

Less waste versus higher quality: how to stimulate consumer demand for frozen bread

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Abstract

Purpose – Bread waste is one of the largest contributors to the environmental footprint of supermarkets, mostly because of the short shelf life of fresh bread. This study examined a possible solution: offering frozen bread with a considerably longer shelf life. Professional freezing of bread can preserve its quality better than freezing at home. In introducing frozen bread, supermarkets can communicate either a high construal social benefit (food waste reduction) or a low construal personal benefit (product quality).

Design/methodology/approach – An online experiment ($n = 367$) with a three group between subjects design was used. Dutch participants saw an offering of frozen bread accompanied by (1) a communication message about food waste, (2) a communication message about product quality, or (3) no communication message (control condition).

Findings – In line with expectations, emphasizing food waste reduction influenced general attitudes toward frozen bread and the bakery department more strongly than the benefit of higher product quality, while the opposite was true for purchase intentions.

Practical implications – Retailers who include frozen bread in their assortment have to make a trade-off between especially stimulating consumer attitudes toward the bakery department by focusing on a food waste reduction message, or especially stimulating sales by focusing on a quality message.

Originality/value – This study provides new insights into the effects of benefit communication on attitudes and purchase intentions. The results show that these effects differ for attitudes and intentions, depending on the communication message.

Keywords Food waste, Bread, Freezing, Shelf life, Food losses

Paper type Research paper

1. Introduction

Food losses and food waste have become a worldwide concern and key barrier to sustainability (do Carmo Stangherlin and De Barcellos, 2018; Porpino, 2016; Stancu *et al.*, 2016; Xue *et al.*, 2017). As a result, the issue of food loss and waste has been progressively discussed in the food industry and retail (de Moraes *et al.*, 2020; Richter and Bokelmann, 2016; Rosenlund *et al.*, 2020). One of the products that is wasted in especially high amounts is bread, both at the consumer (Delley and Brunner, 2018; van Dooren *et al.*, 2019) and retailer stages (Brancoli *et al.*, 2019) and across many European countries (van Geffen *et al.*, 2017). In fact, bread waste is one of the largest contributors to the environmental footprint of supermarkets

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in Sweden (Brancoli *et al.*, 2017). In addition to environmental and economic costs, food waste also raises ethical and moral concerns (van Geffen *et al.*, 2020). While bread is wasted on a large scale, at the same time, people are suffering from malnutrition. The deputy director of the UN Food and Agriculture Organization has warned that “the UN will never reach its sustainable development goal of zero hunger by 2030 if food loss and waste continues unchecked” (Schlein, 2021).

Generally, shelf life has been mentioned as the factor that most influences the generation of food waste and food losses (Muriana, 2017). The shelf life of a product is the time until it becomes unacceptable for consumption. This is also the main cause in bread waste. The large waste of bread at the retail stage can be attributed to its extremely short shelf life (in the Netherlands mostly only one day; van Donselaar *et al.*, 2006). At the end of the day, unsold bread is wasted, returned to bakeries, or donated to charity (Cicatiello *et al.*, 2016; Lebersorger and Schneider, 2014). Drastically decreasing the amount of bread for sale is often not seen as a viable solution, as supermarkets fear negative consumer responses when products are out of stock (Ku *et al.*, 2017). Therefore, other solutions to reduce bread losses have been examined, primarily focusing on the production process (Goryńska-Goldmann *et al.*, 2021). The current study examined a different solution: extending the shelf life of bread loaves by offering them in a frozen state. Frozen bread has two distinct advantages: it extends the shelf-life of the bread, which decreases in-store bread waste (Mena *et al.*, 2011) and professional freezing of bread shortly after baking allows for a good preservation of the bread and high quality and taste compared to freezing at home (Amit *et al.*, 2017).

From a consumer perspective, there are thus two distinct advantages of buying frozen bread: its contribution to lower food waste and its relatively high quality compared to when consumers freeze the product at home under less optimal conditions. These advantages can be used in advertising communications with consumers. However, although communication with consumers about business activities to reduce food waste is important, food companies have been reluctant to do so. The reluctance of food retailers to communicate about the issue of food waste appears based on reputation management and a fear for negative associations. Based on in-depth interviews with managers, it appears that food retailers do not want to focus on an undesired problem of affluent societies and do not want to make public any weakness in logistical management (Hermisdorf *et al.*, 2017; Holweg *et al.*, 2016). As a result little is known about the (relative) effectiveness of communicating about food waste reduction activities (Richter and Bokelmann, 2016). Yet, such communication to consumers is essential when waste reduction activities affect the product assortment, such as in the current situation of the introduction of a new type of product (frozen bread).

