



Refresh

The effects of on-pack storage and consumption guidance on consumer food waste behaviours



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Authors

Barbara Leach, Magenta Research & Evaluation
Roisin O'Brien, WRAP

With contributions from:

Erica van Herpen (Wageningen University) and Kate Bygrave (WRAP)

Hilke Bos-Brouwers (Wageningen Food & Biobased Research), Hans van Trijp (Wageningen University)

Saskia Meyboom, Sandra van der Haar (Wageningen Food & Biobased Research)

Raquel Diaz Ruiz (Universitat Politècnica de Catalunya), Carina Diedrich (Collaborating Centre on Sustainable Consumption and Production), Mariska Nijenhuis-de Vries (Wageningen Food & Biobased Research) Daniëlla Stijnen (Wageningen Food & Biobased Research), Katalin Újhelyi (Hungarian Foodbank Association)

Ffion Batcup, Sue Baughan, Amanda Gadd, Billy Harris, Andrew Parry, Jade Rakela, David Rogers, Tom Quested, Nathan Simmonds, Linda Twamley (WRAP)

Bence Csákváry (Student of Wageningen University)

Project coordination and editing provided by WRAP

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1 Executive Summary

1.1 Introduction

The nature, content, and format of on-pack guidance is thought to play a role in food waste generation, and therefore potentially in food waste prevention. The main objective of this study was to examine the effects on consumers of different contents and formats of guidance on food and drink packaging, using large-scale experiments.

This project is part of REFRESH, an EU H2020 funded research project taking action against food waste. Twenty-six partners from 12 European countries and China are working towards the project's aim of contributing towards Sustainable Development Goal 12.3 of halving per capita food waste at the retail and consumer level and reducing food losses along production and supply chains.

1.2 Scope

Two types of on-pack information have been tested – date labelling and storage advice – forming two experiments in which participants took part.

A range of date label formats and storage guidance formats were tested on a range of products on which they might realistically appear. Two label formats were tested – a sticker-effect and non-sticker-effect label. The product types and labels are shown in Table 1 and Table 2.

Table 1: Products and date marks selected for testing – date labelling

Product	Date marks	Type of label and date format
Yoghurt	Use By	Non-sticker-effect
		Non-sticker-effect
Orange juice	Best Before	Sticker-effect
		Sticker-effect plus day of the week
Pre-packaged carrots	No date	Non-sticker-effect
	Display Until	Non-sticker-effect
Bagged oranges	Best Before	Non-sticker-effect
		Sticker-effect

Table 2: Products on pack guidance selected for testing – storage guidance

Product	Guidance	Type of label
Pre-packaged carrots Bagged oranges	No storage guidance	Non-sticker-effect label
	For best quality store in the fridge	Non-sticker-effect label
	Keep me in the fridge	Sticker-effect label
Bread	Store in a cool, dry place	Non-sticker-effect label
	For best quality do NOT store in fridge	Non-sticker-effect label
	Do NOT store in fridge	Sticker-effect label
Chicken portions Loaf of bread	No guidance	Non-sticker-effect
	Freeze by date	Non-sticker-effect
	Freeze on day of purchase	Non-sticker-effect
Chicken portions	Suitable for freezing by date	Sticker-effect

The hypothesis was that for each product type there would be a relationship between the labels shown and (i) claimed intended behaviour; and (ii) its perceived helpfulness, with some labels being more likely to be considered useful and to encourage behaviours that promote food waste prevention than others.

1.3 Method

A viral survey was circulated by project partners in Germany, Hungary, the Netherlands and Spain between 11 and 31 July 2017. Participants were shown either three or four labels for each product type and asked about how they would act (their intended behaviour) in response to the guidance shown. They were also asked to rate the helpfulness of the guidance.

After data cleansing had removed largely incomplete responses, 611 completed surveys were achieved in Germany, 1,244 in Hungary, 1,114 in the Netherlands and 544 in Spain. The data were then pooled and analysed as a single dataset with no weighting applied. Statistical tests were conducted to determine whether there were any differences between responses by label content and label format.

1.4 Headline results: Date labelling

Research question 1: Do consumers respond in the way intended by the date label?

Participants generally responded in the intended way to Best Before dates (70% for yoghurt, 82% for orange juice, 74% for pre-packaged carrots and 69% for bagged oranges); however, for yoghurt a sizeable minority (30%) would be more cautious, eating only up until the end of the date on the packaging, in effect treating it as a Use By date. This effect was present for the other products tested but less pronounced (16% for orange juice, 12% for pre-packaged carrots and 9% for bagged oranges).

Most participants did not respond as intended to Display Until dates (13.5% would pay them no attention for carrots and 23% for oranges), with a small minority (12% for carrots and 8% for oranges) treating them like Use By dates and only eating up until the date. Similarly, most participants did not respond as intended to Use By dates, using their senses to determine whether the products tested were good to eat rather than strictly complying with the date (78% for yoghurt and 71% for orange juice).

Research question 2: Do consumers respond to different date labels differently?

Participants' responses to the three different types of date label were similar, suggesting either that there is widespread confusion or that the dates are unimportant in consumers' decision-making processes. Most would behave the same way in response to a Best Before date as a Use By date (81% for yoghurt and 73% for orange juice) and most made the same choice for Display Until as Best Before (76% for pre-packaged carrots and 78% for bagged oranges).

Research question 3: Do consumers respond differently to sticker-effect labels?

The evidence is mixed. The sticker-effect label on yoghurt resulted in more appropriate behaviour compared with a non-sticker-effect label (77% compared with 70%; tested using the Wilcoxon signed rank test and significant at $p < .001$). However, no effect was found for orange juice, pre-packaged carrots or bagged oranges.

Research question 4: Does adding the day of the week to a Best Before label make any difference?

No evidence was found that adding day of the week to a Best Before label increased effectiveness. However, the artificiality of the test environment may have contributed to this result so despite the lack of evidence from this study the approach is worth testing in a real-world setting.

Research question 5: Do consumers find some date labels more helpful than others?

Some fresh products do not legally require a date label. For these (pre-packaged carrots and bagged oranges in this study) participants were asked to rate an empty label as well as a series of date labels. All the date labels were rated more helpful than the empty label; for carrots average helpfulness ratings of 4.14, 4.71 and 4.81 were given compared with 3.11 for the empty label and for oranges ratings of 3.79, 4.24 and 4.31 were given compared with 3.14 for the empty label (the date labels were Display Until, non-sticker-effect Best Before and sticker-effect Best Before, respectively). These are statistically significant differences at $p = .000$ using a repeated measures ANOVA with the Bonferroni correction applied.

Display Until labels were rated less helpful than all the other labels, using the same repeated measures ANOVA test.

The sticker-effect label received mixed feedback, being rated more helpful than the non-sticker-effect label for yoghurt (5.45 v. 5.33 mean rating) and carrots (4.81 v. 4.71 mean rating) but no different for orange juice (5.19 v. 5.13 mean rating) and bagged oranges (4.31 v. 4.24 mean rating). This testing again used the previously mentioned repeated measures ANOVA test.

The addition of day of the week to the sticker-effect best before label was not regarded as more helpful; in fact it was rated less helpful than the sticker-effect best before label for orange juice (5.04 v. 5.19 mean ratings). This testing again used the previously mentioned repeated measures ANOVA test. Again, the artificiality of the test environment may have influenced these results and the approach is worth testing in a real-world setting.

1.5 Headline results: Storage guidance

Research question 6: Do consumers currently store foods in the optimal way to extend life?

Most participants store carrots optimally in the fridge (76.2%) and bread optimally at room temperature (84.9%), but store oranges inoptimally at room temperature (74.7%). Just over half of the study participants optimally stored carrots in the original packaging.

Research question 7: Do consumers respond differently to labels containing different types of freeze by guidance?

Products can be frozen up until the end of the date on the label. Many consumers are not behaving in line with this intended behaviour; 9.5% of consumers typically do so for fresh meat and 7.1% did so on their last bread purchase occasion. Even with guidance, the most common response was still to freeze on the date of purchase (35.7% for chicken and 41.5% for bread).

Freezing products only on the day of purchase seems to be an engrained behaviour; even when provided with a label advising to freeze by a particular date 35.0% of participants would still freeze on day of purchase for chicken and 41.7% would do so for bread.

Research question 8: How effective is guidance in changing storage behaviour?

The research suggests that providing guidance about optimal storage location is likely to change behaviour in a positive direction. For example, 18.0% of participants stored bagged oranges in the fridge when they last purchased them, compared with 71.2% who said they would do so in response to guidance suggesting "for best quality store in the fridge". Even for carrots and bread which were already being stored optimally by most participants, significant increases in intention to store optimally occurred, an increase of 13.4 percentage points to 93.8% for carrots and 7.7 percentage points to 92.6% for bread. In response to guidance that carrots should be stored in packaging, 84.2% said they would do so, compared with 48.7% of participants before the survey, an increase of 35.5 percentage points.

Research question 9: Are certain types of wording combined with certain types of design more likely to result in optimal choices?

The study found a clear link between certain tones and presentations of guidance and optimal behaviour. Directive tone guidance using sticker-effect labels was significantly more effective than advisory tone guidance using non-sticker-effect labels, and both were more effective than no guidance at all. For example, 79.9% of study participants stored carrots optimally in the fridge on the last purchase occasion, but this increased to 95.0% when provided with directive tone, sticker-effect guidance, and a directive tone, sticker-effect label increased optimal behaviour for bagged oranges by 56.9 percentage points from 18.0% to 74.9%.

Research question 10: Do consumers find some types of guidance more helpful?

All the storage labels were rated more helpful on average than no guidance. Directive tone sticker-effect guidance was rated as the most helpful.

1.6 Recommendations

To capitalise on the potential for on-pack labelling to help reduce food waste, manufacturers and retailers should consider removing Use By dates for products where they are not required, removing or codifying Display Until dates since these can cause consumer confusion, replacing 'freeze on day of purchase' with 'freeze by [date]' and including guidance on where and how to store fresh produce.

1.7 Recommendations for further research

The research has indicated that an instructional messaging style was preferred to a guidance style. Further research on a wider range of products and a wider range of guidance styles is required to confirm this finding applies more widely than just the products tested.

Because the research was unable to draw firm conclusions about more and less effective label formats, a programme of real-world testing of different approaches and designs would be beneficial.

The nature of the research meant that only a small number of products could be tested; for example, only pre-packaged carrots were tested in relation to storing in the original packaging. To generalise more conclusively about behaviours and the likely impact of optimised on-pack labelling, more products and more formats should be tested. This is particularly important for Use By dates where the products tested were some of the least risky ones.

2 Introduction

2.1 REFRESH

REFRESH is an EU H2020 funded research project taking action against food waste. Twenty-six partners from 12 European countries, and China, are working towards the project's aim to contribute towards Sustainable Development Goal 12.3 of halving per capita food waste at the retail and consumer level and reducing food losses along production and supply chains, reducing waste management costs, and maximizing the value from unavoidable food waste and packaging materials.

2.2 Aim of work package

The main objective of this package of work is to develop a better understanding of consumer behaviour in relation to waste generation, handling, reuse, and by-product valorisation. This subtask specifically looks at developing consumer understanding and acceptance of on-pack information to help in food waste prevention at the consumer level.

This document reports on a study examining different contents and formats of on-pack guidance information, its effect on consumer understanding and on intended food waste behaviours. Based on this evidence, the information-based strategies for reducing food waste developed within REFRESH will be refined and optimised, tested for acceptability and usage intentions, and be made available via the Community of Experts for large scale roll out and testing. More information is available at <https://eu-refresh.org/>.

For the research, "contents" are understood to mean the wording of instruction itself, e.g. "Use By" versus "Best Before". "Format" is understood to mean the design of the on-pack information, e.g. clarity, colour, font type, etc.

2.3 Selection of information to test

At the start of the project, date labels, refrigerator guidance, freezing and portioning advice were all potentially in scope. A workshop was held during the preliminary stage of the project to select the types of guidance, on-pack information and products to test.

Portioning advice was excluded from the project on the basis that although cooking, preparing and serving too much leads to substantial amounts of waste (WRAP 2013a), evidence suggests that consumers tend to pay relatively little attention to on-pack portioning guidance (WRAP 2011); other potential label modifications focusing on healthy, sustainable eating benefits would probably be a more fruitful way to change behaviour (FAO 2016). Date labelling and storage advice (i.e., use of the refrigerator and the freezer) were therefore taken forward as the areas of focus.

2.4 Research questions

Labels and storage guidance are used primarily to ensure food safety, but they can also prompt behaviours that cause food waste or help prevent it. For example, storing fresh produce in the fridge (with some exceptions) extends its life, providing more opportunity for it to be eaten rather than wasted, while storing bread in the fridge damages its quality, making it more likely to be thrown away. These facts are not widely understood by consumers, and because there are exceptions to the general rules (for example bananas and potatoes are fresh produce that should not be stored in the fridge) it can be very confusing to know what to do for the best.

The overarching research question is whether consumer behaviour can be influenced in a positive way using on-pack guidance, resulting in more desirable behaviours from a food waste perspective. The general expectation was that a relationship would be found between the label shown to participants and (i) likely behaviour; and (ii) perceived helpfulness in making decisions. Uncovering the nature of that relationship will help us make recommendations about the content and format of messaging most likely to result in behaviours that reduce food waste.

The remainder of this section sets out in more detail our ideas and questions, firstly for date labelling and secondly for storage guidance.

2.4.1 Date labelling

Table 3 sets out the messages that consumers are intended to take away by the date labels that were included in the research.

Table 3: Intended response to specific messages on date labelling, and related food waste concern

Instruction	Intended message to consumers	Concern from a food waste perspective
Use By [date]	Consume before the end of the date – if eaten after this date it could make you ill	Not a problem on products that genuinely need a Use By date, but may cause food waste if the product only requires a Best Before date
Best Before [date]	Try to consume before the end of the date in question if you want the product to be at its best – if eaten after that date it may not be as nice	May encourage consumers to be overly cautious and throw away perfectly good food
Display Until [date]	None – this is for use by store staff only	Consumers may confuse the date with Use By and Best Before and throw away perfectly good food just because it is past the Display Until date
Freeze on day of purchase Freeze By [date] Suitable for freezing by [date]	You don't have to freeze this product, but if you do then do so by the end of the date specified on the pack	Consumers that haven't frozen the product on the day of purchase may mistakenly believe that it is too late to freeze the product and throw it away

Table 4 takes this one step further and sets out our ideas about the relationship between each type of date and the food waste concern. It also explains how we will test each of our ideas.

Table 4: Possible nature of the relationship between date label and intended behaviour

Possible causes of food waste	Nature of the concern	Test
Most consumers will (correctly) comply with a Use By date. But some Use By dates may be unnecessary.	Unnecessary use of Use By dates causes consumers to throw away good food – work with manufacturers and retailers to remove unnecessarily strict dates	Intended consumption date when presented with a Use By date
People are confused by the different types of date - many consumers behave as if they are strict Use By dates rather than guidance for store staff (Display Until) or guidance on quality (Best Before)	Food will be unnecessarily wasted if consumers respond to Display Until and Best Before dates as if they are Use By dates	Comparison of intended consumption date when presented with different dates (Use By, Display Until, Best Before, no date)
People don't pay enough attention to date labels - a salient 'sticker-effect' label will be more likely to prompt 'correct' behaviour	Food will be unnecessarily wasted if consumers don't read the label properly or confuse types of date	Comparison of intended consumption date when presented with the same information on a) a sticker-effect label and b) a non-sticker-effect label
People don't always know the date but normally know the day – so including the day of the week (e.g. Monday, Friday) on the Best Before label is more likely to prompt 'correct' behaviour	Food will be unnecessarily wasted if consumers don't know the date and are over-cautious in throwing away food	Comparison of intended consumption date when presented with the same information except for the addition of day of the week
People appreciate date labels – guidance on when to consume products is likely to be well received and useful	Food is wasted because people don't have the guidance they would find useful	Comparison of helpfulness ratings across different types of guidance and no guidance

Below we summarise the specific research questions to be addressed by the research.

Research question 1

Do consumers respond to date labels as the labels intend?

We investigate firstly whether consumers behave as intended by food labelling guidelines in reaction to date labels. Intended behaviours are shown in Table 5.

Table 5: Behaviour intended by food date labels

Date label	Intended behaviour
Use By	Eat up until the end of the date on the pack
Best Before	Refer to the date as a guide, but use senses to decide whether something is good to eat
Display Until	ignore the date
Freeze By	put into the freezer by the end of the date on the pack

Our specific research questions are:

- a. Do consumers respond as intended to Use By dates?
- b. Do consumers respond as intended to Best Before dates?
- c. Do consumers respond as intended to Display Until dates?
- d. Do consumers respond as intended to Freeze By dates?

Research question 2

Do consumers respond to different date labels differently?

If labels are effective, we would expect an individual to behave differently in reaction to a Use By date, a Best Before date, a Display Until date and a Freeze By date. Our specific research questions are:

- a. Do consumers say they will respond differently when presented with a label containing no date compared with a label containing a Best Before date?
- b. Do consumers say they will respond differently when presented with a 'Use By' and a 'Best Before' date label?
- c. Do consumers say they will respond differently when presented with a 'Display Until' and a Best Before label?

Research question 3

Do consumers respond differently to a sticker-effect label format compared with a non-sticker-effect label?

We would expect that label formats that are more salient, such as a sticker-effect label, would prompt a response more in line with that intended by the date labelling guidelines. Our specific research question is:

- a. Do consumers say they will respond differently when presented with a sticker-effect label compared with a non-sticker-effect label?

Research question 4

Does adding the day of the week to a Best Before label make any difference?

We would expect labels that make it easier for consumers to understand what the correct action is to take would be more likely to prompt an appropriate response.

Our specific research question is:

- a. Do consumers say they will respond differently when presented with a Best Before label that contains the day of the week (e.g. Thursday, Friday) in addition to a date?

Research question 5
Do consumers find some types of date label more helpful than others?

We would expect consumers to rate those dates that ought to be most important to them as more helpful than those that ought to be less important. Of the three dates, the Use By date ought to be the most important because it relates to food safety and the Display Until date ought to be the least important because it is intended for store staff rather than consumers. Our research question is:

- a. What differences are there in helpfulness ratings of the different types and format of date label?

