

Consumer perceptions of genome edited food

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Executive summary

About the research

Genome editing, also known as gene editing, is one of a group of precision breeding techniques used to develop new varieties of plants and to introduce variation in animals. Plants and animals developed using these techniques can then be used for food. Genome editing in food may be an area of policy divergence now that the UK has left the EU, as the UK government vocally intends to drive change in this area.¹

The Genetically Modified Organism (GMO) environmental releases legislation (stemming from EU legislation) underpins the current GM food and feed regulations. The Department of Environment, Food & Rural Affairs (Defra) holds the lead responsibility for GMO legislation in England and for genome editing which currently falls under it. GMO regulation and policy is devolved in the UK, with the devolved governments having separate legislation. The responsibility of food and feed produced from GMOs is held by the Food Standards Agency (FSA) in England, Wales and Northern Ireland and Food Standards Scotland (FSS) in Scotland. Under the Northern Ireland Protocol, Northern Ireland is obliged to align with EU Single Market rules on food and feed, which includes matters related to GMOs.

The UK Government disagreed with the 2018 European Court of Justice (ECJ) ruling that genome edited organisms should be regulated as GMOs even when the outcomes could have been generated by traditional breeding methods.² There is now interest in reviewing the regulation of genome editing, which requires changing the definition of a GMO in legislation. Defra ran a public consultation from January to March 2021 on genetic technologies including a proposal to change the legislation to amend the definition of a GMO. Defra will use consultation responses to help decide whether to change this legislation in England.³

This research project was commissioned to run alongside the Defra consultation, and complements the Defra consultation by gathering evidence on consumer interests

¹ [Government website page with Boris Johnson's first speech as Prime Minister](#)

² [Government consultation page which states the Government's disagreement with the ECJ ruling](#)

³ [The webpage for the DEFRA consultation on genetic technologies](#)

specifically, to help inform future food policy. This research will also help inform communications with consumers if new genome edited food policy is introduced.

The Food Standards Agency (FSA) commissioned Ipsos MORI to conduct a mixed methods social science research project. The qualitative stage of this research consisted of a series of online deliberative dialogue workshops, bridged by an online community, with 80 consumers across England, Wales, and Northern Ireland. This was followed by a quantitative online survey of 2,066 consumers representative of England, Wales, and Northern Ireland.

There is no one definition of genome editing used in the UK, either in legislation nor one that has been agreed by the UK Government, and the FSA recognises that genome editing uses a spectrum of tools and can result in a range of modifications. The definition used for this project covers a specific sub-set of genome editing outcomes and was agreed between internal and external experts for the purpose of the consumer workshops in order to align with the parallel Defra consultation definition. The definition of genome editing used for this study therefore focuses specifically on genome editing in plants and animals that could also be achieved using traditional breeding (referred to as conventional breeding throughout this report).

Key findings

Consumers tended to have low awareness and very low knowledge of genome edited food. Most had not heard of genome edited food or confused it with GM food.

Consumers tended to find genome edited food more acceptable than GM food, typically because they perceived it as safer and more natural (although others still felt genome editing was unnatural and more closely aligned with GM than conventional breeding). However, consumers found both GM and genome editing applied to plants more acceptable than either GM or genome editing applied to animals, so GM plants were generally seen as more acceptable than genome edited animals.

Consumers were concerned about safety risk to humans (viewing modified and edited plants as safer than modified or edited animals), and animal welfare (including concerns about intensive farming of edited disease resistant livestock).

Generally, more informed consumers were, or became, more accepting of genome edited food, despite some still having concerns.

Consumers felt labelling of genome editing foods should always inform consumers of the presence of genome edited ingredients using the full term 'genome edited'.

Most consumers felt it would be appropriate to regulate genome edited foods separately from GM foods, because they are two different techniques. However, many participants felt that the level of scrutiny, testing and regulation should be just as high as for Genetically Modified Organisms (GMOs), at least to begin with. They felt that as a newer technique there may be unknown risks. They were concerned that large corporations prioritising profit might undermine potential benefits for consumers, animals and the environment unless regulated carefully.

Consumers felt thorough safety assessments were important, and that animal welfare rules should be strengthened if needed. It should be noted that the participants were not provided with in depth information about current animal welfare regulations as this was not the focus of the research. As such, they may not have had the understanding needed to reflect on whether current approaches are adequate or not. However, they were very clear about the importance of adequate animal welfare regulations. Some felt that, because it is a relatively new technique, there may be unknown risks. Some consumers worried that a focus on maximising profits by large corporations may undermine potential benefits for consumers.

Consumers wanted transparent labelling, and reassurance about the thoroughness of regulation and safety assessments, if genome edited foods reach the UK market. As well as communications regarding existing animal welfare regulations in the UK, participants suggested TV documentaries and social media information campaigns would help educate the public on genome edited food products.

Chapter 1: Methods

This chapter is a summary of some aspects of the methods used, which are important to consider when reading this report. The full methodology can be found in the appendices.

Definitions used for this study

There is no one definition of genome editing used in the UK, either in legislation nor one that has been agreed by the UK Government, and the FSA recognises that genome editing uses a spectrum of tools and can result in a range of modifications. The definition used for this project covers a specific sub-set of genome editing outcomes and was agreed between internal and external experts for the purpose of the consumer workshops in order to align with the parallel Defra consultation definition. The definition of genome editing used for this study therefore focuses specifically on genome editing in plants and animals that could also be achieved using traditional breeding (referred to as conventional breeding throughout this report).

It is important to note that the definitions used may have framed research participants' views during the research, especially where previous awareness was low, and these definitions were the only ones that participants had encountered. This is particularly true where participants noted that genome editing usually produced changes that could have happened through natural mutations or conventional breeding methods.

Definitions used

- “Conventional breeding” is a term that describes the range of techniques used for many years to genetically improve animals and plants. In animals it includes selective breeding and artificial insemination. In plant seeds, x-rays or chemicals are sometimes used to increase both the range and number of random mutations in the DNA.
- “Genome editing” is a scientific technique used to create small specific changes to part of a living thing's DNA to improve its existing characteristics. These changes could also be achieved by conventional breeding.

- “Genetic modification” is a scientific technique used to artificially insert DNA from one living thing into the DNA of another living thing, introducing a new or different characteristic. These changes could not be achieved by conventional breeding.

Under the definitions described above, genome editing differs from genetic modification (GM) in some key ways:

- GM introduces foreign genetic material from different organisms, whereas genome editing involves altering the original DNA of an organism, with no introduction of foreign genetic material.
- Genome edited foods are foods that contain, consist of, or are produced by organisms (such as crop plants or farmed livestock) in which the genetic material (DNA) has been altered in a way that could also have occurred naturally by mating, natural recombination, or traditional breeding methods such as selective breeding and chemical mutation.
- Changes introduced by genome editing are not easily traceable or detectable (without any foreign DNA introduction) and cannot be technically distinguished from those which have been bred by conventional farming practices.

Objectives

This research aimed to understand consumer perceptions of genome edited food, particularly current concerns and potential public acceptability. This research complements Defra’s consultation by gathering evidence on consumer interests specifically, to help inform future food policy. This research will also help inform communications with consumers if new genome edited food policy is introduced.

Research Questions

Awareness and knowledge

- What is consumer knowledge of genome edited food and GM food, and the differences between them?

- When genome edited food and GM food is explained to consumers, do they understand the differences between them?
- When genome edited food and GM food is explained to consumers, do they find one of them more acceptable?

Concern

- What are consumer concerns regarding genome edited food?
- Why do consumers have these concerns about genome edited food?

Hypothetical policy scenarios

- How concerned would consumers be about a policy change that would separate genome edited food from GM food?
- How concerned would consumers be about a policy change that would mean genome edited food was not labelled?
- How willing would consumers be to eat and buy genome edited foods under these circumstances?
- How do consumers want genome edited food to be regulated?
- Which policy approaches are most likely to improve consumer acceptability of genome edited food?
- Under what circumstances might consumers trust that genome edited food is safe?

Chapter 2: Awareness and knowledge

Chapter summary

Awareness of both genome editing and genome edited foods was very low among workshop participants, and this was mirrored in the survey findings.

Workshop participants were more aware of GM and GM food than genome editing or genome edited food. Survey respondents who said they had heard of one scientific technique were more likely to also have heard of the other, although were not always able to distinguish between them.

Male survey respondents, those aged 16-34, and those with higher education levels were much more likely to report being informed about genome editing.

Survey respondents who self-reported that they were knowledgeable about genome editing often could not always distinguish between genome editing and GM or did so in a way that did not match the definitions used for this study. It is therefore important to note that perception of knowledge and actual knowledge of these scientific techniques does not always align.

Survey respondents who were male or aged 16-24 were more likely to say that genome edited foods should be available for sale in the UK before being informed in more detail about the technique. Respondents who felt that they were informed about genome editing were also more likely to support these foods being available for sale.

Awareness of genome editing and genetic modification

After an introduction to the project, but before any information was provided about genome edited and genetically modified food, workshop participants were asked about their awareness of these concepts.

Initial awareness of genetically modified (GM) food

Most workshop participants had heard of genetically modified or GM food, particularly those who remembered GM tomatoes in the 1990s. Understanding, however, varied considerably. It was common for participants to have a vague association with the concept, but very few were able to provide a full explanation. The words and phrases that participants used when they were asked about their awareness of genetically modified food were collated through a content analysis of workshop notes and are shown in Figure 1 below. The size of each word indicates the number of times it was used across the workshops, i.e. larger words were used more often than smaller words. Words like “unnatural” and “changes” were more frequently used among participants.

Figure 1: Words commonly used by participants in association with genetically modified or GM food.



Many participants initially reported feeling uncomfortable and wary when discussing genetically modified or GM food due to the idea of tampering with nature. Others perceived potential benefits, such as to improve foods in some way. The former view was more common at this point.

There were also lots of associations with changing the colour, appearance, size or qualities of fruit and vegetables to make them more attractive to purchase, more resilient to disease and more productive.

A third of survey respondents (32%) claimed they were 'very' or 'fairly' informed about the scientific technique of genetic modification while around one in eight (12%) said they had 'never heard of it'. However, over half (54%) indicated that they felt 'not very' or 'not at all' informed about genetic modification.

When asked specifically about their knowledge of GM foods (as opposed to the scientific technique more generally), a quarter (24%) said they knew a 'great deal' or 'fair amount' about them and only 9% had 'never heard of' them. 39% said they knew 'a little' about them and 27% had heard of them but said they knew nothing about them.

