

EVIDENCE AND INSIGHTS

Reducing household food waste and plastic packaging

Ground-breaking new research into the factors affecting how much uncut fresh-produce goes to waste in the home.



FOREWORD

Challenging the Status Quo



Marcus Gover
CEO, WRAP

We're on a mission to protect our planet by driving down food waste and tackling the scourge of plastic pollution.

Our partners in the Courtauld Commitment 2030 and The UK Plastics Pact are leading the way and we've made good progress. But we must now radically challenge the status quo to ramp up action.

Our new bold recommendations on the packaging and labelling of uncut fresh-produce such as bananas and broccoli, the result of ground-breaking new research, will drive the scale of change which is now required.

We are calling upon retailers to sell uncut fresh fruit and veg loose unless they can show there is a compelling reason not to. If fruit and veg do have to be sold in packs, we want retailers to remove date labels, unless having a Best Before date will reduce food waste. And we highlight the need for retailers to support customers in purchasing what they need and storing fresh-produce in the right place and at the right temperature.

We have shed new light on why so much fresh-produce is wasted in our homes and the interaction between wasted food, plastic packaging, date labels and food storage. This has been achieved by combining technical studies on specific food items, in-depth examinations of human behaviour and state-of-the-art modelling in a way never to have been done before.

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We have shed new light on why and how so much food is wasted in our homes and the interaction between food waste, plastic packaging, date labels and food storage.
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We found that storing food in the fridge below five degrees gave days, weeks, and in the case of apples, months more quality product life. We found that for most items, the plastic packaging they were sold in made little or no difference to their shelf life. In cases where consumers had no choice but to buy more than they needed in pre-packed packaging, this could actually increase food waste. We also looked deeper at how consumers respond to date labels, strengthening the evidence showing that food still good enough to eat is discarded because some people are swayed by Best Before dates.



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With the reality of the climate emergency all around us, this new clarity marks a key moment in our journey with partners.
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The scale of opportunity is significant.

- By adopting our recommendations just for the five items we studied, 100,000 tonnes of household food waste could be prevented each year – the equivalent of **14 million shopping baskets of food**.
- It would also amount to 10,300 tonnes of plastic packaging removed – a combined CO₂e emissions saving of 130,000 tonnes a year.
- And at a time when people are facing rising fuel and food prices, there is also a compelling economic as well as environmental case for change.



We know that implementing these changes won't happen overnight, especially as we want to avoid increasing food waste in the supply chain. People will also play a critical role – closing the gap between their intentions to live more sustainably, and their actions. We will be supporting partners and people at every step.

Challenging long-held assumptions can be uncomfortable; especially when confronted with the scale of change required to adapt to a new reality. But at WRAP, we have never shied away from delving deeper to get to that truth. We believe that the best decisions are those guided by credible evidence that inform the right changes for the right outcomes.

With the reality of the climate emergency all around us, this new clarity marks a key moment in our journey with partners. It shows how we can confidently achieve real progress in reducing both food waste and plastic pollution: two of the biggest environmental challenges of our lifetimes.



SUMMARY

Potential impacts

Potential savings of

100,000
TONNES

of food waste and more than

10,300
TONNES

of plastic, equating to

130,000
TONNES

of CO₂e in the UK



As part of its mission to reduce food waste and achieve circularity in plastic packaging WRAP has conducted ground-breaking research into the relationship between plastic packaging and food waste in the home, as well as the influence of date labels and storage temperatures on household food waste.

The results of this research, alongside previous research and evidence, have highlighted that there is significant opportunity to reduce both household food waste and plastic packaging of uncut fresh-produce.

Almost half a million tonnes of fresh vegetables and salad and a quarter of a million tonnes of fresh fruit, worth a total of £2.1bn¹, are thrown away in UK homes each year because they are '*not used in time*' – either they have gone soft/mouldy, or they have passed a date label and been discarded.



EXECUTIVE SUMMARY

Research overview

Not using large amounts of fresh-produce in time results, in part, from people:

- Purchasing larger quantities than needed for their household, for example, buying a pre-bagged pack
- Storing food in sub-optimal conditions, for example, not in the fridge
- Choosing not to eat something past a date on the pack.

WRAP's new research was conducted on five fresh-produce items frequently wasted in the home – apples, bananas, broccoli, cucumbers and potatoes – and demonstrated that selling these five items loose could reduce household food waste by 100,000 tonnes per year, by enabling people to buy the right amount for their households and removing 'Best Before' dates on packaging.

The influence on household food waste of selling these items loose varies. For apples, potatoes and bananas, enabling people to buy the right amount for their needs was the most important factor. For broccoli and cucumber, it was the removal of the Best Before date. The influence of packaging on shelf life for all these products was minimal.

The shelf life of three products was tested to compare refrigeration vs. storing in ambient conditions: all three (apples, broccoli and potatoes) showed a substantial increase in shelf life in the fridge. For the two more-perishable items tested (cucumber and broccoli), storage at an optimal fridge temperature (4°C) gave significantly more life than at a sub-optimal fridge temperature (9°C).

The vast majority of people do not store apples in the fridge at home and, on average, UK fridge temperatures are higher than 5°C, so changing both of these would give people much longer to use the fresh-produce they buy, as well as keeping other items in the fridge safe and fresher for longer.

The preservation qualities of plastic packaging for household food waste prevention are small, when compared to other factors, such as enabling people to buy the right amount for their needs and storing fresh-produce in the fridge, below 5°C.

Selling these items loose and removing Best Before labels could reduce household food waste by the equivalent of

14 million
SHOPPING
BASKETS
(of food)

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For apples, potatoes and bananas, enabling people to buy the right amount for their needs was the most important factor in saving household food waste.
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RESEARCH OVERVIEW

WRAP's recommendations

**Interactive PDF**

Use the top navigation to jump to each section

Using new insights and building on existing evidence, summarised in this report, WRAP recommends the following actions by food retailers and their suppliers, to support consumers and reduce the amount of uncut fresh-produce and single use plastic packaging that gets thrown away in our homes:

RECOMMENDED ACTION 1**Sell loose**

Sell loose unless it can be shown that plastic packaging² reduces overall food waste

- ✓ Reduces problematic or unnecessary plastic packaging
- ✓ Reduces household food waste

[READ MORE](#)**RECOMMENDED ACTION 2****Remove date labels**

Do not apply a date label to uncut fresh-produce - unless it can be shown that a Best Before date reduces overall food waste.

Do not use any alternative wording to 'Best Before' when a date label is applied.

- ✓ Reduces household food waste

[READ MORE](#)**RECOMMENDED ACTION 3****Provide Best Practice guidance on storage**

At home, store below 5°C - help people understand the benefits of storing appropriate fresh-produce in the fridge, set at the right temperature.

- ✓ Reduces household food waste

[READ MORE](#)

OVERVIEW OF RECOMMENDATIONS

Achieving the changes together

This new research helps to create a real sense of scale of the opportunities to reduce household food waste and plastic, as well as giving a clear set of recommendations to work towards – to maximise the positive impact, through actions in the Courtauld Commitment 2030 and The UK Plastics Pact Voluntary Agreements.

For some of the recommendations made here, there are actions that can be taken by retailers right now and there are also those where more effort, exploration and collective action will be needed. Removal of plastic packaging will take time and WRAP is committed to working with retailers and the sector through Courtauld 2030 and The UK Plastics Pact, collectively and individually, to develop and support the action needed to make the most of the opportunities identified. WRAP will also track the extent to which the recommendations have been adopted, through its periodic Retail Survey and The UK Plastics Pact data reporting.

Retailers and suppliers will need to evaluate whether selling produce loose leads to an increase in food waste in the supply chain and retail outlets that outweighs the reduction in waste in the home – and work to find ways to overcome these issues. [Resources](#) are available to help with this and will be developed further, in 2022. When selling produce loose, retailers should encourage customers to use reusable bags to pack their shopping.

