau et al., 2015). Knowing one's socio-demographics, socio-economics, knowledge, attitudes and intentions

(personal factors) provides insights into the consumers that can and should make most improvements. Furthermore, it provides insights into the aspects that can be targeted in future campaigns. This information can be used to make future campaigns more effective. Consumers are thought to feel more attracted to a campaign and use and store information in a better way when this campaign targets his or her personal factors. As a result, consumers are assumed to be more likely to change intentions.

Research that specifically investigates personal factors is executed in the Netherlands for the first time. Personal factors like socio-demographics, socio-economics, knowledge, attitudes and intentions form the basis for this research, where research in the United States, United Kingdom and Belgium mainly focused on behavioral and product factors (Brook Lyndhurst, 2008; Leib et al., 2016; Van Boxtael et al., 2014). Graham-Rowe et al. (2014) suggested that it would be interesting to see whether differences in motivations and barriers regarding food waste could be linked to socio-demographics (area of residence, gender and income level). Van Boxtael et al. (2014) started investigating the relation between socio-demographics and food waste, but this can be explored much further. A year later, Parizeau et al. (2015) suggested to investigate differences between single- and multi person households when looking at behaviors, attitudes, beliefs and waste generation rates, together with other socio-economics. These suggestions for future research were not executed in the meantime. The implications for future research are about food waste in general, but are thought to translate to food waste related to the best before date.

1.2 Conceptual model

Food waste behavior is related to factors that can be divided into four main categories: behavioral, personal, product and societal factors (Roodhuyzen, Luning, Fogliano, & Steenbekkers, 2017). It is thought that the factors that influence consumer food waste behavior can be used as a starting point for investigating best before date intentions. In this research, personal factors are of interest, since little research has been done into personal factors influencing one's approach towards the best before date. A selection of factors is taken that is thought to be useful to consider when investigating the best before date. The personal factors that are useful for this research are socio-demographics, socio-economics, knowledge, attitudes and intentions (Roodhuyzen et al., 2017). Demographics include gender, age, one's household size and presence of children in the household. Socio-economic factors are about one's income level, educational level and type of work. Together with one's knowledge, attitudes and intentions, this provides good insight in personal factors that are affecting one's approach towards the best before date.

No theories or well formulated hypotheses are available for how consumers approach best before dates. Investigations in this research are explorative. The Theory of Reasoned Action (TRA), Theory

of Planned Behavior (TPB) and Theory of Interpersonal Behavior (TIB) were integrated into one large model that serves as the conceptual model for this research. The extended model can be found in Figure 1. The TIB incorporates many aspects of the TRA and TPB, such as attitudes, social aspects and intentions (Moody & Siponen, 2013). Some aspects of the TIB that were not yet covered by the TRA or TPB were included in the conceptual model of this research. The TIB explains that behavior is not entirely rational, but also influenced by affective components and has therefore additional value when compared with the TRA and TPB. The TIB is thought to be suitable for investigating approaches towards the best before date, since one's intention is thought to be (partly) determined by what others do. It might not matter what one's neighbor does, but it does matter what is seen as general positive or negative behavior, for example the non-written rule that wasting food is a negative behavior and thus undesirable. Emotions were added to the model (affect), since behavior is thought to have both cognitive and affective components. Consumers often rely on their feeling when making decisions, instead of making decisions based on solely cognitive aspects. Additionally, frequency of past behavior was added to the conceptual model, since this determines one's habits. Habits are important to consider, since actual behavior is not only determined by intentions, but also by habits (Sheppard, Hartwick, & Warshaw, 1988). Furthermore, social factors are an important aspect. Triandis (1977) divides social factors into norms, roles and self-concept. These aspects were not separately mentioned in the conceptual model, since the social factors are already covered by the Theory of Planned Behavior in the form of subjective norms, which is divided into normative beliefs and motivation to comply. The last factor that was added from the Theory of Interpersonal Behavior was facilitating conditions. Facilitating conditions may make it either easier or more difficult to use products after the best before date. A consumer might have the intention to use products after the best before date, but facilitating conditions might inhibit the translation into actual behavior.

The model shows that one's approach towards the best before date can depend on multiple factors. Not all factors that are mentioned in the model are covered by this research. Nonetheless, the entire model is provided to show how this research fits in the overall picture. The green boxes (personal factors, consisting of socio-demographics, socio-economics, knowledge, attitudes and intentions) are investigated in this research. Since this model is quite large, the aim of this research is to also to open the road for future research and make recommendations about what can and should be investigated. It should be kept in mind that factors that are not included in this research might not only influence one's intention and behavior, but also interfere with factors that are investigated by this research.

1.3 Research questions

The aim of this study is to investigate how well Dutch consumers know the best before date and how consumers with an undesirable approach are characterized in terms of socio-demographics, socio-economics and attitudes. When these consumers are better understood, campaigns can be made more specific, hopefully leading to a further decrease in consumers that throw away edible food products after the best before date. The specific research question and sub research questions are:

- How do Dutch adult consumers with an undesirable approach* differ from Dutch adult consumers with a desirable approach** in their socio-demographics, socio-economics and attitudes about (using food products after) the best before date and how can this group be targeted in campaigns?
 - How well do Dutch adult consumers know the meaning of best before date labels?
 - Does this differ for Dutch adult consumers with a desirable approach**?
 - How are Dutch adult consumers with an undesirable approach* characterized, looking at socio-demographics (gender, age, household size, children in household) and socio-economics (education, work status, spendable income)?
 - Does this differ for Dutch adult consumers with a desirable approach**?
 - What are reasons to (not) use products after the best before date for Dutch adult consumers with an undesirable approach*?
 - Does this differ for Dutch adult consumers with a desirable approach**?
 - How do Dutch consumers handle different food products after the best before date?
 - Does this differ for Dutch adult consumers with a desirable approach**?
 - What topics can be implemented in informative campaigns to reach Dutch adults consumers with an undesirable approach*, based on what one finds important.

* An undesirable approach = having relatively little or unjust knowledge about (using products after) the best before date and/or taking the best before date as an ultimatum (throwing away at least one of the mentioned food products when the best before date has been reached, without testing whether the product is still edible).

** A desirable approach = having relatively much or just knowledge about (using products after) the best before date and not taking the best before date as an ultimatum (throwing away none of the mentioned food products when the best before date has been reached, without testing whether the product is still edible).

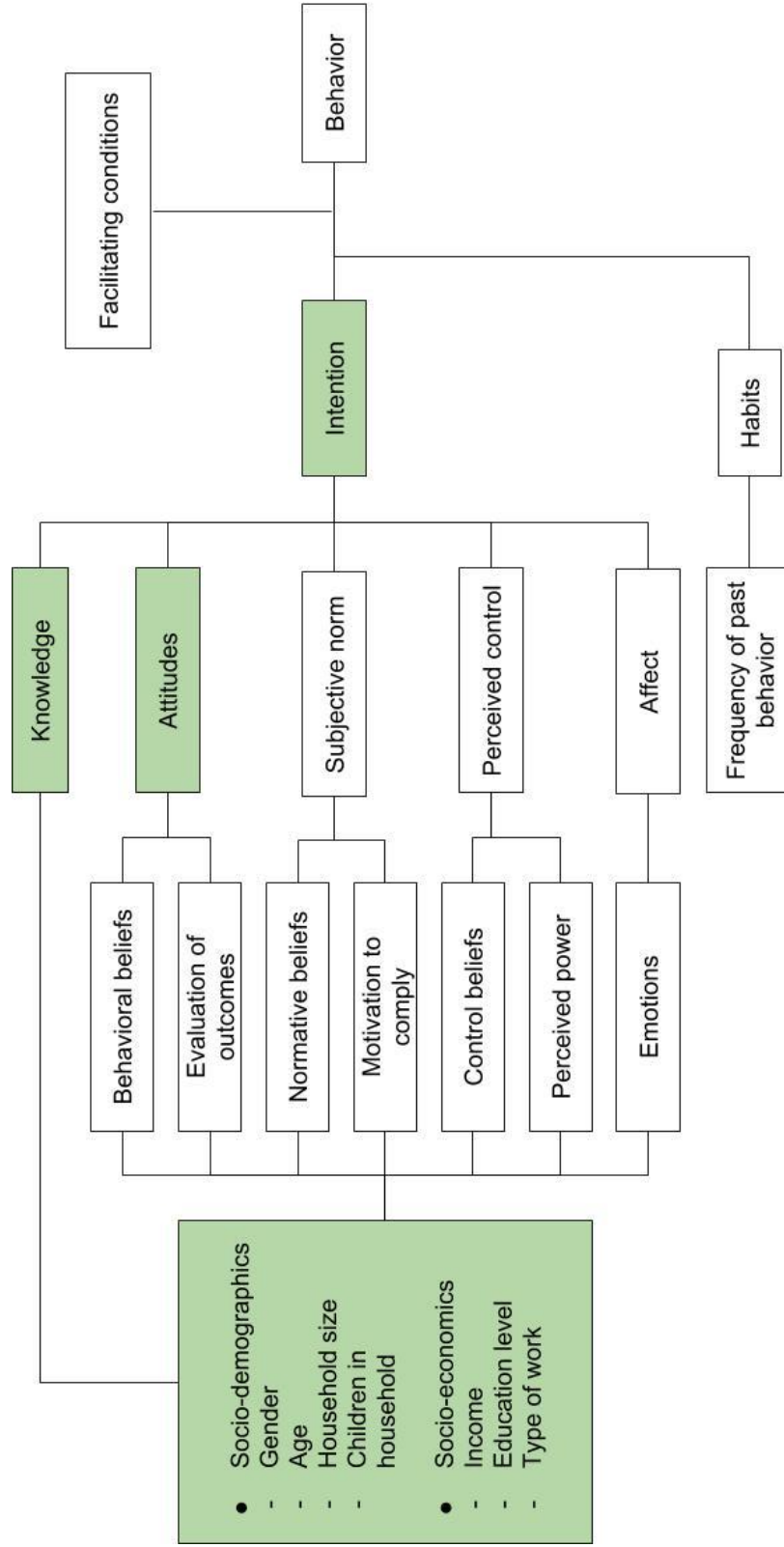


Figure 1 Conceptual model, based on the Theory of Reasoned Action, Theory of Planned Behavior and Theory of Interpersonal Behavior. The boxes that are colored green are the factors that are investigated in this research.

2 Theoretical framework

In the theoretical framework of this research, first, product categories are specified that have most environmental impact, that are judged differently on edibility when these are close to their expiration date and that are wasted most. Secondly, legislation regarding use by and the best before date is discussed. Thirdly, factors related to food waste that are thought to also relate to one's approach towards the best before date are highlighted.

2.1 Differences for product categories

2.1.1 Environmental impact

A list has been presented of most wasted food products with most environmental impact in the United Kingdom (Waste Resource Action Programme, 2013). Despite that this list is based on the most used products in the United Kingdom, it is assumed that the list can be used for an indication of most wasted food product with most environmental impact in the Netherlands. The reason is that British and Dutch consumers come from a quite similar culture with similar products and that the waste rates and impact of food products on the environment is also similar. While the research looked at all food products regardless of the type of expiration date, only those products with a best before date were of interest for this research. Looking at greenhouse gases, milk, cheese and coffee have most impact. For market energy use, milk, chocolate and cheese form the top three. Total water footprint is dominated by chocolate, concentrated juices and coffee. Most improvements regarding avoidable waste can be made for milk, potatoes and carbonated soft drinks. It is important that these high-impact products are not unnecessarily thrown away. Therefore, these products are especially interesting for this research.

2.1.2 Edibility after expiration date

Not only the wasted amount and environmental impact differ for product categories. The acceptance of a food product that is close to its use by or best before also varies. Only one research has been found that looks into differences in edibility for food product categories. Eggs and yoghurt were seen as 'not okay to eat' when they were close to the expiration date, while this occurs less for other product categories such as salads, ready meals, cut fruits, ham, potatoes, tomatoes, chicken, cheese, milk, bread and yoghurt (Brook Lyndhurst, 2008).

2.1.3 Wasted most

Looking at Europe, cereals are wasted most during the consumption stage, followed by respectively milk and eggs, roots and tubers, oilseeds and pulses (Gustafsson et al., 2013). In the consumption stage, different types of waste are present, so findings about waste at the household level could not only be attributed to best before date behavior. Furthermore, no hard conclusions could be made

because of data gaps. Still, results give a good indication of which product types are wasted most at the consumer level and are therefore included in this research. Again, even though this research included products with all types of expiration dates, only the products that contain a best before date are mentioned for this research. The same has been done for the Netherlands (Milieu Centraal, 2016; Parfitt et al., 2010). These numbers are also for food waste in general and not specifically about food waste because of the best before date. Despite that the reasons for the

large numbers of waste for these product categories are not known, it is assumed that the best before date might substantially contribute to the total amount. Parfitt et al. (2010) provided an overview for the United Kingdom, the Netherlands, Austria, USA and Turkey. This overview was based on existing research (Jones, 2004; Pekcan, Köksal, Küçükerdönmez, & Ozel, 2006; Thönissen, 2009; Waste Resource Action Programme, 2009). An overview can be found in Figure 2 (Parfitt et al., 2010). Additionally, the kilograms that are thrown away per person per year per product category according to Milieu Centraal (2016) can be found in Figure 3. Of the ten most wasted foods, five have a best before date. The categories with a best before date are potatoes (aardappel), pies and cookies (gebak en koek), sauces and fat (saus en vet), pasta (pasta) and rice (rijst). It should be noticed that it is not mandatory to mention a best before date for potatoes, but that legally seen, potatoes have a best before date.

