New legislation enabling Norwich scientists' vitamin enriched tomatoes to reach the consumer

A recent change in legislation could be the catalyst for a simple and sustainable innovation to help people across the country who have a vitamin D deficiency. A lack of vitamin D - aka the sunshine vitamin - can be linked to a higher risk of cancer, dementia, rickets in children and many leading causes of mortality. However, researchers at the John Innes Centre at Norwich Research Park have employed gene-editing techniques to produce a vitamin D3 enriched tomato that will offer a sustainable source of the vital vitamin.

Last month, the Precision Breeding Act became law in England which allows the use of gene editing to alter a plant's existing DNA in a way that could have been produced as a result of traditional breeding or natural processes. It means that plants and crops that have been gene edited could now be sold and bought in the country. This has opened up a new world of opportunity at Norwich Research Park as scientists there are at the forefront of this technology and have been researching it for years.

Prof Cathie Martin FRS Group Leader at the John Innes Centre, one of four research institutes based at Norwich Research Park, leads the research in this field. She explained, "Gene editing enables precise, targeted changes to plant DNA in order to make improved varieties that are resistant to disease, last longer, improve yields or, in this case, are enriched with specific vitamins. This process is known as biofortification. Although the technology is highly advanced, it simply replicates the natural process that occurs in traditional plant breeding and accelerates the results which would otherwise take decades to achieve."

Prof Martin and her team of researchers use gene editing techniques to increase the amount of provitamin D3 in a tomato plant's ripe fruit and leaves. When these new variants are exposed to ultraviolet B (UVB) light from the sun the provitamin D3 is converted into vitamin D3, the most absorbable type of this vitamin for humans, which is rarely found in something vegetarian or vegan friendly.

Vitamin D protects bone health and is also important for immune system function. Vitamin D is produced by the body, when skin is exposed to UVB, light from the sun. In the UK, we can get 80–90% of our vitamin D this way with the remainder being derived from food. During the winter, and particularly in countries with higher latitudes, the sun is not strong enough for vitamin D production and therefore supplements are required to prevent a deficiency.

The UK government recommends that everyone takes a daily 10mg vitamin D supplement between October and March. However, uptake is low and there is no mandatory food supplementation in the UK, as there is in other parts of the world such as the USA.

In the UK, almost 20% of children and one in six adults have vitamin D levels lower than government recommendations. As a result, the UK spends £100 million each year prescribing vitamin D supplements. Also, many of the vitamin D supplements on sale are derived from sheep wool extract so the vitamin D3 enriched tomatoes could offer a good vegan alternative.

And there is another benefit of this gene editing process. When growing tomatoes, the leaves usually end up as waste material. However, the vitamin D3 enriched leaves and fruit could be used to make plant-based vitamin D3 supplements or used in food biofortification, thus helping tomato producers with another line of business.

Dr Penny Hundleby, Research Partnerships and HP3 Hub Lead at the John Innes Centre, said, “Precision breeding offers England a unique opportunity to lead the way in sustainable food production. Alongside our partners at Norwich Research Park, we are fast becoming an epicentre for precision breeding. Companies such as Tropic, BioP and Alora are using precision breeding to develop non-browning bananas, disease-resistant potatoes and rice that can be grown on the ocean, respectively. We are focussed on working together and collaborating with partners and investors to improve the sustainability and quality of food and farming for the future.

“The use of precision breeding technologies in research will also expand our understanding of plant genetics and strengthen the entire agricultural science ecosystem, reinforcing the country’s leadership in agricultural innovation.”

Tropic, a food biotech company based at Norwich Research Park, announced recently its new non-browning banana variant that has also been developed by employing gene editing techniques.

Roz Bird, CEO of Anglia Innovation Partnership, the campus management organisation at Norwich Research Park, said, “Now that the Precision Breeding Act has been passed, it will open up many opportunities for scientists to come up with sustainable answers to the massive food security issues our planet faces. Having researchers at the John Innes Centre who have been at the forefront of this technology for many years really does give Norwich Research Park a competitive advantage to develop these solutions into commercial businesses. Because England is the only country in Europe able to conduct gene editing on plants and crops that could then go to market, it means we can now attract scientists, entrepreneurs and investors who want to work in this area of engineering biology.

“We are really proud to have some of the world’s leading minds in precision breeding and plant genetics on our campus, which will help to attract interest from scientists, researchers and entrepreneurs internationally. Gene editing based operations are set to grow rapidly and we are fortunate to have 1.6m sq. ft of planning consent to meet future accommodation demands. We will continue to look for new collaborations with other research communities and large corporates and attract start-ups and their investors to join our campus to benefit from our specialist expertise.”