Of course retailers already sell significant volumes of fresh-produce loose, and packed without a Best Before date. [Case studies](#) are available to show how short-term unintended consequences of expanding these methods of sale can be overcome.

However, as most fresh-produce items are sold packed and with a date label, there is significant opportunity to adopt changes.

If single use bags are offered in-store, then retailers should take account of wider environmental considerations, as outlined in [WRAP's guidance](#). Plastic packaging for fresh-produce should not simply be replaced with a different type of packaging, without exploring the options available, since all materials have an environmental impact and, for some items, a key benefit of removing packaging is to enable people to buy what they need.

Underpinning the recommendations

The extensive programme of work that underpins the recommendations was conducted during 2020 and 2021 and included:

- [Citizen research](#) through an online survey investigated the influence of date labels on disposal choice and determining if there was any impact of plastic packaging on these choices;

- [Laboratory testing](#) of the effects on product life of storing these foods packaged or loose, and at different temperatures;
- [Modelling of the impact of changes](#) when selling fresh-produce loose rather than packed; and
- Industry consultation and input, through a Courtauld 2030 Advisory Group and members of the pact.

This work has provided valuable new evidence that builds on and that goes beyond previously published material (see [here](#) and [here](#)) and will be used to work with WRAP/Defra/FSA Food labelling guidance for uncut fruit and vegetables (subsequently referred to as '[food labelling guidance](#)'). It has also informed updated guidance to members of The UK Plastics Pact on reducing problematic and unnecessary plastic packaging.

RECOMMENDED ACTION 1

Sell loose



Sell loose unless it can be shown that plastic packaging reduces overall food waste.



WRAP estimates approximately 60,000 tonnes each of household food waste and CO₂e could be prevented by selling apples, potatoes and bananas loose – enabling people to buy the right amount.

By modelling the impact of different factors on household food waste, this research showed that selling items loose, so that people are able **to buy just the right amount of a product to meet their needs** (rather than the nearest pack size), is an effective way to reduce household waste. This is particularly true for **apples, bananas and potatoes**, and the benefit is much greater than any influence of packaging on shelf life.

Product life testing of five fresh-produce items showed that plastic packaging had no or little meaningful effect on extending their life.

If a wider range of products that are currently sometimes sold loose were only sold loose, it would save more than 21,500 tonnes of plastic and nearly 70,000 tonnes of CO₂e.



**6,500
WASTE TRUCKS**

worth of food per year could be saved if produce is sold loose and in the right amount.



RECOMMENDED ACTION 1

Sell loose

What's changed?

This is a **significantly strengthened** position. WRAP has previously identified priority actions as follows:

2019

WRAP, FSA and Defra updated [uncut fresh-produce food labelling guidance](#) to encourage and support more fresh-produce to be sold loose, to enable people to buy the right amount for their needs. New principles to underpin decisions were provided, along with decision-support tools and implementation resources.

On deciding whether to sell loose, the decision support tools in the food labelling guidance started from the premise of taking a packed item and determining if it could be sold loose.

The food labelling guidance will be updated and begin with the premise that any item is sold loose, and the decision support tools will be changed to be used to determine when a product should be sold packed (e.g. to protect delicate items like berries, from damage). See Appendix 1 for further information.

2019

Single use plastic packaging of fresh-produce was listed as an item to be investigated in The [UK Plastics Pact](#).

Using this research the [Target 1 report for The UK Plastics Pact on Eliminating Problem Plastics](#) has been updated to include plastic packaging for uncut fresh fruit and vegetables unless it is demonstrated to reduce food waste. It identifies priority products which are already sold loose and where there is the greatest opportunity to reduce food waste and commits to developing a Pathway to 2025.

NEW

NEW



RECOMMENDED ACTION 1

Sell loose

Eliminating unnecessary plastics

Members of The UK Plastics Pact have committed to eliminate problematic or unnecessary³ plastics

In 2019, single use plastic packaging on fresh uncut fruit and vegetables was added to the list of items to be [investigated for elimination](#), under The Pact. This follows on from a 2018 [review](#) that identified further evidence was needed to determine the impact of packaging on household food waste. As summarised in this document, this work has now been conducted, using five frequently-wasted items in the home.

Summary of evidence and insights

Product life testing of five fresh-produce items showed that plastic packaging had no or little meaningful effect on extending the life of fresh-produce.



Packaged vs. loose: [Figure 1](#) provides summary results for the fresh-produce items tested, comparing experiments involving packaged and loose items. The five items tested were stored in various conditions: in their original packaging and with the packaging removed, and at different storage temperatures. The same sensory testing approach was used for all samples, to determine the impact of the packaging and storage temperature on product life.

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Of the 10 comparisons made between packaged and loose products, eight had no detectable difference in shelf life.
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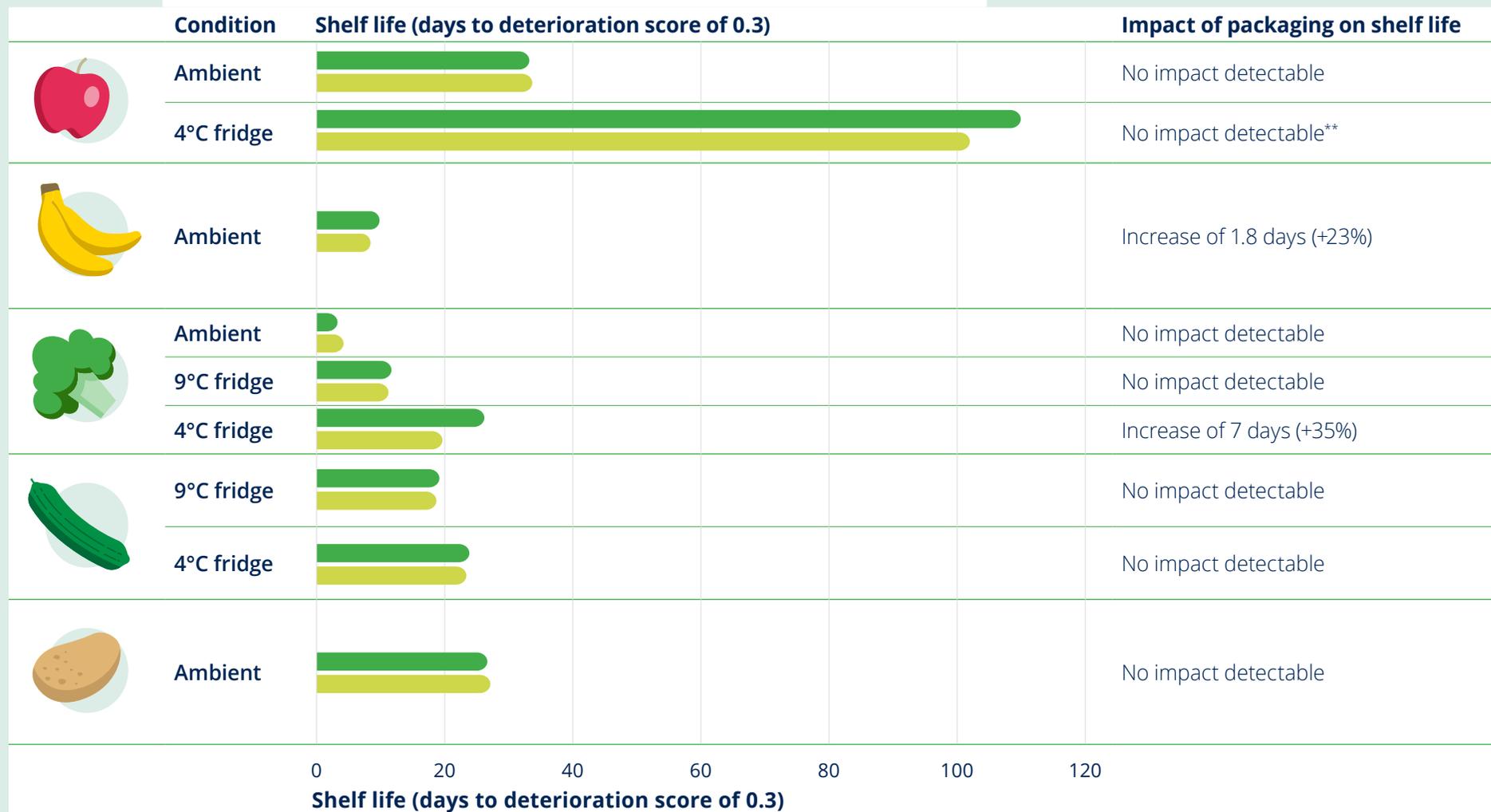
Of the 10 comparisons made between packaged and loose products, eight had no detectable difference in shelf life. This included both storage temperature conditions tested for cucumber: at neither storage temperature did the shrink wrap increase the shelf life.