Initial awareness of genome editing

Awareness of the scientific process of genome editing was lower than awareness of GM as a scientific technique. One in five survey respondents (20%) felt 'very' or 'fairly well' informed about genome editing, while half (49%) said they were 'not very' or 'not at all' informed, and over a quarter (28%) had 'never heard of it'.

In the workshops, participants often confused their understanding between genetic modification and genome editing, and interchangeably used phrases like 'changed', 'tweaked', 'adding' or 'removing'.

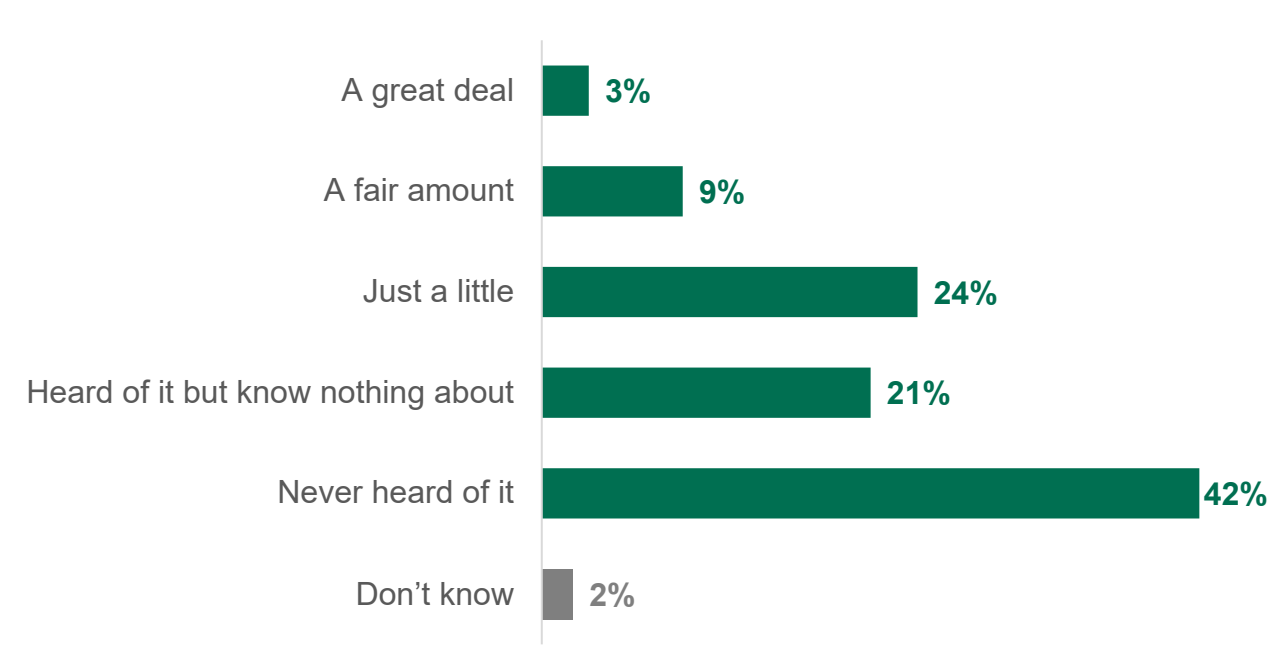
"Modified is changing it, genome [editing] is adding to it." (Midlands).

Reflecting this confusion, some participants felt that the words 'edited' and 'modified' were very similar, and there were others who thought they meant the same thing.

There was a clear link between claimed awareness about genome editing and GM. 94% of survey respondents who felt 'very' or 'fairly' well informed about genome editing also said they knew at least 'a little' about genetically modified food products. Those who claimed to feel 'very' or 'fairly' well informed about genome editing were more likely to say they also felt 'very' or 'fairly' well informed about GM (86%) compared with those who said they were 'not very' or 'not at all' well informed and those who had 'never heard of it' (24% and 6% respectively).

Survey respondents were also unfamiliar with genome edited food products. Just 12% said that they knew 'a great deal' or 'fair amount' about them. Two in five (42%) had 'never heard of' genome edited food products. Those who claimed they were 'very' or 'fairly' well informed about genome editing were much more likely to claim they had heard of and knew at least 'a little' about genome edited food products specifically (90% vs 34% and 2% for those who knew at least 'a little' about genome edited food products or had 'never heard of them', respectively).

Figure 2: Before today, how much, if anything, did you know about genome edited food products?



Base: 2066 adults aged 16-75 in England, Wales, and Northern Ireland (no definition given).

Uninformed views on the sale of genome edited food products in the UK

Before being given a definition of genome editing, all survey respondents were asked whether they thought that genome edited food products should be available for sale in the UK. Nearly a third said they 'probably' or 'definitely' should be for sale (32%), while slightly more said genome edited foods 'probably' or 'definitely' should not be for sale (37%). 31% said they 'don't know'. As these views were shared before respondents were presented with the definition of genome editing they should be considered uninformed views, and ones that may be held by the general public who have also not been informed about the genome edited foods.

Men were more likely than women to say genome edited foods should be for sale (38% compared with 25%), as were younger people (50% of those aged 16-24.).

Those who claimed they were 'very' or 'fairly' informed about genome editing were also more likely to say that they felt they should be for sale compared with those who were

'not very' or 'not at all' informed and those who had 'never heard of it' (60%, 32%, 13% respectively).

Tested knowledge of genome editing and genetic modification

Survey respondents who indicated that they were informed to any extent about genome editing (very, fairly, or not very well informed) were shown the definitions of genome editing and GM used in this research and asked to identify whether the definition corresponded to genome editing, GM, neither or both.

As explained in Chapter 1, it is important to note that the definitions of GM and genome editing used for this research were chosen to align with Defra's consultation. These definitions also differ from international definitions. Some aspects of the GM definition used for the survey may also apply to genome editing according to scientific definitions.

Most respondents did not identify the scientific technique described in a way that would be considered correct according to the definitions used for this study. That said, 28% did match the definition for genome editing to the term 'genome editing', and 36% matched the definition for GM to the term 'genetic modification'. A further 28% said that the definition for GM matched both techniques, which under other definitions not used in this study would also be considered correct.

When shown the genome editing definition, 26% said they thought it described only GM, a third (33%) that it described both and 3% said neither. One in ten (10%) selected 'don't know'.

When given the definition of GM, 22% thought that it described only genome editing, and 3% that it applied to neither. A similar proportion also selected 'don't know' for this question (11%).

Those who claimed they were 'very' or 'fairly' well informed about genome editing did not always identify the scientific technique in the same way as the definitions used for this study did. In fact, these respondents were more likely than those who had said they were 'not very' informed about genome editing to think that the definition for genome editing applied only to GM (30% and 23%, respectively).

These findings emphasise the importance of distinguishing between self-reported knowledge and actual knowledge of these scientific techniques when interpreting the findings. For example, overconfidence bias means most people tend to overestimate their own knowledge. Low awareness of genome edited foods is unsurprising given that there are still not many genome edited foods available worldwide, and none in the UK. However, it is still interesting to note how those who claimed to be more informed about genome editing viewed the technique more positively to those who felt less informed or who had never heard of the technique before.

Chapter 3: Concern and acceptability

Chapter summary

Workshop participants were surprised that they had not heard about genome edited foods before. On considering genome editing further, they felt that genome editing was much closer to conventional breeding methods than they had assumed before learning more. Others still felt genome editing was unnatural and more closely aligned with GM. There was continuing confusion among some participants about the differences between the techniques.

As they considered both techniques further, a key distinguishing feature workshop participants focused on between GM and genome editing was the association of introducing new DNA from another organism for GM. On the other hand, participants associated genome editing with more natural outcomes and alterations of precise parts of an organism's existing DNA.

Not all participants had a preference between GM and genome editing, but when they did, it was always in favour of genome editing. Overall, and regardless of which technique had been used, modifying/editing plants was seen as more acceptable than animals. Survey respondents found genome editing in plants the most acceptable, but they found GM plants more acceptable than genome edited animals. GM animals were the least acceptable to survey participants.

The key drivers of acceptability around genome edited food for participants were: improving animal welfare (for example, resistance against painful diseases), the potential

benefits to human health (allergen safe or coeliac safe foods), whether the example had the potential to increase access to (affordable) food, or was seen to be tackling the impacts of climate change with more sustainable food production.

The key concerns about genome edited food discussed during the workshops centred around food safety (especially in the long-term, and meat or dairy) and animal welfare (concerns about increased intensive farming if animals are edited to be disease resistant, or a perception that animals would suffer pain directly due to genome editing process). Concerns also focussed around regulation, transparency, and consumer choice, and that large corporations may undermine potential 'greater good' causes by using the technique in a way that prioritises profit over other considerations. Environmental concerns (possible negative impacts of introducing edited animals or plants into the wild) were also raised. This was supported by the quantitative findings; survey respondents were most concerned about the impact on animals bred using genome editing techniques, followed by the impact on humans from eating genome edited food products.

Views and concerns about genome edited food when informed (i.e. after information provided)

Workshop participants were given a presentation which included introducing DNA, an explanation of what a genome is, and a timeline of genetic discoveries. This emphasised that artificial selection and selective breeding of livestock and crops has been done for thousands of years but that GM and genome editing techniques were more recent. Information was provided on the range of individuals and organisations involved, and the differences between artificial selection and induced mutation, genome editing and genetic modification. Participants were then shown a video about genome editing and the CRISPR-Cas9 technique.

Overall, familiarity with the information provided was mixed, although most learned something new from it. Some participants gained understanding of the topic, while others said that they still struggled to understand the scientific concepts. During this part of the discussion, there were references to cloning, organic food, Thalidomide, and COVID-19, with the need for moderators and experts to provide extensive clarification.

Regardless of the extent to which people grasped the information, workshop participants were very surprised to learn that this technique has been used in research and development for several years, but they were only hearing about it now.

Those who felt able to grasp the information talked about how they were surprised by how similar some of the final products of genome editing can be to those produced through conventional breeding. There were participants who said that this made them view genome editing as a technique to simply speed up an otherwise natural process. Despite the process itself being lab-based, there were participants who formed the perception that genome editing is a more natural process than they had expected due to the changes being limited to the organisms own existing DNA, and they found this reassuring. There were some who said that they favoured the process of genome editing over the use of chemicals to induce mutation. Other positives that participants noticed from the information provided were the perceived potential health, environmental and sustainability benefits.