Prior research that involves the promotion of products that can reduce food waste has mainly focused on suboptimal food products (Aschemann-Witzel *et al.*, 2018). For these products, communication centres on food waste reduction, as the products are not of higher quality than regular products. Yet, as technology advances and valorization of waste streams becomes more sophisticated, innovative products are likely to come on the market that both diminish food waste in the supply chain and have quality advantages compared to regular products. For these products, the research question of whether to focus on waste reduction or on quality in communication with consumers becomes highly relevant. Our study aims to provide insights on this topic by comparing communication regarding waste reduction versus product quality in the case of frozen bread. Retailers could emphasize either of these advantages in their communication surrounding the introduction of frozen bread into the assortment. These two advantages focus on either the *societal* benefits or the *personal* benefits of the product, which could have different effects on consumer attitudes toward the product and the bakery department, and on purchase intentions. The objective of this study is to examine how communication messages emphasizing either societal or personal benefits of

the introduction of frozen bread affect consumers' attitudes and purchase intentions. We will test this in an online experiment among Dutch participants.

2. Food waste at retail level

Food retailers play an important role in both causing food waste and implementing potential solutions to reduce it (Aschemann-Witzel *et al.*, 2016; Devin and Richards, 2018). Consequently, there is societal pressure for retailers to take responsibility beyond their bottom line (Pulker *et al.*, 2018). In response to this societal pressure, retailers have taken a variety of activities to diminish food waste (Kulikovskaja and Aschemann-Witzel, 2017). Retailers may feel reluctant to communicate widely about several such activities to consumers, because they fear that it might involve negative associations (Hermsdorf *et al.*, 2017; Holweg *et al.*, 2016). Yet, when food waste reduction activities involve the promotion of waste-reducing products in the assortment, communication with consumers becomes essential.

A large stream of literature has focused on consumers' willingness to purchase suboptimal food products to avoid waste (Aschemann-Witzel *et al.*, 2018; De Hooge *et al.*, 2017). Suboptimal foods deviate from regular or optimal products because these are close to expiration, have aesthetic flaws, or have damaged packaging (do Carmo Stangherlin *et al.*, 2019). To compensate for this lower level of (perceived) quality, suboptimal foods are often offered at a reduced price (Aschemann-Witzel *et al.*, 2017, 2018). Research has concluded that communicating about food waste avoidance heightens the acceptance of suboptimal foods, and can decrease the perceived gap in quality compared to regular foods (Aschemann-Witzel *et al.*, 2018). Follow-up studies have furthermore shown that communications about budget saving and emotional appeals both can effectively increase the purchase likelihood for suboptimal foods (Aschemann-Witzel *et al.*, 2019). This shows the effectiveness of communication about food waste. Yet, the communication messages that are examined either focus on sustainability or on a compensation for lower quality. For instance, personal benefits of buying suboptimal foods are related to their reduced price (Aschemann-Witzel *et al.*, 2017), as product quality of suboptimal foods is (perceived as) lower than that of regular foods. Communication of quality and quality-related product aspects for waste-reducing suboptimal foods has thus received no research attention, with a single exception of the study by van Giessen and De Hooge (2019). They show that an authenticity positioning, in which communication surrounding suboptimal foods focuses on the authenticity of these products, can increase quality perceptions. This is a first indication that quality-related communication may be successful in the promotion of waste-reducing products.

Yet, quality-related communications are relevant much more broadly for waste-reducing products outside of the specific scope of suboptimal foods. For instance, food waste valorization opportunities exist in different food industries, which can lead to innovative new products or be used to fortify foods (Galanakis, 2020). So-called upcycled foods, in which ingredients are used that are generally discarded (Zhang *et al.*, 2021) can help to reduce food waste. Although initial investigations point out a large market potential for such products, little is known about how to best promote the purchase of such products (Bhatt *et al.*, 2018; Zhang *et al.*, 2021). Our study looks at a related case, in which technology is used to increase the shelf-life of products. Here the same question arises how to best communicate about waste-reducing new products in the assortment of a retailer.

3. Bread waste

The contribution of cereals, including bread, to total food waste is substantial. Regarding carbon footprint, 34% of the carbon footprint of food waste comes from cereals (FAO, 2013).

The high amount of bread waste produced can be attributed to its short shelf life and to the staling process (Fadda *et al.*, 2014; Taglieri *et al.*, 2021). Consequently, fresh bread is wasted in large amounts at the retail level (Cicatiello *et al.*, 2016; Brancoli *et al.*, 2019), with huge consequences. Specifically, the life cycle assessment of Brancoli *et al.* (2017) in Sweden showed that bread waste has the largest contribution to the total mass of waste and to the economic costs incurred by the supermarket, as well as the largest contribution to ozone depletion, freshwater ecotoxicity and resource depletion.