For two conditions, the packaged product had a longer shelf life than the loose product. These conditions were:

- Bananas at room temperature (1.8 days or 23% longer); and
- Broccoli in the optimal fridge, 4°C (7 days or 35% longer)



Figure 1: Comparison of packaged and loose shelf life.



**For refrigerated apples, there was considerable scatter in the sensory assessment data. Further investigation demonstrated that differences seen between packaged and loose conditions could have been due to this scatter, rather than being a real effect. A similarly high level of scatter was also found for refrigerated potatoes (not shown in graph above). [Appendix 3 of The Shelf Life Report](#) contains further analysis on this point.



Where packaging did extend product life (bananas and broccoli (latter in optimum fridge temperatures)), it should be noted that:

- Previous research indicates that the majority of UK citizens (63%) removed the packaging from their bananas on return from their shopping trip⁴, effectively removing the potential preservation from packaging; and
- For broccoli, storage temperature has a much larger impact on shelf life than the presence or absence of packaging.

Modelling these impacts on household food waste overall showed that **changes in shelf life** are the least important of the factors modelled. This is illustrated in figure 2. In the context of selling items loose or packaged, the ability to buy the right amount of a product influenced food waste more.

For three of the five products (apples, cucumbers and potatoes), shelf life experiments suggested no detectable difference in shelf life between the loose and packaged variants of the product. Therefore, for these products, there is no change in household food waste as a result.

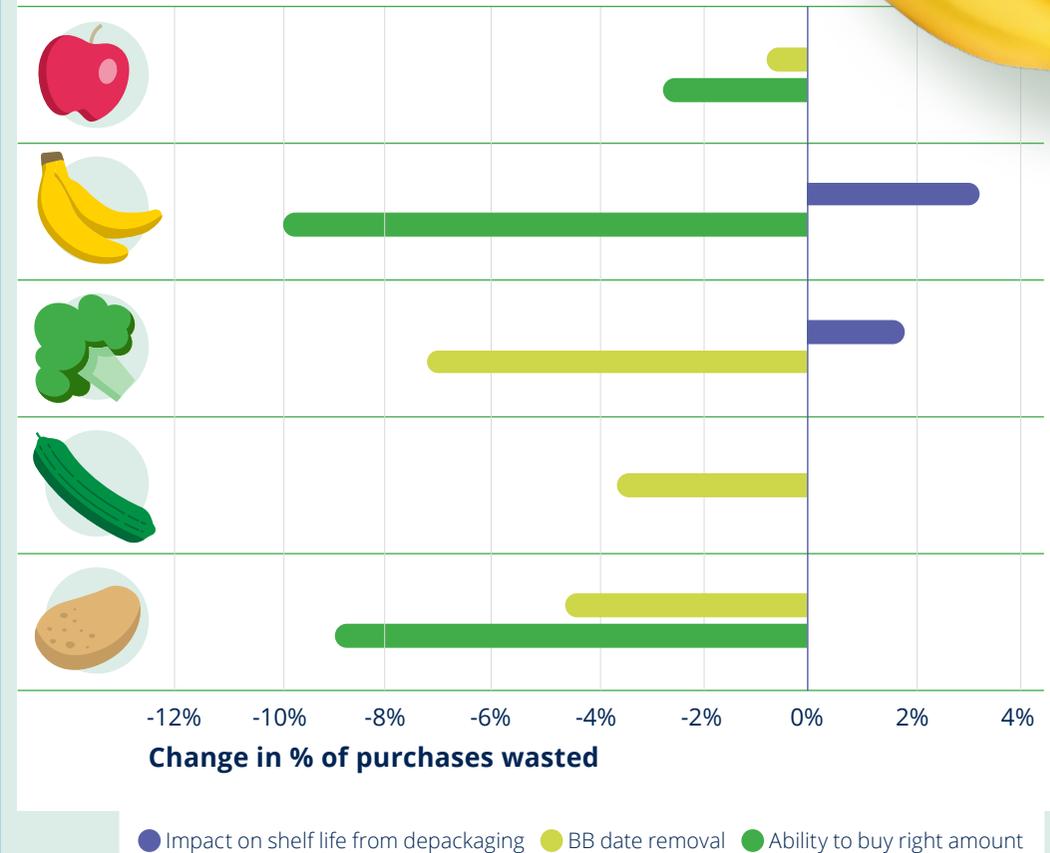
For bananas and broccoli, the loose products did have slightly shorter shelf lives than the packaged products, which increases modelled household food waste by around a fifth in each case.

Change in 'pack-size' options by selling items loose: for apples, bananas and potatoes, allowing people to buy an amount appropriate for their needs (rather than the smallest currently available pack) greatly reduces household food waste, and has the largest impact on household food waste for these three products.

This disproportionately affects single-occupancy households: for packaged items, the smallest pack size available was often much greater than a single-occupancy household generally consumes before the items start to deteriorate in quality. For broccoli, it was assumed that amounts purchased are not affected by whether the product is loose or packaged. For cucumbers, it depends on the size range of cucumbers available.

While household food waste could be reduced by providing smaller pack sizes of the items studied, for smaller households, this would not reduce the environmental impacts relating to the removal of packaging.

Figure 2: Impact on food waste of three different changes from selling loose, without packaging.



Therefore, a key finding of this research is **that the preservation qualities of packaging are small, compared to other factors (Figure 3)**. The strength of these findings for the five frequently-wasted items tested indicates that this may be the case for a wide range of fresh-produce items. The items tested were selected with input from industry and one of the aspects considered was to provide a set of items that could usefully represent other items in the category. For example, apples could act as a proxy for items like pears, broccoli – brassicas, and potatoes – tubers and root vegetables. Cucumbers and bananas might share features with other items too – such as those susceptible to bruising or with extremely high water-content. It is also recognised that fresh-produce varieties and sources change throughout the year, which may have implications for shelf life. For items where presentation is important (e.g. collating large amounts of small items or identifying a product line) and/or are delicate and require protection, then it will still be appropriate to sell these items packed. Examples could include berries, ‘ready-to-eat’ (ripe) pears, and organic items. Where there is evidence that there is a preservation effect of packed items (extending the quality product life), then retailers and suppliers investigate what is appropriate in those situations.

