

## A quick guide to genome editing

Genome editing (also called gene editing) describes a range of techniques that add, remove, or replace DNA at specific locations within the genome (genetic material) of living cells. It has been proposed as a way of helping farmers to grow crops or rear livestock that are more resistant to disease, more nutritious and more productive, as one of a number of ways to address current concerns about climate change and food security. This quick guide to genome editing answers the following questions about the potential applications of this emerging technology:

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### *What is genome editing and how does it work?*

Traditional breeding takes advantage of natural mutations that occur in the genetic material (genome) of plants and animals over time, which gives rise to desirable traits (e.g. a higher milk yield, or resistance to drought) that can be selected for over time through several generations of breeding. Over 3000 crop varieties have been developed through traditional breeding techniques. However, this process is slow and it typically takes several years to develop a new crop variety and to bring this to market. Genome editing (or 'gene editing') can help increase the efficiency of the plant or animal breeding process by making more precise, targeted changes to an organism's genome.

Several approaches to genome editing have been developed, although one of the most well-known techniques is called CRISPR/Cas9, which has attracted a lot of attention because it is considered cheaper, more accurate, and more efficient than other genome editing methods. The CRISPR/Cas9 technique has been adapted from the natural defence mechanism used by bacteria to protect against viruses, whereby bacteria capture small pieces of the invading virus and insert it into their own genome, helping them to 'remember' the virus in future. This same principal is used by scientists to target specific DNA sequences, which are then cut by the enzyme (Cas9), allowing the cell's DNA repair mechanisms to add or delete DNA, or for a new piece of DNA to be introduced.

### *What are the potential nutritional benefits of genome editing?*

Genome editing is being explored as a potential way to speed up the process of traditional plant and animal breeding to address the current challenges facing agriculture, such as changing climate conditions that can reduce the nutritional quality of crops (for example, lower protein, zinc, or iron content in wheat), but also other nutritional issues, including the presence of allergens in common foods. For instance, genome editing is being researched as a way to reduce the gluten content of wheat in an attempt to create varieties that are safe for people with coeliac disease to eat, as well as wheat crops more resistant to diseases such as mildew.

Genome editing could also offer a means to address low intakes or status of nutrients important to public health, such as vitamin D, with a recent study reporting that genome editing could be used to create a tomato variety that contains pro-vitamin D. Other potential

applications for using genome editing to improve the nutritional traits of crops and livestock include:

- Increasing the beta-carotene content of bananas
- Reducing the levels of phytate (a compound that prevents absorption of minerals) in maize
- Changing the sugar content of strawberries
- Reducing the lactose content of milk produced by cattle

### *Is genome editing legal in the UK?*

Currently in the UK, all organisms that have undergone gene editing are considered genetically modified organisms (GMOs), which means that they are regulated under existing legislation that requires their safety to be assessed before they can be placed on the market. This ensures that GMO foods do not have any detrimental effects on nutrition, health, or the environment.

However, this process requires field trials to be conducted, which can be a lengthy and expensive process. The UK government has recently outlined a plan to change how certain genome edited plants are regulated, following a public consultation on the use of genetic technologies in 2021. The proposed changes include a two-step process:

1. To use existing legislation to make the process of research and development of genome edited crops easier.
2. To review the regulatory definition of a GMO to exclude organisms produced by genome editing (or other genetic technologies) if they could have been produced 'naturally' through traditional breeding techniques.

This approach is in line with other recent international developments, including a recent [European Commission review](#), which concluded that current regulation of gene edited organisms is not 'fit for purpose'.

### *What does the UK public think about genome editing?*

The Food Standards Agency published a survey on the perceptions of UK consumers towards genome edited foods in July 2021. Overall, there was a low awareness of genome edited foods, although most consumers believed that genome edited foods should be regulated differently to genetically modified (GM) foods, as these were two different techniques.

Acceptance of genome edited foods increased with consumer knowledge, although there were still a number of concerns and issues raised, including the need for:

- Potential safety risks to humans and animal welfare to be assessed thoroughly.
- Transparent labelling to inform consumers of the presence of genome edited ingredients using the full term 'genome edited'.
- Scrutiny, testing and regulation of genome edited foods to be just as high as for Genetically Modified Organisms (GMOs), at least to begin with.
- TV documentaries and social media information to help educate the public about genome edited foods.

### *Where can I find out more information about genome editing?*

The British Nutrition Foundation has produced a talk '[Genome editing. The future of food?](#)', which is free to view on our website. More information on the plans to '[unlock the potential of genome edited foods](#)' can be found on the government's website.

### *Public dialogue on genome editing in farmed animals*

The Biotechnology and Biological Sciences Research Council (BBSRC – part of UK Research and Innovation, UKRI) and the Nuffield Council on Bioethics, with the support of UKRI's Sciencewise programme, are holding a new public dialogue on genome editing in farmed animals. The dialogue will be run by Basis Social, a social research consultancy, involving around 80 members of the public, with discussions between May and July. A report of the findings will be published in September.

The British Nutrition Foundation is delighted to be involved in the advisory group for the development of this dialogue, chaired by Sarah Mukherjee MBE, CEO of the Institute of Environmental Management & Assessment, and former BBC Environment Correspondent. It is hoped that the outcomes of this public dialogue will help to shape responsible research and innovation pathways as the technologies develop.