2.4.2 Storage guidance

Table 6 sets out the messages that consumers are intended to take away by the storage guidance labels included in the research.

Table 6: Intended response to specific messages on storage, and related food waste concern

Instruction	Intended message to consumers	Concern from a food waste perspective
For best quality store in the fridge Keep me in the fridge	Store in the fridge if you want to keep the product at its best	If not kept in the fridge the product will deteriorate more quickly which may mean consumers don't have time to eat it and it is thrown away
Store in a cool, dry place	Keep cool but not cold – for example in a cupboard, not in the fridge	If not kept in a cool dry place (for example if kept in the fridge or in the sun) the product will deteriorate more quickly which may mean consumers don't have time to eat it and it is thrown away
For best quality do NOT store in fridge Do NOT store in fridge	Do not store in the fridge if you want to keep the product at its best	If kept in the fridge the product will deteriorate more quickly which may mean consumers don't have time to eat it and it is thrown away

Table 7 takes this a step further and sets out possible causes of food waste linked to the storage guidance. It also sets out the testing to be done as part of the research.

Table 7: Possible nature of the relationship between storage guidance and intended behaviour

Possible causes of food waste	Nature of the concern	Test
People are confused about when it is safe or appropriate to freeze products – they think they can only freeze on the day of purchase rather than up to the Use By date	Food is unnecessarily wasted due to people chilling products but running out of time to eat them, and then believing they are not safe to freeze	Comparison of different types of instruction a) freeze on day of purchase b) freeze until end of date c) suitable for freezing but no date guidance provided
People are unaware that certain products can be frozen safely and with no loss of quality	Food is unnecessarily wasted due to failure to use the freezer appropriately	Examining the tendency to use the freezer for appropriate products (meat and bread)
People don't pay enough attention to storage guidance - a salient 'sticker-effect' label will be more likely to prompt 'correct' behaviour	Food will be unnecessarily wasted if consumers don't notice the guidance or read the guidance properly	Comparison of the same guidance using a) a sticker-effect label and b) a non-sticker-effect label
People store products inappropriately because they don't know the correct storage options	Products will be wasted due to faster deterioration in quality than if stored correctly (e.g. bread incorrectly stored in the fridge)	Comparison of where people store such a product with and without guidance
People appreciate guidance – guidance is likely to be well received and useful	Food is wasted because people don't have the guidance they would find useful	Comparison of helpfulness ratings across different types of guidance and no guidance

We set out below the specific research questions to be answered by the research.

Research question 6

Do consumers currently store foods in the optimal way to extend life?

We investigate firstly whether consumers store food optimally. For the food types under investigation this is:

Pre-packaged carrots In the fridge, in the original packaging

Bagged oranges In the fridge

Bread In a cool dry place (but not the fridge, which is too cold)

Our specific research questions are:

- a. To what extent do consumers store foodstuffs appropriately in the fridge?
- b. To what extent do consumers use packaging appropriately?

Research question 7

Do consumers respond differently to labels containing different types of Freeze By guidance?

We tested different formulations of wording around freezing guidance to see which is the most effective in terms of eliciting an appropriate response. The specific research questions are:

- a. Do consumers say they will respond differently when presented with no freezing guidelines compared with guidance stating 'freeze on day of purchase'?
- b. Do consumers say they will respond differently when presented with 'freeze on day of purchase' compared with a 'freeze by' date label?
- c. Do consumers say they will respond differently when presented with 'freeze on day of purchase' compared with 'suitable for freezing'?
- d. Do consumers say they will respond differently when presented with a 'freeze by' date label compared with a 'suitable for freezing' label?

Research question 8

How effective is guidance in changing normal behaviour?

We investigate the extent to which consumer behaviour may be influenced by on-pack storage guidance by comparing current behaviour with stated behaviour when presented with the on-pack guidance. Our specific research questions are:

- a. Are consumers more likely to say they would store products in the fridge when presented with on-pack guidance to this effect?
- b. Are consumers more likely to say they would store products in their original packaging when on-pack guidance advises them it will keep fresher for longer?

Research question 9

Are certain types of wording combined with certain types of design more likely to result in optimal choices?

We investigate the extent to which different types of wording result in participants choosing more optimal storage options. Our specific research question is:

- a. Do consumers make more appropriate storage choices when presented with 'for best quality store in the fridge' or 'keep me in the fridge' and associated non-sticker-effect and sticker-effect label, compared with each other, with no guidance and with their behaviour on their last purchase occasion?
- b. Do consumers make more appropriate storage choices when presented with 'for best quality do not store in the fridge' or 'do not store in the fridge' and associated non-sticker-effect and sticker-effect label?

Research question 10

Do consumers find some types of guidance more helpful?

We investigate the extent to which participants found certain types and design of guidance more helpful than others.

Our specific research question is:

- a. What differences are there in helpfulness ratings when presented with different types and formats of guidance?

2.5 Methodology

Considering the requirement to compare the effect of different contents and formats of on-pack guidance on consumer understanding and food waste behaviours, it was agreed that a survey was the most practical methodology to adopt. However, budgetary constraints meant that the survey had to be delivered at no external cost and this had implications on the sampling method available to us (see section 2.5.6) which in turn has implications for the reliability and generalisability of the results (see discussion in section 5.11).

2.5.1 Selection of product types

The types of food on which to test the different label formats were selected on the basis of an initial shortlist of 20 products derived from the outputs of REFRESH T6.9, (Sweet et al 2016) identifying the top 80 foodstuffs in EU28 by sales volume and environmental impact, cross-referenced with WRAP's evidence on the volume and reasons for waste for each food type in the UK (WRAP, 2013a). Six priority products were selected during the workshop on the basis that they would benefit from fridge/freezer storage and shelf life guidance, were more perishable than others on the shortlist, and also that they acted as close proxies for whole categories, (e.g. carrots were chosen over potatoes because they were considered more characteristic of vegetables that should be stored in the fridge).

In order to reduce the number of conditions to be tested, potential variables were further refined by matching the most appropriate labelling type to the selected products, (e.g. it is unlikely that fresh uncured meat would be stored outside of the fridge and therefore optimising freezer guidance for meat would be more useful than refrigeration guidance; consumers rely less on date labels to ascertain freshness of bread (WRAP 2011), therefore a prompt not to store in the fridge to retain freshness would be more useful than a date label).

In some cases, two food categories were selected to represent each label type in order to give greater confidence that the results and potential modifications could be applied more widely than just the specific product on which it was tested.

Only labels that would be feasible to place on products in the real world were tested. For example, date labels must be included on chilled produce, so the condition 'no label' was not tested on these products. The conditions tested for each product type are set out in Table 8 and Table 9 below.

Table 8: Products and date marks selected for testing – date labelling

Product type	Date marks	Type of label and date format
Yoghurt	Use By	Non-sticker-effect
		Non-sticker-effect
Orange juice	Best Before	Sticker-effect
		Sticker-effect plus day of the week
Pre-packaged carrots	No date	Non-sticker-effect
	Display Until	Non-sticker-effect
	Best Before	Non-sticker-effect
Bagged oranges		Sticker-effect

Table 9: Products on pack guidance selected for testing – storage guidance

Product type	Guidance	Type of label
Pre-packaged carrots	No storage guidance	Non-sticker-effect label
	For best quality store in the fridge	Non-sticker-effect label
	Keep me in the fridge	Sticker-effect label
Bagged oranges	Store in a cool, dry place	Non-sticker-effect label
	For best quality do NOT store in fridge	Non-sticker-effect label
	Do NOT store in fridge	Sticker-effect label
Bread	No guidance	Non-sticker-effect
	Freeze by date	Non-sticker-effect
	Freeze on day of purchase	Non-sticker-effect
Chicken portions	Suitable for freezing by date	Sticker-effect

2.5.2 Images

Photographs of each product type were taken by the project partners in Hungary, Germany, the Netherlands and Spain, and these were used as the basis of generic, computer-generated product designs. In these designs, the product packaging was simplified so that the information could be easily translated by the partners and relatively quickly modified by the designer for each different treatment. Allowing for the different variables of products, labels and languages, over 100 images were modified and tested.

2.5.3 Survey design

The survey was designed and delivered on-line.

First participants were presented with the date labelling questions. In this part of the survey, each participant was randomly assigned to one of the four product

types (yoghurt, orange juice, pre-packaged carrots and bagged oranges). They were then presented with all the variations of the label relevant to that product and asked when they would eat the product from a pre-coded set of answers. The pre-set answers were reflective of degree of caution, ranging from a couple of days before the date to not caring about the date at all. The order in which each of the label variations was presented was randomised. This approach makes the study a mixed design in which product type is a between-subjects factor and label type is a within-subjects factor.¹

Next participants were presented with the storage guidance questions. Again, participants were randomly assigned to one of the product types (pre-packaged carrots, bagged oranges, chicken portions, bread in the fridge or bread in the freezer). First, they were asked about their storage practice on the last occasion they bought the product, with participants who never purchase the product being excluded from the rest of the questions. Then each label variation for that product was presented and participants were asked where they would store each item. Answer options were pre-coded and the order in which the labels were presented was randomised.

Table 10: Achieved sample size for each condition in each country

		Germany	Hungary	The Netherlands	Spain	All
Date labelling	Yoghurt	158	427	284	149	1018
	Orange juice	152	0 ¹	270	126	548
	Carrots	152	409	277	142	980
	Orange	152	402	282	127	963
Storage	Carrots	121	239	216	106	682
	Orange	121	247	207	109	684
	Chicken	112	231	211	97	651
	Bread (freezer)	111	219	212	0 ²	544
	Bread (fridge)	118	239	213	99	669

1 Deliberately excluded because orange juice it is not widely purchased in this format in Hungary.

2 Accidentally excluded due to a mistake when the questionnaire was coded into the on-line software.

Questionnaires are available for download at <https://eu-refresh.org/>.

¹ A within-subjects design is one in which a single participant is exposed to different treatment conditions (i.e. the label presentations). A between-subjects design is one in which a single participant is exposed to one of a set of different treatment conditions (i.e. the products).

2.5.4 Measures

Use By, Best Before and Display Until date labelling behaviour

The date labelling behaviour question was asked as follows:

Based on the information shown in the images, up until what point would you be happy to eat this product?

Participants could choose only one answer, and the following pre-coded options were available:

- I would eat it up until the day before the date on the label (1)
- I would eat it up until the end of the date on the label (2)
- I would eat it up to a couple of days after the date if it looked and smelt ok (3)
- I would eat it any time after the date if it looked and smelt ok (4)
- I would not pay attention to date labels for this type of food (5)
- Don't know – the information provided on the pack is difficult to understand (6)
- Don't know – I'm not sure what I would do until the situation arises (7)
- I never buy this type of product (8)

Where the presentation excluded a date, the following pre-coded options were available:

- I would eat it any time after I bought it if it looked and smelt OK (1)
- I would decide whether or not to eat the product depending on how long ago I had bought it (2)
- I would use a combination of how long I'd had the product and look / smell (3)
- Don't know - there is no date on the pack (4)
- Don't know – I'm not sure what I would do until the situation arises (5)
- None of these (6)
- I never buy this type of product (7)

Freeze by date labelling behaviour

The freeze by date labelling behaviour question was asked as follows:

Based on the information shown in the image, please indicate when you would be happy to freeze this product.

Participants could choose only one answer, and the following pre-coded options were available:

- Only on the day I bought it (1)
- Up until one or two days after I bought it (2)
- Up until one or two days before the date on the label (3)
- Anytime up to and including the date on the label (4)
- Up until one or two days after the date on the label (5)
- Anytime up until it started to look or smell off (6)
- Not applicable: I never freeze this kind of food (7)
- Not applicable: I never buy this (8)
- Don't know (9)

Where the label presentation excluded the date, the following pre-coded options were available

- I would freeze it any time after I bought it if it looked and smelt OK (1)
- I would decide whether or not to freeze the product depending on how long ago I had bought it (2)
- I would use a combination of how long I'd had the product and look / smell (3)
- I would not freeze it at all without freezing guidance (4)
- Don't know - there is no date on the pack (5)
- Don't know - I'm not sure what I would do until the situation arises (6)
- None of these (7)

Fridge storage behaviour

The storage behaviour question was asked as follows:

If you were storing these [carrots/oranges/bread], based on the information shown in the images, where would you be most likely to store them?

Participants could choose only one answer, and the following pre-coded options were available for carrots and oranges:

- Room temperature in the open (e.g. on a worktop, in a bowl or on a shelf) in the original packaging (1)
- Room temperature in the open (e.g. on a worktop, in a bowl or on a shelf) stored loose (2)
- Room temperature in the dark (e.g. in a cupboard) in the original packaging (3)
- Room temperature in the dark (e.g. in a cupboard) stored loose (4)
- In fridge in the original packaging (5)
- In fridge - stored loose (6)
- Don't know - the information provided on the pack is difficult to understand (7)
- Don't know - I'm not sure what I would do until the situation arises (8)
- I never buy this type of product (9)

The appearance of the options was rotated, with the pairs 1&2, 3&4, and 5&6 always rotating together and always before 7, 8 and 9.

The following pre-coded options were available for bread:

- In a bread bin (1)
- In a cupboard (2)
- On a shelf (3)
- On a worktop (4)
- In fridge (5)
- Don't know - the information provided on the pack is difficult to understand (6)
- Don't know - I'm not sure what I would do until the situation arises (7)
- I never buy this type of product (8)

Freezer storage behaviour

The freezer storage behaviour question was asked as follows:

If you were thinking of freezing this product, based on the information shown in the image, which of the following would you be most likely to do (please select one only):

Participants could choose only one answer, and the following pre-coded options were available:

- I would freeze it any time after I bought it if it looked and smelt OK (1)
- I would decide whether or not to freeze the product depending on how long ago I had bought it (2)
- I would use a combination of how long I'd had the product and look / smell (3)
- I would not freeze it at all without freezing guidance (4)
- Don't know - there is no date on the pack (5)
- Don't know - I'm not sure what I would do until the situation arises (6)
- None of these (7)
- Not applicable: I never freeze this kind of food (8)
- Not applicable: I never buy this (9)

Current storage behaviour

The current storage behaviour question was asked as follows:

I'd like you to think about the last time you went food shopping and bought [carrots/oranges]. When you returned home, where did you store them?

The following pre-coded options were available:

- Room temperature in the open (e.g. on a worktop, in a bowl or on a shelf) (1)
- Room temperature in the dark (e.g. in a cupboard) (2)
- In fridge (3)
- Other (4)
- Don't know / can't remember (5)
- Don't buy / store fresh oranges (6)

For bread the question was phrased as follows:

Thinking of times when you have bought fresh, packaged bread, where do you typically store this type of product

The following pre-coded options were available:

- In a bread bin (1)
- In a cupboard (2)
- On a shelf (3)
- On a worktop (4)
- In fridge (5)
- Not applicable: I never buy this (6)
- Don't know (7)

The freezing question was phrased as follows:

Thinking of times when you have bought [fresh, packaged bread/fresh uncooked meat such as a pork chop or chicken breast], when do you typically freeze this type of product?

The following pre-coded options were available:

- Only on the day I bought it (1)
- Up until one or two days after I bought it (2)
- Up until one or two days before the date on the label (3)
- Anytime up to and including the date on the label (4)
- Up until one or two days after the date on the label (5)
- Anytime up until it started to look or smell off (6)
- Not applicable: I never freeze this kind of food (7)
- Not applicable: I never buy this (8)
- Don't know (9)

Helpfulness

For all products and every label presentation, participants were asked:

In my everyday decisions about [xxxx] the information displayed on the packaging would

Not be helpful at all (1) 2 3 4 5 6 (7) Would be very helpful

Demographics and other questions

- Country of residence (Germany, Hungary, The Netherlands, Spain only)
- Gender (male, female, other)
- Age (18-24 25-34 35-44 45-54 55-64 65-74 75+ - under 18s out of scope)
- Employment status (working full time, working part time, retired, unemployed, parent/carer, student, other)
- Number of people living in the home (under 18, 18 and over)
- Responsibility for shopping (all or most, about half, less than half, none)
- Responsibility for cooking (all or most, about half, less than half, none)
- Work in the environment sector or a profession relating to environmental issues (no, yes)
- Work in a profession relating to food (no, yes – manufacturing, yes – supply chain, yes – retail, yes – service, yes – packaging, yes – safety, yes - other)
- Main food shop (large supermarket or hypermarket, smaller convenience store, market, local shops, other)

2.5.5 Procedure

The questionnaire was designed by WRAP and uploaded onto Qualtrics by Wageningen University. The survey was peer tested within WRAP and small amendments, mainly to improve clarity, were made as a result. The survey was then translated into the relevant languages by project partners in each country and uploaded to Qualtrics. A link was generated, which partners circulated via professional and personal networks. The survey was live from July 11th to 31st, 2017.

2.5.6 Sampling

The sample was a convenience sample. A convenience sample is a non-probability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher. Ideally, we would have used a

probability sampling method in which every eligible person in each of the four countries stands an equal chance of being selected. Due to budget restrictions, this was not possible and the sample is therefore made up of people within the networks of the project team who were sufficiently motivated to participate in the survey. Consequently, the results are not representative of the populations in question. To help combat bias, there were specific requirements for inclusion and those not meeting the following criteria were screened out specifically:

- Residents not in the nations of interest (Hungary, Germany, the Netherlands, Spain)
- Those without at least some responsibility for either food shopping or preparation
- Under 18s

Furthermore, participants were asked to indicate if they worked or studied in the environmental or food sectors to help understand the extent to which the sample might be skewed towards these industries due to how the survey was administered. Summary sample characteristics are shown in Table 11.