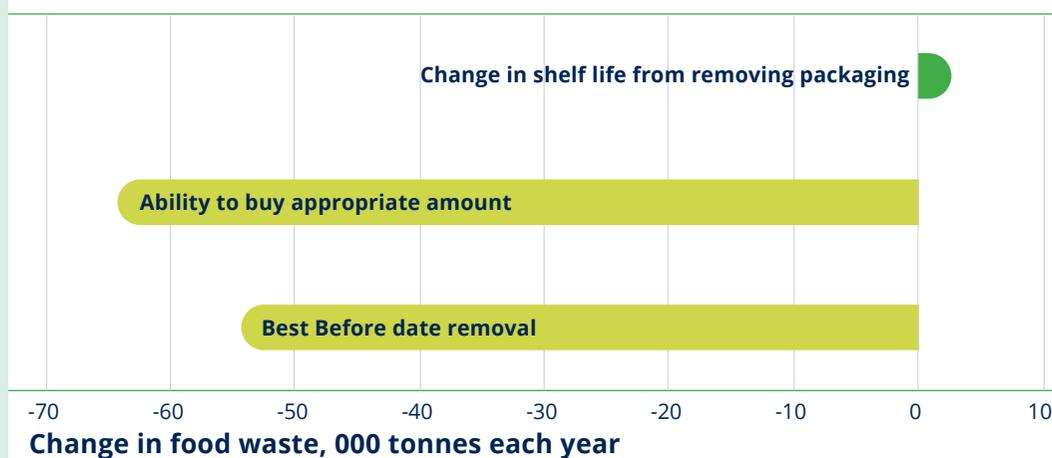
Conclusion for recommendation 1 and proposed next steps

- More items can be sold loose without a loss in preservation, enabling people to buy the right amount for their needs and helping them to reduce household food waste. **WRAP estimates approximately 60,000 tonnes of household food waste could be prevented each year by selling apples, bananas and potatoes loose.**

To sell more fresh-produce items loose in a way where these changes can be managed in supply chains and in-store (and online retail – which presents different, additional challenges), it is recognised that this is not a change that can happen overnight. Retailers should be working towards a largely packaging-free system to enable people to buy what they need and reduce plastic packaging, unless it is evidenced to increase food waste. However, to enable this, consumers and retail supply chains need to change.

To lead this, retailers will need to work collaboratively with supply chains to develop solutions and engage their customers. To support progress towards this goal, WRAP will work together with The UK Plastics Pact members and Courtauld 2030 signatories to develop and support plans to sell more items loose. This will build upon learning from current and previous work to sell more loose fresh-produce. The 2019 [food labelling guidance](#) provides information and examples on supporting customer demand for more loose fruit and vegetables; managing in-store food waste; and trialling alternative packaging materials. Also see a [case study](#) summarising Morrison’s ‘plastic-free aisle’ pilot.

Figure 3: The implications on household food waste of selling loose.



“ Retailers should be working towards a largely packaging-free system to enable people to buy what they need and reduce plastic packaging, unless it is evidenced to increase food waste. ”

In the first instance, the following steps are proposed:

1. The food labelling guidance (last updated in 2019) is revised to incorporate all three of the recommendations in this summary. The aspects of the existing guidance around implementation of changes will be retained. There will be specific Best Practice to apply in each scenario of selling loose and selling packed.

WRAP will work with FSA, Defra and industry to agree updates to the 2019 food labelling guidance, including sharing additional insights, implementation experiences and guidance – such as any implications for managing these changes in the supply chain.

2. The UK Plastics Pact members will be convened to develop a Pathway for the removal of packaging from uncut, fresh-produce. The expectation is:
 - Retailers to work towards a largely packaging-free system to enable people to buy what they need and reduce plastic packaging, unless it is evidenced to increase food waste, and engage their customers to support a change in practice.

- A significant proportion of uncut fresh-produce sales should be sold loose by 2025. This will vary across retailers depending on their current offering and infrastructure e.g. some supermarkets do not currently have tills with weighing capability, while others have a wide range of products already available loose.
- Increases in the proportion of sales will be a result of:
 - **Retailers**
 - Extending the number of lines available loose
 - Reducing the number of lines sold packaged
 - Making loose lines attractive to people e.g. where lines are displayed and how they are priced and how this pricing is displayed.
 - WRAP, retailers and other stakeholders working with people to encourage the purchasing of and drive demand for loose produce.

Products to be prioritised for selling loose are:

- Items where there is the greatest opportunity to prevent food waste e.g. potatoes
- Where the barriers to removing plastic packaging are less e.g. peelable fresh-produce such as bananas
- The items are already sold loose by at least one major UK retailer
- The items are 'main line' fresh-produce and so do not need differentiating in the same way an organic or tiered line might need to be.

Retailers that are members of The UK Plastics Pact will be expected to improve performance year on year and amalgamated data will be shared as part of The Pact's annual reporting.

WRAP encourages retailers to also report externally on an individual basis. Through the Courtauld 2030 Retail Survey, WRAP will monitor changes in the amount of fresh-produce sold loose, as well as adherence to the updated food labelling guidance, overall and for each grocery retailer.

Table 1: A snapshot survey in November 2020, counting the number of product lines sold loose and packaged.

	Loose	Packaged	% packaged
	35	141	80%
	8	33	80%
	5	16	76%
	1	29	97%
	24	172	88%

RECOMMENDED ACTION 2

Remove date labels



Do not apply a date label to uncut fresh-produce – unless it can be shown that a Best Before date reduces overall food waste.

Do not use any alternative wording to 'Best Before' when a date label is applied.



New product life testing shows that products are good to eat for some time after the Best Before date. In many cases, this is for a significant amount of time, when the items are stored in optimal conditions.

New consumer research, conducted online, provides additional evidence that many people's disposal choices are influenced by the presence of a Best Before date, even when products are still good to eat – with some people choosing to dispose of an item when a Best Before date was present, compared with when no date was displayed.



In addition to asking research participants the extent to which they used Best Before dates when deciding whether to throw away items, this new research involved asking people to choose whether to 'use' or 'dispose' of items, presented to them as photos. One group of participants saw photos of the items with a date, the other saw items without a date.

An additional insight from this new work indicated that the presence of a Best Before date appeared to have the greatest impact on disposal decisions for products where they had only minor signs of visual deterioration and were still good to eat.



22,000
CARS

worth of greenhouse gas emissions could be saved by removing date labels.

RECOMMENDED ACTION 2

Remove date labels

What's changed?

This is a **reiterated** position. WRAP has previously identified priority actions as follows:

2019

This is a reiterated position from the 2019 food labelling guidance (developed in conjunction with the sector), where it was recommended that date codes should be removed on many uncut fresh-produce items, but stated that “using a Best Before date only on short-life (e.g. <7 days) products and where there is a limited time (e.g. <4 days or < half the total life) for consumption at home – even when stored in optimum conditions – could help reduce food waste in the home”.

For these items, the recommendation was to use the phrase ‘Best Before’, no alternative wording, and a single date only (for example avoiding the use of ‘display until’ dates). For all other uncut fresh-produce items, the recommendation was not to apply any date label.

It is important that retailers accelerate action to adopt the 2019 food labelling guidance to help reduce household food waste, as the scale of opportunity is now even clearer.

NEW

2019

The food labelling guidance update also included examples and implementation resources for retailers, covering how to manage stock, such as using Julien codes, which avoid the need for a customer-facing date code.

This content will be kept as an integral part of the updated food labelling guidance, along with new examples and insights.

NEW

2019

The 2019 Retail Survey found that 25% of pre-packed fresh-produce items carried no date label and identified a key action where wider implementation of the food labelling guidance – to remove date codes – could help to reduce household food waste.

A Retail Survey using data gathered in 2021 will show to what extent Best Before dates have been removed from uncut fresh-produce and where further action is needed.

NEW

RECOMMENDED ACTION 2

Remove date labels



Product life testing

Product testing of five fresh-produce items (apples, bananas, broccoli, cucumbers and potatoes) demonstrated product quality continued beyond the Best Before date (Table 2), showing this is a poor indicator of when products are good to eat – especially for items stored in optimal conditions, in the home.

Sensory evaluation (also known as organoleptic testing) was performed by trained assessors to evaluate the taste, aroma, appearance and texture of these items. Such tests are commonly applied by retailers and manufacturers to ensure high and consistent quality of products and to set product life. In this research, samples were stored and monitored at different temperatures, to represent, sub-optimal storage and optimal storage conditions, in the home.

The assessors analysed several replicate samples in blind test conditions, at intervals. Each sample was then scored against predefined quality matrices, covering aroma, taste, texture and appearance. Product appearance was benchmarked against reference images. Sensory evaluation enabled WRAP to understand how long items last before deterioration can be detected and when items might be rejected by consumers.