Food preservation through freezing can greatly affect the amount of food lost or wasted. Prior research in Austria has indicated that food waste in households can be reduced six-fold when frozen foods are compared to fresh foods (Martindale and Schiebel, 2017). Freezing can also significantly reduce bread waste in supermarkets. Freshly baked bread can be professionally frozen immediately after cooling, which allows supermarkets to keep the bread on the shelves for much longer than a single day. As limited shelf life is a major factor contributing to food loss and waste, offering frozen bread will decrease in-store food waste due to the extended shelf life (Mena *et al.*, 2011). Supermarkets can sell both fresh and frozen bread, and decrease the amount of fresh bread in the assortment each day as they now offer an alternative. Consumers may adjust to this situation relatively easily. Consumers in the Netherlands have been shown to accept that not all bread options are available at the end of the day and are generally willing to purchase a different type of bread if their preferred alternative is unavailable (van Woensel *et al.*, 2007).

Another benefit of offering frozen bread is that it can increase the perceived product quality for consumers. In various countries, many consumers freeze bread at home directly after purchase (Martindale and Schiebel, 2017; Østergaard and Hanssen, 2018), with seven out of ten Dutch consumers doing so (NOS, 2015). This implies that people are used to consuming bread that has been frozen. Compared to freezing fresh bread at home, professional freezing of bread in-store shortly after baking allows the use of sophisticated and optimal freezing techniques (Amit *et al.*, 2017). This would preserve the freshness of the bread and increase its quality and taste.

4. Communication of societal versus personal benefits

Supermarkets can communicate the introduction of frozen bread on the one hand as a socially responsible activity, to reduce food waste and its environmental impact, and on the other hand as a way to better serve their customers, with frozen bread of high quality. Both of these communication messages are likely to have a positive influence on attitudes and purchase intentions compared to the “neutral” introduction of frozen bread as a new product (i.e. without mentioning its benefits). However, the strengths of the effects on attitudes and purchase intentions may differ between the two communication approaches.

To understand the implications of these different communication approaches, we take the perspective of construal level theory (for a recent literature review of research on construal level theory see Adler and Sarstedt, 2021). According to construal level theory, people think more abstractly about events that are temporally, spatially, and/or socially more distant, and they think more concretely about closer events (Trope and Liberman, 2010). This difference in psychological distance has a profound effect on consumer evaluations and decision making (Dhar and Kim, 2007; Fiedler, 2007).

A communication message that focuses on food waste reduction relates to events associated with high-level construal, such as environmental problems and climate change (Carmi and Kimhi, 2015; Reczek *et al.*, 2018; Spence *et al.*, 2012). By contrast, a communication message that focuses on product quality would result in a more concrete low-level construal, as it relates to direct personal benefits. Prior research has indicated that general attitudes are influenced more by abstract (high-level) messages than by concrete (low-level) messages

(Fujita *et al.*, 2008). This is in line with research showing a positive effect of firms' CSR (corporate social responsible) activities on consumers' attitudes toward these firms (Mohr and Webb, 2005; Xie *et al.*, 2019). Thus, the general attitude toward frozen bread and toward the bakery department of a supermarket may be more strongly affected by abstract communication about food waste than by more concrete communication about product quality.

The effects on purchase intentions may not mirror the effects on attitudes. Concrete intentions to purchase a product may be more strongly influenced by concrete and personal benefits (low construal level). When deliberating on a food purchase, product quality (taste) is an especially important feature for consumers (Brečić, *et al.*, 2017; Sansone *et al.*, 2020). Therefore, when considering a concrete product purchase, consumers may weigh food quality more heavily than environmental benefits. Thus, although both communication messages should increase purchase intentions, communication about product quality should have a relatively strong effect on purchase intentions compared to a message about reduced food waste, when making a concrete decision about whether to purchase a product.

In addition to the effects of the communication messages, the purchase of novel frozen bread is likely to be influenced by the availability of substitute products (i.e. fresh bread). Consumers in the Netherlands generally tend to buy another bread product when their preferred bread is not available (instead of postponing the purchase or visiting another store), and this willingness to substitute for another bread is higher when consumers shop later in the day (van Woensel *et al.*, 2007). Over the course of the day, the availability of bread decreases and the willingness to switch to alternative types of bread increases. Consumers coming later in the day realize and accept that a substantial number of bread products will be sold. These consumers are more willing to buy a substitute for their preferred bread when the latter is unavailable, and we assume that this also holds true for substitution with frozen bread. Thus, we expect that the purchase likelihood for frozen bread will be higher for consumers coming late in the day when many bread products are no longer available, than for consumers coming in the morning when fresh loafs of bread are readily available.