Concerns that participants expressed in the workshops focused on several different themes:

- **Food safety** – There were participants who worried that there may be unknown effects of eating genome edited foods for humans, especially in the long-term and especially regarding edited meat or dairy. This was because it is a relatively new technique for food production and has not seen years of safe consumption as GMO or conventionally bred foods have. Some were also suspicious about why genome edited food is not already for sale in the UK and wondered if this indicated that it was not yet safe to eat.
- **Animal welfare** – Concerns about animal welfare also applied to genetic modification and conventional breeding. However, because genome editing is not yet used in UK food production, and the legislation around that may change soon, participants worried that animal welfare could be compromised by the technique. There were concerns that livestock might suffer due to increased intensive farming if animals are edited to be disease resistant, or directly due to the edits made to their DNA. While there were concerns about perceived disadvantages to animals and their welfare, participants could also see the benefits of using genome editing to reduce disease and suffering.

- **Regulation, transparency, and consumer choice** – There were participants who worried that they might not be aware if they are eating genome edited foods in the future, or who worried that it would not be regulated effectively or transparently. They felt that information about genome edited food regulation is important in order for consumers to have real choice about what they are consuming.
- **Who will (really) benefit** – Even when participants felt that there were potential ‘greater good’ benefits (for example, for consumers, small-scale farmers, the environment, sustainability, animal welfare) they still had concerns that in practice, large corporations may undermine these potential benefits by using the technique solely to increase their profits.
- **Environmental** – There were some concerns about possible negative impacts of introducing edited animals or plants into the wild.

These concerns were mirrored in the quantitative survey findings. Having been given the definition for genome editing, survey respondents were most concerned about the impact on animals bred using genome editing techniques (71% selecting they were ‘very’ or ‘fairly’ concerned about this) followed by the impact on humans from eating genome edited food products (65%). Survey respondents were least concerned about the taste of genome edited food products, though half were still concerned about this (51% ‘very’ or ‘fairly’ concerned).

Women were consistently more likely than men to be concerned about different potential impacts of genome edited food products becoming available for sale in the UK. Older people aged 55-75 were more likely than younger people to be concerned about most potential impacts.

Midway through the first workshops, participants commonly reported being undecided on genome editing, and often said they wanted to know more - particularly around the risks - before deciding on their views. However, there were participants who said they were more comfortable with genome edited food having learnt more about it. They contrasted this with their more negative views of GM food. This tended to be because of the addition of foreign DNA in genetic modification. More specifically, genome edited plants felt more acceptable than genome edited animals for some.

“Yes, I agree, I was shocked that it’s with the animals and stuff, I wouldn’t be on for that at all. As for the plants and stuff it wouldn’t

annoy me, but definitely not modifying animals or anything like that.”
(Northern Ireland).

Workshop participants had the opportunity to have their questions answered by experts, and below are the range of questions that people had at this stage:

Justification/need

- Why is selective breeding not good enough?
- Will genome editing become more common in food?
- Why do we need genome edited food?

Safety

- Is genome edited food safe?
- What are the long-term effects of consuming genome edited food?
- Has genome edited food been tested on people?
- Why is genome edited food on sale in other countries, like America, but not in the UK?
- What are the risks? What happens when genome editing goes wrong?

Consumer choice

- Will genome edited foods cost more, or less to consumers?
- Does genome edited food look or taste different?
- What will be the impact of Brexit on food availability? Will we be forced to import lower quality food in from America?

Regulation

- Will genome edited food be regulated? What if it gets into the wrong hands?
- If genome edited food does come to the UK, will it be labelled?

Ethics

- Where will this go next?
- Where is the end to this?

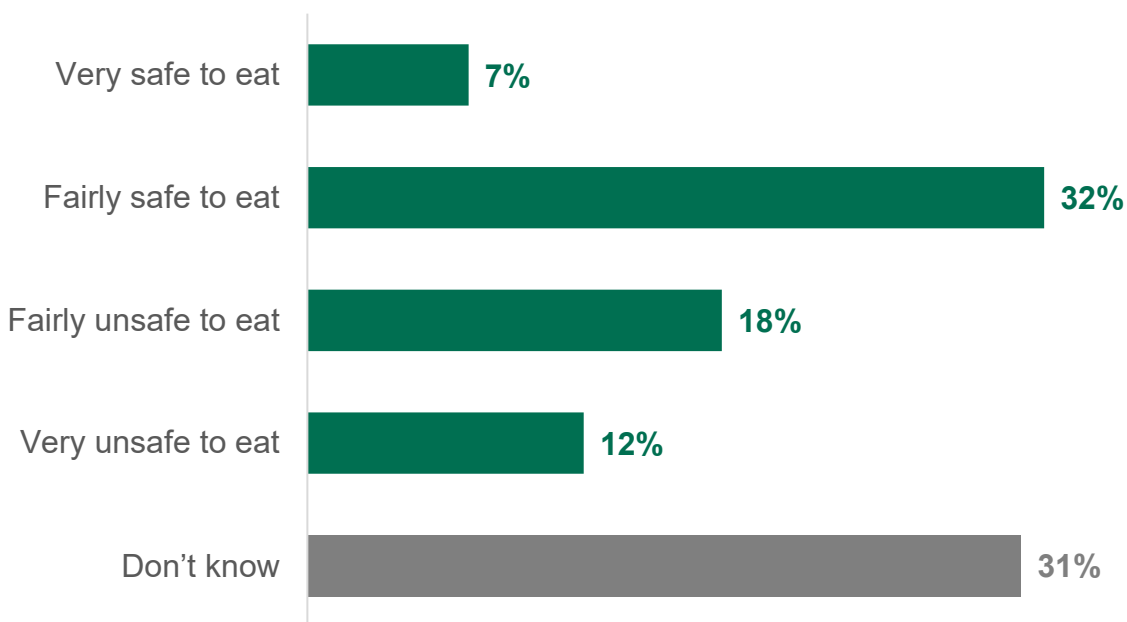
Miscellaneous

- What is the difference between genome edited and organic food?
- Is this just about plants or will it be used in animals too?

- Can genome editing be used in humans too, for example, to eliminate a cancerous cell or Huntington’s disease?
- Is genome editing the best use of research funding?

Survey respondents were asked how safe they thought genome edited foods were once they had been shown the definition of genome editing. Two in five (39%) indicated that genome edited food products were ‘very’ or ‘fairly’ safe to eat, while three in ten thought they were ‘very’ or ‘fairly’ unsafe to eat or said they ‘did not know’ whether genome products were safe to eat (30% and 31% respectively). Some (31%) said they did not know whether these products were safe to eat. Only 7% thought these food products were ‘very’ safe.

Figure 3: To what extent do you think that genome edited food products are safe, or not safe, to eat?



Base: 2066 adults aged 16-75 in England, Wales, and Northern Ireland.

Several socio-demographic groups were more likely to think that genome edited food products were safe to eat: men compared with women (44% versus 35%); people of highest socio-economic status (social grade AB) compared with people of lower social socio-economic status; and young people aged 16-24 (53%) compared with all other age groups.

Survey respondents who saw themselves as ‘very’ or ‘fairly’ well informed about genome editing were more likely to think genome edited food products were safe to eat (61%)

compared to those who reported not feeling informed (41%) or not having heard of genome editing before (22%).

Comparing examples of genome edited food, GM food and conventional breeding

After a 'Question and Answer' session with experts, workshop participants were shown 6 case studies designed to demonstrate the range of reasons why GM or genome editing might be used: 3 examples of genome editing, 2 examples of GM, and 1 example of conventional breeding. Participants were not informed about which technique had been used in each case study before discussing these. In small discussion groups, participants were asked to individually rank the case studies from most to least acceptable to them personally. Following the individual task, participants shared their rankings with the rest of the group for discussion.

Workshop participants weighed up the risks and benefits of each case study, rather than expressing general views on the techniques being used. In doing so they predominantly focused on the safety risk to humans (viewing modified/edited plants as safer than animals), animal welfare, the potential benefits to human health, and the driving need for the change (cosmetic changes to food were deemed unnecessary). The environmental impact, potential to increase access to (affordable) food or was seen to be tackling the impacts of climate change with more sustainable food production, were also considered.

The points below summarise the range of risks and benefits discussed by participants for each case study.

Holstein Friesian dairy cows (conventional breeding)

- Benefits: The highlighted risks (mastitis in cows) are manageable and avoidable, High demand for milk, hence the change seen as a solution
- Risks: Animal welfare (cows more at risk of mastitis), Food waste (excess milk), Feels unnecessary (do we need more milk?), Profit-seeking

Disease resistant pigs (Genome edited)

- Benefits: Animal welfare/reduced suffering to animals, Benefit to farmers, being able to yield more meat to sell

- Risks: Unknown risk to humans if we consume the meat, Pointless intervention if the meat is not yet available for consumption, There is already a solution (the vaccines to protect pigs from the disease)

Pink pineapples (GM)

- Benefits: No foreseen negative side effects of consuming (plants), Improved look and taste
- Risks: Unnecessary change for a novelty reason, Affordability to the consumer (as highlighted by the premium price), Risk of exacerbated inequalities

Faster growing salmon (GM)

- Benefits: Potential cost saving to consumers, A general acceptance of feeding up animals before they go to market
- Risks: Unknown unintended consequences and risk to natural environment, Interference with nature, Addition of genes from two other fish, Animal welfare (larger mass-produced salmon), Profit-seeking

Coeliac-safe whole grain bread (Genome edited)

- Benefits: Benefit to human health/potential to reduce suffering to humans, Potential to offer more affordable choice, and tastier food, No foreseen negative side effects of consuming (plants)
- Risks: Potential environmental impact and risk (gluten free wheat mixing with gluten wheat through pollination)

Disease resistant chocolate (Genome edited)

- Benefits: Sustainability, Positive impact on farmers (assuming they reap the rewards), No foreseen negative side effects of consuming (plants), Potential cost saving to consumer
- Risks: Feels unnecessary to save chocolate, the world could survive without it.

Differentiating between genome edited food, genetically modified food, and conventionally bred food

Following the individual and group exercise comparing the case studies, workshop moderators explored whether participants thought each case study was an example of genetic modification, genome editing, or neither.