Modelling shows the potential to cut annual household food waste of the five items tested by around

**50k
TONNES**

Potential savings of food worth

**£50
MILLION**

could be saved each year by UK households if Best Before dates were removed from these five products.

In this research, samples were stored and monitored at different temperatures, to represent, sub-optimal storage and optimal storage conditions, in the home.



Product life and Best Before dates

In comparing when deterioration started relative to the Best Before date, the product life testing (Table 2) showed that:

- In optimal conditions, some items showed no signs of deterioration whatsoever until well after the Best Before date. For example, apples stored in the fridge showed no deterioration until two-and-a-half months after the Best Before date. In fact, all products showed no deterioration before the Best Before date if stored under optimal conditions, and many showed no deterioration for significant periods of time after that.
- For almost all the conditions tested, fresh-produce items showed no signs of deterioration until after the Best Before date. The exceptions were broccoli stored at ambient conditions and cucumbers stored at 9°C.
- Even after the first signs of deterioration, fresh-produce items were perfectly edible for much longer.

Apples

For apples stored in ambient conditions, the first signs of deterioration were three days after the Best Before date. For apples stored in the fridge, the difference was a staggering 74 days.

Bananas

For bananas stored in ambient conditions (they should not be stored in the fridge), the first signs of deterioration were one day after the Best Before date.

Broccoli

For broccoli stored in the fridge at 9°C, it showed first signs of deterioration one day after the Best Before. Stored in the fridge at 4°C, the first signs of deterioration were 15 days after the Best Before date.

Cucumber

For cucumber stored in the fridge at 9°C, there was no difference between the Best Before date and the first signs of deterioration. Stored in the fridge at 4°C, the difference was one day after the Best Before.

Potatoes

For potatoes stored in ambient conditions in the dark, the first signs of deterioration were four days after the Best Before date. Stored in the fridge at 4°C, the difference was 20 days after the Best Before date.⁵

Table 2: Comparison between Best Before (BB) date and first signs of deterioration (NB products were perfectly edible for some time after first signs of deterioration).



	Storage condition	Best Before date (days after packing)	1st signs of deterioration (days after packing)	Difference between the BB date and 1st signs of deterioration
	Ambient		17	3 days after the date (+21%)
	4°C	14	88	74 days after the date (+530%)
	Ambient	6	7	1 day after the date (+17%)
	Ambient		2	4 days before the date (-67%)
	9°C	6	7	1 day after the date (+17%)
	4°C		21	15 days after the date (+250%)
	9°C		17	0 days – no difference
	4°C	17	18	1 day after the date (+6%)
	Ambient		14	4 days after the date (+40%)
	4°C	10	30	20 days after the date (+200%)

These results indicate that the Best Before date is often not an accurate indication of when products are still good to eat, especially when products are stored in optimum conditions – when they last much longer.



Consumer research

As part of this work, [consumer research](#) was undertaken to understand more about the influence of Best Before dates, and other factors, on disposal decisions in the home. This research builds upon existing evidence and insights used to update Best Practice to remove date labels on most uncut fresh-produce in 2019.

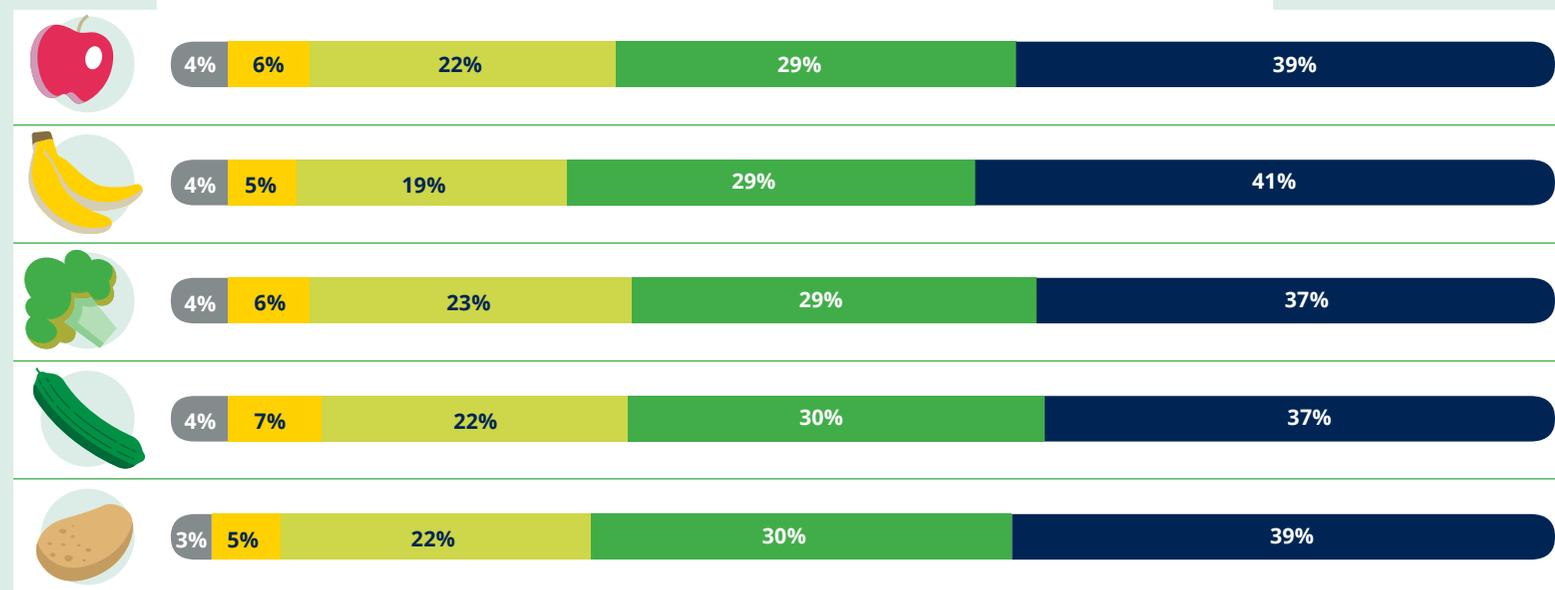
The findings of the new research were consistent with previous insights and indicated that there was a sizable minority of people heavily influenced by the Best Before date.

Furthermore, [modelling](#) suggests that, if this minority were to base their decisions relating to the disposal of fresh-produce items on the level of deterioration of the item, rather than the Best Before date, around 50,000 tonnes of food waste could be prevented each year.

A questionnaire [survey](#) undertaken by WRAP as part of this project⁶ showed that, approximately 10% claimed to use dates 'entirely' or 'mostly' to make decisions for fresh-produce items (Figure 4).

Approximately a further 20% of respondents used a mixture of date labels and judgement, leaving around 70% stating that they used their judgement 'entirely' or 'mostly'.

Figure 4: Stated reliance on date labels versus judgement in disposal decisions.



Q15. Please indicate on the scale below how you make decisions about when to eat or throw away the following foods.