We tested our expectations through an online experiment, in which participants were exposed to a communication message about frozen bread. In this experiment, we compared both communication messages to each other, and to a control condition in which the new offering of frozen bread is merely mentioned without emphasizing a benefit.

5. Method

Participants. Participants were recruited through social media, including the social media of a local supermarket, through an e-mail list of potential participants obtained from prior studies at Wageningen University (i.e. people who participated in other studies before), and through the survey-exchange platform Surveyswap (a platform used primarily by students and academics to exchange study participation). The participants were Dutch purchasers of supermarket bread. A total of 477 participants started in the study. Of these, 68 did not complete the entire study and 41 did not meet the inclusion criteria (i.e. they never purchased supermarket bread). Moreover, one participant was removed from the dataset because he finished very quickly (in less than a minute). This left 367 participants in the final dataset (25.1% male, 74.4% female, 0.5% other sex; age ranging from 17 to 83 years with $M_{age} = 38$).

Design. Participants were randomly allocated to a condition in a three-group between-subjects design, in which the offering of frozen bread was accompanied by (1) a communication message about food waste, (2) a communication about product quality, or (3) no communication message (control condition).

Stimuli. Participants received an introductory text stating that a supermarket had started selling frozen bread. The new product introduction was described as (1) diminishing in-store

bread waste, by explaining that leftover fresh bread is wasted at the end of the day and that offering frozen bread can allow the supermarket to have fewer fresh breads in stock and thus lead to less waste, (2) increasing bread quality for consumers, by explaining that the bread is freshly frozen immediately after baking and therefore retains a better quality, or (3) new products in the assortment, without any further explanation about the reason for their introduction (for full manipulation texts, see [Appendix 1](#)). In all conditions, it was indicated that the frozen bread was sold for the same price as the regular bread. The text was accompanied by a picture of a leaflet in which this message was also incorporated (for leaflets see [Appendix 2](#)). This leaflet was based on the actual in-store communication of a single supermarket store that started selling frozen bread around the time this study was conducted. In addition to the main communication message that differed between conditions, in all conditions this leaflet pictured the six types of frozen bread that were available.

Procedure. The study was administered online, and data were collected in February 2020 among Dutch participants. This study complied with the standards of the Social Sciences Ethics Committee of Wageningen University. Participants were asked for informed consent. After a short introduction to the study, they received two questions related to the inclusion criteria (speaking Dutch and purchasing supermarket bread). Next, they were asked whether they sometimes freeze bread in the household and the amount of bread waste in the past week, as background questions. The participants subsequently saw the stimulus material of one of the three conditions, and were asked about their attitude toward frozen bread, attitude toward the bakery department of the supermarket, and purchase intention of frozen bread. Purchase intention was asked for two scenarios: a situation in which there is sufficient fresh bread available in the supermarket, and a situation in which the fresh bread is almost sold out.

A few questions were added at the end of the study about product attributes that would make the purchase of frozen bread more likely and general impressions of (frozen and unfrozen) bread, which were relevant for the supermarket but are not reported here. Two manipulation checks were also included, in which participants rated their agreement on 7-point scales (disagree very much – agree very much) on the items “frozen bread from the supermarket appears to me to have a fresher quality than regular bread” and “by purchasing frozen bread I contribute to diminishing food waste”. Finally, participants reported their sex and age. As a reward for participation, they could enter the lottery of a 25 Euro gift certificate.

Measures. Attitude toward frozen bread was assessed using five items on a 7-point semantic differential scale (bad/good, unfavourable/favourable, negative/positive, boring/interesting and unattractive/attractive; $\alpha = 0.93$). We measured this for the frozen bread in the supermarket that participants had read information about. Next, we asked participants to imagine that their own supermarket would sell this frozen bread, and asked what their attitude towards the bakery department would be. Attitude toward the bakery department was assessed using five items on a 7-point semantic differential scale (bad/good, unfavourable/favourable, unsatisfactory/satisfactory, negative/positive and disliked/liked; $\alpha = 0.97$). Both attitude measures were constructed in line with those used in prior research ([Bruner, 2016](#)).