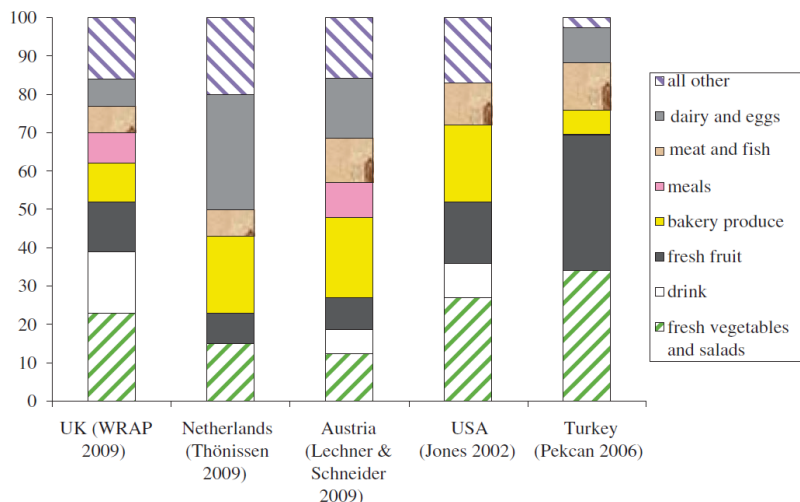


Figure 2 Summary of household food waste composition in five countries (Parfitt et al., 2010).

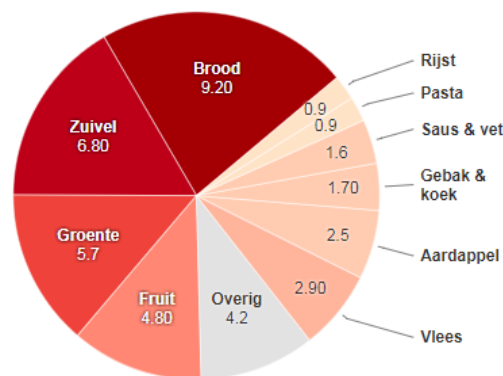


Figure 3 Most wasted food in kilograms per person per year (Milieu Centraal, 2016).

2.2 Legislation

Producers of food products must deal with certain regulations, for example regulations about mentioning expiration dates on food products. The European guidelines are mentioned in the General Food Law. The Dutch guidelines are based on the European guidelines and are mentioned in the Warenwet. A country can adjust the regulations to a certain extent, but the regulations need to be based on the European guidelines. In the Netherlands, the Warenwet contains all regulations that guarantee safety in the Netherlands. Food products should not form a danger for one's health. The Dutch Food and Consumer Product Safety Authority (Nederlandse Voedsel- en Warenautoriteit) makes sure that the regulations that are mentioned in the Warenwet are met. This organization guards the safety of food and consumer products, for example by paying attention that labelling of food products is done in the right way (Voedingscentrum, n.d.-d). Prepackaged foods need to have an expiration date. When food products are not prepackaged, products do not need to have an expiration date. Producers are not the only ones who can set an expiration date. Distributors or sellers of the product could also determine the expiration date and mention it on the package. The product could then be in store as long as desired by the distributor or seller. The one who determined the expiration date, is responsible for the safety and/or quality of the product (Soethoudt et al., 2012). In the Netherlands, the expiration date can be either a best before date, or a use by date. One of both needs to be mentioned on prepackaged products and it is not allowed to refrain from mentioning expiration dates. This research focuses on the best before date, but to fully understand the meaning of the best before date, it is good to also understand the meaning of the use by date. Being able to distinguish between the two is necessary to accurately judge whether a product is still edible.

The best before date is used to guarantee quality of the product until this date. The best before date needs to be presented as day – month – year. Products that could be stored less than three months can only provide day – month. Products that could be eaten within 3 to 18 months only need to mention month – year. When a product has an expiration date that exceeds 18 months, it is sufficiently to only mention a year as expiration date. For the last two categories, 3-18 months and 18> months, the products should be safe and of sufficient quality until the end of that month or year. Quality until the best before date is only guaranteed if consumers adhere to the storing conditions that are mentioned on the package. Storing conditions might for example state that the product should be refrigerated (NVWA, n.d.). Once the expiration date has passed, the product could still be sold to consumers. A retailer could choose to change the expiration date, provided that the product still meets the hygiene requirements and passes the risk analysis. Refrigerated and non-refrigerated products are separated in two categories to make risk analysis easier and more suitable. The risk analysis for non-refrigerated products is quite easily done. Using the senses (looking, smelling, tasting) is sufficient to determine whether the product could still be sold. If the

product passes the sensory test, the product could be sold without any further risk analysis. For refrigerated products, the guidelines are stricter, since these products are sensitive to bacterial spoilage. If the seller wants to sell the product after the best before date, he or she needs to execute a risk analysis (NVWA, n.d.). The risk analysis is composed by the European Union and tests the microbiologic food safety aspects (EUR-Lex, 2004). Only when the product passes the risk analysis, it could still be sold. The European Commission indicates how to use the best before date in Figure 4 (Europese Commissie, n.d.).

'Best before' indicates the date until when the food retains its expected quality.

- Food is still safe to consume after the indicated 'best before' day on the condition that storage instructions are respected, and packaging is not damaged, but it might begin to lose its flavor and texture.
- 'Best before' dates appear on a wide range of refrigerated, frozen, dried (pasta, rice), tinned and other foods (vegetable oil, chocolate, etc.).
- Check if the packaging is intact, and if the food looks, smells and tastes good before throwing away food past its 'best before' date.
- Once a food with a 'best before' date on it has been opened, follow any instructions such as 'eat within three days of opening', when applicable.

Figure 4 How to use the best before date, indicated by the European Commission.

There are situations in which the best before date is not suitable for a food product. A use by date needs to be used if the product needs to be refrigerated and when a food product could not be stored for longer than five days. This use by date is determined by the producer. Other parties, such as distributors or sellers, are not allowed to adjust this date. The way in which the date needs to be presented is the same as for the best before date. The maximum temperature at which the product could be stored needs to be mentioned, followed by within how many days the product needs to be consumed. It is a felony to sell products that have passed the use by date. The European Commission indicates how to use the use by date in Figure 5 (Europese Commissie, n.d.).

'Use by' indicates the date until when the food can be eaten safely.

- Don't use any food after expiration of the 'use by' date.
- 'Use by' dates appear on highly perishable food, such as fresh fish, fresh minced meat, etc.
- Follow the storage instructions such as 'keep in a refrigerator', or 'keep at 2-4 C'; if not the food will spoil quicker and you may risk food poisoning.
- By freezing the food at home soon after purchase, you can extend its life beyond the 'use by' date, if it is frozen properly. But make sure you follow any instructions on the pack, such as 'freeze up to the use by date', 'cook from frozen' or 'defrost thoroughly before use and use within 24 hours'.
- Once a food with a 'use by' date on it has been opened follow any for storage and use instructions such as 'eat within three days of opening', bearing in mind that food should be consumed before the expiration of the 'use by' date.

Figure 5 How to use the use by date, indicated by the European Commission.

2.3 Factors related to one's approach towards the best before date

The following chapters discusses socio-demographics, socio-economics, knowledge and attitudes in relation to food waste behavior. Factors related to food waste behavior are thought to also influence one's approach towards the best before date. Thus, this information provides insights into how the group with a desirable approach possibly differs from the group with an undesirable approach.

2.3.1 Socio-demographic factors

Gender

In general, women are responsible for food gate keeping in a household, meaning that women mostly do groceries and cook dinner (Lipinski et al., 2013; Stefan et al., 2013). This may affect how men and women differ in knowledge, attitudes and intentions about the best before date. Women might have better knowledge and awareness about meaning and usage of the best before date. In line with the fact that women are often the food gate keepers of a households, women are more seriously worried about food safety than men (Stafleu, Van Staveren, De Graaf, Burema, & Hautvast, 1996; Terpstra, Steenbekkers, De Maertelaere, & Nijhuis, 2005). Therefore, it is thought that women will mention food safety as a reason to not eat a food product after the best before date more often. Men are thought to mention this reason less often and have other reasons to make their decision whether to eat a product. Based on this information, the group with a desirable approach towards the best before date might proportionally have more women than the group with an undesirable approach.

Age

Despite that younger people are less seriously worried about food safety (Stafleu et al., 1996; Terpstra et al., 2005) younger people tend to throw away more edible food products than older people (Brook Lyndhurst, 2007; Hamilton, Denniss, & Baker, 2005; Ministerie van Economische Zaken, 2010; Osner, 1982; Stefan et al., 2013; Ventour, 2008; Wassermann & Schneider, 2005). The older one gets, the less worried he or she becomes about food safety (Verhoeven, 2000). As a result, one might become less reluctant to use products after the best before date. This is supported by research that found that younger consumers (aged 18 to 34) are most likely to see the best before date as a safety indicator and throw away products after the best before date, while consumers older than 65 years are least likely to do this (Leib et al., 2016). Consumers between 55 and 60 years of age particularly produce less avoidable food waste than people in other age categories (Ventour, 2008; Wassermann & Schneider, 2005). Parfitt et al. (2010) confirm that lowest waste is found in the post war age cohort (between 54 and 72 years of age). This age range is broader than in research of Ventour (2008) and Wassermann and Schneider (2005), but covers the same ages. When dividing consumers in people over and under 65 years of age, the group with people over 65 years of age produces less food waste. Lower food waste in the group of people over 65 cannot be explained by concerns about the environment. People over 65 mentioned the link between food waste and the environment less often than those under 65 years of age. Reasons to use products after the best before date might therefore be different. Increased welfare is a factor that might explain the fact that younger consumers waste more than older consumers (Meeusen & Hagelaar, 2008). People over 65 might have different attitudes towards food waste, because they are more likely to have experienced food scarcity (Parfitt et al., 2010; Quested, Marsh, Stunell, & Parry, 2013). It is not likely that this trend is going to continue in the future, since the older consumer of the future is likely to keep the same attitudes towards food waste as they have now. Their attitudes are formed during good welfare and without food scarcity. Not having experienced any food scarcity, future elderly will contribute more to food waste than today's elderly. Jörisen et al. (2015) contradicts above-mentioned researches. It was found that older people waste more than younger people. The fact that this research contradicts other research into food waste and age, could be explained by the fact that older people live alone more often. The relation between living situation and food waste is discussed in the next paragraph. Based on this information, the group with a desirable approach towards the best before date might be older than the group with an undesirable approach.

Living situation

The more persons in a household, the less food is wasted per capita (Ministerie van Economische Zaken, 2010; Osner, 1982; Parfitt et al., 2010; Quested, Parry, Eastel, & Swannell, 2011; Van Garde & Woodburn, 1987; Wenlock & Buss, 1977). People who are living alone waste most (Baker,

Fear, & Denniss, 2009; Jörissen et al., 2015; Ministerie van Economische Zaken, 2010; Ventour, 2008). Differences in the amount of food waste between men and women who are living on their own are not known. Single women are thought to produce most food waste, but this is not significantly proven (Koivupuro et al., 2012). Not only the number of persons in a household, but also the living situation matters. Some student houses may share groceries and eat together, acting like a multi person household, while some may act like single person households, doing their own groceries and not eating together. Multi person households are thought to have a different approach towards the best before date than single person households. For example, students who are behaving like a single person household are probably better aware of the products they have stored and for how long they are already stored compared to students that are behaving like a multi person household. Students who are sharing products might be more likely to take the best before date as an ultimate date to consume a product, because they do not know how long the products has been stored and for how long it has been opened. These students might use their senses less often to determine whether a product is still edible after the best before date. Thus, the living situation matters and should be considered. Whether a household has children also influences the amount of food waste. Households with children waste more than households without children (Osner, 1982; Parfitt et al., 2010; Quested et al., 2011; Van Garde & Woodburn, 1987; Wenlock & Buss, 1977). Households with pensioned people waste least (Brook Lyndhurst, 2007; Hamilton et al., 2005; Osner, 1982). Pensioned people stopped working and have relatively high ages. Having a higher age and not working fulltime are both linked to less food waste. Based on this information, the group with a desirable approach towards the best before date might proportionally have more people that are living in a multi person household and that are living with children than the group with an undesirable approach.