Base: 4,559 UK adults aged 18+

● Entirely on date ● Mostly on date ● Mixture of date and judgement ● Mostly judgement ● Entirely judgement

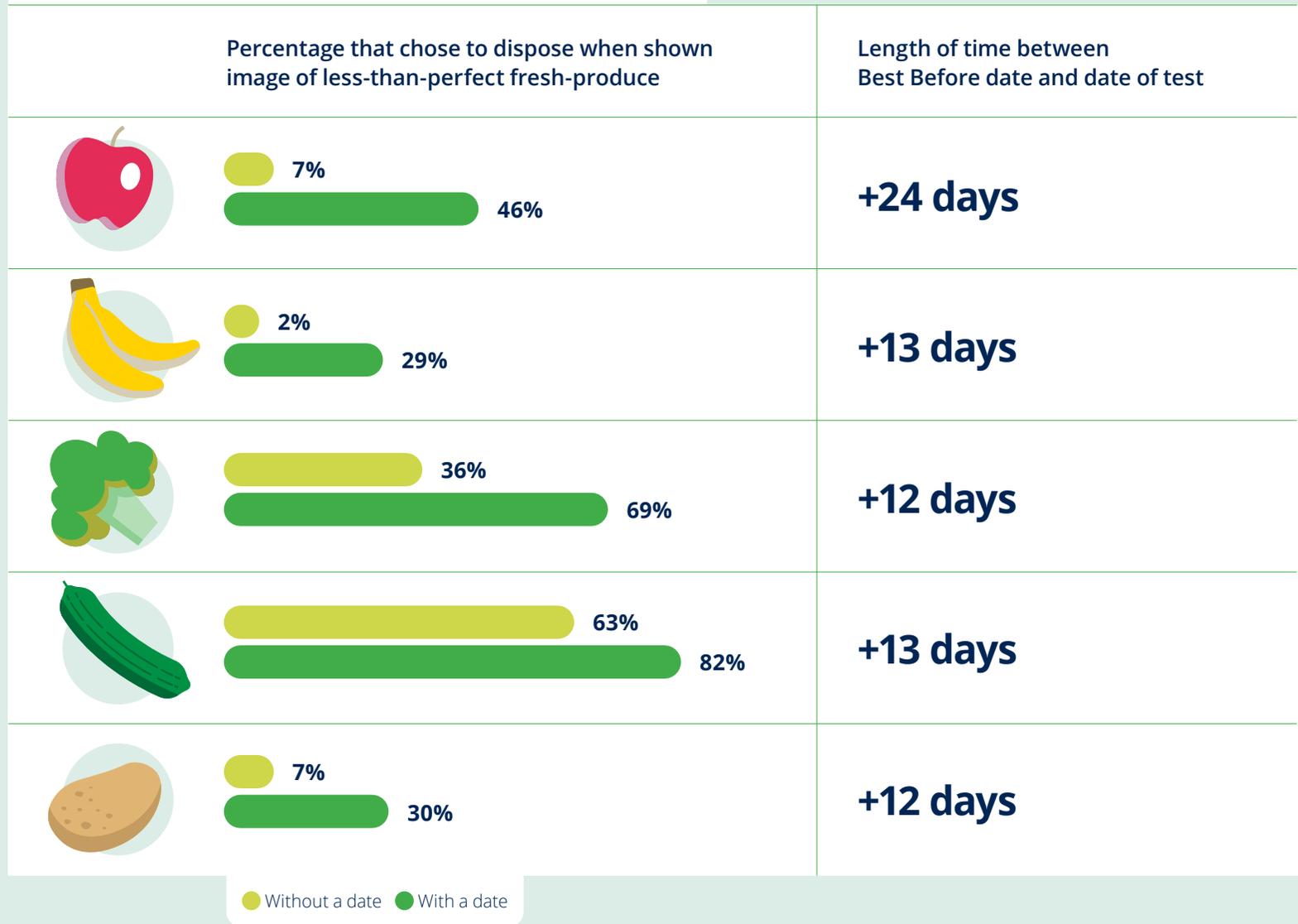
To explore this area further, an Implicit Association Test (IAT) was used. Participants were shown a carousel of randomised images of the various food items at different stages of visual deterioration. Participants were then asked to select whether they would 'Use' or 'Dispose' of the item. Different groups within the survey were shown identical product images, but one group's pictures showed a Best Before date next to the picture of the item, while another group only saw the picture of the item.

The number of people that chose 'dispose' for an item significantly increased when a Best Before date was used, compared with when no date was displayed (Figure 5). This was true for all products and stages of deterioration (except for the most deteriorated image of a cucumber, where the effect of the presence of a Best Before date was not statistically significant).

The presence of a **Best Before date appeared to have the greatest impact on disposal decisions when products had only minor signs of visual deterioration.**

Figure 5 shows an example of the differences in the percentage of people who chose 'dispose' for the same item, depending on if there was a Best Before date or not.

Figure 5: Influence of date labels on decisions to dispose. 



Decreasing household food waste

Modelling, using the Household Simulation Model (HHSM), demonstrated that the effect of removing Best Before dates decreased household food waste for all products except bananas, which rarely have a date label applied. In line with the questionnaire findings, the model assumed only a minority of people dispose on the Best Before date in order to estimate the scale of household food waste prevention.

The removal of Best Before dates on uncut fresh-produce has potential to reduce household food waste and so implementing the 2019 food labelling guidance is a priority action.

It should be noted that this potential reduction is for food waste arising because it has 'not been used in time', not all food wasted in the home and that not all aspects of the complex ways that different people interact with Best Before dates on fresh-produce can be modelled, currently.

WRAP uses the HHSM to help determine the relative effect of different changes on household food waste, in order to identify and prioritise high-impact actions. The HHSM was used in this research to quantify, for the five items tested, the potential to reduce household food waste if Best Before dates were to be removed. The results indicate that, for these five items, food waste associated with not being used in time could be reduced by just over 50,000 tonnes each year, or around one-sixth of the total for type of food waste (Table 3).

240 MILLION

items could be saved each year by UK households if Best Before dates were removed from these five products.

Table 3: Estimated change in annual 'not used in time' household food waste for removal of Best Before date.

	Amount of waste due to item not being used in time (tonnes)	% change in not being used in time	% market currently packaged	Adjustment for interaction*	Estimate of change in food waste (tonnes)
	40,000	-25%	80%	50%	-3,950
	44,000	0%	n/a	n/a	-
	14,000	-70%	76%	75%	-5,600
	26,000	-17%	97%	75%	-3,250
	180,000	-33%	94%	75%	-41,600
Total	304,000				-54,400

* To take into account interactions between the households sensitive to Best Before dates and what products are purchased.

Therefore, these calculations predict that removal of Best Before dates for these products would reduce household food waste by approximately 50,000 tonnes per year.

The change in food waste relating to a Best Before date depends on several factors, including the difference between the shelf life and the Best Before date, and the percentage of the population currently using the Best Before date. As identified previously in this summary, few bananas carry Best Before date and most people remove packaging from their bananas once they return from grocery shopping.⁷

In 2019, [food labelling guidance](#) was updated to support the removal of date labels on most uncut fresh-produce, based on evidence reviews and work with an industry task force.

The 2019 [Retail Survey](#) identified more potential to apply food labelling guidance, including removing date labels, to uncut fresh-produce items and set a clear ambition to apply food labelling guidance to 100% of relevant uncut fresh-produce items.

Table 4: Prevalence of dates on selected fresh produce items.

Apples		52% Best Before, 16% Display Until
Bananas		15% Best Before, 0% Display Until
Berries		65% Best Before, 14% Display Until
Carrots		73% Best Before, 12% Display Until
Potatoes		71% Best Before, 15% Display Until
Tomatoes		72% Best Before, 11% Display Until

Source: Table 16, [Retail Survey 2019](#)

Conclusion for recommendation 2 and next steps

Our new evidence indicates that Best Before dates do not support people's ability to judge when to use or dispose of many fresh-produce items – confirming WRAP's previous evidence from 2019. This means that the removal of Best Before dates from uncut fresh-produce is a priority action. With most fresh-produce having a date label applied, including the majority of potatoes and apples, there is significant scope to remove labels and implement the 2019 food labelling guidance on this topic. The recommendation remains that 'Display Until' dates or alternative wording should never be used.

Next steps are to collaborate and consult with FSA, Defra and with industry to agree updates to the 2019 food labelling guidance, including sharing additional insights, implementation experiences and guidance – such as managing these changes in store.



48km

Annual savings of food waste from removing Best Before dates for these five products could fill waste trucks that would stretch 48 km (or the length of the entire M56) if parked bumper-to-bumper.