Table 11: Achieved sample demographics

Sample characteristic		Germany	Hungary	The Netherlands	Spain
Achieved sample size		611	1243	1114	544
Age profile	18-24	11%	18%	5%	4%
	25-34	43%	27%	10%	23%
	35-44	22%	30%	12%	31%
	45-54	15%	16%	16%	19%
	55-64	9%	7%	24%	16%
	65-74	2%	2%	27%	7%
	75+	0%	0%	7%	1%
Sex	Male	27%	13%	29%	34%
	Female	33%	87%	71%	66%
Employment status	Full time	64%	64%	31%	68%
	Part time	15%	6%	19%	9%
	Retired	2%	5%	35%	11%
	Unemployed	2%	3%	2%	4%
	Parent/carer	4%	10%	3%	1%
	Student	11%	9%	5%	4%
	Other	3%	4%	6%	2%
In food or environment sector		34%	31%	22%	55%
Household size	1	20%	17%	23%	16%
	2	41%	29%	49%	33%
	3	17%	20%	11%	22%
	4	15%	20%	11%	22%
	5	4%	10%	4%	6%
	6+	3%	5%	3%	1%
At least one child <18 at home		25%	43%	21%	34%

Table 12: Main food shop – sample characteristics

Sample characteristic	Germany	Hungary	The Netherlands	Spain
Large super or hyper market	45%	71%	74%	18%
Smaller convenience store	44%	18%	17%	58%
Market	2%	4%	2%	6%
Local shops	5%	6%	5%	16%
Other	5%	2%	2%	2%

2.5.7 Data preparation and analysis

Data preparation

Wageningen University exported the survey results to SPSS. The data were cleaned by WRAP and the variables and values translated into English for analysis and reporting.

The following cases were deleted:

- Those completed before the launch date of July 11th as these were test cases.
- Those completed in less than 2.5 minutes, as five observed and timed peer-completed test cases took between 3.5 and 5.5 minutes to complete and 2.5 minutes is therefore considered by the researcher to be the minimum completion time necessary.
- Incomplete cases.

An outcome of the way in which the survey was administered was that 16.7% of the sample worked or studied in the food or environmental sectors, a factor that may have biased the results. Weighting factors were not applied to the demographic variables as it was felt that this would not address the sampling bias inherent in the research design.

Statistical tests

The aim of the study was to manipulate the on-pack information shown for each product (independent variable) and then examine the effect that this change has on two dependent variables – perceived helpfulness score and behavioural intention. The significance threshold was set at $p=.05$.

The data on date labelling behaviours was regarded as ordinal rather than categorical because there was a definite scale of caution implied, from very cautious (eat up until the day before the date) to not at all cautious (would not pay attention to date labels).

Although the data was in many cases negatively skewed, in no cases was it so skewed as to warrant a change of approach.

For helpfulness scores, the main statistical test used was repeated measures analysis of variance (ANOVA) which was carried out using the Bonferroni correction. This was used to test whether any observed differences in means were statistically significant. Where other tests have been used, they are described in the text.

'Don't know' and 'not applicable' responses were removed from the analysis.

3 Date labelling results

3.1 Introduction

This section presents the results of the date labelling investigations, focusing on a) the way participants to the survey stated they would behave having been presented with each label and b) their rating of the helpfulness of each of label. The section is structured according to the research questions set out in the methods section.

3.2 Results for research question 1 Do consumers respond to date labels as the labels intend?

3.2.1 Response to Use By dates

Yoghurt and orange juice were the products tested for Use By dates.

Figure 1 Use By presentations



The intended consumer response to a Use By date, to avoid food safety risks, is to eat the product before the end of the Use By date.

Most participants did not choose this option; 15% of participants chose it for yoghurt and 19% for orange juice. A small proportion were more cautious (6% for yoghurt and 8% for orange juice), choosing to eat/drink up to the *day before* the Use By date. Most (78% and 71%) were less cautious and would eat/drink past the Use By date. A very small proportion (0.5% and 2.5%) would not pay any attention to the date at all.

Table 13: Response to Use By date

Response when presented with Use By date	Yoghurt		Orange juice	
	n	%	n	%
Eat/drink up until day before date on the label	60	6.0	41	7.9
Eat/drink up until end of date on label	153	15.4	99	19.2
Up until couple of days after date if looked and smelled ok	440	44.4	182	35.3
Any time after date if it looked and smelled ok	334	33.7	181	35.1
Would not pay attention to date labels for this type of food	5	0.5	13	2.5
Total	992	100.0	516	100.0

Green shading denotes the response intended by labelling guidelines

3.2.2 Response to Best Before dates

Yoghurt, orange juice, pre-packaged carrots and bagged oranges were the products included for testing Best Before dates. The test presentations are shown below.

Figure 2 Best Before presentations



The intended response to a Best Before date is to refer to the date as a guide but also rely on look and smell to decide whether the food is good to eat.

Most participants said they would behave as intended by the label, using the date for guidance but also using their senses; 70% would do so for yoghurt, 82% for orange juice, 74% for carrots and 69% for oranges.

Table 14: Response to Best Before date (no sticker)

Response when presented with Best Before date	Yoghurt		Orange juice		Carrots		Oranges	
	n	%	n	%	n	%	n	%
Eat/drink up until day before date on the label	95	9.6	18	3.5	44	4.6	35	3.7
Eat/drink up until end of date on label	204	20.5	63	12.2	76	7.9	50	5.3
Up until couple of days after date if looked and smelled ok	417	42.0	179	34.6	241	25.2	185	19.7
Any time after date if it looked and smelled ok	275	27.7	246	47.5	464	48.5	458	48.8
<i>Sub-total – intended behaviour</i>	<i>692</i>	<i>69.7</i>	<i>425</i>	<i>82.1</i>	<i>705</i>	<i>73.7</i>	<i>643</i>	<i>68.5</i>
Would not pay attention to date labels for this type of food	2	0.2	12	2.3	131	13.7	211	22.5
Total	993	100.0	518	100.0	956	100.0	939	100.0

Green shading denotes the response intended by labelling guidelines

3.2.3 Response to Display Until dates

Pre-packaged carrots and bagged oranges were the products included for testing Display Until dates.

Figure 3 Display Until date presentations



The intended response to a Display Until date is for it to be ignored completely since it is not an instruction to the consumer.

Just 14% of participants correctly said they would not pay attention to the Display Until date for pre-packaged carrots and 23% for bagged oranges.

Table 15: Response to Display Until dates

Response when presented with Display Until date	Pre-packaged carrots		Bagged oranges	
	n	%	n	%
Eat up until day before date on the label	49	5.3	30	3.3
Eat up until end of date on label	59	6.4	44	4.9
Up until couple of days after date if looked and smelled ok	207	22.6	145	16.1
Any time after date if it looked and smelled ok	478	52.1	474	52.5
Would not pay attention to date labels for this type of food	124	13.5	209	23.2
Total	917	100.0	902	100.0

Green shading denotes the response intended by labelling guidelines

3.3 Results for research question 2 Do consumers respond to different date labels differently?

3.3.1 Introduction

To test whether there were significant differences between responses to the different labels worthy of further investigation, a Friedman two-way analysis of variance (ANOVA) by ranks test was carried out. This compares the responses to:

- a) taken together, the Use By date label and all three presentations of the Best Before date, for yoghurts and orange juice; and
- b) taken together, the Display Until date label and the two presentations of the Best Before date label, for pre-packaged carrots and bagged oranges.

The results are shown in Table 16.

Table 16: Results of the Related Samples Friedman Two-Way Analysis of Variance (ANOVA) by Ranks Test to test whether there are significant differences between Use by and Best Before, and Display Until and Best Before

	Use By and 3x Best Before presentations		Display Until and 2x Best Before presentations	
	Yoghurt	Orange Juice	Pre- packaged carrots	Bagged oranges
Total sample size (n)	982	505	752	637
Test statistic	152.07	137.67	8.55	11.90
Degrees of freedom	3	3	2	2
Asymptotic significance (2-sided test)	<.001	<.001	.014	.003
Significantly different (p≤0.05)?	YES	YES	YES	YES

The table shows that there are statistically significant differences for all four products. The rest of this section therefore explores the nature of these differences in more depth by comparing pairs of variables rather than sets of variables.

3.3.2 Do consumers respond differently to a label containing no date compared with a Best Before date?

Pre-packaged carrots and bagged oranges were the products tested.

Figure 4 No label v. Best Before date label presentations



Responses to the label with no date and the identical format Best Before date label for pre-packaged carrots and bagged oranges were firstly cross-tabulated to

explore differences in response. Each row shows how people responded to the Best Before date label for each category of response to the lack of a date on the label; percentages are row-wise.

Table 17: Response to Best Before date compared with response to equivalent format label without any date (pre-packaged carrots)

Intended behavioural response when presented with label without a date	Intended behavioural response when presented with Best Before date label					
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would pay no attention to date labels for this type of food
Decide depending on how long ago I bought it (n=43)	n	6	5	18	12	2
	%	14.0%	11.6%	41.9%	27.9%	4.7%
Combination of how long plus look / smell (n=363)	n	16	24	120	169	34
	%	4.4%	6.6%	33.1%	46.6%	9.4%
Any time after I bought it if it looked and smelled ok (n=412)	n	6	12	59	246	89
	%	1.5%	2.9%	14.3%	59.7%	21.6%

Table 18: Response to Best Before date compared with response to equivalent format label without any date (bagged oranges)

Intended behavioural response when presented with label with no date	Intended behavioural response when presented with Best Before date label					
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would pay no attention to date labels for this type of food
Decide depending on how long ago I bought it (n=34)	n	1	4	13	8	5
	%	3.2%	12.9%	41.9%	25.8%	16.1%
Combination of how long plus look / smell (n=371)	n	12	11	75	183	80
	%	3.3%	3.0%	20.8%	50.7%	22.2%
Any time after I bought it if it looked and smelled ok (n=423)	n	11	9	34	253	112
	%	2.6%	2.1%	8.1%	60.4%	26.7%

Despite the categories not being identical (and therefore not amendable to statistical testing), visual inspection of the cross-tabulations suggests that intended behavioural responses are similar regardless of whether the label contained a date or not. For example, very few of those who reacted to the Best Before date by saying they would eat oranges any time after the date provided they looked and smelled ok also said, when presented with a label containing no

date, that they would refer solely to how long ago they bought them (8 people out of 444, or 1.8%).

3.3.3 Do consumers respond differently to a label containing a Use By date compared with a Best Before date?

Yoghurt and orange juice were the products tested.

Figure 5 Use By v. Best Before presentations



A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there were statistically significant differences in the way participants said they would behave in relation to Use By and Best Before dates for yoghurt and orange juice. Responses of 'would not pay attention to dates labels for this type of food' were removed from the analysis due to the very small number of participants choosing that option.

For both yoghurt and orange juice, statistically significant differences between the distributions ($p < .001$) were observed, indicating that participants would behave differently in response to a Best Before label compared with a Use By label.

Responses were cross-tabulated to explore the differences (Table 19 for yoghurt and Table 20 for orange juice). Each row shows how people responded to the Best Before date label for each category of response to the Use By date; percentages are row-wise. Graphs were also prepared, based on the cross tabulations and using table-wise percentages, to illustrate whether participants would be more or less cautious in response to a Best Before date than a Use By date.

Table 19: Response to Best Before date compared with response to equivalent format Use By date (yoghurt)

Intended behavioural response when presented with Use By date		Intended behavioural response when presented with Best Before date			
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok
Eat up until day before date on the label (n=60)	n	57	3	0	0
	%	95.0%	5.0%	0.0%	0.0%
Eat up until end of date on label (n=153)	n	18	128	6	1
	%	11.8%	83.7%	3.9%	0.7%
Up until couple of days after date if looked and smelled ok (n=438)	n	17	54	355	12
	%	3.9%	12.3%	81.1%	2.7%
Any time after date if it looked and smelled ok (n=331)	n	2	15	55	259
	%	0.6%	4.5%	16.6%	78.2%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice

Percentages are row-wise i.e. of each Use By date response

Figure 6 Caution displayed in Best Before choice compared with Use By choice (yoghurt) - % of whole sample

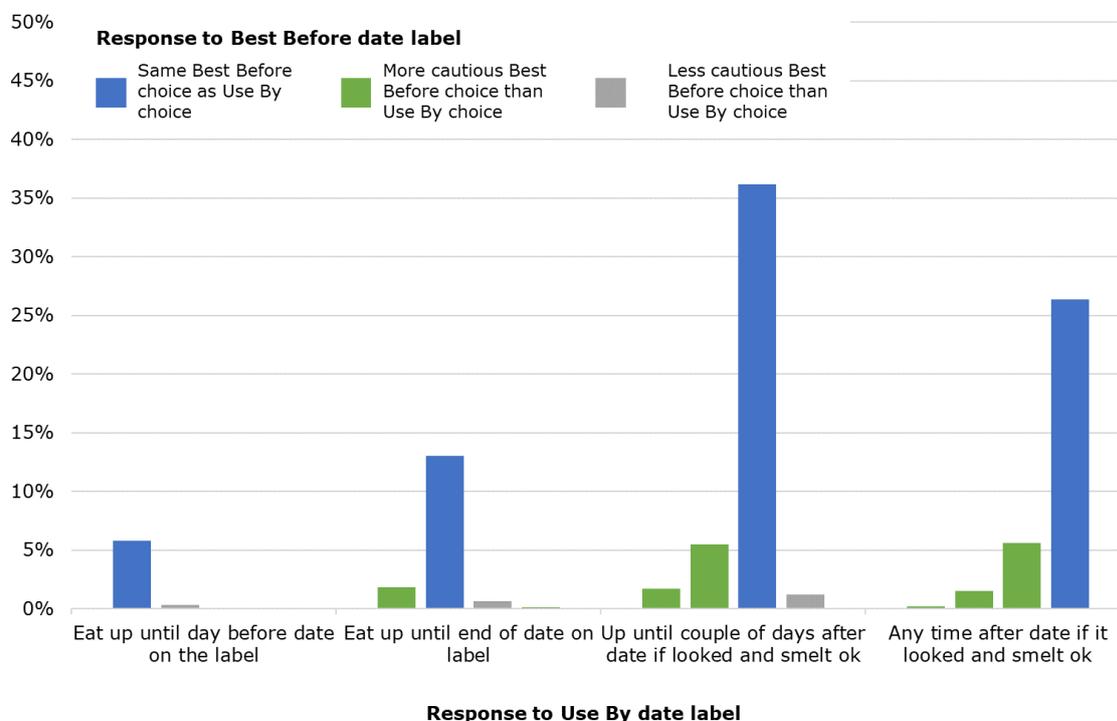
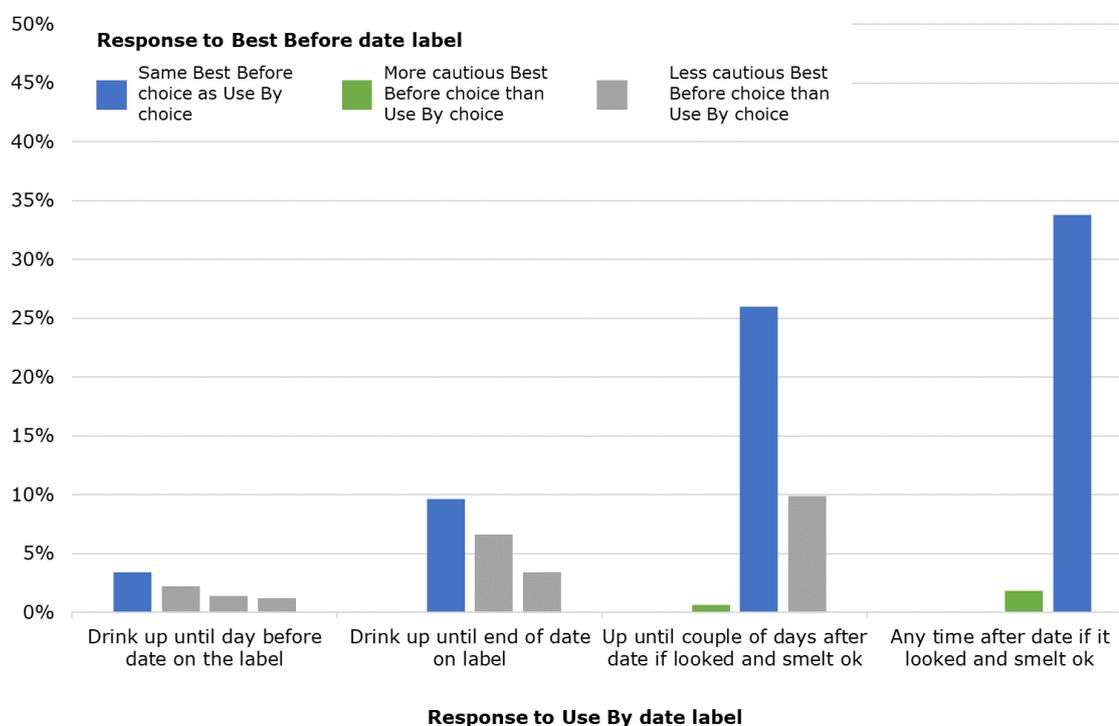


Table 20: Response to Best Before date compared with response to equivalent format Use By date (orange juice)

Intended behavioural response when presented with Use By date		Response when presented with Best Before date			
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok
Eat up until day before date on the label (n=41)	n	17	11	7	6
	%	41.5%	26.8%	17.1%	14.6%
Eat up until end of date on label (n=98)	n	0	48	33	17
	%	0.0%	49.0%	33.7%	17.3%
Up until couple of days after date if looked and smelled ok (n=181)	n	0	3	129	49
	%	0.0%	1.7%	71.3%	27.1%
Any time after date if it looked and smelled ok (n=177)	n	0	0	9	168
	%	0.0%	0.0%	5.1%	94.9%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise i.e. of each Use By date response

Figure 7 Caution displayed in Best Before choice compared with Use By choice (orange juice) - % of whole sample

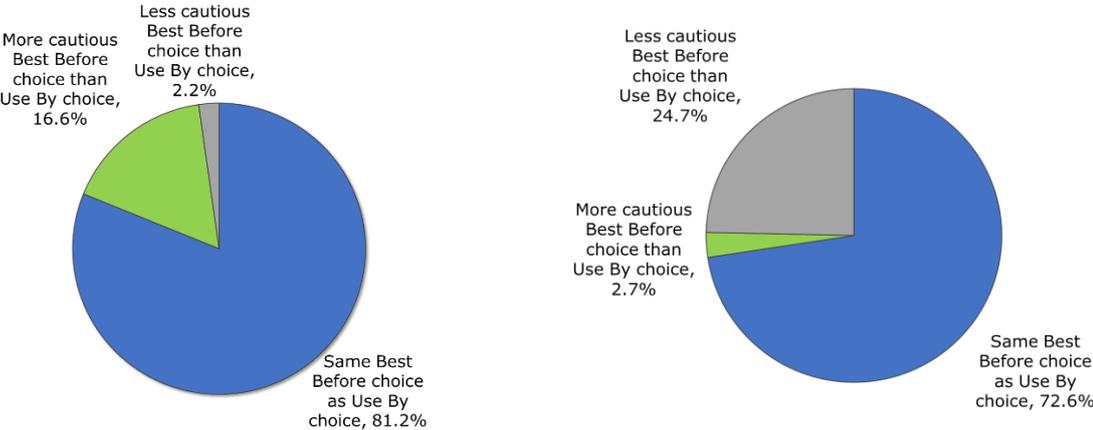


The results show that participants were most likely to say they would behave in the same way for both types of date. Where there were different responses, the graphs suggest that for yoghurt people tended to make more cautious responses

for Best Before dates than Use By dates while for orange juice the opposite was true.