Within most groups there was confusion, and participants were not always able to identify the correct technique or method that had been used. In particular, the conventional breeding example of the dairy cows was commonly assumed to be an example of genetic modification given the reference to two breeds of cow (and the association with adding DNA from one organism into another for genetic modification), and to 'genetic tracking'. Again the blurred lines between 'editing' and 'modifying' made it difficult for participants to identify which technique had been used, or in some cases where participants could understand the difference in techniques (i.e. they could see there had been no foreign DNA added), they could not remember which descriptor to use (i.e. genome editing or GM).

Where participants were clear on the differences, this was due to the following differentiating features:

- The introduction of new DNA from another organism to the existing organism signalled an example of GM.

"I'd go for modification as they've introduced a gene from tangerine DNA. They've introduced something else to it." (Midlands)

"It said on the case study they've introduced some specific genes from two other fish. So, I'm assuming that must be genetic modification because they're introducing genes that don't belong to that fish from another fish." (Manchester/Leeds)

- A process where the changes achieved are equivalent to those that could be found in nature or produced through conventional breeding, differentiated genome editing from GM. This conclusion had been highlighted in information workshop participants received, including a video.

"That wouldn't have happened naturally. Wouldn't that be genetic modification if they've put something in from something else."
(Midlands)

- References to altering precise parts of the existing DNA made a technique more clearly associated with genome editing.

"That says they removed a precise part of the gene. That's genome editing." Manchester/Leeds)

While for some participants, the removal of genes from the organism's DNA was the defining feature of genome editing, for others the reference to genes or parts of genes being removed caused confusion. Consequently, where this confusion arose, there was an assumption that the example was GM.

"[An example of genetic modification] because they are changing the protein in the cells, they took that out. They are removing the precise part of the gene that produced the protein." (Northern Ireland)

When genome editing and GM were explained, which was more acceptable?

To close the first workshop, participants were asked which technique they felt was more acceptable now that the differences had been explained and participants had a better understanding.

While there were participants who said that they were still undecided or confused, and others who said that they favoured neither (because both were associated with tampering with nature), where a preference was expressed, genome editing was more acceptable.

Genome editing was generally described as "less extreme", alongside the perception that the changes are generally smaller, more precise, and thus less unpredictable and risky.

"I personally find genetic modification less acceptable because it changes on a larger scale, it can create a larger scale change. What kind of implications it can then have, we don't know...Whereas genome editing is very targeted. It doesn't change on a greater scale." (Midlands)

Genome editing was also more acceptable than GM because participants perceived it to be a more natural process given the changes are to an organism's existing DNA. The addition of foreign DNA in genetic modification was off-putting.

"I suppose the genome editing seems more natural. It's tweaking what already exists rather than introducing something foreign. There is a difference between them." (Manchester/Leeds)

The fact the changes could have been achieved through conventional breeding (according to the definitions used for this study) was also reassuring. This conclusion had been highlighted in information workshop participants received, including a video.

"Editing sounds more acceptable when you see it in black and white like that because it's replicating what would happen naturally, just in a shorter space of time. They're speeding it up." (Wales)

After the workshop, participants who took part in the online community activities in between workshops reiterated these views when completing the quiz. A quarter (25%) said they were very concerned about GM food compared to only 4% for genome edited food.

The quantitative survey findings provide further evidence supporting the factors shaping acceptability found in the workshops. Survey respondents were asked about the acceptability of using genome editing and GM in both animals and plants within food production.

They were most likely to view genome editing in plants as acceptable (49%), followed by GM in plants (44%). GM in animals was seen as least acceptable (57% said it was unacceptable). Nearly half of respondents felt that genome editing in animals was unacceptable (47%), while just over a quarter (27%) saw genome editing in plants as unacceptable.

Men were more likely to view both genome editing in plants and animals as acceptable for food production (52% and 31% compared to 45% and 23% among women).

Younger people aged 16-34 were more likely to view genome editing in plants for food production as acceptable. 16-24 years olds were also more likely to view genome editing in animals as acceptable compared to older people aged 55-75 (32% versus 25%).

Those who claimed to be 'very' or 'fairly' well informed about genome editing were more likely to feel that editing in plants and animals was acceptable compared to people who did not feel well informed.

Chapter 4: Evolving attitudes and awareness

Chapter summary

Becoming informed about genome editing shifted workshop participants towards becoming more accepting of genome editing, especially when compared to genetic modification.

Workshop participants said this was because they felt that new varieties/breeds made using genome editing were more natural due to no foreign DNA being added to organisms, and that this in turn made the technique less risky than GM.

Many participants felt optimistic and enthusiastic about the potential benefits and uses for genome editing, but these positive feelings were held alongside some strong concerns. Some were moderately supportive because they felt the public have no choice but to accept new technology if conventional methods alone will not be enough to overcome challenges such as increasing populations, climate change and food security around the world.

Therefore, participants stressed that proper regulation and safety assessments would be essential for use of genome editing in food to be acceptable.

Understanding of the differences between genome editing and genetic modification

Workshop participants who took part in the online community quiz between the two workshops answered four questions that sought to establish whether they understood the differences between selective breeding (a sub-set of conventional breeding), genome editing and genetic modification. Their responses suggested that most had grasped the difference between the three processes: 79% identified that GM involved the addition of DNA from other organisms, and 86% identified genome editing as being when scientists change specific parts of the genetic code, without adding anything new. A smaller proportion (66%) correctly thought that the removal of DNA would also fall under the technique of genome editing. Participants were also confident about the definition for selective breeding, with 81% correctly identifying this. Furthermore, 86% thought that genome editing achieves changes that could have happened through natural mutation or breeding over a longer time.

While the online community quiz had demonstrated a good understanding of the differences between the techniques, at the beginning of the second workshop participants still demonstrated mixed levels of understanding of the differences between genome editing and GM when discussing these in more detail.

Evolving views on the acceptability of genome editing

Participants described how becoming informed about genome editing had influenced their attitudes towards its acceptability.

While far from unanimous, there was a strong shift among participants towards being more open to genome editing than they had before the first workshop, especially when compared to genetic modification.

Participants who felt more positively towards genome editing reiterated that this was because it felt more natural than genetic modification, because no foreign DNA had been introduced. This in turn felt less risky than genetic modification because the outcomes seemed more predictable and could have occurred through selective breeding or random mutation.

“I had no idea of the difference between gene editing and genetic modification, so it was interesting to understand the differences. I’m

quite suspicious of genetic modification but I think the consensus was that gene editing is much less of a risk and on balance.” (Midlands)

Among those who were supportive towards genome editing in food, there was a range in the strength of feeling. There were participants who felt optimistic and enthusiastic about the perceived potential benefits and uses for genome editing. However, others were supportive based on the idea that the public have no choice but to accept new technique because conventional methods alone will not be enough to overcome challenges such as increasing populations and demand for food, climate change and food security around the world.

“The world is getting smaller and there’s more people on it, and the way that we’re going to have to do something to be able to feed the number of people that are increasing on a yearly basis.”

(Manchester/Leeds)

Increased openness to genome editing was not unanimous amongst participants. Those who had not become more supportive since the first workshop explained that despite the differences between genome editing and genetic modification, any direct intervention in the DNA of other organisms felt unnatural, and therefore wrong, even if they could not explain why. The idea that these changes were made in a laboratory by scientists, rather than through conventional breeding, also added to the sense that it was overstepping a boundary as to how much control humans should have over the DNA of other organisms.

“[My family] hadn’t heard of it. I had to explain it to them, as much as I knew. They just don’t agree. Nature makes its own things. It would be artificial. They’re making stuff themselves, the scientists, and [my family] are not sure on that.” (Wales)

Even participants who said they had come to support genome editing in principle made it clear that their acceptance was conditional upon thorough safety assessment (discussed further in Chapter 5). Participants also repeated some findings from the first workshop: that the reason for using genome editing is important, and it is more acceptable when benefiting a cause for the greater good rather than purely for profit.

Participants often referred to two case studies from the first workshop: coeliac-safe wheat for bread, and disease resistant cocoa (both examples of genome editing). These stood out to participants due to the positive impact that could be achieved for human health and the livelihood for small scale farmers and Ghana's economy, with a perceived low risk trade-off associated with editing plants and not animals.

During the online community, participants were asked to read and comment on news articles about genome edited food. With guidance from the FSA, three articles were selected to demonstrate a balance of arguments, accessibility of information and writing styles. These articles, from the BBC, the Guardian and the Mail Online, were reporting on the same story: the launch of Defra's consultation on the regulation of genetic technologies. Participants were asked to move coloured pins to indicate which parts of the article they agreed or disagreed with and explain why.

This explored how participants responded to arguments for and against genome editing in food. 60 participants completed this activity.

47% of participants thought the benefits of genome edited food outweighed the risks, and 40% were still undecided about whether the benefits of genome edited foods outweighed the risks.

“My fear is if an error occurs during the DNA process, what would happen to the livestock, milk and vegetables, it's disposal and the impact on the consumers health.” (Midlands)

Many thought that, in theory, genome edited products could be beneficial for the greater good. Participants commented on how the technique could be used to help farmers and create food that was healthier and more sustainable. However, participants remained sceptical about who would benefit in practice, suspecting that those who would profit from genome edited produce would benefit most.

Chapter 5: Regulation and labelling

Chapter summary

Workshop participants had generally high levels of trust in UK food regulation, feeling confident that food available to buy on the shelves is safe to consume.

Most workshop participants felt that it would be appropriate to regulate genome edited foods separately from GM foods. They explained that as they are two separate techniques, they should be treated as such, and that categorising them the same may confuse the public and possibly undermine their chances of learning about the differences.

However, many participants felt that the level of scrutiny, testing and regulation should be just as high as for Genetically Modified Organisms (GMOs), at least to begin with. This was because they felt as a newer technique there may be unknown risks and market behaviour such as profit-seeking from large corporations that may undermine potential benefits for consumers, animals and the environment unless regulated carefully.

Some participants thought that the appropriate level of scrutiny could be re-assessed after genome edited foods have been available in the UK for several years and more understanding of its safety has been gained.

Workshop participants felt that regulation for genome edited animal products must be accompanied by a review of, and if needed, amendments to animal welfare regulations. This is to ensure that the new technology does not undermine protections for livestock, particularly around intensive farming.