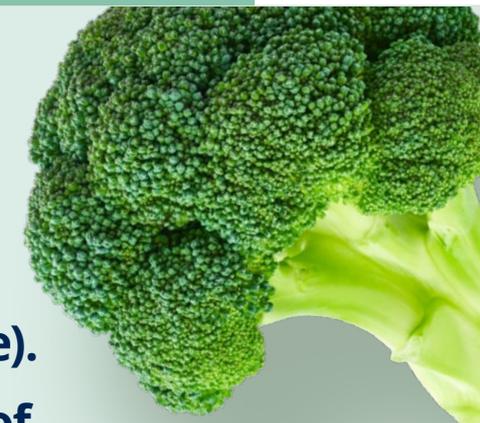
RECOMMENDED ACTION 3



Refrigerate below 5°C

Provide Best Practice guidance on storage (refrigerate below 5°C at home).

Help people understand the benefits of storing appropriate fresh-produce in the fridge, set at the right temperature.



Product testing showed significant opportunity to increase quality product life of three (apples, broccoli and potatoes) of the five fresh-produce items, by storing them in the fridge.

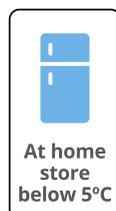
For the two more perishable items (cucumber and broccoli) storage at an optimal fridge temperature (4°C) gave significantly more life than at a sub-optimal fridge temperature (9°C).

There is significant potential to increase the number of people who store fruit and vegetables in the fridge and who check and change their fridge temperature.

More action is needed as the proportion of people storing fresh-produce in the fridge have not increased over recent years. Only around half of people know that apples will stay fresher for longer in the fridge and only around a quarter of people store them in the fridge, at home. This has remained at around a quarter for several years.

 **102**
DAYS

In our tests, loose apples stored in a fridge lasted 102 days, almost 70 days longer than in ambient conditions.



RECOMMENDED ACTION 3

Refrigerate below 5°C

What's changed?

This is a **strengthened** position. WRAP has previously identified priority actions as follows:

2019

Retailers to apply food labelling guidance by enhancing the storage information on refrigerated products especially the use of the 'little blue fridge' logo (launched in 2017) and stating numerical storage temperature advice of <5°C, in particular for uncut fresh-produce, which may be sold in ambient conditions.



NEW

When sold packed, it is essential that the food labelling guidance is used on uncut fresh-produce. When sold loose, it is important that best practice storage is encouraged in other ways, for example at point of sale or online.

2019

Organisations to raise awareness e.g. using communications campaigns that most uncut fresh-produce should be stored in the fridge at home; and to support WRAP's '[Chill the Fridge Out](#)' campaign to help people check and change their fridge temperatures to keep all their food safe and fresher for longer.

In addition to the changes above, there is a need for behaviour change activities and campaigns, innovative engagement, and technical changes to encourage people to store items in their fridges at home and to check and adjust their fridge temperature to be optimised, and in the design and operation of the fridges themselves.

NEW

Given the scale of opportunity identified, these kind of actions should be explored and given greater emphasis, in order to reduce household food waste of fresh-produce.

RECOMMENDED ACTION 3

Refrigerate below 5°C

Summary of evidence and insights

Product testing of three fresh-produce items (apples, broccoli, and potatoes⁸) demonstrated quality product life was significantly extended through storage in the refrigerator as opposed to in ambient (room temperature) conditions.

Product testing of the two more perishable fresh-produce items (cucumber and broccoli) demonstrated that storage at an optimal fridge temperature (4°C) gave significantly more life than at a sub-optimal fridge temperature (9°C) (Figure 7).

The magnitude of the shelf life extensions from storage at optimal fridge temperature compared with ambient conditions was significant. In all cases, shelf life at least tripled when items were stored in the fridge at an optimal temperature, compared to ambient conditions (Figure 6).

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The magnitude of the shelf life extensions from storage at optimal fridge temperature compared with ambient conditions was significant.
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Figure 6: Comparison of shelf life for optimal fridge (4°C) and ambient conditions for different product/condition combinations.⁹

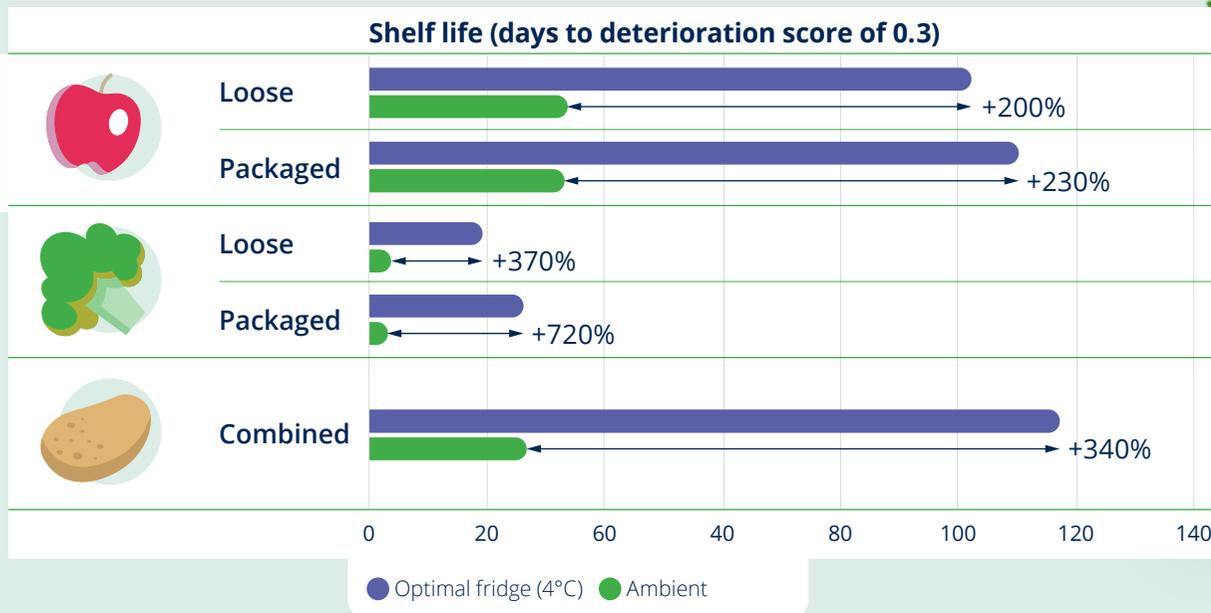
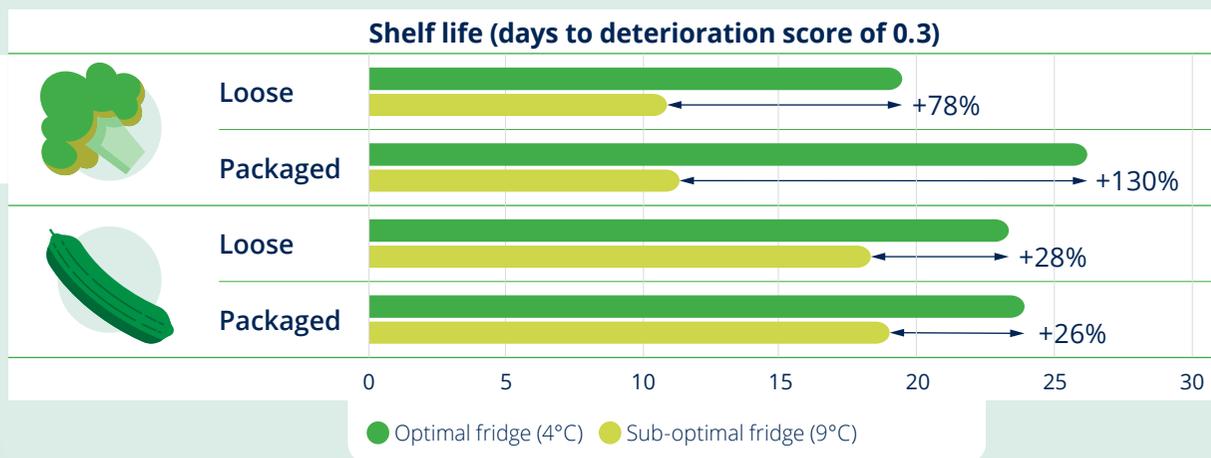


Figure 7: Comparison of fridge temperatures (4°C vs 9°C) on shelf life.