2.3.2 Socio-economic factors

Educational level

People with limited education are relatively more seriously worried about food safety (Stafleu et al., 1996; Terpstra et al., 2005). Being relatively more seriously worried about food safety might result in a reluctance against using products after the best before date. Food products might be discarded faster. However, these low educated consumers tend to waste less than those who are higher educated (Wassermann & Schneider, 2005). At first, it seems contradictory that the ones who are higher educated and are assumed to have better knowledge and awareness, waste more. However, it should be considered that these numbers reflect food waste in general, not only waste because edible food products are thrown away after the best before date. Thus, it could still be the case that educated people have better knowledge and awareness and have different attitudes and intentions. People with higher education are thought to better understand differences between use by and the best before date than people with lower education. Also, they are thought to be more

aware of consequences of their behavior. Based on this information, the group with a desirable approach towards the best before date might consist of higher educated consumers than the group with an undesirable approach.

Type of work

Whether one is employed or not matters. Employed people waste more than people who are not employed (Ministerie van Economische Zaken, 2010). This is in line with research of Wassermann and Schneider (2005) who found that working full-time leads to higher food waste. This might be explained by the fact that consumers that work full-time have less time to put effort in understanding and judging whether products are still edible (Koens, 2006). Based on this information, the group with a desirable approach towards the best before date might have more unemployed consumers than the group with an undesirable approach.

Income

There is no clear indication whether income and food waste are related (Parfitt et al., 2010). Multiple studies suggest that less income means less waste (Brook Lyndhurst, 2007; Osner, 1982), but other studies found little or no relation between income and waste (Dowler, 1977; Koivupuro et al., 2012; Wansink & Wright, 2006). Consumers with lower income are relatively more seriously worried about food safety (Stafleu et al., 1996; Terpstra et al., 2005) and thus might be more likely to throw away products after the best before date. Consumers with high incomes are less likely to change their food waste behavior (Principato et al., 2015) and thus are also assumed to be less likely to change their approach towards the best before date. Perhaps, differences in knowledge, attitudes and intentions can be found between consumers with low incomes and high incomes.

Food products have become relatively cheap over the years, when the price of food products is compared with spendable income (Organisatie voor Economische Samenwerking en Ontwikkeling, 2011). As a result, consumers may attach different values to food products. Earlier, when people were doubtful about the quality of a product when it has passed the best before date, they might have been more likely to use their senses to determine whether the product could still be used. After all, they invested a relatively large amount of their income in food. Nowadays, since food products are relatively cheap and accessible at all times in supermarkets, people in doubt might throw away the product anyway to be sure that they will not get sick. Or they might throw products away after the best before date without even using their senses. After all, there is less need to be cost efficient. The impact of having to buy a new food product is much smaller compared to years ago (Roels & Van Gijsegheem, 2011). Consumers with a low income are likely to attach more value to food products, resulting in less waste (Koivupuro et al., 2012). Based on this information, the

group with a desirable approach towards the best before date might consist of consumers with a lower income than the group with an undesirable approach.

2.3.3 Knowledge

Knowledge is an important factor in food related behaviors (Tsiros & Heilman, 2005). Knowledge is on the one hand about the meaning and usage of the best before date and on the other hand about awareness of the fact that there are different types of expiration dates, that food waste is a problem and that it has consequences. Consumers lack knowledge about the kilograms of food that are wasted (Brook Lyndhurst, 2007; Exodus, 2007; Graham-Rowe et al., 2014; Hamilton et al., 2005; Quested et al., 2011). This number is systematically underestimated (Quested et al., 2011; Roels & Van Gijseghem, 2011). Most people probably do not feel like wasting food products, but many think that they do not waste much food, or that their wastage does not contribute that much to the total amount of food that is wasted (Graham-Rowe et al., 2014). Since they are not aware that they contribute to food waste themselves, they are not likely to have concerns about the environment and change their behavior (Roels & Van Gijseghem, 2011). Beyond the fact that consumers are not aware of wasting food products, they often lack knowledge and skills that enables them to reduce food waste (Roels & Van Gijseghem, 2011). Once consumers become more aware of food waste, they are assumed to get more motivated to reduce food waste (Marklinder & Eriksson, 2015; Principato et al., 2015; Roels & Van Gijseghem, 2011). Feeling more in control, a likely consequence of having proper knowledge, is thought to promote food waste reduction, since lacking these skills is known to lead to food waste (Brook Lyndhurst, 2007; Graham-Rowe et al., 2014). Without proper knowledge, people have stronger fears of food poisoning and are more likely to engage in wasteful behavior (Exodus, 2007). People who were more confident about their knowledge, state that they waste little food (Graham-Rowe et al., 2014).

Misinterpretations of use by and the best before date are known to be an important cause of food waste (Monier et al., 2010; Timmermans et al., 2014). Consumers need expiration dates to be able to make informed decisions (Tsiros & Heilman, 2005), but 50% of consumers do not know the difference between the use by and best before date (FSA, 2008) and 45% of consumers does not understand the meaning of the use by date (Parfitt et al., 2010). More specifically, only 52% knows that the use by date is about safety (Brook Lyndhurst, 2008). Looking at the type of expiration date that is of interest for this research, 49% does not understand the meaning of the best before date (Parfitt et al., 2010). In studies in the United States and the United Kingdom became clear that quite some people know that the best before date is about quality, respectively 67% and 65% (Brook Lyndhurst, 2008; Leib et al., 2016). Still, this means that in the case of Leib et al. (2016), 33% does not know that the best before date is a quality measure. 12% even linked the best before date incorrectly to safety. Additionally, Brook Lyndhurst (2008) found that of the

persons that correctly linked the best before date to quality, 27% incorrectly linked the term to safety. Furthermore, besides insufficient knowledge about the meaning of the dates, 36% confuses the best before date with the use by date (Parfitt et al., 2010). These people might unnecessarily throw away food products (Leib et al., 2016; Parfitt et al., 2010).

Legally seen, an expiration date needs to be mentioned on many products, also on products that can be stored for a long time. Products like sugar are not perishable if they are stored in a proper way, but since an expiration date is mentioned on the package, consumers may get confused, think that the product cannot be used anymore and throw away their sugar, while they might have used it when no expiration date would have been present. Consumers might unjustly think that this date provides information about safety (Leib et al., 2016). When consumers misinterpret quality risks, uninformed and incorrect decisions are made. On the one hand, people might dispose a product while the product could have been eaten, on the other, people might consume a product while it is not wise to consume the product anymore. When consumers become more aware and pay more attention to the expiration date, food waste because of the misinterpretation of the best before date could be reduced, consumers become more literate and are able to make grounded decisions (Tsiros & Heilman, 2005). If a consumer knows what the best before date entails and that there are no safety risks, he or she is more likely to use the product (Terpstra et al., 2005). The question is whether consumers misinterpret expiration dates, or that they often do understand expiration dates, but are too lazy to check whether the product is still edible. Perhaps, consumers are too wealthy to care about throwing away products. Therefore, it is important to first investigate whether consumers have accurate knowledge.

Edibility is determined via different ways (Brook Lyndhurst, 2007), mostly via the best before date (Terpstra et al., 2005). 73% of British consumers determined edibility by the date labelling, 49% by look, 9% by feel, 3% by smell, 1% by perceived risk of the food and 1% by ingredients (Brook Lyndhurst, 2008). For some categories, the best before date plays a larger role than for other categories (Terpstra et al., 2005; Tsiros & Heilman, 2005). When consumers think that a product is not likely to decrease in quality, he or she is less likely to check the expiration date than when he or she is doubtful about the quality risks that are attached (Tsiros & Heilman, 2005). According to Terpstra et al. (2005), the numbers of days that were left until the expiration date were seen as more important for meat, sliced cold meats and dairy. These products are the products that are perceived as risky when looking at functional, performance and physical risks. Psychological, social and financial risks do not influence whether and how often consumers check expiration dates (Tsiros & Heilman, 2005). When products are 'trustworthy', consumers are less likely to pay attention to the expiration date. The expiration date then serves as a guideline, taken together with their sensory perceptions of the edibility of the product. When consumers 'distrust' a food

product, for example eggs, they are more likely to see the expiration date as leading. Consumers will be less likely to use their senses and make their own decision. People who are more concerned about food safety, are thought to be stricter with the best before date. The strictness of using the best before date may vary within one person, depending on the product type. Determining the edibility of a food product based on date labelling, was different for the use by and best before date. Of consumers that based their decision on the date labelling, 43% said that they made their decision based on the use by date, whereas 24% said that they based their decision on the best before date. The fact that no products were shown with use by dates indicates that people do not seem to make a distinction between use by and the best before date. Consumers saw a best before date, generalized this to expiration dates and afterwards referred to it as use by date (Brook Lyndhurst, 2008).

Knowledge about dates is retrieved from family members or education. Daughters are likely to resemble their mother when it comes to knowledge and attitudes about food (Stafleu et al., 1996). Furthermore, education at school helps to become literate about the edibility of food products from different food categories with respect to the best before date. Education will be especially useful for those who think that individuals are most responsible to reduce food waste, but do not possess the knowledge and/or skills to reduce food waste (Parizeau et al., 2015).

Young consumers are aware that food waste has certain consequences. However, consumers often relate these consequences to economic aspects and not to environmental aspects. One-third of respondents did not know that food waste provides greater damage to the environment than packaging materials (Principato et al., 2015). Consequences of food waste should therefore be educated to young people. The two main causes of wasting edible food products after the best before date are that the consumer is worried if the food product is still edible and that the consumer misinterprets the best before date (Brook Lyndhurst, 2007; Principato et al., 2015; Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012). Accordingly, it seems fruitful to teach young consumers differences between use by and the best before date, but also how sensory skills could be developed and food products could be judged on edibility (Principato et al., 2015). Social messages might be especially effective in educational campaigns. For example, food scarcity in developing countries might be linked to food waste in developed countries (Parizeau et al., 2015).

All these researches point out that it is important to raise awareness about food waste and educate consumers about the meaning and usage of the best before date. The question is who should raise awareness and who should educate consumers. Lies this responsibility with the government, idealistic organizations, commercial organizations, consumers or educational institutions (e.g. schools)? Consumers' attitudes about who is most and least responsible for raising awareness and

educating consumers about the best before date is not known. Based on this information, the group with a desirable approach towards the best before date might consist of consumers that more often heard of the use by and best before date than the group with an undesirable approach. Differences in knowledge about the meaning of both dates will be used to divide consumers into the group with a desirable and the group with an undesirable approach towards the best before date. Therefore, those respondents that do not know the meaning of the best before date will automatically be categorized in the group with an undesirable approach.

2.3.4 Attitudes

Some consumers think that food waste is not a serious problem, others think that it is not possible to reduce food waste. Consequently, these consumers think that it is a waste of time to try to reduce food waste (Graham-Rowe et al., 2014). When consumers are not aware of the food they waste and when they think that food waste is not a serious problem or that it cannot be reduced, they probably also do not feel targeted by food waste campaigns that try to reduce food waste. When consumers' priorities, and thus their responsibilities, lie elsewhere, they are not likely to try to reduce food waste (Graham-Rowe et al., 2014).

Throwing away edible food products bothers consumers for different reasons. Consumers' motivation to reduce food waste is higher when consumers are more concerned about negative consequences. Both consumers over 65 years of age and consumers under 65 years of age mention waste of money as most important aspect (respectively 71% and 73%). Money is followed by feeling bothered because it is a waste of good food (respectively 42% and 41%) (Brook Lyndhurst, 2007; Graham-Rowe et al., 2014; Quested et al., 2013). These two most important factors are followed by feelings of guilt (respectively 37% and 32%) and not being able to afford to throw away food (respectively 26% and 22%) (Quested et al., 2013). Lastly, of least importance, that it is bad for the environment (respectively 13% and 24%) (Graham-Rowe et al., 2014; Quested et al., 2013). Consumers under 65 years of age make the relation between food waste and environment slightly more often. Not being able to afford to throw away food is mentioned less often by this age category. The little concern about the environment is contradicted in the research of Doron (2013). In that research, environment was consumers' most important concern. The reason why this difference occurs, might be explained by the fact that Doron (2013) let consumers choose between the desire to save money and the desire to protect the environment. If these two answers are handed to consumers, they might respond differently than when they have to mention motivators to reduce food waste themselves (Doron, 2013). The fact that consumers would like to save money is caused more by disapproval of unused items than disapproval of wasting money (Bolton & Alba, 2012). This phenomenon is related to the economy of a country. When a country is in a recession, consumers have less to spend and excessive consumption is disapproved even

more (Flatters & Willmott, 2009). Consumers are encouraged most to minimize their food waste by the possibility to save money, followed by wanting to manage their home efficiently, feelings of guilt when they throw food away that could have been eaten, eating the healthiest diet possible, a desire to reduce their impact on the environment and food shortages elsewhere in the world (Quested et al., 2013). The fact that environmental impact and food shortages score relatively low on the question to what extent the factors encourage to minimize food waste indicates that consumers have no clear link between food waste and environmental influence in their minds. They seem to be not very concerned about consequences for something or someone else than him- or herself. This contradicts findings of Parizeau et al. (2015) that social messages might be effective in educational campaigns, for example when linking food scarcity in developing countries to food waste in developed countries (Parizeau et al., 2015). Food can also be thrown away because it otherwise might cause illness. Despite that this research mentions inconvenience that is related to cooking and storing, it might also be perceived in one's approach towards the best before date. To avoid the risk of becoming ill, consumers might throw away products earlier than necessary, since consumers want to minimize inconvenience (Graham-Rowe et al., 2014). Based on this information, it is difficult to suggest what differences might be found between consumers with a desirable approach and consumers with an undesirable approach. Hopefully, differences will be found that make it possible to set up campaigns in such a way that these campaigns respond to the attitudes of the group that has an undesirable approach towards the best before date, making campaigns more appealing.