To show this more clearly, data were recoded into 'same choice', 'more cautious choice' and 'less cautious choice'. 16.6% of people make a more cautious choice when presented with a Best Before date for yoghurt than a Use By date. The same does not apply to orange juice, with 2.7% of participants making a more cautious choice for a Best Before date.

Figure 8 Degree of caution shown when responding to Use By date compared with a Best Before date for yoghurt (left) and orange juice (right)



The Wilcoxon signed rank test was performed to test whether the degree of caution shown is significantly different between Use By and Best Before (i.e. the difference between the green and grey segments in the pie charts above). The results of the test show these differences are significant ($p < .001$) in both cases; for yoghurt people are significantly *more* cautious with a Best Before date while for orange juice people are significantly *less* cautious with a Best Before date.

3.3.4 Do consumers respond differently to a label containing a Display Until date compared with a Best Before date?

Pre-packaged carrots and bagged oranges were the products tested.

Figure 9 Display Until date v. Best Before date label presentations



A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to pre-packaged carrots and bagged oranges.

The test found no difference in the distribution of the two variables for carrots. A statistically significant difference ($p=.008$) in the distribution of the two sets of data was observed for bagged oranges, indicating that participants would behave differently in response to a Display Until label compared with a Best Before label.

Responses were cross-tabulated to illustrate the differences (Table 21 and Table 22). Each row shows how people responded to the Best Before date label for each category of response to the Display Until date; percentages are row-wise. Graphs were also prepared, based on the cross tabulations, to illustrate whether participants would be more or less cautious in response to a Best Before date than a Display Until date.

Table 21: Response to Best Before date compared with response to equivalent format Display Until date (pre-packaged carrots)

Intended behavioural response when presented with Display Until date	Intended behavioural response when presented with Best Before date					
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would not pay attention to date labels for this type of food
Eat up until day before date on the label (n=47)	n	32	6	5	2	2
	%	68.1%	12.8%	10.6%	4.3%	4.3%
Eat up until end of date on label (n=59)	n	3	41	10	5	0
	%	5.1%	69.5%	16.9%	8.5%	0.0%
Up until couple of days after date if looked and smelled ok (n=207)	n	4	16	146	33	8
	%	1.9%	7.7%	70.5%	15.9%	3.9%
Any time after date if it looked and smelled ok (n=478)	n	0	6	62	385	25
	%	0.0%	1.3%	13.0%	80.5%	5.2%
Would not pay attention to date labels for this type of food (n=123)	n	0	1	6	25	91
	%	0.0%	.8%	4.9%	20.3%	74.0%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise i.e. of each Display Until date response

Figure 10 Caution displayed in Best Before choice compared with Display Until choice (pre-packaged carrots) - % of whole sample

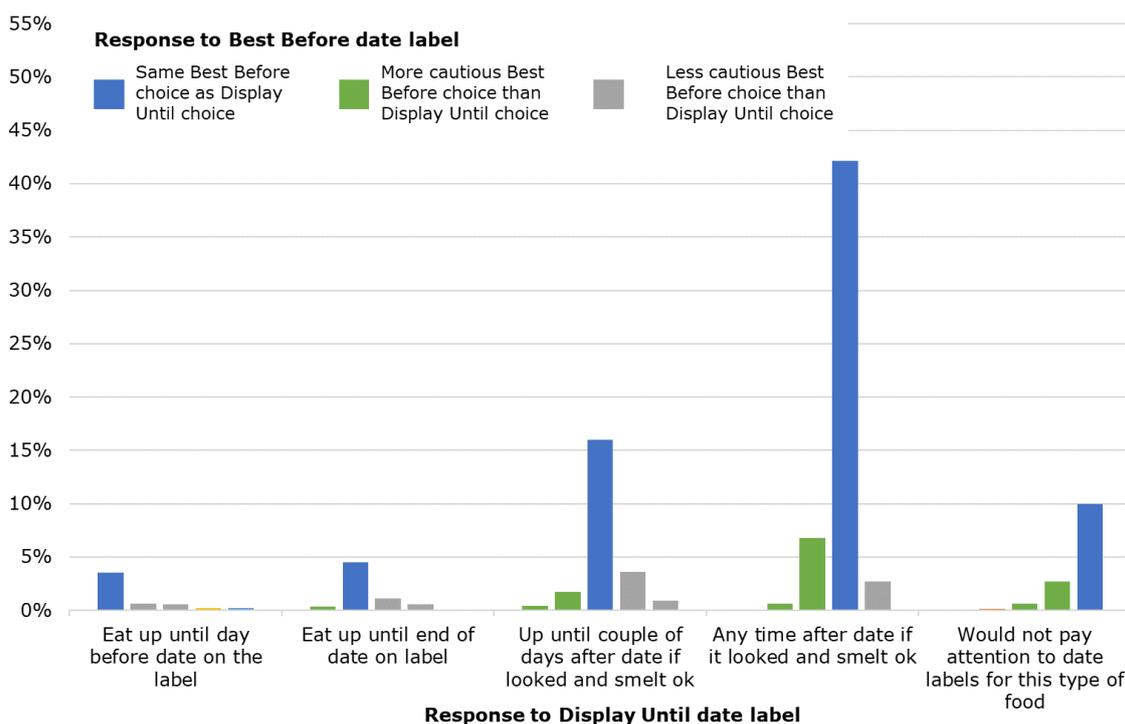
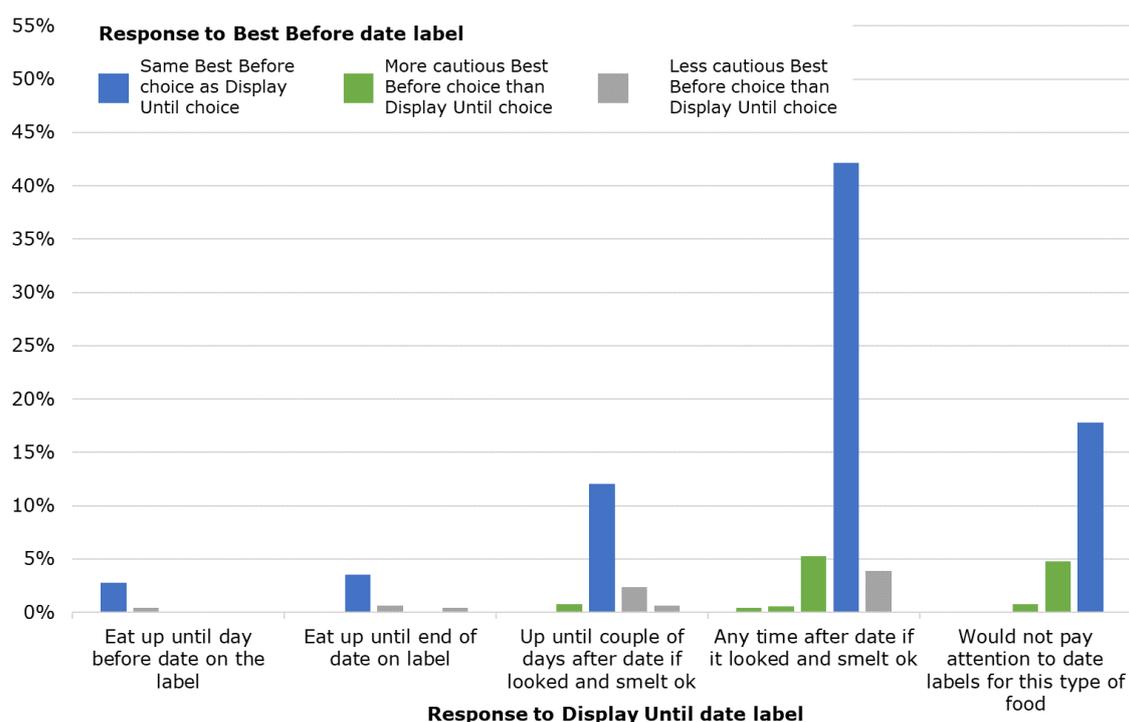


Table 22: Response to Best Before date compared with response to equivalent format Display Until date (bagged oranges)

Intended behavioural response when presented with Display Until date	Intended behavioural response when presented with Best Before date					
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would not pay attention to date labels for this type of food
Eat up until day before date on the label (n=30)	n	25	4	0	0	1
	%	83.3%	13.3%	0.0%	0.0%	3.3%
Eat up until end of date on label (n=144)	n	1	32	6	1	4
	%	2.3%	72.7%	13.6%	2.3%	9.1%
Up until couple of days after date if looked and smelled ok (n=143)	n	1	7	108	21	6
	%	.7%	4.9%	75.5%	14.7%	4.2%
Any time after date if it looked and smelled ok (n=468)	n	4	5	47	377	35
	%	.9%	1.1%	10.0%	80.6%	7.5%
Would not pay attention to date labels for this type of food (n=209)	n	0	0	7	43	159
	%	0.0%	0.0%	3.3%	20.6%	76.1%

Blue shading = same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise i.e. of each Display Until date response

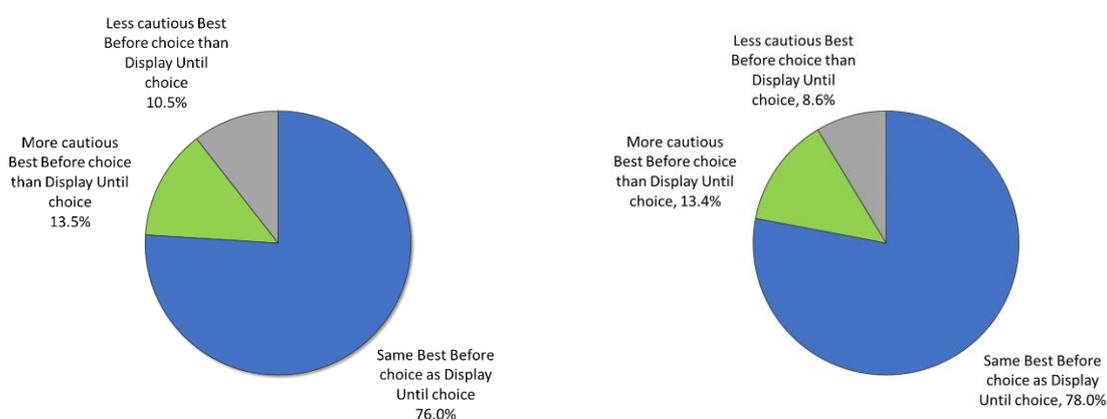
Figure 11 Caution displayed in Best Before choice compared with Display Until choice (bagged oranges) - % of whole sample



The results show that participants were most likely to say they would behave in the same way for both types of date. Where there were differences in response, the graphs suggest that they are reasonably evenly split between more and less cautious responses.

To test whether there were differences, data were recoded into 'same choice', 'more cautious choice' and 'less cautious choice'. The pattern is almost identical for the two products; 13.5% of people make a more cautious choice when presented with a Best Before date for pre-packaged carrots and 13.4% for bagged oranges than a Display Until date.

Figure 12 Degree of caution shown when responding to Best Before date compared with a Display Until date for pre-packaged carrots (left) and bagged oranges (right)



The Wilcoxon signed rank test was performed to test whether the degree of caution shown is significantly different between Use By and Display Until (i.e. the difference between the green and grey segments in the pie charts above). The results of the test show there are no significant differences for pre-packaged carrots ($p=.289$) but there are significant differences for bagged oranges ($p=.015$), with respondents being more cautious with Best Before than with Display Until.

3.4 Results for research question 3

Do consumers respond differently to a sticker-effect label compared with a non-sticker-effect label?

The products tested were yoghurt, orange juice, pre-packaged carrots and bagged oranges.

A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to sticker-effect and non-sticker effect labels. The tests were carried out on Best Before dates for yoghurt, orange juice, pre-packaged carrots and bagged oranges.

Figure 13 Sticker-effect v. non-sticker-effect label presentations



A statistically significant difference ($p < .001$) in the distribution of the two variables was observed for yoghurt, indicating that participants would behave differently in response to a sticker-effect label compared with a non-sticker-effect label. However, no significant differences were found for orange juice ($p = .535$), pre-packaged carrots ($p = .065$) nor bagged oranges ($p = .869$).

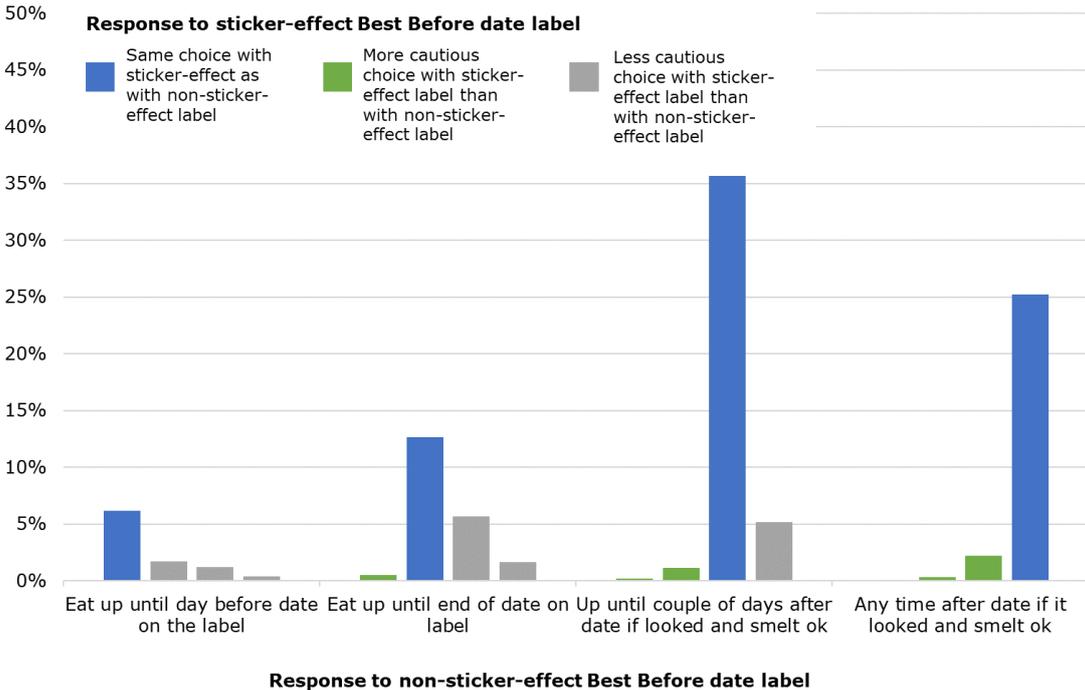
To explore this further for yoghurt, responses to the sticker-effect label and the non-sticker-effect label were cross-tabulated. Each row shows how people responded to the non-sticker-effect Best Before date label for each category of response to the sticker-effect Best Before date; percentages are row-wise. Graphs were also prepared, based on the cross tabulations, to illustrate whether participants would be more or less cautious in response to a sticker-effect Best Before date than a non-sticker-effect Best Before date.

Table 23: Response to sticker-effect Best Before date label compared with response to non-sticker-effect Best Before date label (yoghurt)

Intended behavioural response when presented with non-sticker-effect Best Before label		Intended behavioural response when presented with sticker effect Best Before label				
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would not pay attention to date labels for this type of food
Eat up until day before date on the label (n=94)	n	61	17	12	4	0
	%	64.9%	18.1%	12.8%	4.3%	0.0%
Eat up until end of date on label (n=202)	n	5	125	56	16	0
	%	2.5%	61.9%	27.7%	7.9%	0.0%
Up until couple of days after date if looked and smelled ok (n=416)	n	2	11	352	51	0
	%	.5%	2.6%	84.6%	12.3%	0.0%
Any time after date if it looked and smelled ok (n=274)	n	0	3	22	249	0
	%	0.0%	1.1%	8.0%	90.9%	0.0%
Would not pay attention to date labels for this type of food (n=2)	n	0	0	0	0	2
	%	0.0%	0.0%	0.0%	0.0%	100.0%

Blue shading= same choice for sticker-effect label as for non-sticker-effect label; Green shading = more cautious choice for sticker-effect label compared with non-sticker-effect label; Grey shading = less cautious choice for sticker-effect label than non-sticker-effect label
 Percentages are row-wise i.e. of each non-sticker-effect Best Before label response

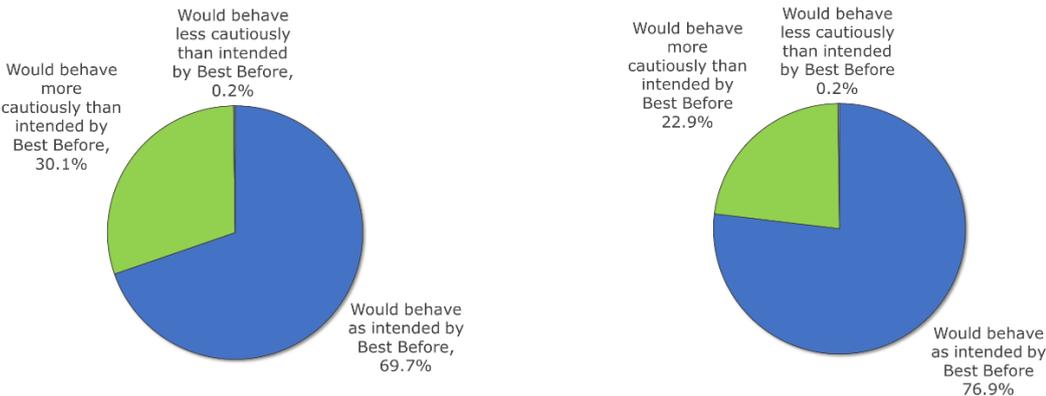
Figure 14 Caution displayed in sticker-effect Best Before choice compared with non-sticker-effect Best Before choice (yoghurt) - % of whole sample



The results show that participants were most likely to say they would behave in the same way for both types of date.