There was strong agreement among most workshop participants and survey respondents that labelling should always inform the consumer of the presence of genome edited ingredients in the product. Survey respondents also thought that labelling should indicate which ingredients have been genome edited, though during the workshops not all participants felt this would be necessary.

Workshop participants thought that labelling should state the full term 'genome edited' rather than abbreviating it to 'GE', and that the information should always be next to the ingredients list.

Regulation of genome edited foods

During the second workshop, participants were given a presentation by the FSA that explained the current and potential future approaches to regulating genome editing. This outlined the decision to be made about whether some types of genome editing are categorised and regulated separately from genetic modification, and that this could mean

that genome edited foods are labelled differently. This section explores participants' views on the overall approach to regulating genome edited foods, before focusing specifically on labelling.

General feelings around food regulation in the UK

Participants often spoke about having a generally high level of trust in UK food regulation, explaining that they felt confident that foods sold in shops are always safe for consumers, despite knowing little about how food regulation works.

“One thing I wanted to make a note of was the regulation on food labelling is quite strong in this country, so it's comforting to know that if, for example, genome edited products were introduced in the UK that they would follow strong regulation.” (Manchester/Leeds)

How should genome edited foods be regulated?

Most participants felt that it would be appropriate to regulate genome edited foods separately from GM foods. They explained that due to the key differences between the two techniques, they should be considered as two distinct processes under regulation. Some participants had concerns that unless genome edited foods are regulated separately, the public may not be aware that it is a separate process and may be put off from buying genome edited foods.

“It is something different. It's not the same. If it's grouped together people are going to think it's the same technology, science. It's not. It's completely different.” (Midlands)

Despite this support for separate regulation of genome edited food, participants shared reservations due to the European Court of Justice's 2018 ruling that genome edited foods should be classed as GM foods⁴, ⁵. Participants wanted to know why this decision had been made. Some worried that there may be a chance that the UK moves too quickly to reverse this EU ruling after EU exit and, if this is the case may overlook risks in its

⁴ [The formal ruling by the EJC](#)

⁵ [A press release about the EJC ruling](#)

enthusiasm to bring genome edited foods to UK shelves. This concern was often reduced when participants understood that the 2018 decision was not made by EU member countries, and that there were many EU and non-EU countries that thought genome edited foods should be regulated separately from GM foods.

While they thought genome editing should be regulated in its own category, many participants felt that the level of scrutiny, testing and regulation should be just as high as for GMO's. They feared unknown risks because it is a relatively new technique. They were concerned that profit-seeking from large corporations may undermine potential benefits for consumers, animals, and the environment unless regulated carefully.

“There shouldn't be any relaxation with regulations when it comes to things that we consume, wherever it's grown... That is my concern, what is the process of this pig, or bacon or whatever with the genome editing or genetically modified. Nothing should be relaxed. The relaxation will open up doors for it to be about money-making. Lives would be at risk.” (Manchester/Leeds)

For this reason, some participants also suggested that the level of regulation of genome edited foods should be revisited once genome edited foods have been available in the UK for long enough for more to be known about their safety. Some also thought that communicating the high level of regulation to consumers would help build public trust in the safety of genome edited foods over time.

“It should be the norm. It makes sure it stays safe. Doing those checks or the points where it's retested, checked, re-approved, you could look at the data over the past ten years to show it's safe, it's still the same.” (Midlands)

However, there were also participants who felt that regulation of genome edited foods did not need to be as stringent as for GM foods, because they felt genome editing was more natural and therefore inherently less risky process.

“I don't see a problem with relaxing them. I think modifying is making completely new DNA. Editing isn't the same. We're not putting something completely alien in. We're just doing something that could happen in time anyway. We as human beings get defences against

things. Quicker isn't always better, but in this case, I think it is."

(Midlands)

While their concerns about animal welfare also applied to genetic modification and conventional breeding, participants wanted reassurance that existing animal welfare regulations would protect livestock from intensive and unethical farming practices and would ensure that animals do not suffer due to changes made to their DNA using genome editing.

It should be noted that the participants were not provided with in depth information about current animal welfare regulations, so may not have had the understanding needed to reflect on whether they are currently adequate or not. However, they were very clear that if existing animal welfare regulations did not protect livestock from these potential new impacts, then changes to genome editing legislation should be accompanied by updated animal welfare regulations.

Labelling of genome edited foods

One of the online community activities asked participants how much attention they paid to labelling, and what they look for on food labels when shopping. Participants were asked to find a food product from their cupboard and see if they had noticed and understood all the information on the label before buying it. The purpose of this activity was to get a sense of what participants look for on food labels, and the extent to which this information is an important factor in their purchasing decisions.

58 participants took part in this activity. 37 said that they paid 'some attention to food labelling when buying products for their household'; 13 'a lot of attention' and 8 'very little attention'. Participants had a range of priorities when looking at food labels, but use by date, dietary and nutritional information appeared to be the most important. Overall, participants thought that current food labelling is clear and easy to understand and included all the key information.

However, some participants were surprised by aspects of the label that they had not noticed before, such as country of origin, or things they did not understand, such as ingredients or vague certification stamps.

“On my label, there was some information I didn’t realise was there. It made me look a bit more. If I saw it while I was shopping, I probably would have taken it home anyway. Now, I’m in two minds whether I’m going to buy that again or not. I didn’t realise it was there. That was interesting. I thought I was looking at labels, I actually wasn’t looking at them fully.” (Manchester/Leeds)

During the second workshop, participants were asked how, if at all, genome edited food products should be labelled. To aid this discussion mock genome edited labels and menus and real (conventionally bred) food and drink products, were posted to each participant. The aim was to bring a range of genome editing labelling scenarios to life in a more realistic way by accompanying a range of genome edited food information with price, branding, and nutritional information.

The labels showed a range of levels of detail, with some not declaring that genome edited ingredients were included, others gave a full breakdown of each ingredient and the purpose of the edits made. The products also aimed to target different consumer types, including children, health-conscious consumers, people who drink alcohol, and those wanting a chocolate treat. The following section of this report focuses on the overall priorities and concerns that participants had about labelling, rather than their comments about specific items they had received. Due to the design of the session, some quotes and findings refer to specific items received. The labels for the different items can be found in the appendices, Figure 4 below shows one example.

Figure 4: Mocked-up genome edited cereal used in Workshop 2

HAPPY EARTH

FRUIT CRUNCH MUESLI
banana | apple | toasted coconut

Nutritional Information
Typical values per 100g

Energy (kcal)	1587
Energy (kJ)	379
Protein (g)	10.1
Fat (g)	9
Saturates (g)	3.65
Carbohydrates (g)	64.49
Sugars (g)	10.2
Sodium (mg)	0
Fibre (g)	8

Genome Edited Ingredients Information

Raisins	Grapes edited to be resistant to disease
Peanuts	Edited to be allergen-free and safe for all
Banana Chips	Edited to be vitamin A enriched and more resistant to climate change

Genome Edited

Ingredients Information

Raisins Edited to be allergen-free and safe for all

Peanuts Edited to be allergen-free and safe for all

Banana Chips Edited to be vitamin A enriched and more resistant to climate change

NO ADDED SUGAR **TOTALLY VEGAN**

100% RECYCLABLE

HIGH IN FIBRE • VEGAN • GREAT SOURCE OF PROTEIN

Our Fruit Crunch Muesli is a carefully selected and finely crafted blend of toasted & malted wheat flakes, jumbo oats and barley flakes mixed with juicy raisins, sweet banana chips, flaked apple, roasted peanuts and hazelnuts, and toasted coconut. Sweet and crunchy it's the perfect energising and filling breakfast.

Ingredients: **Wheat Flakes**, Barley Flakes, Raisins (16%), Jumbo Oats, Banana Chips (12%), **Peanuts** (6%), **Hazelnuts** (4.5%), Toasted Coconut, Flaked Apple (3%)

Allergy advice: For allergens, including cereals containing gluten, see ingredients in bold. May also contain other nuts.

At Happy Earth we pick ingredients that are best for you and best for our earth. To learn more about our Genome Edited ingredients visit www.happyearthfoods.com/genomeeditingdeclaration

How do you enjoy yours? Some suggestions for your bowl:
Looking for extra sweetness? Top your Fruit Crunch muesli with yoghurt and drizzle with honey
Like it hot? Mix Fruit Crunch muesli in a pan with your favourite milk and slowly heat until it reaches your perfect warmth
Fresh and fruity? Try adding some fresh mango, apricots or berries and drizzling in cold almond milk

Storage Instructions
Store in a cool, dry place.
Once opened, keep bag tightly closed and eat within a month

01 793618 222222

Do genome edited foods need to be labelled as genome edited?

While there were a range of views shared in the workshops about whether genome edited foods should be labelled or not, most participants strongly felt that labelling should always tell consumers if there are genome edited ingredients in the product, because transparency is crucial to enable consumers to choose for themselves, and to build consumer trust in genome edited foods.

Participants also felt that genome edited foods should be labelled differently to GM foods so that consumers can tell the difference. For some participants this was because they felt more comfortable about the idea of consuming genome edited foods than GM foods, and so would like to be able to differentiate between them when shopping for themselves. Others felt that while being different and more natural compared to GM, genome editing was still an artificial method of influencing the DNA of food, so choosing to label GM foods but not genome edited foods would be inconsistent and possibly misleading.

“I can’t quite justify in my head why you would say that you should tell the consumer about one but not the other. I don’t feel comfortable with that. There should be labelling for both, not just genetically modified.” (Manchester/Leeds)

There were participants who disagreed and thought that labelling as genome edited would cause unnecessary concern and confusion because if genome edited food has been proven safe for consumers, and if the outcomes could have also been achieved with conventional methods, then there is nothing that consumers needed to be informed about.

In the post-workshop survey, workshop participants were asked about labelling, perceived safety of genome edited food, and revisited willingness to eat. When asked how concerned they would be if genome edited food was not labelled as genome edited, 75% of participants said they would be concerned, with more saying they would be 'very' concerned (49%) than 'fairly' concerned (26%).