2.3.5 Intention

Intention is influenced by socio-demographics, socio-economics, knowledge and attitudes and thus builds on the literature that was discussed earlier. Differences in intention regarding the use of products after the best before date will be used to divide consumers into the group with a desirable and the group with an undesirable approach towards the best before date. Respondents with an undesirable intention will be categorized in the group with an undesirable approach.

It is important to note that these results are about intentions and not about actual behavior. Not all intentions translate into corresponding behavior (Carrington, Neville, & Whitwell, 2014; Fedusiv & Bai, 2016; Mullan, Allom, Fayn, & Johnston, 2014; Sheeran, 2002; Sheeran & Webb, 2016; Zhou, Thøgersen, Ruan, & Huang, 2013). There are facilitating conditions that either promote or inhibit the translation of an intention into actual behavior. The reason why intentions were investigated, is because knowing intentions is useful in distinguishing consumers and specifying campaigns. In that way, especially those consumers with bad intentions can be targeted.

3 Methodology

3.1 Questionnaire

A questionnaire was used to gain insight into the knowledge, attitudes and intentions of Dutch consumers regarding the best before date. This questionnaire was targeted at people living in the Netherlands with different socio-demographic factors (gender, age, living situation) and socio-economic factors (education, work, income). By knowing these factors, consumers that have a desirable approach towards the best before date and consumers that have an undesirable approach towards the best before date can be characterized in terms of socio-demographics, socio-economics and attitudes. This questionnaire was distributed in December 2017 via a database and several Facebook groups. This research was not bound to specific occasions or specific seasons and could thus have been executed at any point in the year. The questionnaire has been conducted in Dutch. In that way, language barriers were excluded. The questionnaire consisted of closed questions that were mostly answered on five-point scales. Some questions provided the option to choose multiple answers or to rank answers based on importance. These questions were therefore not asked on five-point scales. The questionnaire can be found in Appendix I.

The target group of this research is adult, Dutch-speaking consumers. Three respondents that were 17 years of age were still included in the analysis, even though they were not officially seen as adults yet. The reason why these respondents were still included, is that they are students that are likely to have a say in household food behavior and thus act like adult consumers. It was kept in mind to distribute the survey in ways that also reach older consumers. To reach older consumers, a database with people interested in research within the Food Quality and Design department was used. In that way was tried to also include consumers from other socio-demographic and socio-economic groups, leading to a more diverse population. To retrieve more practical educated persons, a practical educated acquaintance was approached to share the questionnaire on her Facebook page.

Some of the questions were asked for different product categories. The chosen product categories were based on existing research of the British Product Sustainability Forum. Most of the researches that were used by the British Sustainability Forum to come up with these product categories were executed in the United Kingdom. However, it was assumed that the impact of several food products on the environment is very similar for the Netherlands, since British and Dutch consumers were thought to come from a quite similar culture with similar products. From the product categories that were mentioned in these researches, all product categories that contained another type of date labelling than 'best before', or categories that had no date at all, were excluded. Also, food categories that had no clear, uniform image and could be interpreted in different ways by

consumers were excluded. An example of such an unclear category is 'ready meals'. As a result, the remaining food categories with most environmental impact, with a best before date and with uniform meaning, are milk, cheese, coffee, chocolate, concentrated juice, potatoes and carbonated soft drink. These categories were compared to the most wasted food products in the Netherlands. Thönissen found that dairy and eggs are wasted most (Thönissen, 2009). Attention should be paid that dairy and eggs were taken together as one. Thus, it was not clear how much each product category contributed to the category. For example, eggs may only account for 10% of the product category, meaning that in the end, not that much eggs were thrown away. Comparing these results to research of Waste Resource Action Programme (2013), it turns out that eggs also belong to the most wasted products in the United Kingdom. Therefore, it was decided to still include eggs in the product categories that were used in the questionnaire. Milieu Centraal found that dairy is wasted most (Milieu Centraal, 2016). This is in line with research of Waste Resource Action Programme (2013) and Thönissen (2009). Gustafsson mentions cereals, milk and eggs as most important categories. Since Gustafsson (2013) is the only one that mentions cereals as one of the most wasted categories, cereals were not included in this research. Milk and eggs were included (Gustafsson et al., 2013). Brook Lyndhurst (2008) found that consumers perceive eggs and yoghurt as 'not okay to eat' when they come close to the best before date. Since dairy seemed to be an important product category in all used researches and an important food products in the Netherlands with different product types, this category was broken down into several products. Milk and cheese were accompanied by yoghurt and butter. As a result, the final list with product categories consisted of milk, cheese, yoghurt, butter, eggs, coffee, chocolate, concentrated juice, potatoes and carbonated soft drinks. It should be noted that it was deliberately chosen to replace butter with low-fat margarine (halvarine), since it is recommended to use this healthy option instead of butter and consumers are thought to be more familiar with this product. (Voedingscentrum, n.d.-c).

Some questions were illustrated with images of products. Some product categories that had no uniform image, such as ready meals, were already excluded from the product list. However, better-known products that seem to leave little room for own interpretation, could still be interpreted in multiple ways. For example, there are different sorts of milk: from different animals, different fat percentages and different shelf lives. When providing an image of a milk carton of pasteurized, not sterilized, semi-skimmed cow milk, it is made sure that all respondents had the same product in mind when answering questions. The images that were used in the questionnaire can be found in Figure 6.



Figure 6 Images that were used in the questionnaire.

Some of the questions that were asked in the questionnaire were based on questions that were used in research of Brook Lyndhurst (2008) and Van Boxtael et al. (2014). For this research, no validated questionnaires were available. Since no validated questionnaires were used, this questionnaire was tested on five pilot respondents. In that way, validity and reliability were tested to see whether the question really measures what it should measure and whether the question can be interpreted in only one way. Questions that were asked can be divided into different categories that each measure another aspect of this conceptual model.

Table 1 shows how each aspect of the conceptual model is covered in the questionnaire. Per aspect, several questions are asked that should provide an overview of socio-demographics, socio-economics, knowledge, attitudes and intentions of a respondent.

Table 1 Overview of measured aspects and belonging questions in the questionnaire.

Aspect	Belonging questions in questionnaire
Socio-demographics	Gender Age Household size Children in household
Socio-economics	Education Work status Income
Knowledge	Do you know the labels use by and best before? How well do you know the labels use by and best before? Indicate what the labels use by and best before mean. Statement: I know campaigns/websites/articles/flyers/explanation about using products after the best before date. Statement: I feel supported by campaigns/websites/articles/flyers/explanation about using products after the best before date.
Attitudes	Statement: Throwing away food products after the best before date is food waste. Statement: Throwing away food products after the best before date can be avoided. Statement: Throwing away food products after the best before date affects the environment. Statement: Throwing away food products after the best before date is a waste of money. Statement: Using products after the best before date helps to reduce food scarcity. Statement: Using products after the best before date makes a difference for the environment. Statement: I feel engaged with the environment. Statement: I feel engaged with food scarcity. Statement: It is important what others think of me. Statement: It is important to behave like others. Who is most eligible to create awareness? Reasons to use products after the best before date. Reasons to not use products after the best before date.
Intention	At what best before date would you definitely throw away this product? (asked for ten different products). Before this date is reached, I determine edibility via...

It is important to mention that for some questions, an additional answer option 'other, ...' was added. Sometimes, default answer options might not cover respondents' answers. By adding the answer option 'other, ...' respondent could add another option that described their situation in the best possible way. The respondents that answered 'other, ...' will be included in the analyses in SPSS, but no further analysis will be done on what they filled in. Multiple times, respondents

thought that their preferred answer option was not present, so he or she chose 'other, ...' and described his or her answer. For example, 'living situation – other, ... with housemates'. Though, this described answer was sometimes the same as one of the default answer options. When the answer was similar to one of the default answer options, the answer with own explanation was categorized within one of the default answer options. When the answer option 'other...' could not be recategorized into one of the default answer options, respondent's answer was analyzed as 'other...'.

3.2 Recategorization of answer categories

Some of the answer categories were recoded into broader categories, meaning that the number of answer categories decreased. The answer options that were recategorized, are the answers on questions about age, education, living situation, children in household and income. Appendix II shows the original and recategorized answer options and provides an explanation about how recategorization took place.

3.3 Excluded questions

In the questionnaire, the question was asked 'How often do you shop for groceries?'. This question has been deliberately excluded from analysis. First thoughts were that this question could serve as an indirect measure for one's knowledge of products and expiration dates. The assumption was made that the more a person goes grocery shopping, the better knowledge he or she has. However, a person might do groceries once a week for the whole family, buying all kinds of products, probably resulting in a better knowledge of expiration of products and the importance of expiration dates. Another person might do groceries every day of the week to buy only bread. Thus, how often groceries are done is not an accurate indirect measure of one's knowledge. To avoid a biased result, this question was left out of analysis.

One demographic factor that was included in the questionnaire, number of people in household, will also be excluded from analysis. Living situation already showed whether people behave like a single person household (when living alone or when living with housemates, acting as a single person household) or like a multi person household (all other answer categories). The way in which was determined whether respondents living with housemates acted more like a single person or multi person household can be found in Appendix II. Using the question about living situation to determine household type was more accurate than number of people in household. Respondents living with housemates often look like big multi person households, while often behaving like a single person household.

One of the questions was about reasons to (not) use products after the best before date. Respondents were asked to put these reasons in three boxes (see Appendix I), the first box representing the most important reason, the second box the second most important reason and the third box the third most important reason. It was mandatory to fill in a reason in the first box. The second and third box were optional. One reason per box was allowed. However, it looked like respondents did not understand the question or did not read it carefully. They filled in more than one reason per box. Therefore, it was decided to not look at importance of reasons, but at whether the reason was mentioned by the respondent in one of the three boxes.

3.4 Dividing respondents into groups

After the data had been retrieved, respondents were divided into two groups. The first group consisted of respondents that have a desirable approach towards the best before date. Whether one has a desirable approach is determined via the answers that were given on a set of specific questions of the questionnaire. When the question 'Is the best before date about safety?' was answered with 'Yes', or when the question 'At which best before date would you definitely throw away this product?' was answered with 'tomorrow' or 'today' for one of the ten products, or when the question 'What are reasons to use this product after the best before date' was answered with 'I do not use products after the best before date', one has an undesirable approach. Answering one of these questions with one of the mentioned answers was already enough to be categorized in the group that has an undesirable approach, since there is room for improvement on at least one – maybe more - of these aspects. When the question 'Is the best before date about safety?' was answered with 'No', the question 'At which best before date would you definitely throw away this product?' was answered with an answer other than 'tomorrow' or 'today' for all ten products, and when the question 'What are reasons to use this product after the best before date' was not answered with 'I do not use products after the best before date', one has a desirable approach.

3.5 Analysis

Data analysis was executed with SPSS 25. Since the questionnaire existed of different questions and answer types, different analyses were needed. Crosstabs were used to show percentages about knowledge, socio-demographics, socio-economics, reasons to (not) use products after the best before date and how edibility is determined. Percentages were shown for the total sample, the group that has a desirable approach towards the best before date and the group that has an undesirable approach towards the best before date. Questions that were analyzed using crosstabs, were tested on significant differences between the group with a desirable approach and the group with an undesirable approach with Chi-square tests. The answers on questions that retrieved means and standard deviations were significantly tested with independent samples t-tests. For all tests, a p-value that is equal to or lower than 0.05 was significant.

Means and standard deviations were used for scores on statements and for the question about who is most eligible to create awareness that products can often be used after the best before date. Again, this was done for the total sample, the group that has a desirable approach towards the best before date and the group that has an undesirable approach towards the best before date. It is important to note that when two questions have the same mean, the given answers do not have to have the same distribution. Answers might be distributed differently. When comparing means of different questions, this was taken into account in the independent samples t-tests via the Levene's test. This test examines whether equal variances are assumed.

4 Results

In total, 434 respondents participated in the questionnaire. Questionnaires were only included in the analyses when these were filled in completely. Missing answers were not tolerated. 376 questionnaires were filled in completely. The average age of the sample size is 30, with a range from 17 to 77 years. Women were better represented than men (81.9%).