Next, data were recoded to test whether participants' selection was more likely to be as intended by a Best Before label with a sticker-effect than without. Data were therefore recoded into 'intended response' and 'unintended response – more cautious' and 'unintended response – less cautious'.

Figure 15 Intended behaviour when presented with a non-sticker-effect Best Before date (left) and a sticker-effect Best Before date (right) for yoghurt



The data was tested using a Wilcoxon signed rank test to determine whether there were any significant differences.

For yoghurt, significantly more people would behave as intended where a sticker-effect label was used compared with a non-sticker-effect label – 77% compared with 70% ($p < .001$).

3.5 Results for research question 4 Does adding day of the week to a Best Before date make any difference?

The products tested were yoghurt and orange juice.

Figure 16 Sticker-effect v. non-sticker-effect plus day of the week label presentations



A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to the sticker-effect Best Before label and the sticker-effect Best Before label with day of the week added. The tests were carried out on Best Before dates for yoghurt and orange juice.

A statistically significant difference ($p < .001$) in the distribution of the two sets of data was observed for orange juice, indicating that participants would behave differently in response to a sticker-effect label compared with a non-sticker-effect label. However, no significant differences were found for yoghurt ($p = .571$).

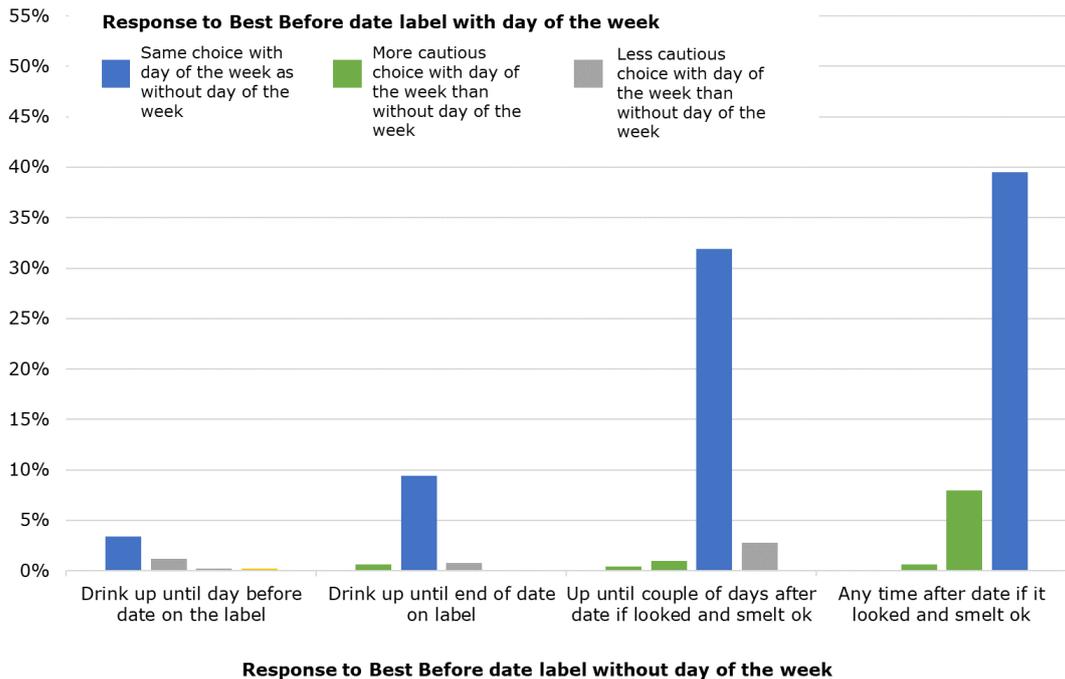
To explore this further, responses to the sticker-effect label and the sticker-effect label with the day of the week added were cross-tabulated for orange juice.

Table 24: Response to sticker-effect Best Before date label with day of the week compared with response to a sticker-effect Best Before date label without day of the week (orange juice)

Intended behavioural response when presented with sticker-effect Best Before label <u>excluding</u> day of the week		Intended behavioural response when presented with a sticker-effect Best Before label <u>including</u> day of the week				
		Eat up until day before date on the label	Eat up until end of date on label	Up until couple of days after date if looked and smelled ok	Any time after date if it looked and smelled ok	Would not pay attention to date labels for this type of food
Eat up until day before date on the label (n=25)	n	17	6	1	1	0
	%	68.0%	24.0%	4.0%	4.0%	0.0%
Eat up until end of date on label (n=54)	n	3	47	4	0	0
	%	5.6%	87.0%	7.4%	0.0%	0.0%
Up until couple of days after date if looked and smelled ok (n=181)	n	2	5	160	14	0
	%	1.1%	2.8%	88.4%	7.7%	0.0%
Any time after date if it looked and smelled ok (n=242)	n	0	3	40	198	1
	%	0.0%	1.2%	16.5%	81.8%	.4%
Would not pay attention to date labels for this type of food (n=11)	n	0	0	1	0	10
	%	0.0%	0.0%	9.1%	0.0%	90.9%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice

Figure 17 Caution displayed in sticker-effect Best Before choice compared with sticker-effect Best Before with day of the week added choice (orange juice)



The results show that participants were most likely say they would behave in the same way for both formats; the graph shows that people were more likely to make a more cautious choice when presented with the day of the week.

To explore this further, data were recoded into 'intended response' and 'unintended response – more cautious' and 'unintended response – less cautious'. The responses were then compared to see whether there were any differences between Best Before labels with and without the day of the week. 'Would not pay attention to date labels for this type of food' was excluded from the analysis due to the small number of participants selecting this option. The recoded data was then tested using a Wilcoxon signed rank test to determine whether there were any significant differences. No significant differences were found ($p=.419$).

3.6 Results for research question 5 Do consumers find some date labels more helpful than others?

Participants were asked to rate the helpfulness of the labels in their everyday decisions about when best to eat each product. They were asked to do so using a seven point scale, where 1 was 'not helpful at all' and 7 was 'very helpful'. Repeated measures analysis of variance (ANOVA) tests² were carried out to determine whether there were any statistically significant differences worthy of further investigation, and the results are shown below.

Table 25: Results of the Repeated Measures Analysis of Variance (ANOVA) Tests

	Use By and three varieties of Best Before		No Label, Display Until and two varieties of Best Before	
	Yoghurt	Orange Juice	Pre-packaged carrots	Bagged oranges
Total sample size (n)	1018	548	980	960
F-test	$F(3,3051)=5.21$	$F(3,1641)=3.02$	$F(3,2937)=307.96$	$F(3,2877)=154.64$
p-value	.001	.029	<.001	<.001
Effect size (partial eta squared)	.005	.005	.239	.139
Significantly different ($p\leq 0.05$)?	YES	YES	YES	YES

The results show that there were significant differences between the label presentations for participants for all four of the product types, so further investigation was undertaken into the nature of those differences by running pairwise comparisons.

² Responses to all but three of the questions about helpfulness were negatively skewed (the other three were positively skewed), but none so much so that the assumption of normality was deemed to have been violated.

The mean helpfulness ratings were compared using an analysis of variance (ANOVA) test with the Bonferroni correction applied. The results are shown in Table 26 and Table 27. Where superscript letters are the same, the results do not significantly differ from each other.

Table 26: Comparison of mean helpfulness ratings (standard deviation shown in brackets) – chilled and fresh products

	Yoghurt	Orange juice	Pre-packaged carrots	Bagged oranges
No label	-	-	3.11 ^a (2.16)	3.14 ^a (2.17)
Display Until	-	-	4.14 ^b (2.05)	3.79 ^b (2.14)
Use By	5.34 ^a (1.68)	5.14 ^{ab} (1.79)	-	-
Best Before	5.33 ^a (1.68)	5.13 ^{ab} (1.74)	4.71 ^c (1.91)	4.24 ^c (2.12)
Best Before sticker	5.45 ^b (1.64)	5.19 ^a (1.76)	4.81 ^d (1.89)	4.31 ^c (2.10)
Best Before sticker + day of the week	5.40 ^{ab} (1.69)	5.04 ^b (1.83)	-	-

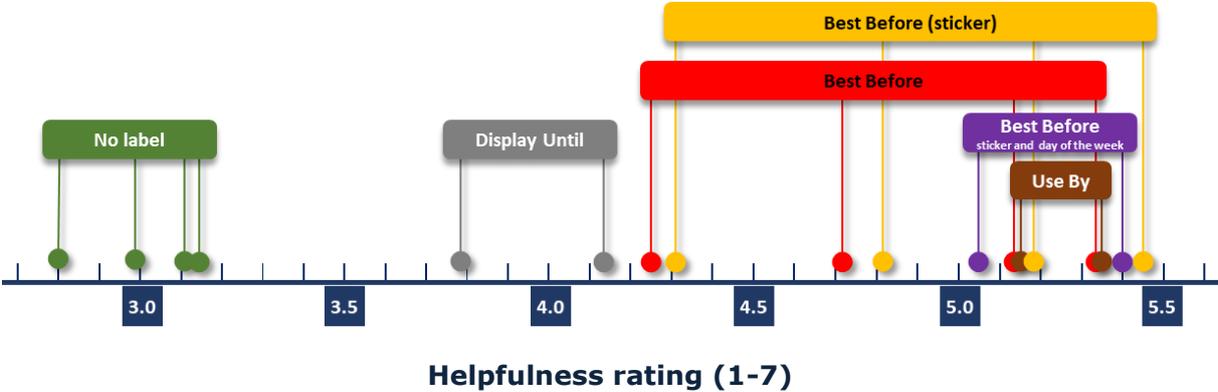
There was no difference in the helpfulness rating given to Use By and Best Before dates (tested for yoghurt and orange juice). However, the Best Before date was rated more helpful than the Display Until date (tested for pre-packaged carrots and bagged oranges).

In terms of format, the sticker-effect Best Before label was rated more helpful than the non-sticker-effect Best Before label for yoghurt and carrots but this effect was not observed for orange juice and oranges.

The addition of day of the week to the sticker was not rated any more helpful; indeed, for orange juice it was rated *less* helpful (tested for yoghurt and orange juice).

Figure 18 shows the relative helpfulness ratings, grouped by type of date label.

Figure 18 Graphical depiction of helpfulness ratings (each circle represents a product type)



4 Storage advice results

4.1 Introduction

This section presents the results of the storage advice investigations, focusing on the way participants to the survey stated they would behave when presented with each label and their rating of the helpfulness of each of label. The section is structured according to the research questions.

4.2 Results for research question 6 Do consumers currently store foods in the optimal way to extend life?

4.2.1 Storage in the fridge

Participants were asked about how they currently store carrots, oranges and bread.³ Carrots and oranges should be stored in the fridge to prolong life; bread should be stored at room temperature and not in the fridge to prolong life.

Table 27: Storage method used for fresh carrots, oranges and bread on the last purchase occasion (of those who purchase the item) – optimal option is shaded green

	Carrots	Oranges	Bread
Room temperature in the open (including shelf and worktop)	9.4%	68.4%	61.8%
Room temperature in the dark (including bread bin and cupboard)	9.7%	6.3%	23.1%
In the fridge	76.2%	15.5%	15.1%
Other	4.6%	9.7%	-
OPTIMAL	76.2%	15.5%	84.9%

Most participants stored carrots and bread optimally (76% and 85%), but most participants did not do so for oranges; just 15.5% put them in the fridge where their life would be extended.

4.2.2 Storage in packaging

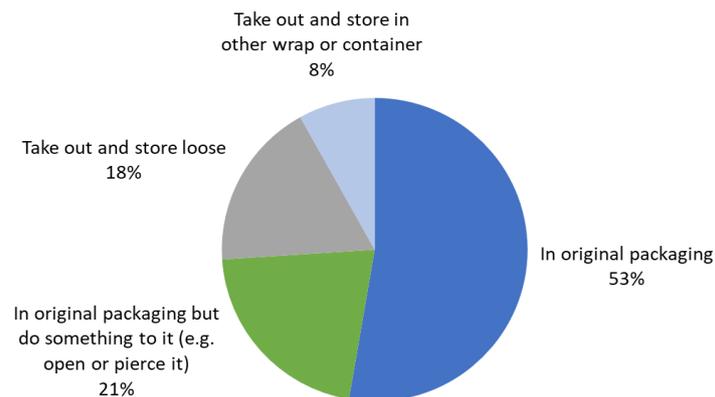
Fresh items that come in packaging should be stored in that packaging until needed. Participants were asked whether they stored pre-packaged carrots in their original packaging on the last purchase occasion. Participants who never buy pre-

³ The question was phrased around what they did on the last buying occasion rather than asking participants to generalise across all buying occasions, for example, "I'd like you to think about the last time you went food shopping and bought fresh carrots. When you returned home, where did you store them?"

packaged carrots were excluded, as were those who said they didn't know or couldn't remember.

Just over half of the participants correctly stored carrots in their original packaging which means 47% of participants potentially lose product life by the way they treat the packaging.

Figure 19 Storage of pre-packaged carrots



4.3 Results for research question 7 Do consumers respond differently to labels containing different types of Freeze By guidance?

4.3.1 Response to Freeze By dates

Chicken portions and bread were the products included for testing Freeze By dates.

Figure 20 Freeze By date presentations



The intended response to a Freeze By date is to freeze the product up until the end of the date on the label. Many consumers are accustomed to being instructed to freeze on the date of purchase.

Participants were asked not only what they would do when presented with the Freeze By label but also what they did the last time they purchased the item. When presented with guidance, significantly fewer participants said they would only freeze the item on the day of purchase and significantly more said they would freeze up to and including the date on the label for both chicken and bread. However, around three quarters of participants would still freeze the product sooner, suggesting there is potential for food waste if they would otherwise throw the product away.

Table 28: Intended freezing behaviour in relation to the guidance presented for chicken portions and bread – optimal option is shaded grey

	Chicken portions***		Bread	
	Typically	With guidance*	Last purchase occasion	With guidance**
Only on day I bought it	47.5%	35.7%	55.8%	41.5%
Up to 1 or 2 days after I bought it	35.1%	21.7%	23.2%	15.0%
Up to 1 or 2 days before the date on the label	4.3%	10.5%	2.4%	5.3%
Up to and including the date on the label	9.5%	26.0%	7.1%	22.3%
Up to 1 or 2 days after the date on the label	2.0%	4.2%	3.0%	5.8%
Anytime until it started to look or smell off	1.5%	1.8%	8.4%	10.0%

Grey shading denotes the response intended by labelling guidelines

* "Freeze by dd.mm.yy"

** "Freeze by date shown on label"

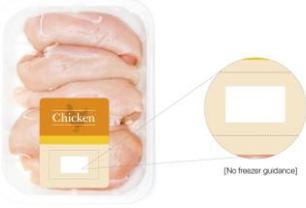
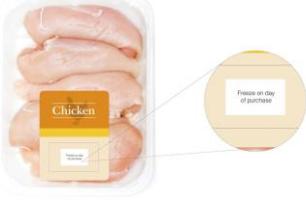
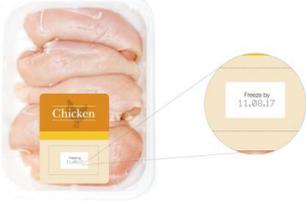
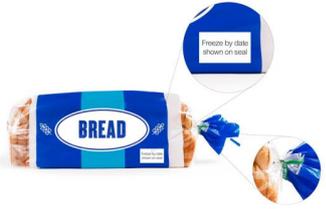
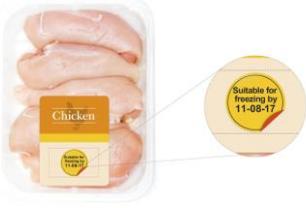
*** Participants were asked about their behaviour in relation to "fresh meat" for typical behaviour and presented with guidance specifically for chicken portions

Four formulations were tested – no freezing guidelines, "freeze on day of purchase", "freeze by [date]" and "suitable for freezing by [date]". There were some differences between the presentations for chicken and bread due to the different food safety requirements. Specifically, a freeze by date would be required for chicken as it has a Use By rather than a Best Before date. The fact that Best Before dates are normally presented on the seal for bread rather than the pack was also reflected in the designs presented.

The "suitable for freezing by [date]" label was presented as a sticker-effect label; all the other freezing labels were presented as non-sticker-effect.

It is worth noting that nearly one quarter (24%) of the sample who were asked about when they typically freeze bread responded that they do not freeze bread. These were not filtered out so did go on to respond to the presentations of guidance even though this is not a behaviour that they typically engage in.

Figure 21 Freeze By guidance presentations

<p>No freezing guidelines</p>		
<p>Freeze on day of purchase</p>		
<p>Freeze by [date] (on seal – for bread)</p>		
<p>Suitable for freezing (by [date] for chicken)</p>		

4.3.2 Do consumers respond differently to a label containing no freezing guidelines compared with Freeze on Day of Purchase?

Responses to the label with no guidance and the identical format “freeze on day of purchase” label were firstly cross-tabulated to explore differences in response. Each row shows how people responded to the “freeze on day of purchase” label for each category of response to the lack of guidelines label; percentages are row-wise.