Purchase intention for frozen bread was measured in two situations. The first is described as: “At the beginning of the afternoon you are doing groceries in a supermarket. You are looking for bread. The normal bread is still sufficiently available, because it is still early on in the day and not much bread has been sold yet.” The second situation is described as: “Near the end of the evening you are doing groceries in a supermarket. You are looking for bread. The normal bread is not sufficiently available anymore, because it is already late in the day and much of the bread has been sold already.” Purchase intention for frozen bread was measured for both situations, using a 7-point likelihood to purchase scale ranging from “very unlikely” to “very likely”.

For the background questions, the frequency of freezing bread was measured in four categories (never, sometimes, often, and always). The quantity of bread waste in the past week was measured on a 5-point scale (less than one slice; one or several slices; approximately half a loaf; approximately one whole loaf; more than one loaf; cf. WRAP, 2011; van Herpen *et al.*, 2019). Full question texts are included in [Appendix 2](#).

Analysis plan. Analyses were performed using SPSS version 25. We first described the sample using the demographics and background information that we collected. Differences between conditions regarding the manipulation checks and attitudes were analyzed using ANOVAs with posthoc tests (LSD). We also calculated correlations between attitudes and purchase intentions. Purchase intentions were analyzed using a repeated measures ANOVA with situation sketch as a within-subjects variable. Furthermore, to assess potential effects of demographics and other differences in household food management, we explored whether these variables affected attitudes and purchase intentions using a regression analysis. The variables that we used in these exploratory analyses were the frequency of freezing bread, the quantity of bread waste in the past week, gender (dummy coded) and age. Experimental condition was included as two dummy variables in these regressions, and we checked that significant results obtained for effects of the conditions remained significant after controlling for the demographic and food management variables.

6. Results

Background questions: Only 8.4% of participants indicated that they never freeze bread, 46.0% indicated that they always freeze bread, and 27.2% indicated that they regularly do so. Thus, for the majority of participants, frozen bread should be very relevant, as they would freeze the bread at home anyways. When asked about bread waste in the past week, most participants indicated that they wasted little: less than a slice (59.4%), or one/a few slices (32.4%). Thus, saving a loaf of bread at the supermarket level is likely to diminish food waste overall (i.e. customers are unlikely to waste all of the half loaf).

Manipulation checks: As expected, quality communication increased quality perceptions ($M = 3.95$), which were significantly higher than in both the waste communication condition ($M = 3.41, p = 0.004$) and the control condition ($M = 3.14, p < 0.001$) ($F(2, 364) = 9.78, p < 0.001, \eta_p^2 = 0.05$), while the latter two conditions did not significantly differ from each other. Moreover, the waste communication message successfully boosted participants' perception that purchasing frozen bread contributes to diminishing food waste ($M = 5.02$), which was significantly higher than in both the quality communication condition ($M = 4.43, p = 0.015$) and the control condition ($M = 4.10, p < 0.001$) ($F(2, 364) = 7.66, p = 0.001, \eta_p^2 = 0.04$); the latter two conditions did not significantly differ from each other. Thus, the communication manipulation was successful.

Attitudes: Correlations between attitude toward frozen bread, attitude toward the bakery department, and both purchase intentions, showed that these constructs were all positively correlated (all $ps < 0.001$). The correlation between attitude toward frozen bread and attitude toward the bakery department was the highest ($r = 0.85$). Correlations between attitudes and purchase intentions ranged between $r = 0.36$ and $r = 0.58$. Despite these positive correlations, the effect of communication messages on attitudes and purchase intentions was not the same. [Table 1](#) lists means and standard deviations of the dependent variables.

Attitudes toward frozen bread and toward the bakery department significantly differed between conditions ($F(2, 364) = 9.66, p < 0.001, \eta_p^2 = 0.05$ and $F(2, 364) = 9.84, p < 0.001, \eta_p^2 = 0.05$, respectively). Posthoc tests using LSD comparisons showed that attitudes were highest in the waste communication condition, lower in the quality communication condition, and lowest in the control condition (see [Table 1](#) for details). Thus, both communication about

waste and about quality increased attitudes compared to control, and this increase was highest when diminished food waste was communicated.

Purchase intention. For purchase intention, the pattern of results differed from that for attitudes. A repeated measures ANOVA with situation sketch as a within-subjects variable, showed that purchase intentions significantly differed between the two situations ($F(1, 364) = 584.01, p < 0.001, \eta_p^2 = 0.62$). Participants were far more likely to buy frozen bread when the alternative (i.e. fresh bread) was not available than when fresh bread was available. Additionally, there was a significant main effect of condition ($F(1, 364) = 5.40, p = 0.005, \eta_p^2 = 0.03$) and a significant interaction between situation and condition ($F(1, 364) = 5.03, p = 0.007, \eta_p^2 = 0.03$), which indicates that the effects of the communication messages differ depending on the situation. As shown in Table 1, purchase intentions were high and did not depend on communication when the alternative product was less available. Thus, participants were generally likely to purchase frozen bread when alternatives were less available.