4.1 Knowledge status

An important question in this research was how well Dutch adult consumers know the meaning of the best before date. Table 2 shows an overview of whether respondents have heard of the use by and best before date. Numbers are shown for the entire sample, group with a desirable approach and group with an undesirable approach. The division of the entire sample into the two groups is approximately equal (n=183 and n=193). Additionally, the number of consumers that correctly sees the use by date as a measure of safety and the best before date as a measure of quality is shown for the entire sample. These questions were not separately shown for the two groups, since answers on this question formed the basis for the division of consumers into groups.

Table 2 Whether respondents have heard about the use by and best before date, shown for the entire sample, group with a desirable approach and an undesirable approach and what the use by and best before date mean according to the entire sample.

		Total sample (n=376) % respondents	Desirable approach (n=183) % respondents	Undesirable approach (n=193) % respondents
Heard of	Neither	1.1	0.0	2.1
	Only use by	0.0	0.0	0.0
	Only best before	11.7	6.6*	16.6*
	Both	87.2	93.4*	81.3*
Use by	Safety	75.5		
	Quality	40.2		
Best before	Safety	45.5		
	Quality	66.8		

* Significant difference between group with a desirable approach and group with an undesirable approach.

Differences between the group with a desirable approach and group with an undesirable approach were tested on significance with Chi-square tests. Significant differences are indicated with an asterisk (*). All other reasons were not statistically significant for the group with a desirable approach and group with an undesirable approach. An overview of tests for significance are presented in Appendix III.

Table 3 presents who is seen as most eligible to create awareness that products can often be used after the best before date. A lower mean tells that a party is seen as more eligible to create awareness.

Table 3 Most to least eligible parties to create awareness that products can often be used after the best before date, shown for the entire sample, group with a desirable approach and an undesirable approach.

	Total sample (n=376) M (SD)	Desirable approach (n=183) M (SD)	Undesirable approach (n=193) M (SD)
Party Profit organizations	2.71 (1.489)	2.61 (1.478)	2.81 (1.495)
Government	2.73 (1.355)	2.64 (1.236)	2.81 (1.458)
Educational organizations	2.75 (1.243)	2.85 (1.247)	2.65 (1.233)
Non-profit organizations	3.01 (1.302)	2.95 (1.364)	3.07 (1.242)
Consumers	3.80 (1.366)	3.95 (1.306)*	3.66 (1.409)*

* Significant difference between group with a desirable approach and group with an undesirable approach.

Differences between the group with a desirable approach and group with an undesirable approach were tested on significance with independent samples t-tests. Significant differences are indicated with an asterisk (*).

4.2 Socio-demographics and socio-economics

Table 4 shows socio-demographics and socio-economics of the entire size, the group with a desirable approach and group with an undesirable approach. The numbers in the table describe the percentage of respondents of the entire sample, the group with a desirable approach and the group with an undesirable approach that have certain socio-demographics and socio-economics.

Table 4 Socio-demographic and socio-economic characteristics of sample size, group with a desirable approach and group with an undesirable approach (%).

		Total sample (n=376)	Desirable approach (n=183)	Undesirable approach (n=193)
		% respondents	% respondents	% respondents
Gender	Male (n=68)	81.9	15.8	20.2
	Female (n=308)	18.1	84.2	79.8
Age (years)	0-20 (n=65)	17.3	18.6	16.1
	20-40 (n=228)	60.6	59.6	61.7
	40-60 (n=49)	13.0	11.5	14.5
	60-80 (n=34)	9.0	10.4	7.8
Living situation	Single person (n=137)	36.4	38.3	34.7
	Multi person (n=235)	62.5	60.7	64.2
	Other (n=4)	1.1	1.1	1.0
Children in household	Yes (n=55)	14.6	17.5	11.9
	No (n=321)	85.4	82.5	88.1
Education	VMBO MBO (n=18)	4.8	3.8	5.7
	HAVO HBO (n=67)	17.8	17.5	18.1
	VWO WO (n=291)	77.4	78.7	76.2
Work status	Full time (n=44)	11.7	9.8	13.5
	Part time (n=57)	15.2	12.0	18.1
	No paid job (n=35)	9.3	12.6	6.2
	Student (n=236)	62.8	65.0	60.6
	Other (n=4)	1.1	0.5	1.6
Income per month (€)	Less than 500 (n=129)	34.3	36.6	32.1
	More than 500 (n=194)	51.6	50.8	52.3
	Do not want to tell (n=53)	14.1	12.6	15.5

Differences in socio-demographics and socio-economics between the of group with a desirable approach and group with an undesirable approach were tested on significance with Chi-square tests. However, no significant differences were found.

4.3 Reasons to (not) use products after the best before date

In Table 5, reasons to (not) use products after the best before date are shown for the entire sample, group with a desirable approach and group with an undesirable approach. The numbers in the table describe the percentage of respondents of the entire sample, the group with a desirable approach and the group with an undesirable approach that mentioned the reason. It was possible to give multiple reasons.

Table 5 Reasons to (not) use products after the best before date, mentioned by of group with a desirable approach and group with an undesirable approach (%).

		Total sample (n=376) % respondents	Desirable approach (n=183) % respondents	Undesirable approach (n=193) % respondents
Reasons to use	Save money (n=266)	70.7	69.4	72.0
	Reducing poverty (n=121)	32.2	32.8	31.6
	Save environment (n=226)	60.1	57.4	62.7
	Good image (n=17)	4.5	1.6*	7.3*
	Feel good (n=59)	15.7	15.8	15.5
	Food still good (n=343)	91.2	92.3	90.2
	Want to eat (n=65)	17.3	15.3	19.2
	Habits (n=58)	15.4	13.1	17.6
	Other (n=9)	2.4	3.3	1.6
Reasons to not use	Not becoming ill (n=312)	83.0	80.3	85.5
	Taste deteriorates (n=243)	64.6	67.2	62.2
	Smell deteriorates (n=102)	27.1	22.4*	31.6*
	Texture deteriorates (n=108)	28.7	31.1	26.4
	Bad image (n=16)	4.3	1.1*	7.3*
	Food not good (n=115)	30.6	29.0	32.1
	Habits (n=56)	14.9	9.8*	19.7*
	Other (n=14)	3.7	5.5	2.1

* Significant difference between group with a desirable approach and group with an undesirable approach.

Differences between the group with a desirable approach and group with an undesirable approach were tested on significance with Chi-square tests. Significant differences are indicated with an asterisk (*).

4.4 Means and standard deviations for statements

In Table 6, the mean and standard deviations of the scores on the statements are shown for the entire sample, the group with a desirable approach and group with an undesirable approach, based on a 5-point Likert scale where 1 = strongly disagree and 5 = strongly agree.

Table 6 Means and standard deviations of statements for the group with a desirable approach and group with an undesirable approach (%).

	Total sample (n=376) M (SD)	Desirable approach (n=183) M (SD)	Undesirable approach (n=193) M (SD)
Throwing away food products after the best before date is...			
... food waste	4.04 (0.879)	4.17 (0.762)*	3.91 (0.962)*
... can be avoided	4.19 (0.580)	4.27 (0.534)*	4.12 (0.613)*
... affects the environment	4.20 (0.612)	4.22 (0.679)	4.18 (0.543)
... is a waste of money	4.24 (0.667)	4.29 (0.636)	4.20 (0.694)
Using products after the best before date...			
... helps to reduce food scarcity	3.40 (0.942)	3.47 (0.931)	3.34 (0.950)
... makes a difference for the environment	4.22 (0.605)	4.24 (0.609)	4.21 (0.603)
I feel engaged with...			
... the environment	4.06 (0.632)	4.13 (0.612)	4.00 (0.645)
... food scarcity	3.37 (1.020)	3.48 (0.988)*	3.27 (1.041)*
It is important...			
... what others think of me	2.84 (0.907)	2.78 (0.895)	2.90 (0.916)
... to behave like others	1.99 (0.743)	1.95 (0.693)	2.03 (0.787)
I know campaigns	2.61 (1.013)	2.68 (0.949)	2.55 (1.070)
I feel supported by campaigns	2.69 (0.928)	2.76 (0.906)	2.62 (0.945)

* Significant difference between group with a desirable approach and group with an undesirable approach.

Differences in average scores between the group with a desirable approach and group with an undesirable approach were tested on significance with independent samples t-tests. Significant differences are indicated with an asterisk (*).

4.5 How senses are used to determine edibility

Table 7 shows the ways of determining edibility after the best before date for different products for the entire sample. It was possible to give multiple reasons. The numbers in the table describe

the percentage of respondents of the entire sample that mentioned the way of determining edibility.

Table 7 Ways of determining edibility after the best before date of different products for entire sample (%).

Total sample (n=376) % respondents			Total sample (n=376) % respondents		
Milk	Smell	91.5	Coffee	Smell	49.7
	Look	66.2		Look	39.1
	Taste	57.7		Taste	31.6
	Other	1.3		Other	5.1
	Do not use	6.1		Do not use	27.7
Cheese	Smell	61.4	Chocolate	Smell	42.8
	Look	88.8		Look	73.7
	Taste	48.4		Taste	71.5
	Other	1.9		Other	5.6
	Do not use	6.6		Do not use	3.2
Yoghurt	Smell	80.3	Juice	Smell	73.1
	Look	70.5		Look	64.4
	Taste	60.1		Taste	63.8
	Other	0.5		Other	2.1
	Do not use	7.4		Do not use	9.8
Butter	Smell	57.2	Potatoes	Smell	45.2
	Look	75.8		Look	93.4
	Taste	44.4		Taste	16.0
	Other	2.9		Other	9.0
	Do not use	14.9		Do not use	3.2
Eggs	Smell	46.3	Soda	Smell	36.7
	Look	51.3		Look	43.9
	Taste	16.0		Taste	64.6
	Other	35.1		Other	4.8
	Do not use	4.0		Do not use	19.1

* Significant difference between group with a desirable approach and group with an undesirable approach.

Table 8 shows whether there are significant differences between the group with a desirable approach and group with an undesirable approach when looking at ways in which edibility after the best before date is determined. The numbers in the table describe the percentage of respondents of the group with a desirable approach and group with an undesirable approach that mentioned the way of testing edibility. It was possible to give multiple reasons.

Table 8 Ways of determining edibility of different products after the best before date of group with a desirable approach and group with an undesirable approach (%).

		Desirable approach (n=183) % respondents	Undesirable approach (n=193) % respondents			Desirable approach (n=183) % respondents	Undesirable approach (n=193) % respondents
Milk	Smell	93.4	89.6	Coffee	Smell	50.3	49.2
	Look	64.5	67.9		Look	38.8	39.4
	Taste	62.3	53.4		Taste	30.1	33.2
	Other	0.0*	2.6*		Other	6.0	4.1
	Do not use	4.9	7.3		Do not use	27.9	27.5
Cheese	Smell	58.8	64.2	Chocolate	Smell	42.6	43.0
	Look	88.0	89.6		Look	73.2	74.1
	Taste	48.1	48.7		Taste	71.6	71.5
	Other	1.6	2.1		Other	5.5	5.7
	Do not use	7.7	5.7		Do not use	3.8	2.6
Yoghurt	Smell	78.7	81.9	Juice	Smell	72.7	73.6
	Look	71.0	69.9		Look	61.2	67.4
	Taste	63.4	57.0		Taste	60.1	67.4
	Other	0.5	0.5		Other	2.2	2.1
	Do not use	7.7	7.3		Do not use	13.1*	6.7*
Butter	Smell	51.9*	62.2*	Potatoes	Smell	42.6	47.7
	Look	68.3*	82.9*		Look	96.2*	90.7*
	Taste	42.1	46.6		Taste	15.3	16.6
	Other	6.0*	0.0*		Other	7.7	10.4
	Do not use	20.2*	9.8*		Do not use	2.7	3.6
Eggs	Smell	51.4	41.5	Soda	Smell	35.5	37.8
	Look	51.4	51.3		Look	41.0	46.6
	Taste	12.0*	19.7*		Taste	61.2	67.9
	Other	34.4	35.8		Other	3.3	6.2
	Do not use	4.4	3.6		Do not use	24.0*	14.5*

* Significant difference between group with a desirable approach and group with an undesirable approach.

Differences between the group with a desirable approach and group with an undesirable approach were tested on significance with Chi-square tests. Significant differences are indicated with an asterisk (*). All other reasons were not significantly different for the group with a desirable approach and group with an undesirable approach.

An overview of tests for significance are presented in Appendix III. When differences between groups were not indicated with an asterisk (*), differences were not significantly different. Despite that no other significant differences between groups were found than the ones with an asterisk, these p-values and percentages are still interesting to look at. When a p-value is close to 0.05, it should be considered to include this factor in future research. A larger sample size, or a more specific research might lead to a significant difference between groups. This is the reason why all p-values are given in Appendix III.