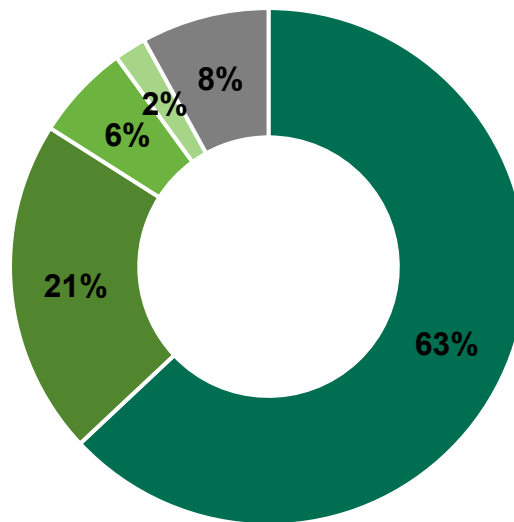
However, this concern did not appear to be due to their own worries about safety or unwillingness to eat genome edited foods: 81% of participants who responded to the post-workshop survey felt that genome edited foods were safe. No participants said that they were 'sure it's unsafe', but 18% said they were 'not sure it's safe'.

If genome edited foods were labelled as being genome edited, participants indicated they would be 'fairly' (56%) or 'very' (32%) willing to eat them. Only 10% said they would be 'not at all' or 'not very' willing to do so.

This mirrors the discussions had during the workshops, when participants placed importance on transparent genome editing labelling. This was not always because they themselves are worried about the safety or are unwilling to eat genome edited foods, but often because they see it is as crucial for consumer choice.

Survey respondents also saw the labelling of genome editing food products as important. If genome edited food products became available for sale in the UK, 84% said that it is important that these products are labelled as "genome edited", with 63% viewing this as 'very' important.

Figure 5: If genome edited food products became available for sale in the UK, how important, if at all, would it be for these products to be labelled as “genome edited”?



■ Very important ■ Fairly important ■ Not very important ■ Not at all important ■ Don't know

Base: 2066 adults aged 16-75 in England, Wales, and Northern Ireland.

Older people were more likely to think that labelling as genome edited was important. 90% of people aged 55-75 said was 'very' or 'fairly' important compared to 76% of those aged 16-24.

Respondents with degrees or higher qualifications were more likely to view labelling as important than those with no formal qualifications (87% and 77% respectively).

Workshop participants shared their views on what should be prioritised when labelling genome edited ingredients. One clear priority that arose was that labels must use the full words 'genome edited' rather than the abbreviation 'GE'. This is important for consumers who do not already know about genome editing and will allow them to look for information if they choose to, which would be harder to do if the full wording is not on the label.

“I think it's very important, because you don't know what 'GE' is. You type it in on Google, you'll get multiple different results. If you typed genome editing into Google, you'd get more results.” (Midlands)

Many participants liked the idea of a symbol to indicate that the product contained genome edited ingredients. They explained that this would be easy for consumers to look out for, especially if they have difficulty understanding labelling text. However, participants felt that any symbol must still include the full wording 'genome edited' rather than 'GE' for the reasons described above.

Participants suggested that the information about genome edited ingredients should be placed next to the ingredients list on the labelling, because this is where they would expect to see important information about the ingredients. Placing it elsewhere on the packaging could lead to it being missed or perceived as an attempt to hide the information from plain sight. When looking at mock products which had this information elsewhere on the packaging, participants often commented that it did not stand out enough to them, and some perceived this as an intentionally misleading attempt to disguise the information.

Level of detail required in food labelling for genome editing products

During the workshop discussions there were a wide range of views about the appropriate level of detail needed when disclosing genome editing on food labelling. Ultimately, the different perspectives on this matter came down to whether participants should have to seek out further information themselves if they wished, or if it should be proactively presented to them on the label at the point of purchase.

Those who preferred a minimal approach to labelling genome edited foods thought that it was sufficient to state that there were genome edited ingredients. They felt that consumers would then be able to decide for themselves if they wanted to buy the product or do their own individual research if they wished to know more.

Other participants thought that a label should also say which ingredients have been edited. They explained that this may influence how comfortable people feel consuming it, especially if they feel more comfortable consuming genome edited plants than genome edited animal products.

“I think more with meat than plants. If it's been regulated, I don't think I would have massive concerns, but I think it should definitely be labelled on meat and consumers should know.” (Northern Ireland)

There were also participants who thought that labelling of genome edited foods should go further by indicating why ingredients had been edited. Participants thought this approach would help educate and build trust with consumers and could be scaled back once the public were familiar with genome editing. This suggestion was aimed at building public trust more than protecting consumers rights or safety, so participants often framed it as advice for marketing genome edited products and not as something that regulations should enforce.

“I think it’s a good idea to do it anyway, especially if they’re worried about having a bad rep from GMO products. Just to say, ‘This is why we’re doing it. This is something that we’re doing to better the food.’”
(Manchester/Leeds)

During the workshops, some participants felt strongly that genome edited foods marketed as healthy, marketed towards children, or containing animal products should have a more detailed approach to labelling. They explained that these consumers might be more likely to have an interest in the nutritional information and seek to make more informed decisions about ingredients. Participants suggested that unhealthy snacks, processed foods or alcoholic beverages that do not contain animal products did not need as much information about the genome editing that had taken place, as consumers of these products are not likely to make decisions based on nutritional content.

“I think it depends on who the product is marketed at. The cereal [mocked-up muesli product] is for somebody who’s conscious on their health, they are going to want to read the label. If you are buying chocolate, you don’t care, you just want chocolate. It’s the same with alcohol, you just want to see the percentage.” (Midlands)

Some workshop participants thought that it would be suitable for a label to direct consumers to a website where they could access more information about the genome edited ingredients in the product and learn more about genome editing generally. However, there was also concern that this approach may exclude those who do not use or have access to the internet, so the label itself should still clarify which ingredients have been edited.

“There is so much information on the packaging. If it had genome editing and a website address, that would be fine. It’s quite instant and straight to the point.” (Midlands)

As workshop participants had the opportunity to hold and read example genome edited labels, they developed and deliberated on their priorities for labelling during the session and had the time and stimulus to imagine the reality of the scenarios they were presented with. In contrast, survey respondents were presented with a range of specific scenarios generated from the workshops. This difference in engagement and deliberation time should be considered when reflecting on the two datasets about priorities for labelling of genome edited products as workshop participants may have had more developed views.

With that consideration in mind, among survey respondents a clear majority (70%) wanted labels for genome edited food products to state that these were “genome edited” and specify which ingredients have been genome edited. 14% said the label should state that the food product has been “genome edited” but does not need to specify which ingredients have been genome edited. Very few felt that the product did not need to be labelled as “genome edited” (3%) or wanted none of the options suggested (3%).

Women were more likely than men to say that they want the ingredients to be specified on the label (74% as opposed to 66%).

Older people were more likely to want the product to be labelled specifying which ingredients had been edited. 76% of those aged 55-75 wanted this information included as opposed to 58% aged 16-24.

Similarly, those with no formal qualifications were less likely to indicate that the ingredients edited needed to be specified. They were more likely to select none of the options listed (7%) or ‘don’t know’ (17%).

Those who saw genome editing in plants or animals as unacceptable were also more likely to want the ingredients specified. Around 8 out of 10 who saw editing in plants (81%) or animals (80%) as unacceptable wanted the ingredients to be specified, compared to around two thirds of those who saw editing in plants (69%) or animals (66%) as acceptable who wanted the ingredients to be specified.

Survey respondents were asked whether they supported or opposed different labelling options (they could choose to support or oppose multiple options). Most respondents supported all the proposed options. There was strongest support for the product label to include the words “genome edited” (77% supported this) and to include a symbol representing that the product is “genome edited” (76% supported this). Most (73%) supported the product including a link that consumers could use to find out further information about the product and for the place of purchase to include information that the product is “genome edited”. Respondents also supported labels including the reasons why a product had been edited (66%).

Self-reported knowledge about genome editing also seemed to influence these preferences. While 63% of survey respondents who felt ‘very’ or ‘fairly’ informed about genome editing supported labelling that specifies which ingredients have been edited, this was much less than those who reported being less informed (73%) or not at all informed (72%). Similarly, those who felt ‘not very’ or ‘not at all’ informed about genome editing were more likely to support a symbol being included on the packaging, the place of purchase having genome editing information, and the label including the reasons why a product has been edited.

Chapter 6: Building public trust and willingness to eat genome edited food

Chapter summary

Workshop participants felt strongly that educating the public about genome editing, its potential benefits, the differences between these and GM foods, and how these are regulated would be the most effective way to increase public trust of genome edited foods. The pre- and post-workshop tracking questionnaires supported this, as a much higher proportion said they were not concerned about genome editing after the workshops than before.

Participants felt that strict regulation, safety assessments and transparent labelling should be maintained and communicated to the public when genome edited foods first

reach the UK market. They also suggested TV and social media information campaigns, documentaries to help educate the public on genome edited products.

Workshop participants were much more likely to say they would be willing to eat genome edited food after the second workshop than before the first workshop (reported in the pre- and post-workshop tracking questionnaire). However, survey respondents were divided on this. Survey respondents were much less likely to express willingness to eat foods if they contained genome edited meat or dairy. They were most likely to express willingness to eat a product if it was better for the environment, contained genome edited crops, if the food had been edited to improve animal welfare or be allergen safe.

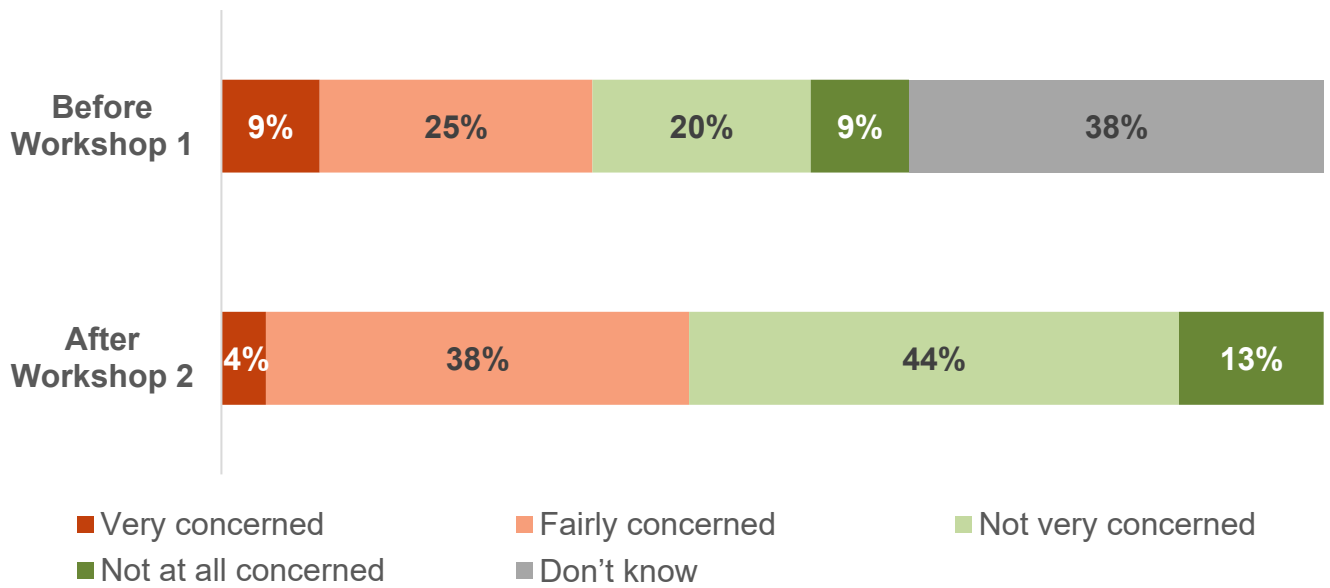
Most survey respondents were interested in finding out more about genome edited foods, especially those with a degree level education or above. Those who found genome editing unacceptable were much less likely to be interested in finding out more.