As evidenced by the significant interaction, the pattern of results was different for the situation in which fresh bread was available. In this situation, participants indicated a significantly higher intention to buy it in the quality condition than in the other two conditions, and the waste condition did not differ significantly from the control condition. In other words, only quality communication was persuasive in promoting purchase likelihood compared with the control condition, whereas food waste communication did not increase purchase likelihood compared with control.

Exploration of the effects of demographics and differences in food management: Using regression analyses, we explored the effects of demographics (gender and age) and food management (whether bread is frozen at home and amount of bread waste in the past week) on attitudes and purchase intentions. Dummies for the experimental conditions were included in these analyses and the reported significant differences between conditions remained significant after including the demographic and food management variables.

Results for age and freezing of bread at home were consistent across these regression analyses using the two attitudes measures and the two purchase intentions as dependent variables. For both attitudes and for both purchase intentions, we found significant negative effects of age (β s between -0.12 and $-0.29, t$ s $> 2.35, p$ s < 0.02). This implies that older participants had a less positive attitude and purchase intentions towards frozen bread. For both attitudes and both purchase intentions, we also found a significant positive effect of freezing bread at home (β s between 0.16 and $0.24, t$ s $> 3.05, p$ s < 0.002). This implies that participants who freeze bread at home had a more positive attitude and purchase intention towards frozen bread. The only additional significant effect was an effect of gender on the purchase intention in the situation that fresh bread was available ($\beta = -0.11, t = -2.04, p = 0.042$), with woman having a lower purchase intention than men.

	Control condition (<i>n</i> = 126)	Waste condition (<i>n</i> = 121)	Quality condition (<i>n</i> = 120)
Attitude towards frozen bread	4.58 (1.44) ^a	5.36 (1.35) ^b	4.97 (1.39) ^c
Attitude towards bakery department	4.75 (1.55) ^a	5.58 (1.36) ^b	5.20 (1.50) ^c
Purchase intention, alternatives available	2.31 (1.63) ^a	2.59 (1.82) ^a	3.32 (1.96) ^b
Purchase intention, alternatives not available	5.16 (1.84) ^a	5.12 (1.92) ^a	5.37 (1.79) ^a

Note(s): Means with standard deviations provided between brackets. Means with the different superscripts differ significantly from each other in the posthoc analyses

Table 1.
Attitudes and purchase
intentions for
frozen bread

7. Discussion

The current study provides new insights into an under-researched topic: the effects of differently framed communication messages about waste-reducing product introductions. As innovative products are coming on the market that combine waste reduction with high quality, which of these benefits to emphasize becomes an important question. Our study has shown that different communication messages for frozen bread have distinct effects on attitudes and purchase intentions. Although both communication about waste reduction and product quality increase attitudes toward frozen bread compared to the control, attitudes are highest when frozen bread is presented as reducing supermarket bread waste. However, this does not imply that purchase intentions are highest as well. In fact, purchase intentions strongly depend on the availability of alternative products, and, most strikingly, when alternatives are available purchase intentions are highest when frozen bread is communicated as having a high quality. Communicating diminished food waste does not affect purchase intentions compared with the control condition.

These results are in line with construal level theory (Carmi and Kimhi, 2015; Spence *et al.*, 2012), in that abstract attitudes are most influenced by communication about societal benefits, whereas concrete purchase intentions are most influenced by communication about product quality. They are also in line with prior research indicating that consumers (especially certain segments) generally have positive attitudes toward sustainable and green initiatives (Verain *et al.*, 2016), and with research showing that quality considerations are of relatively high importance in consumer purchase decisions (Markovina *et al.*, 2015).

Our findings indicate that freshness remains an important product attribute: consumers are far less likely to purchase frozen bread when fresh bread is available than when it is not, even though the majority of them would freeze the bread at home. The finding that consumers are more likely to purchase frozen bread when alternatives are not available provides opportunities for retailers. Prior research has found that consumers in the Netherlands generally accept that not all bread options are available at the end of a day (van Woensel *et al.*, 2007). This implies that retailers could diminish the availability of fresh bread at the end of the day, without having to worry about consumer dissatisfaction, as long as alternatives (i.e. frozen bread) remain available.