5 Conclusion and discussion

The aim of this study was to investigate how well Dutch consumers know the best before date and how consumers with an undesirable approach towards the best before date are characterized in terms of socio-demographics, socio-economics and attitudes. When these consumers are better understood, campaigns can be made more specific, hopefully leading to a further decrease in an undesirable approach towards the best before date.

Dutch consumers are quite familiar with the best before date. Despite that 98.9% heard of the best before date, 45.5% incorrectly thought that the best before date is about safety, insinuating that the product is not safe to consume after this date. This number is even higher than the 27% that was found for Belgian consumers ten years ago (Brook Lyndhurst, 2008) and the recently found 15% for American consumers (Leib et al., 2016). Consumers with an undesirable approach towards the best before date less often know both the use by and best before date (81.3%) compared to those with a desirable approach (93.4%). When a person has only heard of the best before date, it is assumed to be more difficult to accurately judge edibility of a product with this date, compared to when both types of expiration dates are known. Unfortunately, no advice can be given about the type of consumer that needs to be targeted, since no significant differences were found between the group with a desirable approach and group with an undesirable approach on socio-demographic and socio-economic aspects. Most important reasons to use products after the best before date are respectively that food is still good (91.2%), to save money (70.7%), to save the environment (60.1%), to reduce poverty (32.2%), want to eat the product (17.4%), to feel good (15.7%), because of habits (15.4%) and to have a good image (4.5%). The major interest is in reasons why respondents do not use products after the best before date. Most mentioned reasons are respectively not becoming ill (83.0%), that taste deteriorates (64.6%), that food is not good (30.6%), that texture deteriorates (28.7%), that smell deteriorates (27.1%), because of habits (14.9%) and to avoid to have a bad image (4.3%). Literature also pointed out that the two main causes of wasting edible food products after the best before date are that the consumer is worried if the food is still good and that the consumer misinterprets the best before date (Brook Lyndhurst, 2007; Principato et al., 2015; Williams et al., 2012). Emphasizing that the risk of becoming ill is very small possibly leads to higher usage of food products after the best before date. Looking at differences between groups, respondents with an undesirable approach towards the best before date more often mentioned that a good image is a reason to use products after the best before date and that bad image, deterioration of smell and habits are reasons to not use products after the best before date are a bad image. Therefore, to reach the group with an undesirable approach, image can be targeted. Further research is needed to determine what is meant by consumers with 'bad image'. Not using products after the best before date should be communicated as 'being inappropriate' in such a way that it becomes more attractive to use

products after the best before date. For some products, the two groups tested edibility in different ways. Milk, yoghurt, coffee and juice are mostly smelled, whereas cheese, butter, eggs, chocolate and potatoes are mainly looked at. Quality of soda is determined with taste. It seems like liquid products are mostly smelled, while more solid products are judged by the eye. How often senses are used for different products significantly differed between groups on some aspects. These findings can be used when making product specific campaigns about the best before date. This is not discussed in this thesis, since this thesis aims at targeting consumers with an undesirable approach in their general approach towards the best before date, not in relation to a specific food product. Looking at possible topics for future campaigns, relatively low scores are found for the statements 'I know campaigns' and 'I feel supported by campaigns'. It can be difficult to let respondents feel supported, but it is thought to be relatively easy to make sure that consumers know campaigns. This should be the first thing to tackle in the future. Respondents think that profit organizations are most eligible to raise awareness, followed by the government, educational organizations, non-profit organizations and consumers. Respondents with an undesirable approach place consumers lower than respondents with a desirable approach, suggesting that they have stronger ideas that the responsibility lies with someone else. Respondents strongly agree with the statement that throwing away food products after the best before date can be avoided. This provides possibilities for the future, since consumers need to believe that changing behavior has effects. Otherwise, consumers are not likely to try to change their behavior (Graham-Rowe et al., 2014). Furthermore, throwing away products after the best before date is seen as food waste and a waste of money. This is in line with earlier findings of research into what bothers consumers about food waste (Brook Lyndhurst, 2007; Graham-Rowe et al., 2014; Quested et al., 2013). Thus, respondents luckily see the negative consequences of an undesirable approach towards the best before date. The statements about the environment all score relatively high, including that respondents feel engaged with the environment. This contradicts previous findings that consumers find it of least importance that food waste is bad for the environment (Graham-Rowe et al., 2014; Quested et al., 2013), but agrees with Doron (2013) that also found that the environment was consumers' most important concern regarding food waste. Despite different findings, it can possibly be effective to communicate the effects of a changed approach towards the best before date on the environment. Presumably, when respondents can see what their behavior change means for the environment, they become more motivated to use products after the best before date. Relatively little agreement was found with the statement that food waste has an influence on food scarcity and the engagement that respondents feel with food scarcity. Quested et al. (2013) also found little agreement that food scarcity encourages to minimize food waste. Agreement on importance of the what others think and to behave like others. Therefore, it can be suggested that telling consumers what others do, is not the best way to change one's approach to the best before date. Still, the subjective norm might be targeted in other ways, since social

messages are thought to be effective in educational campaigns (Parizeau et al., 2015). The group with an undesirable approach scores significantly lower on agreement with statements that throwing away food products after the best before date is food waste and can be avoided. In line with this, is that the group with an undesirable approach does not know that best before date is not about quality and not about safety. Once understanding of the meaning of the best before date is improved, that the best before is about quality, the agreement that throwing away edible food products after the best before date is food waste and can be avoided is assumed to become higher. Furthermore, this group scores lower on engagement with food scarcity. Engaging them more might open their eyes why they should not throw away edible food products. For the group with an undesirable approach, habits are a reason that products are not used after the best before date. Habits might arise from relatively little or unjust knowledge about the best before date. When one is unjustly convinced that the best before date communicates safety and that products should be thrown away after this date, one might not see any reason to break through these habits, since he or she thinks that correct behavior is performed. Both in qualitative and quantitative research was found that money provides great motivation for changing habits (Quested et al., 2013). Since throwing away edible products after the best before date is seen as a waste of money, financial aspects could be emphasized in campaigns to motivate consumers to change habits.

Some points of discussion arise. Part of the questionnaire was based on research of Brook Lyndhurst (2008) and Van Boxtael et al. (2014), but most questions were created for this study. The questionnaire was tested with pilots to make sure that questions were clear and that all answer options were provided. When repeating this research, outcomes can be made more powerful by asking multiple questions that measure the same underlying factor. These questions can then be tested with a Cronbach's alpha to see whether questions can be merged into one overall score for an underlying factor. In this research, Cronbach's alphas were tested to see whether still some questions can be taken together to measure one underlying factor, but the alphas were not high enough. Underlying factors were each measured with one question. No underlying factors were determined beforehand.

A sample size of 376 respondents was retrieved and might therefore be a good representation of the Dutch population. The group of respondents was biased in a way that some socio-demographic and socio-economic groups were better represented than others. Categories that are well represented are likely to provide more representative results for the Dutch population than categories that exist of less persons. Most respondents fall within the gender female (81.9%), age category 20-40 years (60.6%), having a living situation in a multi person household (62.5%), without children in household (85.4%), an academic education (77.5%), being student (62.5%), with no strong division in spendable income (34.3% that earns less than €500 versus 51.6% that

earns more than €500 versus 14.1% that does not know or does not want to tell). From these numbers can be seen that women are better represented than men, a phenomenon that often occurs in studies that are linked to food (Curtin, Presser, & Singer, 2000; Grunert, Wills, & Fernández-Celemín, 2010; Moore & Tarnai, 2002; Sampers et al., 2012; Singer, Van Hoewyk, & Maher, 2000; Smith & Leigh, 1997; Smith, 2008; Van Boxtael et al., 2014). One of the reasons why women are better represented than men, might be that women are in general responsible for food gate keeping in a household, meaning that women mostly do groceries and cook dinner (Stefan et al., 2013). When a person is more engaged in doing groceries and cooking dinner, he or she might also be more likely to engage in a questionnaire about expiration dates on food products. For all other mentioned factors, a possible explanation is that most respondents were retrieved via Facebook groups that were linked to Wageningen University or via personal Facebook pages. This led to a relatively high number of students with young age, acting like multi person households, with no children in household, high education, a part-time job or no job, and a low income. Besides that this questionnaire was distributed at Wageningen University, and thus recruited relatively many high educated students, evidence can be found in literature that high educated consumers tend to participate in questionnaires more quickly than less educated consumers (Curtin et al., 2000; Singer et al., 2000; Smith, 2008; Warriner & Miller, 2002). The respondent population is relatively young. This can be explained that previous research found that younger consumers tend to fill in questionnaire more quickly than older consumers (Moore & Tarnai, 2002; Smith, 2008; Warriner & Miller, 2002). Despite that the division of respondents among socio-demographic and socio-economic groups is skewed, all socio-demographic and socio-economic groups are covered by the sample, with the smallest groups containing 18 respondents.

64 of 376 respondents were already of relatively high age and still indicated that VWO was their highest followed education. It is unlikely that all these respondents who followed a VWO level education, did not do another study and all stopped after their VWO. Earlier, it was more likely to stop after secondary school, so the relatively old respondents might have answered this question correctly. However, it might be that respondents in the middle age category read this question as the highest 'finished' education instead and did not think about the education that they are currently in. For the analysis of results, this was not a problem, since the answer categories were recategorized into VMBO/MBO, HAVO/HBO and VWO/WO, but it is important to note such 'discrepancies' in the data.

It is important to note that even when respondents indicate that they live in a household setting that suggests multi person household behavior (e.g. living with partner), they might still behave more like a single person household. The assumption was made that respondents that indicated that they live alone or with housemates acting like a single person household, were the only two

categories that show single person household behavior. For all other answer categories, it was assumed that these respondents perform multi person household behavior. This assumption might have influenced results in such a way that the number of consumers acting like a single or multi person household was slightly different. It would be interesting to extend the questionnaire in order to be able to make a more informed decision about the division between single and multi person households.

The issue of food waste resulting from an undesirable approach towards the best before date can also be tackled by not mentioning expiration dates on food products. For some products, expiration dates are needed to guarantee food safety, but for many products that have a best before date, date labelling is thought to be unnecessary. Recent research indicated that food waste decreased with 12 percent when the best before date was not mentioned on the package. This was specifically effective for products with long shelf life. In this category, 31% less food products were wasted (Holthuysen, Kremer, & Bos-Brouwers, 2016). Even though consumers are no longer able to just rely on the best before date and are forced to use their senses, it is thought that it is not the most appropriate and most effective way to reduce this type of food waste. The way that was discussed in this research, raising awareness and educating consumers in a proper way, is thought to be necessary to provide consumers the opportunity to make informed decisions (Canali et al., 2016). Furthermore, it will be easier to implement. Once consumers are more aware and educated, the suggestion of Holthuysen et al. (2016) can still be implemented, but in line with research of Tsiros and Heilman (2005), the most important thing for now is that consumers become literate about the best before date.

6 Recommendations for future research

The conceptual model that was used in this research, was based on the TRA, TPB and TIB. There are several ways in which this research could be extended, since multiple factors are known or thought to influence behavior. This research only covered a small part of the entire puzzle of one's approach towards the best before date that could be measured with a questionnaire. This research was partly based on research of Roodhuyzen et al. (2017). Four categories of factors were presented that possibly influence food waste. Behavioral factors, product factors and societal factors were not the main interest. This research was about what plays in consumers' minds and could be investigated with questionnaires. In the future, behavioral factors can be investigated with observational research. Since intentions are often different from actual behavior, observational research about the best before date can be of great additional value (Carrington et al., 2014; Fedusiv & Bai, 2016; Mullan et al., 2014; Sheeran, 2002; Sheeran & Webb, 2016; Zhou et al., 2013). One can also choose to focus more on product factors. Product factors are about properties of the food product itself, for example its taste or package properties. For now, consumers did not get in contact with real products and were not asked to eat the product and look at e.g. poor quality, taste or freshness. In the real-life setting, consumers get in contact with a product when they decide to eat or not eat the product after the best before date. Therefore, this research can be very useful. Societal factors are thought to be relatively less important in one's best before date behavior, since this behavior mostly happens in the household. Household behavior is something that is often not perceived by others outside the household, unless it is communicated to the outside world. As a result, consumers are less likely to feel the need to comply to social norms than for behaviors that are perceived outside the home, for example whether someone uses many plastic bags for his or her groceries, or that he or she has own bags (Tucker & Douglas, 2006). Additionally, there is evidence that the link between subjective norms and intention is not that strong, especially for food (Armitage & Conner, 2001; Connor & Armitage, 2002). However, since the amount of evidence for this statement is relatively small, subjective norms regarding one's approach towards the best before date should still be investigated. For some factors, questionnaires will not be useful and observational behavior will be needed. For example, habits could be examined. Consumers do not always act in a conscious way and use shortcuts to perform a certain behavior. Thus, if a consumer is likely to always throw away dried pasta that has passed the best before date, he or she might continue this behavior in future situations without giving it any thought. The practice has become a habit (Darnton, Verplanken, White, & Whitmarsh, 2011). Since habits often happen unconsciously and consumers are thought to be often not aware of their habits, habits should be investigated with observational research instead of questionnaires. Other factors that are mentioned in the conceptual model and that can be investigated, are perceived control, affect and facilitating conditions.