WRAP's UK Food Trends Survey and other data shows significant potential to increase the number of people who store fruit and vegetables in the fridge and who check and change their fridge temperature.

Storing fresh-produce in the fridge

- The WRAP UK Food Trends Survey showed around half the population are unaware that storing apples in the fridge extends their life
- Other data shows that the proportion of the UK population storing their apples in the fridge remains around one-quarter (WRAP UK Food Trends Survey) and that this has remained largely unchanged for many years – despite ongoing efforts to encourage this behaviour.

Fridge temperature

- Data shows that many UK domestic fridges are kept at sub-optimal temperatures: two separate studies showed that the time spent above 5°C by refrigerators was 38% and 51% respectively.^{10 11}
- The WRAP UK Food Trends Survey (August, 2021) showed that only half of people correctly believe that fridges should be set to below 5°C.

Engaging with consumers

- The WRAP UK Food Trends Survey (August, 2021) showed Love Food Hate Waste is playing a key role in helping people to manage food in the home. Those who saw Love Food Hate Waste's A-Z of food storage undertook 12.4 food waste prevention behaviours more often (compared to a UK average of 6.7)
- Recognition of 'fridge temperature below 5 degrees (little blue fridge)' logo has increased to 24% (up from 9% in 2019) – the highest on record
- A previous WRAP UK Food Trends Survey in 2019 showed that those who recognise the blue fridge logo were found to be more likely to: i) know what their fridge temperature should be set at; and ii) have checked their fridge temperature in the last 2–3 months
- Other data shows that, of people who had seen *Chill the Fridge Out* materials, 33% had changed the temperature of their fridge in the last month (twice as likely as someone who hadn't). They were also more likely to have been actively engaged in food waste conversations.

The 2019 Retail Survey identified more potential to apply Best Practice labelling to uncut fresh-produce items and set a clear ambition to apply Best Practice to 100% of relevant uncut fresh-produce items.

Table 5: % packed products with correct numerical fridge temp advice.

	Apples 12% (17%)
	Berries 6% (10%)
	Carrots 9% (36%)
	Tomatoes 10% (12%)

Source: Retail Survey 2019

Conclusion for recommendation 3 and next steps

The evidence clearly indicates the substantial potential to reduce waste of fresh-produce items 'not used in time' by getting people to store fruit and vegetables in the fridge at home and to keep their fridges at the recommended temperature. This is because of the significant product life increases shown as a result of optimum storage.

Getting more people to adopt the right behaviours is key. This opportunity has long been recognised and, with the new data showing the significant increases in product life (far beyond previous estimates), is now imperative.

There are other potential routes to achieving this goal – such as fridge design and manufacture. Further action in these areas can increase the positive impact on reducing household food waste.

APPENDIX

Further information around selling packed and loose

Principles around selling packed or loose

Preservation – *helping to extend the life of fresh-produce.* The effect of packaging on shelf life was the least important factor. For apples, cucumber and potatoes, there was no (or minimal) difference between packed and loose, therefore no impact on household food waste. For bananas and broccoli shelf life was slightly shorter.

Presentation – *containing and collating for convenience and/or a quantity.* For apples, bananas and potatoes, allowing people to buy what they need greatly reduces household food waste and is the most impactful factor for these products. It was assumed the amount of broccoli purchased is not affected by being sold packed or loose. For cucumber, it depends on whether smaller ones are available.

Principles for continuing to sell packed fresh-produce

Protection – *preventing deterioration, damage and contamination across the supply chain.* Packaging can support products on their journey from farm to fork by inhibiting and controlling the gases and moisture that are the main causes of spoilage, reducing deterioration. Packaging also prevents access to foreign bodies or contaminants and protects it from physical damage during transport and storage. It is often used for fresh-produce items where there is concern about bruising/damage in the supply chain or in-store and for climacteric (ripe) fruit, where packaging is generally used to limit bruising/damage in their ripened state. Fresh-produce items such as these may be suitable for retailing loose only some of the time.

Presentation – *containing and collating for convenience and/or a quantity.* Packaging is often used for fresh-produce items that are small and/or difficult to contain such as strawberries or mushrooms. Fresh-produce items that are difficult to contain AND susceptible to damage in the supply chain or in-store may not be suitable for selling loose. To reduce single use plastic packaging, alternative packaging options should be investigated, and WRAP's Best Practice guidance followed.

When selling items packed:

- Do not apply any date label
- Provide prominent best practice home storage advice front of pack – including the 'Little Blue Fridge' and numeric storage temperature advice
- Investigate changes that could be made to address the need to sell packed
- Investigate options to reduce plastic use
- Apply correct recycling label to pack
- Provide film recycling facilities and promote their use to customers.

When selling items loose:

- Do not display any date label for customer use
- Provide prominent best practice at home storage advice with the product
- Ensure compliance with relevant legislation such as supplying country of origin and allergen information
- Use the implementation guidance and resources in the food labelling guidance.

ENDNOTES

- 1 Table 14 in https://wrap.org.uk/sites/default/files/2021-03/WRAP-Household-food-waste-restated-data-2007-2015_0.pdf
- 2 Substituting another material should not create any additional environmental impact and food waste should not increase because of changes in packaging
- 3 According to the Pact, plastic packaging can be problematic or unnecessary if it:
 - is avoidable, or reusable options are available;
 - does not commonly enter recycling or composting systems;
 - is not recyclable or hampers the recycling process; or
 - pollutes our environment
- 4 Consumer Attitudes to Food Waste and Food Packaging, WRAP (2013): <https://wrap.org.uk/sites/default/files/2020-12/Consumer-attitudes-to-food-waste-and-packaging.pdf>
- 5 Current advice from the Food Standards Agency is that potatoes should not be stored in the fridge
- 6 Citizen insights on food disposal, packaging, and date labels. WRAP 2021. Figure 1
- 7 Consumer Attitudes to Food Waste and Food Packaging, WRAP (2013): <https://wrap.org.uk/sites/default/files/2020-12/Consumer-attitudes-to-food-waste-and-packaging.pdf>
- 8 <https://www.food.gov.uk/safety-hygiene/home-food-fact-checker#vegetables>
- 9 The differences quoted are at a deterioration score of 0.3, which is when it is estimated (using the consumer research) that, whilst there may be some visible signs of deterioration, most people would choose to eat the item rather than dispose of it – so it's important to note that products were edible for some time after this date
- 10 J. A. Evans, A. M. Foster and T. Brown (2014). Temperature Control in Domestic Refrigerators and Freezers.
- 11 Temperature and energy performance of domestic cold appliances in households in England. Biglia et al. (2018). <https://doi.org/10.1016/j.ijrefrig.2017.10.022>

Reducing household food waste and plastic packaging



WRAP works across six continents with governments, businesses and people to create a world where resources are sourced and used sustainably.

WRAP's mission is to accelerate to accelerate the move to a sustainable resource efficient economy through re-inventing how we design, produce and sell products; re-thinking how we use and consume products; and re-defining what is possible through re-use and recycling.

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The Courtauld Commitment 2030

is a voluntary agreement that enables collaborative action across the entire UK food chain to deliver farm-to-fork reductions in food waste, greenhouse gas (GHG) emissions and water stress that will help the UK food and drink sector achieve global environmental goals.

www.wrap.org.uk/courtauld

The UK Plastics Pact brings together businesses from across the entire plastics value chain with UK governments and NGOs to tackle the scourge of plastic waste. We are creating a circular economy for plastics, capturing their value by keeping them in the economy and out of the natural environment.

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