Supermarkets who plan to offer frozen bread need to carefully consider what their aim is, as this will inform their decision on how to communicate with consumers. When supermarkets aim to increase their store image and obtain a higher consumer *attitude* toward the bakery department, they can best emphasize that frozen bread reduces supermarket bread waste. However, when supermarkets primarily aim to increase *sales* of frozen bread, the current findings recommend that they emphasize the product quality.

Supermarkets can also target specific consumers who are more likely to purchase frozen bread. Our exploratory analyses indicate that younger consumers and consumers who are used to freezing their bread at home have more positive attitudes and purchase intentions towards frozen bread. Still, not all consumers who freeze bread at home may be equally inclined to purchase frozen bread in the store. In addition to buying fresh loafs of bread out of habit, their preference for a specific type or size of bread may be more influential in the purchase decision than whether it is frozen or not. Moreover, the transport of frozen bread from the store to the home may be less convenient for some consumers than the transport of fresh bread. Future research could examine these potential barriers to the purchase of frozen bread, to gain insights into their relative importance.

Our study also has implications for the broader food industry, and may help to stimulate discussions among members of the supply system, regarding actions around food storage and food waste globally. Policy makers and leading institutions can facilitate communication, not only between all members of the food supply system, but also between the supply system and consumers (Richter and Bokelmann, 2016). Calling attention to business activities to

diminish food losses and waste, and to communicate about the issue of food losses and waste in general, can change consumers' attitudes toward a company, but in addition, may change consumer perceptions of the importance of this issue. Future research could explore the way in which food waste reduction can be communicated to consumers, so that it not only affects their attitude toward the food retailer (as in the current study) but also their own treatment of food in the household. To the extent that convincing communications in the retail setting can increase consumer concern for food waste, this could change their waste-prevention routines (Le Borgne *et al.*, 2021).

The current study has several limitations that may inspire further research. First, it used an online questionnaire and convenience sampling. Future research should generalize the findings to more realistic situations (i.e. actual purchases) and for a representative sample. Second, we examined the influence of two distinct messages – food waste and product quality – to clearly distinguish their effects. Future research may consider combining these messages, as this could potentially lead to an increase in both attitudes toward the store and purchase intentions, although there is also the possibility that a combined message leads to confusion or dilutes the strength of the effects.

The current study focused on the introduction of frozen bread into the assortment, and more research is needed to understand its longitudinal effects and repeat purchase decisions. As consumers become more accustomed to stores offering bread in frozen form, they may become more inclined to buy it. Future research could also explore the effect of purchasing frozen bread on how consumers treat it at home. Are they more likely to freeze the bread themselves? Prior research in the Netherlands has shown that frozen foods are wasted to a (much) lower extent than their fresh alternatives (Janssen *et al.*, 2017). Thus, if offering frozen bread in a store increases freezing at home, this would imply that food waste is reduced in both stages.

In conclusion, this study illustrated that communicating a message about food waste reduction increases attitudes toward the product and department, but not purchase intentions. A message about product quality, in contrast, has less effect on consumer attitudes, but is able to increase purchase intentions. The type of communication message that supermarkets can best use thus depends on the goal they are trying to reach (i.e. increased attitudes or increased sales). To obtain actual behavioral change, messages centered on product quality appear to be the most effective.

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Appendix 1

Study materials

A1. Manipulation texts (translated from Dutch)

Control condition:

As the first supermarket in the Netherlands, Jumbo Wageningen Verberne has started to sell frozen bread. These are half loafs that are sold in frozen condition for the same price as the regular fresh version.

The leaflet below is offered at the bakery department of Jumbo Wageningen Verberne to announce this new concept.

Quality condition:

As the first supermarket in the Netherlands, Jumbo Wageningen Verberne has started to sell frozen bread. These are half loafs that are sold in frozen condition for the same price as the regular fresh version.

With the introduction of this frozen bread, Jumbo Wageningen Verberne aims to increase the fresh quality of bread for its customers. Extremely honest frozen bread is frozen directly after baking in the bakery, and stays fresher when the customer freezes and defrosts at home.

The leaflet below is offered at the bakery department of Jumbo Wageningen Verberne to announce this new concept.

Waste condition:

As the first supermarket in the Netherlands, Jumbo Wageningen Verberne has started to sell frozen bread. These are half loafs that are sold in frozen condition for the same price as the regular fresh version.

With the introduction of this frozen bread, Jumbo Wageningen Verberne aims to diminish food waste. Because customers want fresh bread at the end of the day, supermarkets now have fresh bread in stock during the whole day. The consequence: bread that is not sold at the end of the day. By having frozen bread in stock, the customer has an alternative when the fresh bread is sold out. The supermarket can stock fewer fresh breads and waste less.