For this questionnaire, a selection of the most used and most wasted products was made. In the future, it would be interesting to execute this research for more product categories. The products with a use by date could also be included to determine the difference between the use by and best before date. Not much research has been done into differences in judged edibility for products categories (Brook Lyndhurst, 2008).

The rich data set was used to do analyses that provided answers on the research questions. Speaking of the richness of the data set, more analyses can be done that possibly yield interesting results. In this research, literature was consulted to determine the most wasted foods. When respondents had undesirable intentions towards one of these products, they were seen as a respondent with an undesirable approach towards the best before date. Thus, retrieved information about products was only used for categorization of respondents. It can be analyzed which products are thrown away fastest. Another example of future research with this data set is to test for significant differences in how edibility of products is tested. It was only shortly described what differences occur, but it is assumed to be very interesting to run more tests on this aspect and be able to make product-specific campaigns. This research found that liquid products are mostly smelled, while more solid products are mostly judged by the eye. This can be used in future research that looks at different ways of determining edibility of a product. Other ways of building on and extending this research, is by looking at the results in more detail. For example, this research looked at differences between household with and without children. Number of children was not considered. In the future, it might be interesting to compare large families with multiple children and small families with one or two children. Another important aspect is that no division has been made between respondents that provided any additional information or that stayed with the option 'other...' without providing any additional text. In this research, analyses were done for two groups, one with a desirable approach and one with an undesirable approach towards the best before date. Another way of showing the data is by not investigating differences between those two groups, but between e.g. males and females. Literature showed that women are more seriously worried about food safety and might therefore have different reasons to (not) use products after the best before date (Stafleu et al., 1996; Terpstra et al., 2005).

Food waste literature was used to get an insight into possible relations between socio-demographics, socio-economics, knowledge, attitudes and intentions and one's approach towards the best before date, since relatively little literature was available that was specifically about the best before date. This research already started to investigate the relation of above mentioned factors with the best before date. It is encouraged to further investigate whether the relations that can be found with food waste, also translate to the best before date.

In Appendix III, tests for significance are included. In the results section, only significant differences were discussed. However, some tests are very close to significance and might therefore be investigated more thoroughly in the future on a larger scale. It is possible that these relations turn out to be significant when investigated in a larger, more representative population in terms of socio-demographics and socio-economics.

This type of research can be very suitable for cluster analysis. A cluster analysis determines structures between variables in a data set in an exploratory way. It was considered to perform a cluster analysis on the answers that respondents provided in the questionnaire, but since a very broad data set was retrieved, including all variables in the cluster analysis would not have yielded a useful result. It is known that one can choose which variables should be used for clustering (Williams, 2015), but to do this, one assumes certain links between variables. When previous research would have indicated or proven such links, cluster analysis might have been more appealing, but since little previous research has been done about knowledge and intentions in relation to socio-demographics, socio-economics and attitudes regarding the best before date, it was difficult to accurately select the variables that should be included in clustering. There is not a 'right' way, so clustering would have still been an option, even without any prior knowledge. However, since little knowledge was available and since it is not possible to check whether selected variables are chosen correctly, it was decided that investigating links between one's approach and one's socio-demographics, socio-economics and attitudes separately was much more useful for this moment. Now that this research indicates possible relationships, future clustering (perhaps even with this same data set), is thought to yield more valid results.

When consumers are clustered, it is desired to have as much resemblance within a group and as much difference between groups as possible. These consumer clusters can be used for the design of future campaigns. First, it needs to be known what relationships can be found in the data set. That step was already taken by this research. It might be useful to do more research to be able to work with larger data sets and more relationships, but it is not discouraged to work with data sets such as the one that was retrieved and used in this research. Then, it should be decided what factors are included to cluster consumers. One can decide how many clusters there should be beforehand, but one can also let a statistical software program determine how many clusters are useful. Once clusters are made, it is important to know how each cluster can be characterized and, more important, how these clusters differ from each other. Campaigns can be made for each separate cluster, so that each cluster can be specifically targeted.

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Appendices

Appendix I Questionnaire

Houdbaarheidsdata

Start of Block: Vragenlijst

Bedankt dat je deelneemt aan dit onderzoek naar hoe consumenten omgaan met houdbaarheidsdata op voedingsproducten. Dit onderzoek is onderdeel van mijn masterscriptie, geschreven aan de Universiteit van Wageningen.

Het invullen duurt ongeveer 10 minuten. Je mag op elk moment stoppen met deze vragenlijst zonder de reden te hoeven geven. Er zal vertrouwelijk met gegevens worden omgegaan en de data zal anoniem worden verwerkt. Onder de respondenten die de vragenlijst volledig invullen, worden vijf VVV-cadeaubonnen van €10,- verloot. Wanneer je hiervoor mee wilt loten, kun je aan het eind van de vragenlijst je e-mailadres achterlaten. Mocht je nog vragen of opmerkingen hebben over het onderzoek, neem dan contact met mij op via iris.kleinherenbrink@wur.nl.

End of Block: Vragenlijst

Start of Block: Vragenlijst

Geslacht:

- ☐ man
- ☐ vrouw
- ☐ anders

Leeftijd (in jaren):

0 10 20 30 40 50 60 70 80 90 100



Hoogst genoten opleiding:

- ☐ basisschool
 - ☐ VMBO
 - ☐ HAVO
 - ☐ VWO
 - ☐ MBO
 - ☐ HBO
 - ☐ WO
 - ☐ anders, _____
-

Werkstatus:

- ☐ full time (36 uur per week of meer)
 - ☐ part time (minder dan 36 uur per week)
 - ☐ Full time huisman/huisvrouw
 - ☐ student
 - ☐ anders, _____
-

Leefsituatie:

- ☐ met ouders
 - ☐ met huisgenoten (studenten of werkenden)
 - ☐ met partner
 - ☐ met kinderen (zonder partner)
 - ☐ met partner en kinderen
 - ☐ alleen
 - ☐ anders, _____
-

Aantal mensen in huishouden inclusief jezelf:

- ☐ 1
 - ☐ 2
 - ☐ 3
 - ☐ 4
 - ☐ 5
 - ☐ 6
 - ☐ 7
 - ☐ 8
 - ☐ 9
 - ☐ 10 of meer
-

Aantal thuiswonende kinderen

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 of meer

Besteedbaar inkomen per maand:

- ☐ minder dan €500
- ☐ €500-€1000
- ☐ €1000-€1500
- ☐ €1500-€2000
- ☐ €2000-€2500
- ☐ €2500-€3000
- ☐ meer dan €3000
- ☐ weet niet/wil ik niet zeggen

End of Block: Vragenlijst

Start of Block: Vragenlijst leefsituatie met huisgenoten (studenten/werkenden)

Hoe vaak per week doe je gemiddeld boodschappen?

- ☐ minder dan 1 keer
 - ☐ 1-2 keer
 - ☐ 3-4 keer
 - ☐ 5-6 keer
 - ☐ 7 keer of vaker
-

Hoe veel van deze boodschappen worden ook door anderen gegeten/gedronken?

- ☐ zeer weinig
 - ☐ weinig
 - ☐ noch weinig, noch veel
 - ☐ veel
 - ☐ zeer veel
-

Hoe vaak per week eet je gemiddeld samen met (één van) je huisgenoten?

- ☐ minder dan 1 keer
- ☐ 1-2 keer
- ☐ 3-4 keer
- ☐ 5-6 keer
- ☐ 7 keer of vaker

End of Block: Vragenlijst leefsituatie met huisgenoten (studenten/werkenden)

Start of Block: Vragenlijst leefsituatie niet met huisgenoten (studenten/werkenden)

Hoe vaak per week doe je gemiddeld boodschappen?

- ☐ minder dan 1 keer
- ☐ 1-2 keer
- ☐ 3-4 keer
- ☐ 5-6 keer
- ☐ 7 keer of vaker

End of Block: Vragenlijst leefsituatie niet met huisgenoten (studenten/werkenden)

Start of Block: Vragenlijst

Ken je de termen *te gebruiken tot (TGT)* en *tenminste houdbaar tot (THT)*?

- ☐ geen van beide
- ☐ alleen TGT
- ☐ alleen THT
- ☐ beide

Hoe goed ken je het verschil tussen *te gebruiken tot (TGT)* en *tenminste houdbaar tot (THT)*?

- ☐ helemaal niet goed
- ☐ niet goed
- ☐ redelijk
- ☐ goed
- ☐ zeer goed

End of Block: Vragenlijst

Start of Block: Vragenlijst

Geef per term aan wat het volgens jou communiceert. Er zijn meerdere antwoorden mogelijk.

Te gebruiken tot (TGT):

- ☐ informatie voor producenten
 - ☐ informatie voor winkeliers
 - ☐ informatie voor consumenten
 - ☐ informatie over kwaliteit
 - ☐ informatie over veiligheid
 - ☐ informatie over voedingswaarde
 - ☐ weet ik niet
-

Tenminste houdbaar tot (THT):

- ☐ informatie voor producenten
- ☐ informatie voor winkeliers
- ☐ informatie voor consumenten
- ☐ informatie over kwaliteit
- ☐ informatie over veiligheid
- ☐ informatie over voedingswaarde
- ☐ weet ik niet

End of Block: Vragenlijst

Start of Block: Vragenlijst

Onderstaande vragen gaan over 10 verschillende producten.

MELK

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

KAAS

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

YOGHURT

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

HALVARINE (BOTER)

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

EIEREN

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

KOFFIE

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

CHOCOLADE

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

SAP

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

AARDAPPELS

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
 - ☐ kijken
 - ☐ proeven
 - ☐ anders, _____
 - ☐ ik gebruik dit product niet
-

FRISDRANK

Bij welke *tenminste houdbaar tot (THT)* datum zou je dit product zeker weggooien?

- ☐ THT morgen
 - ☐ THT vandaag
 - ☐ THT gisteren
 - ☐ THT 2-4 dagen geleden
 - ☐ THT 5-7 dagen geleden
 - ☐ THT 1-3 weken geleden
 - ☐ THT meer dan 3 weken geleden
 - ☐ niet afhankelijk van datum
 - ☐ gebruik ik niet
 - ☐ weet ik niet
-

Vóór de datum dat ik het product zeker zou weggooien (zie vraag hiervoor), bepaal ik de eetbaarheid door:

- ☐ ruiken
- ☐ kijken
- ☐ proeven
- ☐ anders, _____
- ☐ ik gebruik dit product niet

End of Block: Vragenlijst

Start of Block: Vragenlijst

Geef aan in welke mate je het met de volgende 12 stellingen eens bent.

Het weggooien van eetbaar voedsel na de *tenminste houdbaar tot (THT)* datum is voedselverspilling.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Het weggooien van eetbaar voedsel na de *tenminste houdbaar tot (THT)* datum kan voorkomen worden.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik voel me betrokken bij het milieu.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Het weggooien van eetbaar voedsel na de *tenminste houdbaar tot (THT)* datum heeft een effect op het milieu.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Minder eetbaar voedsel weggooien kan een verschil maken voor het milieu.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik voel me betrokken bij voedselschaarste in ontwikkelingslanden.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Producten gebruiken na de *tenminste houdbaar tot (THT)* datum helpt om voedselschaarste te beperken.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Het weggooien van eetbaar voedsel na de *tenminste houdbaar tot (THT)* datum is geldverspilling.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik vind het belangrijk wat anderen over me denken.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik vind het belangrijk dat ik me hetzelfde gedraag als de meeste consumenten.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik ken campagnes/websites/artikelen/flyers/uitleg over het gebruik van producten na de *tenminste houdbaar tot (THT)* datum.

- ☐ zeer oneens
 - ☐ oneens
 - ☐ noch oneens, noch eens
 - ☐ eens
 - ☐ zeer eens
-

Ik voel me gesteund door campagnes/websites/artikelen/flyers/uitleg over het gebruik van producten na de *tenminste houdbaar tot (THT)* datum.

- ☐ zeer oneens
- ☐ oneens
- ☐ noch oneens, noch eens
- ☐ eens
- ☐ zeer eens

End of Block: Vragenlijst

Start of Block: Vragenlijst

Wie is volgens jou het meest geschikt om bewustzijn te creëren dat producten vaak nog na de *tenminste houdbaar tot (THT)* datum gebruikt kunnen worden? Sleep de blokken in de gewenste volgorde. 1 is het meest geschikt, 5 het minst geschikt.