The impact of becoming informed

Workshop participants felt strongly that educating the public about genome editing, its potential benefits, its differences from GM foods, and how it is regulated would be the most effective way to increase public trust on genome edited foods. They reflected on how their increased understanding of genome editing had led to their increased acceptance of genome edited foods.

This was supported by their responses to the pre- and post-workshop tracking questionnaire. When asked about the extent to which they were concerned about genome edited food, there was an increase in those who said 'not at all' or 'not very' concerned (28% before the workshops, and 57% afterwards). However, there was also an increase in those who said they were 'fairly' or 'very' concerned (33% before the workshops, and 42% afterwards). This simultaneous increase in concern and lack of concern is because 38% of participants answered 'don't know' before the workshops, and none did so afterwards. This indicated that as participants became informed, they formed their opinion either way, and that while there was still a considerable amount of concern at the end of the second workshop, more people were not concerned than concerned.

Figure 6: To what extent are you concerned or unconcerned about genome edited food?



Base: 81 workshop 1 participants and 71 workshop 2 participants, via the pre- and post-workshop surveys

During the second workshop, participants made suggestions about how the FSA could best educate the public about genome editing, and the regulations that ensure it is safe. These suggestions included TV and social media information campaigns, documentaries, school education, and transparent and informative labelling on genome edited products.

Willingness to eat

During the discussion about labelling, participants were told to assume that the food and drink products contained genome edited ingredients. This was so that moderators could explore their hypothetical willingness to eat the products which could potentially contain genome edited ingredients. Some participants expressed that they did not want to try the food and drink products that they had received, however this was not always because of the potential genome edited ingredients, and often purely because the products they had receive were not the type of products they enjoyed.

“The only reason I wouldn't is that I'm not vegan, I don't eat cereal, and I don't like wine. It's not to do with genome editing...it's generally because I don't ever buy these in my shopping.” (Midlands)

Some participants were put off by the possibility that the products they had received contained genome edited ingredients, wondering if it would be safe given these foods are not yet on UK food shelves.

“I’m still sceptical about it all really. Especially if it’s not in the UK yet, how come we’ve got these products we can eat and how safe are they?” (Midlands)

Others felt uncomfortable about the prospect of consuming genome edited meat products.

“With the chocolate because it’s only cocoa beans I feel comfortable trying that. I would want to avoid meat, I’m not really a meat eater but with it being edited I probably wouldn’t go near it.” (Wales)

However, there were many participants who were willing to try products they assumed were genome edited. The strength of feeling ranged amongst these participants, from those who were unphased by genome edited ingredients, to those who were activity excited about the prospect of trying them. Those who were excited to try them said they were curious to see if the food tasted any different to non-genome edited products, and that they felt confident that they would be safe to eat.

“I want to see if there’s a difference in taste. Curiosity factor, more than anything else.” (Midlands)

“If they’ve all been tested and they’re all safe to eat in the UK, why would you not?” (Northern Ireland)

When moderators informed workshop participants that the products they had received did not contain genome edited ingredients, some were disappointed because they had looked forward to trying them.

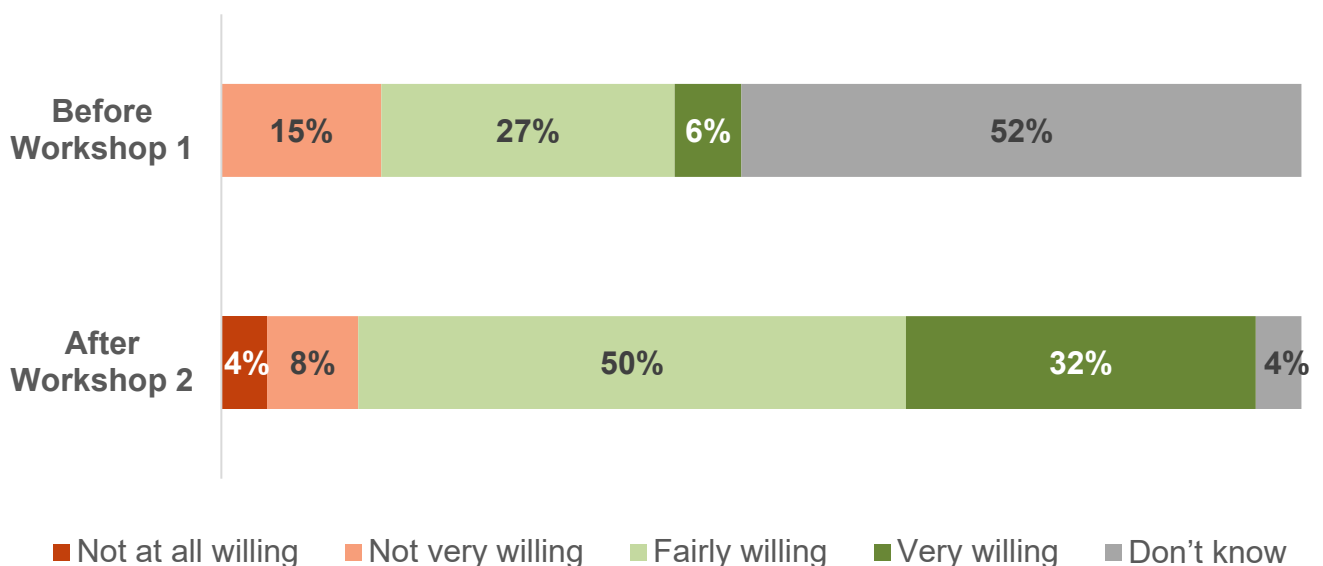
“This might be weird, but I was hoping for some genome edited food.” (Midlands)

“I was excited to say I was one of the first people to try genome edited food in the UK.” (Wales)

The pre- and post-workshop surveys also asked participants how willing they would be to eat genome edited foods compared to conventionally bred food and compared to GM foods. Their responses before the workshops and after the workshops showed a similar pattern around the level of concern. In the pre-workshop survey, there were far more participants answering ‘don’t know’ than in the post-workshop survey. As those participants made up their mind during the process of the workshops, willingness to eat genome edited foods increased, with 82% saying they would be ‘fairly’ or ‘very’ willing to eat genome edited food compared to conventionally bred food after the workshops compared to 33% before the workshops. After the workshops, 74% said that they would be ‘fairly’ or ‘very’ willing to eat genome edited food compared to GM food, compared to 30% before the workshops.

While the overall number of participants indicating that they were not willing to eat genome edited foods did not change much over the course of the workshops, there seemed to be an increase in strength of feeling among this group with some people answering ‘not at all willing’ after the workshops.

Figure 7: How willing would you be to eat genome edited food compared to conventionally bred food?



Base: 81 workshop 1 participants and 71 workshop 2 participants, via the pre and post-workshop surveys

The quantitative survey asked respondents whether they would be willing to eat different types of genome edited food products if they became available for sale in the UK.

Respondents were divided; The highest proportion expressed willingness to eat genome edited food if it was better for the environment than non-genome edited food (48%), followed by if it was allergen safe (46%), or if it contained genome edited crops or had been edited to improve animal welfare (45% for both). Respondents were least likely to express willingness to eat genome edited food if it contained genome edited meat (28%), with a majority reporting they would be unwilling to eat this (54%). They would also be less willing to eat genome edited food products containing dairy (34% expressed willingness to eat this).

Between 15 and 20% of survey respondents were unsure of whether they would eat these products and selected don't know for each of the options.

Reflecting their more positive views of genome editing overall, male respondents were generally more willing than female respondents to eat certain types of genome edited products. They were most willing to eat food products containing genome edited crops (49%) but also fresh produce, those that are more resilient and adaptable to changing climates and those that had been edited to improve animal welfare (each 48%).

Younger respondents were more likely to be willing to eat all the different types of genome edited food products listed. They were more likely to do this if a food product had been edited to achieve benefits such as being allergen safe (57%), better for the environment (57%) or to improve animal welfare (55%).

Survey respondents who felt more informed about genome editing in general were also more likely to be willing to eat different types of genome edited food products. More than half were willing to eat all genome edited food products (ranging between 51% and 65% for each category), with the exception for genome edited meat, which just under half of these respondents indicated they would eat (48%). These respondents were most likely to express willingness to eat a product if it was better for the environment (65%), contained genome edited crops (63%) or if the food had been edited to improve animal welfare or be allergen safe (both 62%).

Interest in finding out more information about genome editing

At the end of the survey, respondents were asked whether they thought that someone like them would be interested in finding out more information about genome editing in

food production. 71% said they thought someone like them would be 'very' or 'fairly' interested in finding out more information. 22% were 'not very' or 'not at all' interested.

Respondents with higher educational qualifications were more likely to say people like them would be 'very' or 'fairly' interested in finding out more information about genome editing in food production.

Those who already felt 'very' or 'fairly' well informed about genome editing were more likely than those who felt 'not very' or 'not at all' informed or had 'never heard of it' to say people like them would be interested in finding out more information about genome editing in food production, (81%, 75%, and 59%, respectively).

Notably, those who viewed both editing in animals and plants in food production as acceptable felt that people like them would be more interested in finding out more information (animals: 83%, plants: 82%), compared to those who viewed this as unacceptable (animals: 69%, plants: 62%).