The leaflet below is offered at the bakery department of Jumbo Wageningen Verberne to announce this new concept.

NIEUW

INGEVROREN BROOD

Jumbo Wageningen Verberne introduceert
Goud Eerlijk Vers ingevroren brood.

**GOUD
EERLIJK**

VERS INGEVROREN



 **WIT**

 **BRUIN**

 **WIT
SPELT**

 **FIJN
VOLHOREN**

 **VOLHOREN
MEERGRANEN**

 **GROF
VOLHOREN**

Verkrijgbaar in de vriezer op de broodafdeling.

JUMBO

Note(s): Top line is “New. Frozen bread. Jumbo Wageningen Verberne introduces Extremely Honest Freshly frozen bread”. Slogan text is “Extremely Honest. Freshly frozen”. Final line is “Available in the freezer of the bakery department”

NIEUW

VERS INGEVROREN BROOD

Jumbo Wageningen Verberne introduceert **Goud Eerlijk Vers ingevroren**. Het brood wordt direct na bakken ingevroren waardoor het verser blijft als u het na aankoop thuis invriest.

GOUD EERLIJK
VERS INGEVROREN

WIT

BRUIN

WIT SPELT

FIJN VOLHOREN

VOLHOREN MEERGRANEN

GROF VOLHOREN

Blijft verser als u het invriest.

JUMBO

Note(s): Caption text is “New. Freshly Frozen Bread. Jumbo Wageningen Verberne introduces Extremely Honest Freshly frozen bread. The bread is frozen directly after baking, so that it maintains fresher when you freeze it at home after purchase”. Slogan text is “Extremely Honest. Freshly frozen”. Final line is “Remains fresher when you freeze it”

Samen MINDER

VERSPILEN

Jumbo Wageningen Verberne introduceert **Goud Eerlijk Vers ingevroren**. Want met vers ingevroren brood en een kleinere voorraad dagvers brood blijft er minder over.

GOUD EERLIJK

VERS INGEVROREN

WIT

BRUIN

WIT SPELT

FIJN VOLHOREN

VOLHOREN MEERGRANEN

GROF VOLHOREN

Zo wordt er minder verspild.

JUMBO

Note(s): Caption text is “Waste less together. Jumbo Wageningen Verberne introduces Extremely Honest Freshly frozen bread. Because with freshly frozen bread and a small supply of day fresh bread less is left”. Slogan text is “Extremely Honest. Freshly frozen”. Final line is “This way less is wasted”

Appendix 2

Question formulation (translated from Dutch)

Background questions on food management:

Do you ever freeze bread at home?

- (1) No, never
- (2) Yes, sometimes
- (3) Yes, often
- (4) Yes, always

In your household, how much bread has been thrown out in the past week?

A (current) bun, portion of baguette or bread roll equals one slice.

- (1) Less than one slice
- (2) One or several slices
- (3) Approximately half a loaf
- (4) Approximately one whole loaf
- (5) More than one loaf

Dependent variables

After studying the previous information, what is your general impression of the frozen bread in the assortment of the Jumbo Wageningen Verberne?

Bad	o	o	o	o	o	o	o	Good
Unfavourable	o	o	o	o	o	o	o	Favourable
Negative	o	o	o	o	o	o	o	Positive
Boring	o	o	o	o	o	o	o	Interesting
Unattractive	o	o	o	o	o	o	o	Attractive

Imagine that the supermarket where you buy bread most often would also take up this frozen bread in the assortment, what would be your general impression of the bakery department?

My general impression of the bakery department of the supermarket, after the addition of frozen bread, is:

Bad	o	o	o	o	o	o	o	Good
Unfavourable	o	o	o	o	o	o	o	Favourable
Unsatisfactory	o	o	o	o	o	o	o	Satisfactory
Negative	o	o	o	o	o	o	o	Positive
Disliked	o	o	o	o	o	o	o	Liked

For the next questions two situations will be outlined that can occur, given that you are buying bread in a supermarket with frozen bread in the assortment.

The first situation is as follows: At the beginning of the afternoon you are doing groceries in a supermarket. You are looking for bread. The normal bread is still sufficiently available, because it is still early on in the day and not much bread has been sold yet.

How likely is it that you will choose frozen bread in this situation?

Very unlikely	o	o	o	o	o	o	o	Very likely
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The second situation is as follows: Near the end of the evening you are doing groceries in a supermarket. You are looking for bread. The normal bread is not sufficiently available anymore, because it is already late in the day and much of the bread has been sold already.
How likely is it that you will choose frozen bread in this situation?

Very unlikely	o	o	o	o	o	o	o	Very likely
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