- _____ Overheid
- _____ Ideële organisaties (bijv. Foodwatch en Stichting Ideële Reclame (SIRE))
- _____ Commerciële organisaties (bijv. Unilever en Albert Heijn)
- _____ Consumenten
- _____ Educatieve organisaties (bijv. scholen)

End of Block: Vragenlijst

Start of Block: Vragenlijst

Wat zijn belangrijkste redenen om producten WEL te gebruiken na de *tenminste houdbaar tot (THT)* datum? Sleep de antwoorden naar de juiste box. **Geef één antwoord per box.** Een antwoord bij box 1 is vereist. Box 2 en 3 zijn optioneel. Wanneer je nooit producten gebruikt na de *tenminste houdbaar tot (THT)* datum, kun je in box 1 het antwoord gebruiken: 'Eet geen producten na THT datum'.

1 (belangrijkst)	2 (een-na-belangrijkst)	3 (twee-na-belangrijkst)
_____ eet geen producten na THT datum	_____ eet geen producten na THT datum	_____ eet geen producten na THT datum
_____ geld besparen	_____ geld besparen	_____ geld besparen
_____ voedselschaarste reduceren	_____ voedselschaarste reduceren	_____ voedselschaarste reduceren
_____ het milieu sparen	_____ het milieu sparen	_____ het milieu sparen
_____ een goed imago hebben/krijgen	_____ een goed imago hebben/krijgen	_____ een goed imago hebben/krijgen
_____ je goed voelen/een slecht gevoel voorkomen	_____ je goed voelen/een slecht gevoel voorkomen	_____ je goed voelen/een slecht gevoel voorkomen
_____ voedsel is vaak nog goed na THT datum	_____ voedsel is vaak nog goed na THT datum	_____ voedsel is vaak nog goed na THT datum
_____ het product heel graag willen eten en daarom het risico nemen	_____ het product heel graag willen eten en daarom het risico nemen	_____ het product heel graag willen eten en daarom het risico nemen
_____ gewoonte	_____ gewoonte	_____ gewoonte
_____ anders,	_____ anders,	_____ anders,

Wat zijn belangrijkste redenen om producten NIET te gebruiken na de *tenminste houdbaar tot (THT)* datum? Sleep de antwoorden naar de juiste box. **Geef één antwoord per box.** Een antwoord bij box 1 is vereist. Box 2 en 3 zijn optioneel.

1 (belangrijkst)	2 (een-na-belangrijkst)	3 (twee-na-belangrijkst)
<input type="text"/> kans om ziek te worden	<input type="text"/> kans om ziek te worden	<input type="text"/> kans om ziek te worden
<input type="text"/> kans dat smaak achteruit gaat	<input type="text"/> kans dat smaak achteruit gaat	<input type="text"/> kans dat smaak achteruit gaat
<input type="text"/> kans dat de geur achteruit gaat	<input type="text"/> kans dat de geur achteruit gaat	<input type="text"/> kans dat de geur achteruit gaat
<input type="text"/> kans dat de textuur achteruit gaat	<input type="text"/> kans dat de textuur achteruit gaat	<input type="text"/> kans dat de textuur achteruit gaat
<input type="text"/> een slecht imago hebben/krijgen	<input type="text"/> een slecht imago hebben/krijgen	<input type="text"/> een slecht imago hebben/krijgen
<input type="text"/> voedsel is niet meer goed na THT datum	<input type="text"/> voedsel is niet meer goed na THT datum	<input type="text"/> voedsel is niet meer goed na THT datum
<input type="text"/> gewoonte	<input type="text"/> gewoonte	<input type="text"/> gewoonte
<input type="text"/> anders,	<input type="text"/> anders,	<input type="text"/> anders,

End of Block: Vragenlijst

Start of Block: Vragenlijst

Bedankt voor het invullen van deze vragenlijst. Je bijdrage wordt erg gewaardeerd. Eventuele vragen kunnen gestuurd worden naar iris.kleinherenbrink@wur.nl.

Als je vaker wilt meewerken aan onderzoek van de leerstoelgroep Food Quality and Design waar ik mijn thesis schrijf, laat dan hieronder je e-mailadres achter. Het e-mailadres zal alleen voor deze doeleinden gebruikt worden.

Als je kans wilt maken op één van de vijf VVV cadeaubonnen van €10,-, laat dan hieronder je e-mail adres achter. Het e-mailadres zal alleen gebruikt worden om te communiceren als je gewonnen hebt.

Klik op volgende om deze vragenlijst af te ronden.

End of Block: Vragenlijst

Appendix II Recategorization of answer categories

Some of the answer categories were recoded into broader categories. First, an explanation is given about how recategorization took place. An overview of the answer options that were recategorized, can be found in Table 9.

Age categories were recoded from a continuous variable into four response categories. No clear-cut rules exist that describe how age categories should be determined. Therefore, age categories as defined by Centraal Bureau voor de Statistiek were used (Nederlands Interdisciplinair Demografisch Instituut, n.d.). Looking at education, the reason why the division was made between VMBO MBO, HAVO HBO and VWO WO, is that VMBO is a preparatory school for MBO, HAVO for HBO and VWO for WO. It was not desired to take VMBO, HAVO and VWO (all secondary schools) together, since this tells more about one's age, than one's educational level. Regarding living situation, it is important that consumers living in student houses specify whether they act more like a single person or multi person household. Respondents who indicated that their living situation was with housemates, were shown two additional questions. 'How much of your groceries are consumed by others?' and 'How many times per week, on average, do you eat with (one of) your housemates?' Both questions were answered on 5-point scales. The answer options for the first question were 'almost never/rarely/neither rarely nor frequently/frequently/very frequently'. The answer options for the second question were 'less than once/1-2 times/3-4 times/5-6 times/7 times or more'. Questions about sharing groceries and dinner together help to determine whether students that are living together behave more like a multi person household or a single person household. When one of the first two answer options was chosen for both questions (so very little or little groceries consumed by others and eating together less than once or 1-2 times), these respondents were recategorized into a single person household. When one of the three last answer options was chosen for both questions (so neither little, nor much, much or very much groceries consumed by others and eating together 3-4 times, 5-6 times or 7 times or more, these respondents were subcategorized into a multi person household. Some respondents acted as single person households on the first question and as multi person households on the second question, and vice versa. Since these respondents all showed some type of multi person households behavior, whether on the first or second question, they were all analyzed as a multi person household. For other living situations (with parents, with partner, with partner and children, with children without partner, alone) it was assumed that the last one is acting as a single person household, the others as multi person households. In the questionnaire, respondents indicated how many children are living in their household. In the analysis, number of children was neglected. It was only analyzed whether there are children in the household (yes/no). It is good to first know whether presence of children in the household has a possible relationship with one's approach towards the best before date, before looking at the number of children. Answer categories about

income were split in such a way that number of respondents per group were distributed as equal as possible, resulting in the approximate half of the sample that earns least (n=129) and the approximate half of the sample that earns most (n=194). The rest of respondents did not want to share their income or did not know (n=53).

Table 9 Answer categories of factors that were recategorized.

Factor	Answer options questionnaire	Recategorized answer options
Age categories (years)	Continuous variable	0-20
		20-40
		40-60
		60-80
Education	Primary school	VMBO or MBO
	VMBO	HAVO or HBO
	HAVO	VWO or WO
	VWO	
	MBO	
	HBO	
	WO	
Living situation	Other	
	With parents	Single person household
	With housemates	Multi person household
	With partner	Other
	With partner and children	
	With children (without partner)	
	By myself	
Children in household	Other	
	1	6
	2	7
	3	8
	4	9
Income	5	10 or more
	Less than €500	Less than €500
	€500-€1000	€500 or more
	€1000-€1500	
	€1500-€2000	
	€2000-€2500	
	€2500-€3000	
	€3000 or more	
	Do not know or do not want to tell	

Appendix III Statistical tests for testing significant differences

Table 10 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding whether respondents have heard about the use by and best before date.

		X²	df	p-value
Heard of	Neither*	.	.	0.124
	Only use by	.	.	.
	Only best before	9.133	1	0.003
	Both	12.340	1	<0.0001

* When cells have an expected count less than 5, the p-value of the Fisher's exact was used instead of a Chi-square test. The factors that were analyzed with a Fisher's exact test show the values for the Odds ratio.

Table 11 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding most to least eligible parties to create awareness that products can often be used after the best before date.

		t	df	p-value
Party	Profit organizations	-1.349	374	0.178
	Government	-1.214	369.493	0.225
	Educational organizations	1.601	374	0.110
	Non-profit organizations	-0.867	374	0.386
	Consumers	2.054	373.815	0.041

Table 12 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding socio-demographic and socio-economic characteristics.

	X²	df	p-value
Gender	1.205	1	0.272
Age (years)	1.783	3	0.619
Living situation*	.	.	0.819
Children in household	2.333	1	0.127
Education	0.789	2	0.674
Work status*	.	.	0.065
Income per month (€)	1.183	2	0.553

* When cells have an expected count less than 5, the p-value of the Fisher's exact was used instead of a Chi-square test. The factors that were analyzed with a Fisher's exact test show the values for the Odds ratio.

Table 13 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding reasons to (not) use products after the best before date, mentioned by of group with a desirable approach and group with an undesirable approach.

		X²	df	p-value
Reasons to use	Save money	0.312	1	0.576
	Reducing poverty	0.060	1	0.807
	Save environment	1.108	1	0.293
	Good image	6.859	1	0.009
	Feel good	0.007	1	0.936
	Food still good	0.565	1	0.452
	Want to eat	0.984	1	0.321
	Habits	1.459	1	0.227
	Other*	.	.	0.327
Reasons to not use	Not becoming ill	1.774	1	0.183
	Taste deteriorates	1.042	1	0.307
	Smell deteriorates	4.023	1	0.045
	Texture deteriorates	1.023	1	0.312
	Bad image	8.751	1	0.003
	Not good	0.443	1	0.506
	Habits	7.194	1	0.007
	Other	3.015	1	0.083

* When cells have an expected count less than 5, the p-value of the Fisher's exact was used instead of a Chi-square test. The factors that were analyzed with a Fisher's exact test show the values for the Odds ratio.

Table 14 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding means and standard deviations of statements.

	t	df	p-value
Throwing away food products after the best before date is...			
... food waste	2.868	374	0.004
... can be avoided	2.500	374	0.013
... affects the environment	0.671	378.416	0.502
... is a waste of money	1.348	374	0.178
Using products after the best before date...			
... helps to reduce food scarcity	1.318	374	0.188
... makes a difference for the environment	0.531	374	0.596
I feel engaged with...			
... the environment	1.936	374	0.054
... food scarcity	2.018	374	0.044
It is important...			
... what others think of me	-1.344	374	0.180
... to behave like others	-1.051	374	0.294
I know campaigns	1.183	372.383	0.238
I feel supported by campaigns	1.496	374	0.136

Table 15 Statistics about differences between the group with a desirable approach and group with an undesirable approach regarding ways of determining edibility of different products after the best before date.

		X²	df	p-value			X²	df	p-value
Milk	Smell	1.747	1	0.186	Coffee	Smell	0.041	1	0.839
	Look	0.484	1	0.487		Look	0.013	1	0.908
	Taste	3.067	1	0.080		Taste	0.419	1	0.517
	Other*	.	.	0.061		Other	0.682	1	0.409
	Do not use	0.892	1	0.345		Do not use	0.008	1	0.930
Cheese	Smell	1.324	1	0.250	Chocolate	Smell	0.006	1	0.940
	Look	0.261	1	0.610		Look	0.037	1	0.848
	Taste	0.014	1	0.905		Taste	<0.0001	1	0.986
	Other*	.	.	1.000		Other	0.010	1	0.921
	Do not use	0.576	1	0.448		Do not use	0.463	1	0.496
Yoghurt	Smell	0.600	1	0.439	Juice	Smell	0.039	1	0.844
	Look	0.054	1	0.817		Look	1.552	1	0.213
	Taste	1.601	1	0.206		Taste	2.138	1	0.144
	Other*	.	.	1.000		Other*	.	.	1.000
	Do not use	0.021	1	0.884		Do not use	4.308	1	0.038
Butter	Smell	4.041	1	0.044	Potatoes	Smell	0.965	1	0.326
	Look	10.908	1	0.001		Look	4.580	1	0.032
	Taste	0.790	1	0.374		Taste	0.115	1	0.735
	Other	11.951	1	0.001		Other	0.840	1	0.359
	Do not use	7.975	1	0.005		Do not use	0.243	1	0.622
Eggs	Smell	3.715	1	0.054	Soda	Smell	0.215	1	0.643
	Look	<0.0001	1	0.989		Look	1.217	1	0.270
	Taste	4.118	1	0.042		Taste	1.830	1	0.176
	Other	0.072	1	0.788		Other	1.780	1	0.182
	Do not use	0.136	1	0.712		Do not use	5.517	1	0.019

* When cells have an expected count less than 5, the p-value of the Fisher's exact was used instead of a Chi-square test. The factors that were analyzed with a Fisher's exact test show the values for the Odds ratio.