Table 29: Response to “freeze on day of purchase” label compared with response to equivalent format label without any guidelines (chicken portions)

Intended behavioural response when presented with label without any freezing guidelines	Intended behavioural response when presented with “freeze on day of purchase” label						
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Anytime if it looked and smelled ok (n=97)	n	59	22	1	7	1	7
	%	60.8%	22.7%	1.0%	7.2%	1.0%	7.2%
Depends on how long ago I bought it (n=157)	n	107	39	5	3	2	1
	%	68.2%	24.8%	3.2%	1.9%	1.3%	0.6%
Combination of how long plus look/smell (n=132)	n	59	48	4	13	5	3
	%	44.7%	36.4%	3.0%	9.8%	3.8%	2.3%

Percentages are row-wise

Table 30: Response to “freeze on day of purchase” label compared with response to equivalent format label without any guidelines (loaf of sliced white bread)

Intended behavioural response when presented with label without any freezing guidelines	Intended behavioural response when presented with “freeze on day of purchase” label						
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Anytime if it looked and smelled ok (n=116)	n	63	22	3	5	2	21
	%	54.3%	19.0%	2.6%	4.3%	1.7%	18.1%
Depends on how long ago I bought it (n=112)	n	71	31	2	4	2	2
	%	63.4%	27.7%	1.8%	3.6%	1.8%	1.8%
Combination of how long plus look/smell (n=79)	n	26	28	0	10	4	11
	%	32.9%	35.4%	0.0%	12.7%	5.1%	13.9%

Percentages are row-wise

Despite the categories not being identical (and therefore not amendable to statistical testing), visual inspection of the cross-tabulations suggests that the guidance does have an effect; 54.3% of those who, without guidance, would freeze bread anytime would freeze only on the day of purchase if presented with guidance to do so.

4.3.3 Do consumers respond differently to a label containing “freeze on day of purchase” compared with a freeze by date label?

A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to chicken portions and a loaf of bread.

Statistically significant differences in the distribution of the two sets of data were found for both chicken portions and bread ($p < .001$), indicating that participants would behave differently in response to a freeze on day of purchase label compared with a freeze by date label.

Responses were cross-tabulated to illustrate the differences (Table 31 and Table 32). Each row shows how people responded to the Freeze By date label for each category of response to the “freeze on day of purchase” label; percentages are row-wise. Graphs were also prepared.

Table 31: Response to “freeze by [date]” label compared with response to equivalent format “freeze on day of purchase” label (chicken portions)

Intended behavioural response when presented with “freeze on day of purchase” label	Intended behavioural response when presented with “freeze by [date]” label						
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Only on the day I bought it (n=378)	n	199	49	40	83	7	0
	%	52.6%	13.0%	10.6%	22.0%	1.9%	0.0%
Up to 1 or 2 days after I bought it (n=127)	n	4	69	12	34	7	1
	%	3.1%	54.3%	9.4%	26.8%	5.5%	0.8%
Up to 1 or 2 days before the date on the label (n=13)	n	0	1	7	4	1	0
	%	0.0%	7.7%	53.8%	30.8%	7.7%	0.0%
Any time up to and including the date on the label (n=27)	n	1	1	3	21	1	0
	%	3.7%	3.7%	11.1%	77.8%	3.7%	0.0%
Until 1 or 2 days after the date on the label (n=10)	n	1	2	0	0	7	0
	%	10.0%	20.0%	0.0%	0.0%	70.0%	0.0%
Anytime until it started to look or smell off (n=13)	n	1	0	0	2	1	9
	%	7.7%	0.0%	0.0%	15.4%	7.7%	69.2%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
Percentages are row-wise

Table 32: Response to “freeze by [date]” label compared with response to equivalent format “freeze on day of purchase” label (loaf of bread)

Intended behavioural response when presented with “freeze on day of purchase” label		Intended behavioural response when presented with “freeze by [date]” label					
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Only on the day I bought it (n=233)	n	165	16	9	37	3	3
	%	70.8%	6.9%	3.9%	15.9%	1.3%	1.3%
Up to 1 or 2 days after I bought it (n=89)	n	2	42	5	25	7	8
	%	2.2%	47.2%	5.6%	28.1%	7.9%	9.0%
Up to 1 or 2 days before the date on the label (n=7)	n	0	0	5	1	1	0
	%	0.0%	0.0%	71.4%	14.3%	14.3%	0.0%
Any time up to and including the date on the label (n=24)	n	1	1	1	18	3	0
	%	4.2%	4.2%	4.2%	75.0%	12.5%	0.0%
Until 1 or 2 days after the date on the label (n=8)	n	0	0	1	0	6	1
	%	0.0%	0.0%	12.5%	0.0%	75.0%	12.5%
Anytime until it started to look or smell off (n=35)	n	0	0	0	4	3	28
	%	0.0%	0.0%	0.0%	11.4%	8.6%	80.0%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise

Figure 22 Caution displayed in "Freeze By [date]" choice compared with "freeze on day of purchase" choice (chicken portions) - % of whole sample

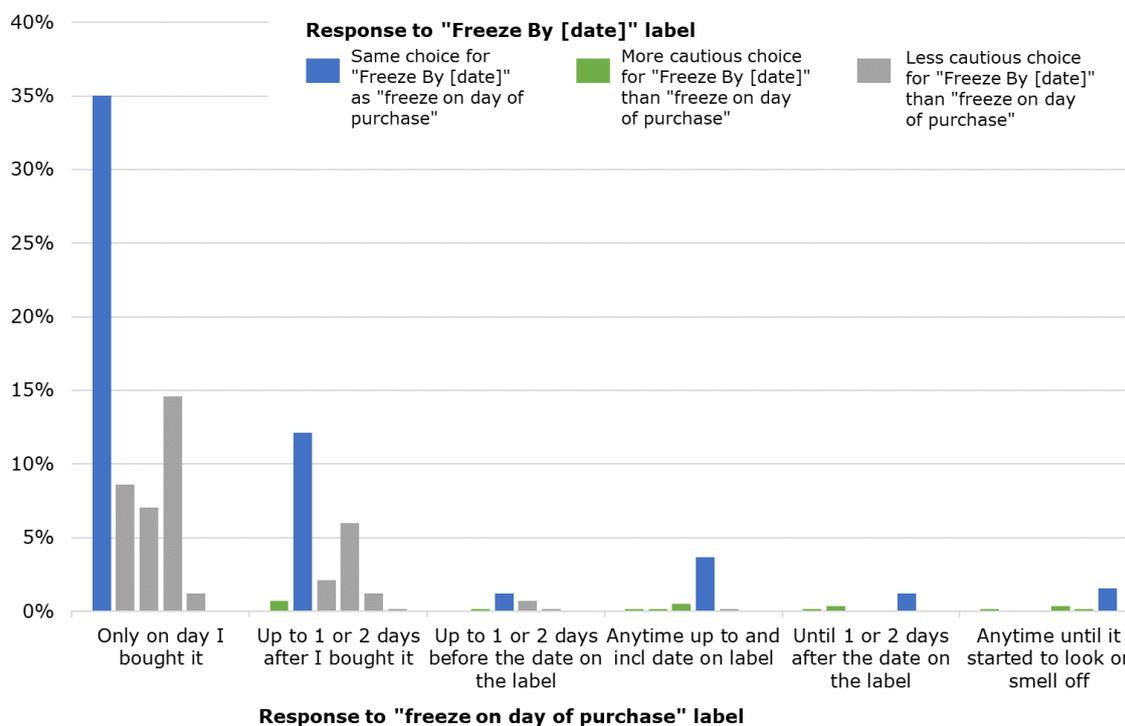
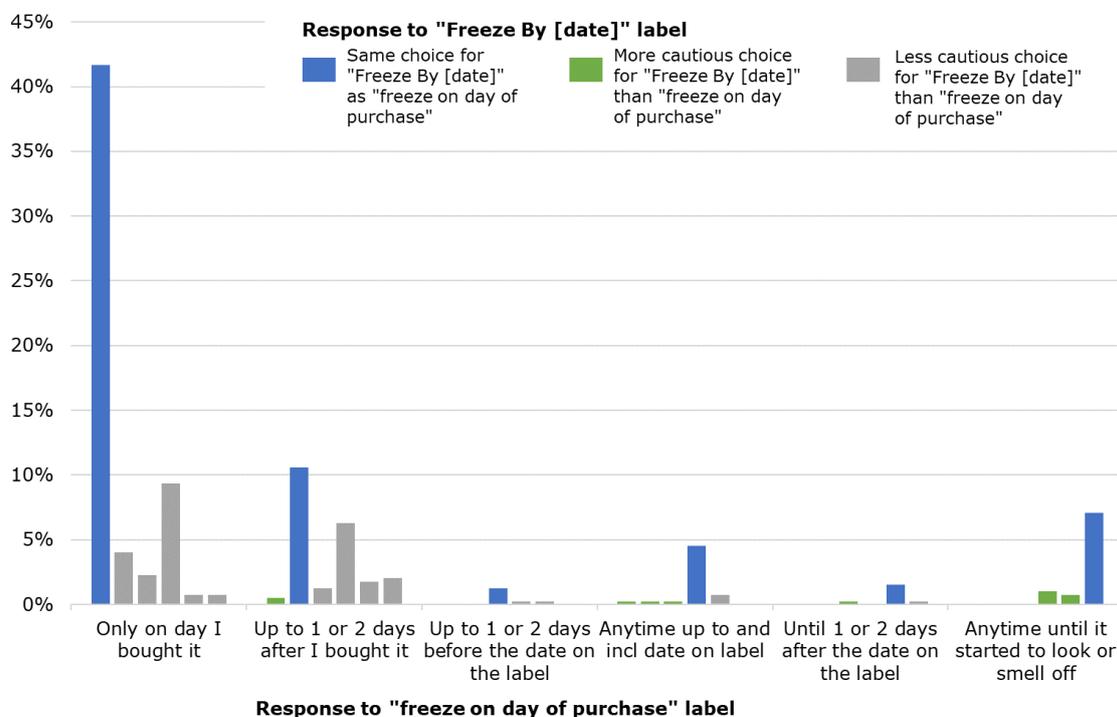
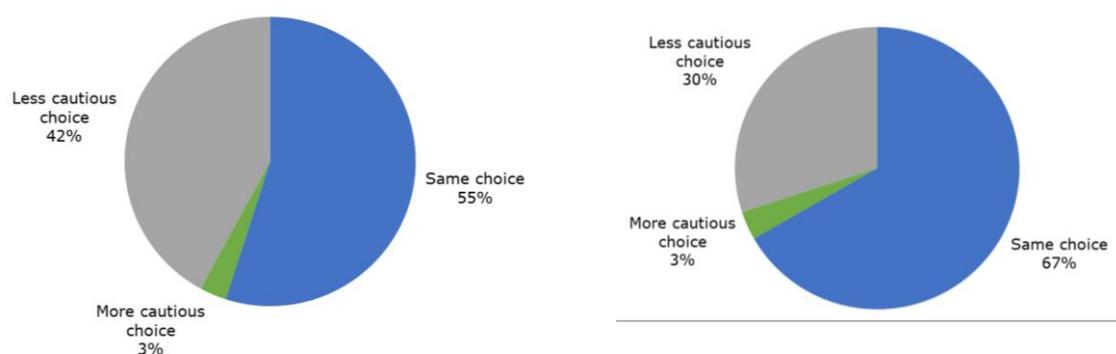


Figure 23 Caution displayed in "Freeze By [date]" choice compared with "freeze on day of purchase" choice (loaf of bread) - % of whole sample



The results show that participants were most likely to say they would behave in the same way for both types of date. Where there were differences in response, the graphs suggest that participants made less cautious choices when presented with guidance encouraging less cautious behaviour. To explore further, data were recoded into 'same choice', 'more cautious choice' and 'less cautious choice'.

Figure 24 Degree of caution shown when responding to Freeze By [date] label compared with a "freeze on day of purchase" label for chicken (left) and bread (right)



The Wilcoxon signed rank test was performed to test whether the degree of caution shown is significantly different between Freeze By [date] and "freeze on day of purchase" (i.e. the difference between the green and grey segments in the pie charts above). Significant differences were found for both chicken and bread ($p=.000$ for both; based on negative ranks with $Z=-12.517$ for chicken and $Z=-8.897$ for bread).

4.3.4 Do consumers respond differently to a label containing "freeze on day of purchase" compared with a "suitable for freezing" label?

A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to chicken portions and a loaf of bread.

Statistically significant differences in the distribution of the two sets of data were found for both chicken portions and bread ($p<.001$), indicating that participants would behave differently in response to a "freeze on day of purchase" label compared with a "suitable for freezing" label.

Responses were cross-tabulated to illustrate the differences (). Each row shows how people responded to the "suitable for freezing" label for each category of response to the "freeze on day of purchase" label; percentages are row-wise. Graphs were also prepared.

Table 33: Response to “suitable for freezing by [date]” label compared with response to equivalent format “freeze on day of purchase” label (chicken portions)

Intended behavioural response when presented with “freeze on day of purchase” label		Intended behavioural response when presented with “suitable for freezing by [date]” label					
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Only on the day I bought it (n=375)	n	202	53	32	82	6	0
	%	53.9%	14.1%	8.5%	21.9%	1.6%	0.0%
Up to 1 or 2 days after I bought it (n=125)	n	2	64	9	36	10	4
	%	1.6%	51.2%	7.2%	28.8%	8.0%	3.2%
Up to 1 or 2 days before the date on the label (n=13)	n	0	1	7	4	1	0
	%	0.0%	7.7%	53.8%	30.8%	7.7%	0.0%
Any time up to and including the date on the label (n=27)	n	0	0	2	25	0	0
	%	0.0%	0.0%	7.4%	92.6%	0.0%	0.0%
Until 1 or 2 days after the date on the label (n=10)	n	1	3	0	0	6	0
	%	10.0%	30.0%	0.0%	0.0%	60.0%	0.0%
Anytime until it started to look or smell off (n=13)	n	0	0	1	1	2	9
	%	0.0%	0.0%	7.7%	7.7%	15.4%	69.2%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise

Table 34: Response to “suitable for freezing” label compared with response to equivalent format “freeze on day of purchase” label (loaf of bread)

Intended behavioural response when presented with “freeze on day of purchase” label		Intended behavioural response when presented with “suitable for freezing” label					
		Only on the day I bought it	Up to 1 or 2 days after I bought it	Up to 1 or 2 days before the date on the label	Any time up to and including the date on the label	Until 1 or 2 days after the date on the label	Anytime until it started to look or smell off
Only on the day I bought it (n=230)	n	84	79	13	18	10	26
	%	36.5%	34.3%	5.7%	7.8%	4.3%	11.3%
Up to 1 or 2 days after I bought it (n=90)	n	20	36	25	3	2	4
	%	22.2%	40.0%	27.8%	3.3%	2.2%	4.4%
Up to 1 or 2 days before the date on the label (n=7)	n	3	1	1	1	1	0
	%	42.9%	14.3%	14.3%	14.3%	14.3%	0.0%
Any time up to and including the date on the label (n=23)	n	6	4	3	7	0	3
	%	26.1%	17.4%	13.0%	30.4%	0.0%	13.0%
Until 1 or 2 days after the date on the label (n=8)	n	1	0	3	0	2	2
	%	12.5%	0.0%	37.5%	0.0%	25.0%	25.0%
Anytime until it started to look or smell off (n=37)	n	14	1	6	0	1	15
	%	37.8%	2.7%	16.2%	0.0%	2.7%	40.5%

Blue shading= same Best Before choice as Use By choice; Green shading = more cautious Best Before choice than Use By choice; Grey shading = less cautious Best Before choice than Use By choice
 Percentages are row-wise

Figure 25 Caution displayed in "suitable for freezing by [date]" choice compared with "freeze on day of purchase" choice (chicken portions) - % of whole sample