Ease of finding trustworthy information about genome editing

The final activity on the online community asked participants to spend a few minutes searching for an article on genome edited food they found interesting or useful. Follow up questions were asked to find out how participants went about searching for this information and how they assessed articles for bias and accuracy. As this was an optional activity, 36 participants took part.

Participants were initially asked to select aspects of genome edited food that they found interesting. The top five selected statements are listed below. Participants could select multiple options so the percentages below exceed 100% when combined.

- Potential benefits and risks for consumers: 30 (86%)
- Potential benefits and risks for crops and livestock: 30 (86%)
- When and where genome edited foods may become available to consumers in the UK: 29 (83%)
- UK genome edited food regulation, and how that may change: 24 (69%)
- Potential benefits and risks to the environment: 22 (63%)

When asked how confident they felt finding accurate and unbiased information about genome edited food online, none of the participants said they were 'very confident'. 42% said they were 'fairly confident', 48% said they were 'not very confident', and 9% said they were 'not at all confident'. Participants explained in their answers that media bias and high levels of misinformation online make it difficult to trust the information you find, especially as genome edited food is a relatively new topic for consumers and therefore the facts are less clear to a normal, non-expert reader.

"I feel anything I've read before for example the news articles from a previous activity were extremely biased either towards or against with each news article pushing their own "agenda"... I feel like until more is known about genome editing and there is proven facts there will always be a lot of speculation around it." (Northern Ireland, selected 'not very confident')

"I am still not 100% sure on genome [editing] and [GMO] so wouldn't know where to look up to get the exact information without mixing the two up" (Northern Ireland, selected 'not at all confident')

Participants described using search terms such as 'genome editing in food', 'genome editing in agriculture', 'benefits of genome edited food', 'impact of genome edited food', 'genome latest', and 'true facts on genome editing for crops and livestock'.

Participants said they chose articles from trusted sources such as government websites, like the FSA, the BBC, and scientific sources such as the National Geographic and academic papers. Participants thought that these were probably accurate (59%) and unbiased (38%) but some did not feel like they knew enough about genome editing to critically assess the content.

"The information is based on scientific research and based on what we have learned about genome editing recently I am sure the information is accurate." (Wales, selected 'I'm sure it is accurate')

"I can't comment as I would need to know a lot more about genome editing and study it to be able to make a worthy comment on whether biased or not." (Northern Ireland, selected 'I don't know')

That said, there were also participants who suggested that even academic sources may have underlying bias, either because some level of bias is unavoidable in any article, or because scientists who are professionally invested in genome editing may be invested in progressing genome editing in food, rather than writing content that challenges it.

“Despite citing academic research findings, the academics themselves have a vested interest in the maintenance of their research funding. They are hardly likely to come out and say that genome editing is harmful as that would result in a loss of funding. That said, I err towards accurate rather than inaccurate.” (Midlands, selected ‘I think it’s probably accurate’)

Conclusions

This research highlights that consumer knowledge and awareness of genome editing is extremely low, which aligns with findings from other research.^{6,7}

This research found that as members of the public were given information and time to discuss and digest the application of the technique in food production, most were able to form views on whether they thought it was acceptable or not. This was not true of all participants, however. There were participants who remained confused and/or undecided about genome editing, even after further information was provided in the workshops.

This research highlights that there is potential for confusion between genome editing and GM in food production, partially due to there being a higher awareness of GM than genome editing. Survey respondents with self-reported knowledge of genome editing often could not easily distinguish between the working definitions used to describe genome editing and genetic modification.

The qualitative workshops found that even after further clarification and examples, the terminology ('editing', 'modification') increased confusion rather than helping to distinguish between the two techniques. While the terminology did not always help to distinguish between techniques, differentiating features of genome editing in food production (when compared to genetic modification), were associated with processes that could happen naturally (given how this was framed to workshop participants), and precise alterations to an organism's existing DNA. This suggests that the concepts themselves can be grasped by consumers, but existing terminology may be a barrier to this.

Research by Genetic Alliance UK and the Progress Educational Trust found that explaining genome editing to the public works best when this is done as straightforwardly as possible, and by using simple analogies and metaphors such as 'find and replace', 'copy and paste' and 'cut and paste', building on the idea that 'editing' is already a metaphor.⁸ However, when simplifying descriptions for the public, it would be important to

⁶ [A PDF of a 2019 BEIS report named 'Public attitudes to science.'](#)

⁷ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: country synthesis report'.](#)

⁸ [The study linked to here explored human medical applications of genome editing](#)

consider the precise application of genome editing in question (i.e. words like 'replace' and 'paste' would not be appropriate for the definition used in this study), as well as to avoid oversimplifying to the extent that meaning is lost and consumers are instead misled.

Using the working definition of genome editing, this research found that genome edited food was generally more acceptable to workshop participants than GM food, because the changes in genome editing are generally smaller and more precise, and therefore seen as less risky. Public perception that the risk is lower for genome editing in food production than is it for genetic modification has also been observed in other research.⁹

Genome editing also felt more natural to workshop participants because, unlike in GM, no foreign DNA is introduced to the host organism. Other studies have also suggested that 'genome editing technologies might be more acceptable to the public than previous technologies because no foreign DNA is introduced into the animal'.¹⁰

When participants perceived genome editing to be aligned to conventional breeding following presentations and videos shown to them which discussed some of the similarities in outcomes, this acted as a reassuring factor which improved acceptability of genome editing in food. This also mirrors the findings from the ORION open science public dialogue.¹¹ Framing genome editing as a process that 'speeds up nature', with the outcomes achieved as the same as those which occur through conventional breeding, as this research did, is likely to result in the application of the technique being perceived by the public as more natural, and therefore more acceptable.

This research found that concerns about genome edited food and GM food mainly relate to the risk to humans of consuming these food products. This is unsurprising given low levels of knowledge about food regulation more generally. Genome edited plants were deemed more acceptable, and presumed safer for consumers to eat, than edited animals. The perception that genome edited plants must be safer to eat than genome

⁹ [A 2019 article in Palgrave Communications Journal named 'Expert and public perceptions of gene-edited crops: attitude changes in relation to scientific knowledge'](https://doi.org/10.1057/s41599-019-0328-4). DOI link: <https://doi.org/10.1057/s41599-019-0328-4>

¹⁰ [Cited in this Royal Society article](https://doi.org/10.1098/rstb.2018.0106). DOI link: <https://doi.org/10.1098/rstb.2018.0106>

¹¹ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: UK country report'](#).

edited animals has also been observed in other research¹², including the ORION public dialogue.¹³

This research found concerns over animal welfare, for example, where genome editing might be used in the future to change farming practices which would adversely affect the animals involved. Participants in workshops raised similar concerns in relation to conventional breeding methods, hence this concern is not specific to genome editing in food production. There seemed to be a low level of understanding of current animal welfare standards in the UK, therefore findings should be interpreted with this in mind.

Concerns were also raised around the environmental impact of introducing genome edited organisms back into the ecosystem (also voiced when participants reviewed case study examples of genetic modification).

Participants were particularly worried about what, or who, is driving these changes to our food, and whether the food products will benefit consumers, or large corporations who may use the technology to maximise profits in a way that undermines other potential benefits. Similar concerns have been raised in other public dialogues, including those commissioned by the Royal Society¹⁴ and the ORION open science consortium.¹⁵

This research found that, in line with previous research^{16,17}, there is increased acceptance of genome editing techniques (as well as genetic modification) in food production where there is a justified reason for using the technique, for example, clear benefits to human health; potential to increase access to affordable food; and potential to tackle impacts of climate change with more sustainable food production.

On the other hand, as similarly found in other research¹⁸, participants found the application of genetic technologies (genome editing and genetic modification) unacceptable where the reason was not well justified or where there were concerns around equity. For example, applications were deemed less acceptable if the food was

¹² [A 2021 article in the CABI Agriculture and Bioscience Journal named 'Effects of information on consumer attitudes towards gene-edited foods: a comparison between livestock and vegetables'](#). DOI link: <https://doi.org/10.1186/s43170-021-00029-8>

¹³ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: UK country report'](#).

¹⁴ [A 2019 report from the Royal Society named 'Potential uses for genetic technologies'](#).

¹⁵ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: country synthesis report'](#).

¹⁶ [A 2019 report from the Royal Society named 'Potential uses for genetic technologies'](#).

¹⁷ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: country synthesis report'](#).

¹⁸ [A 2021 Ipsos MORI and ORION report named 'Public dialogue on genome editing: country synthesis report'](#).

being changed for cosmetic reasons. Workshop participants cautioned that this might widen existing inequalities due to potentially expensive food products. (Note, this discussion was in relation to an example of using genetic modification to create a more aesthetically pleasing fruit). Applications were also deemed less acceptable if there is a chance that the technique will not be accessible to all, i.e. smaller farmers will fall behind and not reap the benefits.

This research identified that the public recognise a need to regulate genome edited food separately from GM because they are different. However, those involved were also clear that the level of scrutiny, testing and regulation should be just as high as for Genetically Modified Organisms (GMOs). Participants suggested re-assessing the levels of regulation after genome edited foods have been in the UK market for several years, once more is known about them.

This research concluded that participants felt the labelling of genome editing foods should always inform the consumer of the presence of genome edited ingredients in a food product. This is important for consumer choice and transparency.

During the workshops, some participants felt strongly that genome edited foods marketed as healthy, marketed towards children, or containing animal products should have a more detailed approach to labelling. They explained that these consumers might be more likely to have an interest in the nutritional information and seek to make more informed decisions about ingredients. Participants suggested that unhealthy snacks, processed foods or alcoholic beverages that do not contain animal products did not need as much information about the genome editing that had taken place, as consumers of these products are not likely to make decisions based on nutritional content.

Becoming more informed about genome editing, and the differences between this technique and GM, shifted participants towards being more open to genome edited food. At the same time, there were participants at the very end of the workshops who were uncomfortable with the application of genome editing in food production, given that it felt 'unnatural' to them. Participants themselves highlighted that education is essential so that consumers can make informed choices around the food they purchase and consume.

Finally, this research raised the importance for participants of communicating that regulation and thorough safety assessments remain in place, as well as transparent labelling, if genome edited foods reach the UK market. As well as communications

regarding existing animal welfare regulations in the UK, participants suggested TV and social media information campaigns and documentaries would help educate the public on genome edited food products.

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