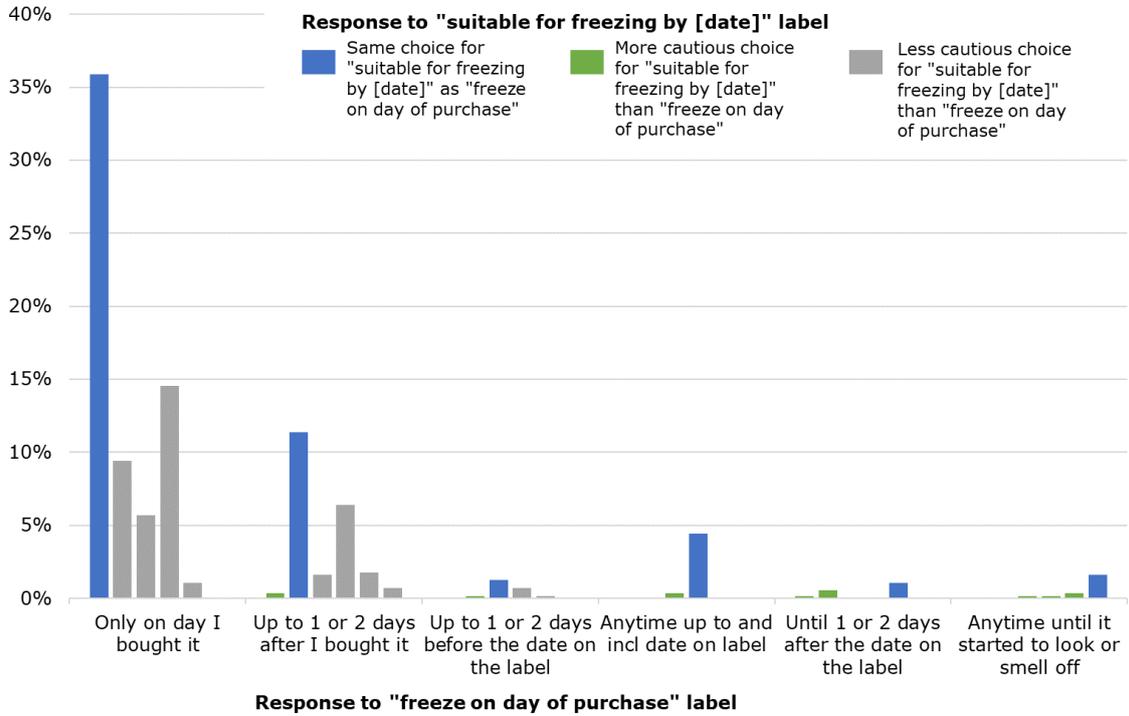
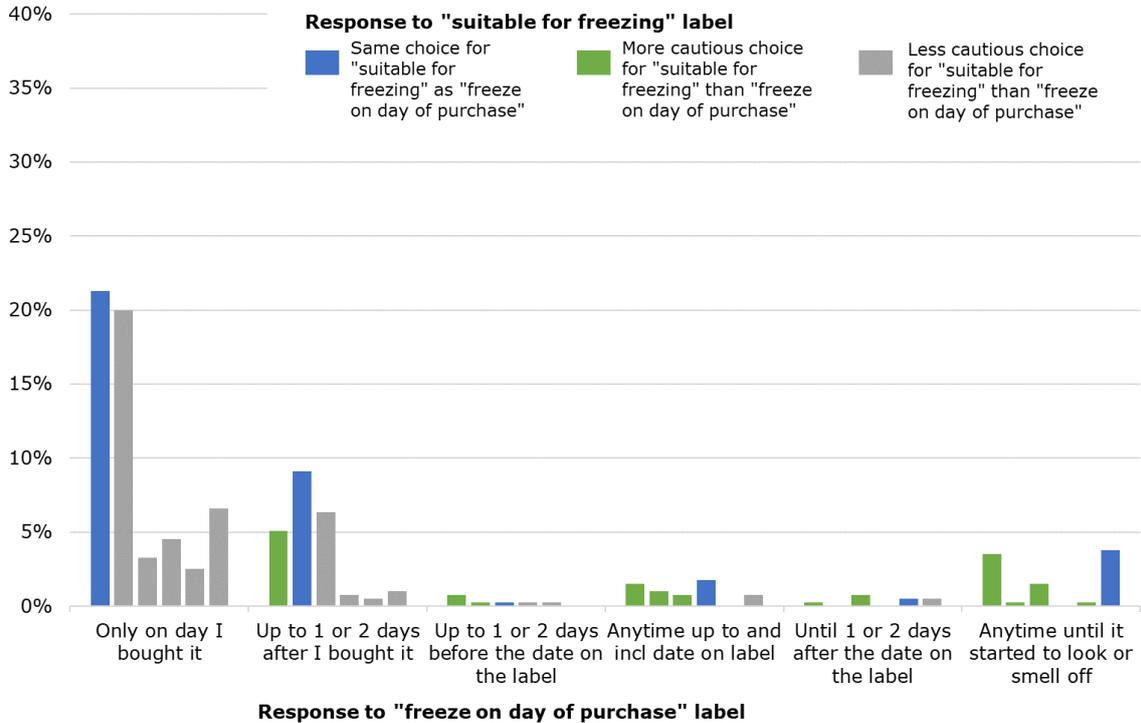
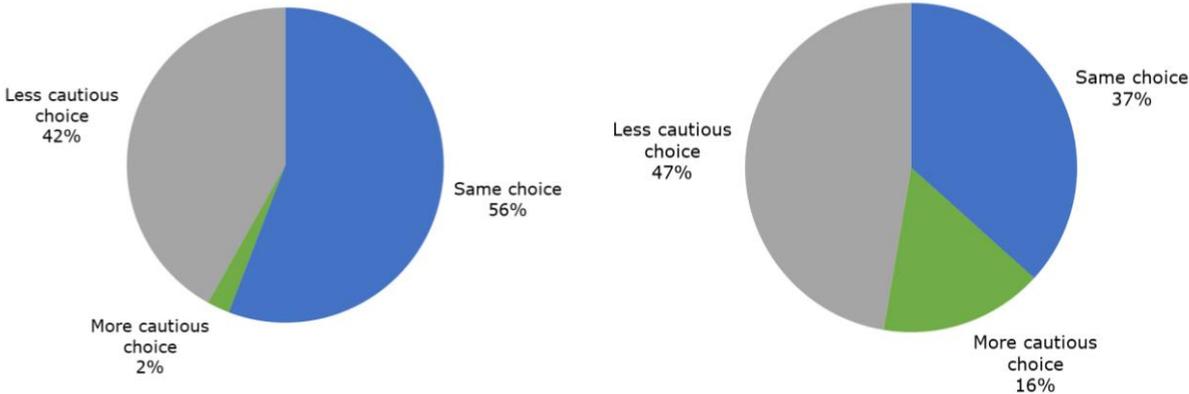


Figure 26 Caution displayed in "suitable for freezing" choice compared with "freeze on day of purchase" choice (loaf of bread) - % of whole sample



The results show that participants were most likely to say they would behave in the same way for both types of date. Where there were differences in response, the graphs suggest that participants made less cautious choices when presented with guidance encouraging less cautious behaviour. To explore further, data were recoded into 'same choice', 'more cautious choice' and 'less cautious choice'.

Figure 27 Degree of caution shown when responding to a "suitable for freezing" label compared with a "freeze on day of purchase" label for chicken (left) and a loaf of bread (right)



The Wilcoxon signed rank test was performed to test whether the degree of caution shown is significantly different between "suitable for freezing" and "freeze on day of purchase" (i.e. the difference between the green and grey segments in the pie charts above). For both chicken and bread there are significant differences ($p=.000$ in both cases; based on negative ranks with $Z=-12.666$ for chicken and $Z=-6.038$ for bread).

4.3.5 Do consumers respond differently to a label containing "freeze by [date]" compared with a "suitable for freezing" label?

A Friedman two-way analysis of variance (ANOVA) by ranks test was carried out to determine whether there are statistically significant differences in the way participants said they would behave in relation to chicken portions and a loaf of bread. No statistically significant differences were found which implies that any differences between responses may have simply been the results of chance. No further exploration of the two variables was carried out.

4.4 Results for research question 8

How effective is guidance in changing normal behaviour?

4.4.1 Storage in the fridge guidance v. behaviour on last purchase occasion

The products tested were pre-packaged carrots, bagged oranges and a packaged loaf of bread. Participants were presented with a label containing guidance on how to store carrots, oranges and bread and asked what they would do in relation to each. Table 35 shows stated behaviour in relation to the guidance; this was presented in an 'advisory tone' using a non-sticker-format.

Figure 28 Storage in the fridge guidance (advisory tone, non-sticker-effect label) presentations



Data were recoded into optimal and sub-optimal. McNemar's Chi-Squared test with continuity correction was performed to determine whether there were significant differences between normal behaviour (last purchase occasion for carrots and oranges; typical behaviour for bread) and intended behaviour in response to seeing the guidance.

For all three products, optimal storage is statistically significantly higher when presented with guidance than on the last purchase occasion ($p < .001$ for all three).

Table 35: Intended storage behaviour in relation to the guidance presented for carrots, oranges and bread – optimal option is shaded green

	Carrots		Oranges		Bread	
	Last purchase occasion	With guidance*	Last purchase occasion	With guidance*	Typically	With guidance**
Sub-optimal storage (room temperature for carrots and oranges, fridge for bread)	20.1%	6.3%	82.0%	28.8%	15.1%	7.4%
Optimal storage (fridge for carrots and oranges, room temperature for bread)	79.9%	93.8%	18.0%	71.2%	84.9%	92.6%

* "For best quality store in the fridge"

** "For best quality DO NOT store in the fridge"

4.4.2 Storage in packaging

Pre-packaged carrots was the product tested for guidance on storing in packaging

Figure 29 Store in original packaging presentation



Participants were presented with guidance that told them to store pre-packaged carrots “in original pack to keep fresher for longer”. Their response to this guidance was recoded into optimal and sub-optimal behaviour. Optimal behaviour was defined as storing in the original packaging for typical behaviour before the survey and as storing *intact* in the original packaging when presented with guidance. Whether the packaging was intact was not asked for the typical behaviour question. Consumers who did not typically buy pre-packaged carrots were excluded from the analysis.

Table 36: Storage of pre-packaged carrots

Typical behaviour before the survey	Intended behavioural response when presented with guidance	
	OPTIMAL Store in <i>intact</i> original packaging	SUB-OPTIMAL Store in another way
OPTIMAL Store in original packaging	n 315	3
	% 99.1%	0.9%
SUB-OPTIMAL Store in another way	n 235	100
	% 70.1%	29.9%

* “Store in original pack to keep fresher for longer”

Table 36 shows that participants were significantly more likely to say they would store carrots in packaging having been presented with instructions to do so; 70% of those typically storing pre-packaged carrots in a sub-optimal way would store them in an optimal way in response to guidance. A McNemar’s chi-squared test with continuity correction was carried out which showed this is statistically significant ($p < .001$).

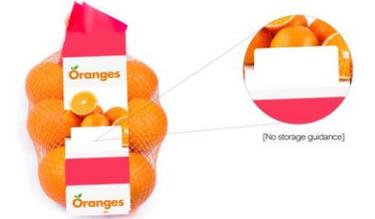
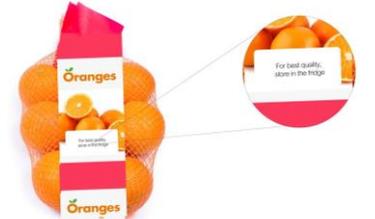
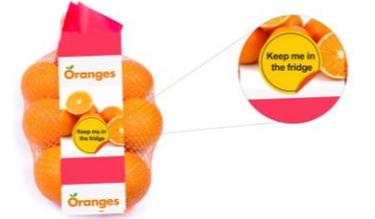
4.5 Research question 9

Are certain types of wording combined with certain types of design more likely to result in optimal choices?

4.5.1 Introduction

Pre-packaged carrots, bagged oranges and a sliced loaf of bread were the products tested for different tones of guidance. Two tones were tested. We refer to the first as 'advisory' and the second as 'directive'. Two visual presentations were tested – a sticker-effect label and a non-sticker-effect label. The sticker-effect label was used only with the directive tone and the non-sticker-effect label only with the advisory tone.

Figure 30 Storage guidance tone presentations

No guidance	Advisory tone	Directive tone
 <p>[No storage guidance]</p>	 <p>For best quality, store in the fridge</p>	 <p>Keep me in the fridge</p>
 <p>[No storage guidance]</p>	 <p>For best quality, store in the fridge</p>	 <p>Keep me in the fridge</p>
<p>Not tested</p>	 <p>For best quality, do NOT store in the fridge</p>	 <p>Do NOT store in the fridge</p>

For pre-packaged carrots and bagged oranges, participants were presented with 'for best quality store in the fridge' without a sticker (advisory tone) and 'keep me in the fridge' with a sticker (directive tone). Participants' intended behaviour responses are compared with their typical behaviour in a cross-tabulation of the results (Table 37 – percentages are column-wise). Survey participants who did not buy pre-packaged carrots or bagged oranges were excluded from the analysis.

McNemar's chi-squared tests with continuity correction were run to determine whether differences between the different presentations were statistically significant. This is denoted in the tables using the convention of superscript letters showing where there are no significant differences, looking across each row at the optimal choice.

Table 37: Intended storage behaviour in relation to different presentations of guidance for pre-packaged carrots

		Intended behavioural response when presented with guidance			
		Last purchase occasion	Blank label	Advisory tone non-sticker-effect label	Directive tone sticker-effect label
OPTIMAL Store in fridge	n	545	535	615	627
	%	79.9% ^a	83.9% ^a	93.8% ^b	95.0% ^c
SUB-OPTIMAL Store at room temperature	n	137	103	41	33
	%	20.1%	16.1%	6.3%	5.0%

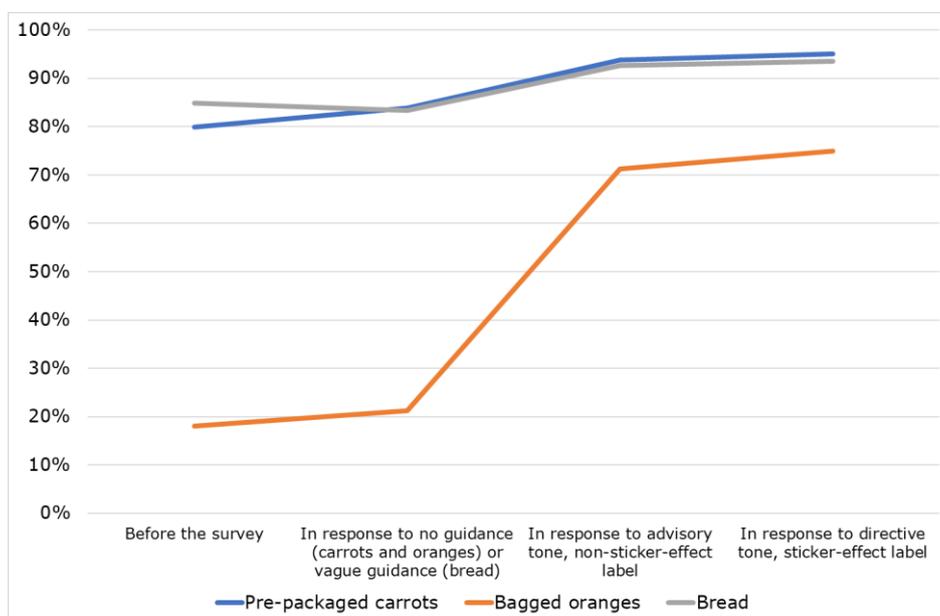
Table 38: Intended storage behaviour in relation to different presentations of guidance for bagged oranges

		Intended behavioural response when presented with guidance			
		Last purchase occasion	Blank label	Advisory tone non-sticker-effect label	Directive tone sticker-effect label
OPTIMAL Store in fridge	n	122	139	472	495
	%	18.0% ^a	21.2% ^a	71.2% ^b	74.9% ^c
SUB-OPTIMAL Store at room temperature	n	557	518	191	166
	%	15.9%	78.8%	28.8%	25.1%

Table 39: Intended storage behaviour in relation to different presentations of guidance for loaf of sliced bread

		Intended behavioural response when presented with guidance			
		Typically before the survey	"Store in a cool dark place"	Advisory tone non-sticker-effect label	Directive tone sticker-effect label
OPTIMAL Store at room temperature	n	562	525	591	594
	%	84.9% ^a	83.3% ^a	92.6% ^b	93.5% ^b
SUB-OPTIMAL Store in the fridge	n	100	105	47	41
	%	15.1%	16.7%	7.4%	6.5%

Figure 31 Percentage of participants making the optimal storage choice (fridge or room temperature) before the survey and in response to different forms of guidance



As might be expected, no statistically significant differences were found between the way respondents stored pre-packaged carrots and bagged oranges before the survey and in response to no guidance. The same applies to bread, for which no differences were found between the way respondents stored it before the survey and in response to the vague “store in a cool dark place” guidance. Advice significantly improves storage behaviour ($p < .001$ for all three products). The directive tone sticker effect label is significantly more effective for carrots ($p = .049$) and oranges ($p = 0.45$) but this effect is not observed for bread ($p = .405$).

4.6 Research question 10

Do consumers find some types of storage guidance more helpful?

4.6.1 Freezer storage

We investigate the extent to which participants found certain types and design of guidance more helpful than others in relation to freezer storage.

Analysis of variance (ANOVA) tests⁴ were carried out to determine whether there were any statistically significant differences worthy of further investigation, and the results are shown below. The sticker-effect label was rated significantly *less* helpful for bread and there was no difference for chicken; however, the wording

⁴ Responses to all but three of the questions about helpfulness were negatively skewed (the other three were positively skewed), but none so much so that the assumption of normality was deemed to have been violated.

was different between the two presentations which complicates interpretation of the results.

Table 40: Comparison of mean helpfulness ratings (standard deviation shown in brackets) – freezing

	Chicken portions	Bread
No label	2.80 ^a (2.18)	2.99 ^a (2.11)
Freeze on day of purchase, non-sticker effect	5.05 ^b (2.07)	4.46 ^b (2.25)
Freeze by [date], non-sticker-effect	5.11 ^b (1.93)	4.20 ^c (2.22)
Suitable for freezing, sticker-effect	5.09 ^b (2.03)	3.85 ^d (2.21)

4.6.2 Fridge storage

Repeated measures analysis of variance (ANOVA) tests⁵ were carried out to determine whether there were any statistically significant differences worthy of further investigation, and the results are shown below.

Table 41: Results of the Repeated Measures Analysis of Variance (ANOVA) Tests

	No label, advisory tone, directive tone, store in original packaging		No label, 3 x freezing instructions	
	Pre-packaged carrots	Bagged oranges	Chicken portions	Bread
Total sample size (n)	682	684	651	542
F-test	$F(3,2043)=555.79$	$F(2,1366)=607.89$	$F(3,1950)=362.89$	$F(3,1623)=102.93$
p-value	<.001	<.001	<.001	<.001
Effect size (partial eta squared)	.449	.471	.358	.160
Significantly different (p≤.05)?	YES	YES	YES	YES

The results show that there were significant differences between the label presentations for participants for all four of the food types, so further investigation was undertaken into the nature of those differences by running pairwise comparisons.

The mean helpfulness ratings were compared using an analysis of variance (ANOVA) test with the Bonferroni correction applied. The results are presented in Table 42. Where superscript letters are the same, the results do not significantly differ from each other, reading row-wise.

⁵ Responses to all but three of the questions about helpfulness were negatively skewed (the other three were positively skewed), but none so much so that the assumption of normality was deemed to have been violated.

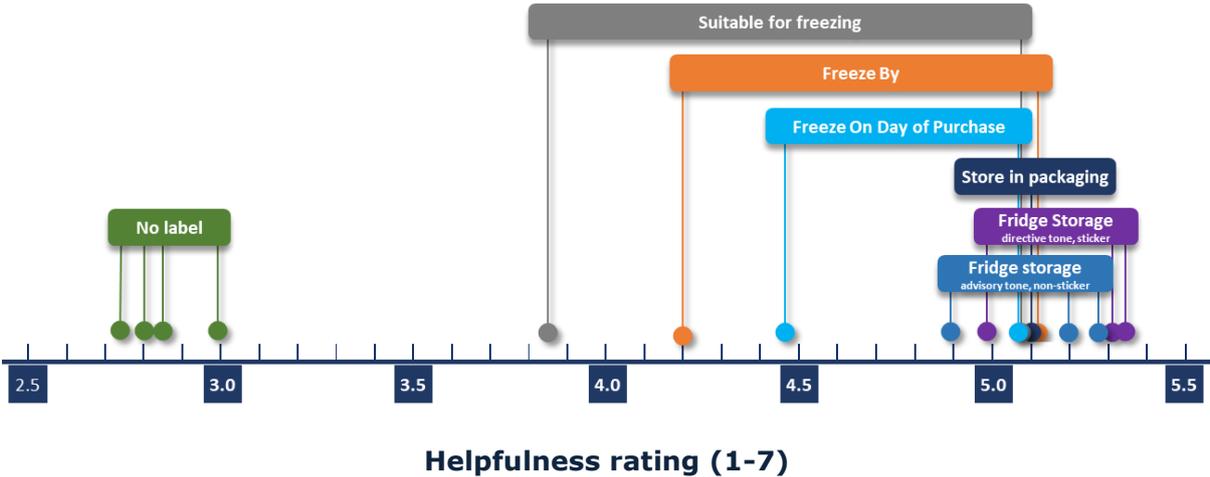
Table 42: Comparison of mean helpfulness ratings (standard deviation shown in brackets) – fridge storage

	Intended behavioural response when presented with guidance		
	No label	Advisory tone, non-sticker-effect	Directive tone, sticker-effect
Pre-packaged carrots	2.73 ^a (2.07)	5.29 ^b (1.76)	5.33 ^c (1.79)
Bagged oranges	2.83 ^a (2.09)	5.20 ^b (1.78)	5.36 ^c (1.78)
Chicken portions	2.80 ^a (2.18)	5.05 ^b (2.07)	5.11 ^b (1.93)
Bread	2.99 ^a (2.11)	4.46 ^b (2.25)	4.20 ^c (2.22)

The results show that both types of guidance label were preferred to the label containing no guidance, and that except for chicken portions, the directive tone sticker-effect label was preferred to the advisory tone non-sticker-effect label. For bread the helpfulness ratings are noticeably lower for both types of guidance than for carrots and oranges.

Figure 32 shows graphically the spread of the helpfulness ratings. It clearly illustrates the extent to which guidance was more helpful than no guidance, the discrepancy between the helpfulness of the suitable for freezing guidance for bread (at 3.89) and chicken portions (at 5.09), and the relatively little difference between the two types of fridge storage guidance.

Figure 32 Graphical depiction of helpfulness ratings (each circle represents a product type)



5 Discussion and conclusions

This chapter discusses the results presented in chapters 3 and 4 on date labelling and storage guidance. It is structured around the specific research questions that were posed in chapter 1.

5.1 Research question 1

Do consumers respond in the way intended by the date label?

5.1.1 Use By dates

Use By dates are applied where there is a food safety risk if a product is not used before a particular date. Products with Use By dates should always be consumed before the date. Yoghurt and orange juice – the two products tested in this research – may have either Use By or Best Before dates.

Most participants in the study would respond as intended and eat up to and including the Use By date. While a small proportion were more cautious, and an even smaller proportion did not pay attention to the date label at all, most participants would use their senses to determine whether the products tested were good to eat (78% for yoghurt and 71% for orange juice).

While at face value this is good news for food waste, suggesting that disposing of these products at Use By date regardless of the state of the food is uncommon, this behaviour is not something to be encouraged; Use By dates should be complied with.

Although not tested in this research, it is possible that this behaviour would not transfer to other products such as fresh meat, fish and dairy produce that are typically deemed riskier from a food safety perspective. Yoghurt and orange juice are unusual in that they may carry Use By or Best Before dates, depending on the preparation method and ingredients, so another explanation is that the participants knew from their own experience that eating until the product looks or smells bad is low risk.

Further research would be required to determine the extent to which these results can be generalised to other products.

5.1.2 Best Before dates

Best Before dates are applied as a guide to food quality. The intended response to a Best Before date is for a consumer to refer to the date as a guide but also rely on judgement to decide whether the food is good to eat.

While most participants would use the dates as intended, a sizeable minority would be more cautious, eating only up until the end of the date on the packaging, so in effect using it like a Use By date. This suggests there may be a risk of food waste if this group do not consume products in time as they may simply dispose of them at this point without checking whether they could still be eaten.

5.1.3 Display Until

Display Until dates are placed on packaging to help stock management within a store. The intended consumer response to a Display Until date is for it to be ignored completely since it is not an instruction to the consumer. However, few participants ignored them completely, just 13.5% for pre-packaged carrots and 23.2% for bagged oranges. More worryingly, a minority treated Display Until dates like Use By dates and would only eat food up until the date; 11.7% said they would do so for pre-packaged carrots and 8.1% for bagged oranges. This is concerning from a food waste perspective because it suggests food past a Display Until date, which bears no relationship to food safety and little relationship to food quality, would be thrown away prematurely.

5.1.4 Conclusions

Overall, there are a significant minority of consumers not behaving in line with the expectations of the various types of date label. This suggests that they are not well understood, or if they are understood they are widely ignored. This is problematic because misunderstanding date labels can lead to food waste.

5.2 Research question 2

Do consumers respond to different date labels differently?

5.2.1 Absence of a date

Some products do not have to have date labels, for example if they pose no risk to safety. If a product does not have a date on it, consumers must either judge whether it is good to eat by the look and smell, or by making an assessment against when it was purchased. It would be possible for many fresh and ambient products not to carry a Best Before date.

The research suggests that removal of Best Before dates would not make much impact on consumers. Many participants in the study said they would use their senses to make the decision if there was no date (50% for carrots and 51% for oranges). And even when a Best Before date was available, many would not use it as a reference point for deciding when to eat the food (77.4% for oranges, for example). Only a tiny minority of participants would rely solely on their senses (i.e. not refer to purchase date) to make the decision if there was no date but abide strictly by the date if there was one (2% for oranges).

This suggests that removal of Best Before date would have limited impact on food waste although equally it would do no harm.

5.2.2 Best Before and Use By

Most participants would behave the same way in response to a Best Before date as a Use By date. This is potentially a cause of food waste if good food is thrown away when it reaches its Best Before date. However, interpretation of these results is complicated by the fact that most participants would not respond to Use By dates

correctly. This means that participants are eating past both Use By and Best Before dates, relying on their senses to determine whether the food is good to eat. This is to be encouraged for food with Best Before dates but discouraged for food with Use By dates.

Overall, this shows the importance of ensuring Use By dates are applied correctly and not over-cautiously, and then promoting better understanding of the meaning of the date labels.

5.2.3 Display Until and Best Before

In terms of food waste, eating only up until a Best Before date is of concern, but it is recognised that the dates have a role to play in assessing whether something is good to eat. Eating up until the Display Until date is more concerning because these dates are largely unrelated to food safety or quality, but to in-store stock management. They generally appear on the own-brands of large retailers.

Most participants made the same choice for Display Until as Best Before – 76% for pre-packaged carrots and 78% for bagged oranges. Of the remainder, there is a reasonably even split between those who would make a more cautious Display Until choice and a less cautious Display Until choice.

5.2.4 Conclusions

The research shows that participants' responses to the different dates are overwhelmingly similar, suggesting either that there is widespread confusion, or that the dates are unimportant in consumers' decision-making processes. This is concerning for several reasons. In terms of food waste, treating Display Until and Best Before dates the same as a Use By date is the most concerning behaviour because it suggests food is being unnecessarily thrown away.

- 21.0% treated a Best Before on yoghurt as a Use By
- 15.3% treated a Best Before on orange juice as a Use By
- 9.0% treated a Display Until on pre-packaged carrots as a Use By
- 6.2% treated a Display Until on bagged oranges as a Use By

The study suggests that consumer education is required on the meaning of different dates, and the importance from a food waste perspective of not being over-cautious.

It indicates removing Best Before dates altogether where that is a legal possibility may have less impact than might be expected; for the products tested few people would rely solely on the date to make a decision about whether the food was good to eat. Below we also show that date labels are popular with consumers who generally find them helpful.

Removal of unnecessary Use By dates may be helpful. For orange juice, 24.7% of participants made a less cautious choice in response to a Best Before date compared with a Use By date, meaning that food had more opportunity to be eaten. However, the opposite was true for yoghurt (16.6% made a more cautious choice) so this would need further research on a wider range of product types to be certain.

5.3 Research question 3

Do consumers respond differently to sticker-effect labels?

The sticker-effect label was designed to be more eye-catching than the non-sticker-effect label, although design compromises for the survey along with the somewhat artificial test environment meant that it was perhaps less effective than it might have been. Overall the evidence about effectiveness is mixed with only the label on yoghurt resulting in more appropriate behaviour and no effect being found for orange juice, pre-packaged carrots or bagged oranges. However, the principle of making labels more salient is sound and solidly backed by theory, so we believe this should be further explored in a real-life setting using a style and colour of label that stands out more against the product.

5.4 Research question 4

Does adding the day of the week to a Best Before label make any difference?

We theorised that relatively few people will know the date without checking but that most would know the day of the week (Monday, Tuesday etc.). Adding the day of the weeks that corresponds to the date should therefore make it easier for people to plan, to know whether something is in or out of date, and therefore to eat food in time. This should reduce the incidence of food being thrown away unnecessarily because someone thinks the date has passed.

No evidence was found to support this theory, with most participants saying they would respond in the same way as the Best Before label without the day of the week and of those that would behave differently there was a relatively even split between those who would behave more cautiously and those who would behave less cautiously.

We believe that the artificial test environment may have influenced this finding and believe that the approach is worth further testing in a real-world setting.

5.5 Research question 5

Do consumers find some date labels more helpful than others?

Some labels are significantly more helpful to consumers than others. Reassuringly, all the labels that were tested were rated more highly than no label. Display Until was also rated less helpful than all the other labels.

The sticker-effect label received mixed feedback, being rated more helpful than non-sticker-effect label for yoghurt and carrots, no different for orange juice, oranges and chicken, and less helpful for bread. As discussed above, it is worth testing this further in a real-world setting using a more salient sticker-effect presentation.

The addition of day of the week was not regarded as more helpful, in fact it was rated less helpful for orange juice.

5.6 Research question 6

Do consumers currently store foods in the optimal way to extend life?

To prolong life, fresh produce should generally be stored in the fridge while bread should not be stored in the fridge. Most participants correctly store carrots in the fridge (76.2%) and bread at room temperature (84.9%), but store oranges incorrectly at room temperature (74.7%). This suggests there may be scope for educating consumers about the optimum storage locations for fresh fruit and vegetables.

Products that are bought in packaging should generally be stored in that packaging until required to prolong life. Only just over half of the study participants correctly stored carrots in the original packaging, which suggests there is scope for education and on-pack guidance.

5.7 Research question 7

Do consumers respond differently to labels containing different types of freeze by guidance?

Freeze By guidance is put on products to ensure food safety (for products with Use By dates, for example) and to increase the likelihood of a quality product once defrosted. Until recently, typical guidance has been to freeze on day of purchase, but this is not necessary, and food can safely be frozen until the end of the date on the label, be that Use By or Best Before.

Many consumers are not behaving in line with the intended behaviour; just 9.5% of consumers typically do so for fresh meat and 7.1% did so on their last bread purchase occasion. Even with guidance, the most common response was still to freeze on the date of purchase (35.7% for chicken and 41.5% for bread). This suggests that consumers may be unnecessarily throwing away food that has reached its date, for example that could not be used in time, rather than freezing it.

The study shows that many participants would comply with guidance provided but might behave differently when faced with different or no guidance. For example, 58.3% of participants said they would freeze chicken on the day of purchase when given "freeze on day of purchase" instructions, but 26.2% these same individuals when faced with no guidance would freeze it anytime if it looked and smelled ok. Similarly, 42.3% of participants would freeze bread on the day of purchase when given this instruction, but 39.4% of these would freeze it anytime if it looked and smelled ok in the absence of guidance.

Having said that many participants were influenced by the guidance provided, freezing products only on the day of purchase seems to be a somewhat engrained behaviour; 35.0% of participants would do so for chicken even when provided with a freeze by date and 41.7% would do so for bread. Whether this is simply a storage

practice following a shopping trip or whether there are deeper concerns about food safety would require further research. Where participants made a different choice of behaviour in response to a freeze by date compared with a freeze on day of purchase instruction it was often a less cautious choice, indicating that food waste may be avoided by moving away from freeze on day of purchase guidance.

5.8 Research question 8

How effective is guidance in changing storage behaviour?

The study indicates strongly that providing guidance about optimal storage location is likely to change behaviour. Participants were significantly more likely to choose the optimal option when provided with guidance than their typical approach to storage or their approach on the last purchase occasion. For example, just 18.0% of participants stored bagged oranges in the fridge when they last purchased them, but 71.2% said they would do so in response to guidance suggesting “for best quality store in the fridge”. Even for carrots and bread which were already being stored optimally by most participants, significant increases in intention to store optimally occurred, an increase of 13.4 percentage points to 93.8% for carrots and 7.7 percentage points to 92.6% for bread.

Similarly, in response to guidance on storing carrots in packaging 84.2% would do so, compared with 48.7% of participants before the survey, an increase of 35.5 percentage points.

This suggests that storage guidance, more so than date labelling guidance, has a role to play in changing the behaviours that lead to food waste.

5.9 Research question 9

Are certain types of wording combined with certain types of design more likely to result in optimal choices?

The study found a clear link between certain tones and presentations of guidance and optimal behaviour. Directive tone guidance using sticker-effect labels was significantly more effective than advisory tone guidance using non-sticker-effect labels, and both were more effective than no guidance. For example, 79.9% of study participants stored carrots optimally in the fridge on the last purchase occasion, but this increased to 95.0% when provided with directive tone, sticker-effect guidance. Even more dramatically, for oranges a directive tone, sticker-effect label increased optimal behaviour by 56.9 percentage points from 18% to 74.9%.

This lends support to our previous conclusions that storage guidance has a significant role to play in reducing food waste, and that sticker-effect labels should be further tested in real-world settings.

5.10 Research question 10

Do consumers find some types of guidance more helpful?

Reassuringly, all the labels were rated more helpful on average than no guidance. There should be further research into bread as all guidance related to bread was rated lower than other products. As well as being the most effective, directive tone sticker-effect guidance was also rated as the most helpful.

5.11 Research limitations

This section considers the limitations of the research.

5.11.1 Size and representativeness of the sample

Between 22% and 55% of the country samples either work or study in the environmental and/or food sectors, most likely a reflection of the professional and personal networks of the project partners who circulated the viral survey.

The use of convenience sampling means the results of this study should be generalised with caution and viewed as indicative of the situation in the four countries. That said, there were no notable patterns in the differences in responses between demographic groups, or between those who do and do not study/work in the food or environmental sectors, which offers some reassurance that the results are a broad reflection of the views and intended behaviours of the populations of Hungary, Germany, the Netherlands and Spain.

As participants only saw one product type in the date marks section and one product type in the storage section, the sub-samples per country for individual product types are small, just over 100 participants in some cases.

5.11.2 Impact of translating the questionnaire

The questionnaire was prepared in English and translated by project partners in each member state. The act of translation can be subjective, and translations were not cross-checked for variability in interpretation. Therefore, there could be subtle or even substantive differences between the meaning and intention in English text and the equivalent in the country surveys.

5.11.3 Impact of design decisions

One of the research questions of the study was whether participants would respond differently (more positively) to labels where the information was presented in a 'sticker' format. The intention was to increase the salience of these labels by making them simpler and more noticeable. However, decisions made during the research design phase determined that all labels had to stand-out to some extent. The reasons for these decisions were:

- Translations: If the guidance was presented amidst other on-pack information, this information would also require translation, resulting in over 120 pieces of additional translation, increasing project time and costs

- Designs: Similarly, these 120+ translations would need to be integrated into the designs, increasing design time and costs
- Ease of accessing the information for participants: It was important that the labels were sufficiently legible, which was not the case with early designs where the information was smaller and less discernible alongside other on-pack information.

The outcome of the final, stylised designs was that the salience of all the labels was increased thereby potentially reducing the differential impact of the stickers.

5.11.4 Intended versus actual behaviour

This study examines different contents and formats of on-pack guidance information and its effect on consumer understanding and food waste behaviours. The effect is measured by gauging consumers' stated intended behaviour in response to exposure to different treatments. It is therefore reliant on the participants' hypothetical reasoning about what they might do in the future. However, in answering the question, participants were not constrained by their real-life situations (e.g. space in the fridge; a perception of reduced quality after freezing bread; not reading the label, etc.).

"Research into intended, future behaviour may be biased because of its hypothetical and/or prospective character... [The practicalities] might be underestimated or wrongly judged because of the lack of actual experience. A gap between intended and actual behaviour could result." (Wagner 2003)

Furthermore, Kahneman (2011) suggests that while people's 'system two' mindset, which is slower, more deliberative and rational, will attempt to predict what we will do in a particular context, our fast, instinctive and emotional 'system one' mindset is more likely to drive our actual behaviour in a given situation.

This report suggests that, for instance, on-pack information is likely to be effective in encouraging consumers to store their oranges in the fridge. However, the vast majority of packaged apples in the UK do have guidance directing consumers to store them in the fridge (WRAP 2017) and yet less than a quarter follow this advice (WRAP 2016).

Nonetheless, despite this constraint the research has succeeded in filtering the many possible label modifications and has helped to identify suitable candidates for future research. It is recommended that, in any future pilots, the prototype labels are created as close as possible to the final manufactured versions, appear on the products themselves and that actual behaviour is observed in people's homes.

6 Recommendations

6.1 Recommendations for manufacturers and retailers

To capitalise on the potential for on-pack labelling to help reduce food waste, manufacturers and retailers should consider removing Use By dates for products where they are not required, removing or codifying Display Until dates since these can cause consumer confusion, replacing 'freeze on day of purchase' with 'freeze by [date]' and including guidance on where and how to store fresh produce.

6.2 Recommendations for further research

The research has indicated that an instructional messaging style was preferred to a guidance style. Further research on a wider range of products and a wider range of guidance styles is required to confirm this finding applies more widely than just the products tested.

Because the research was unable to draw firm conclusions about more and less effective label formats, a programme of real-world testing of different approaches and designs would be beneficial.

The nature of the research meant that only a small number of products could be tested; for example, only pre-packaged carrots were tested in relation to storing in the original packaging. To generalise more conclusively about behaviours and the likely impact of optimised on-pack labelling, more products and more formats should be tested. This is particularly important for Use By dates where the products tested were some of the least risky ones.