

## Good news for health-conscious, tech-embracing consumers: Here's the science behind the latest gene-edited food, a tastier mustard green

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recision [gene editing methods such as CRISPR are revolutionizing everything](#) from cell and gene therapies to diagnostics, bioenergy, and [agriculture](#). Gene-edited projects are slowly rolling out globally.

Japan has emerged as the world leader in commercializing food products made with New Breeding Technology (NBT). It has introduced three CRISPR-edited products to date: fleshier red sea bream, high-growth tiger puffer, and a [GABA-enriched tomato](#). Referred to in the media as a 'super tomato', the engineered Sicilian tomato features five times the normal amount of GABA, an amino acid linked to lower blood pressure, thanks to tweaks to genes that normally limit GABA production.



Credit: Santatechseed

The first CRISPR-edited food developed in the US will be available to consumers later this year, and it exemplifies the consumer-oriented potential for this technology. A start-up company called [Pairwise](#) has edited the genes of a highly nutritious mustard green to eliminate its original bitter taste. It will be part of a ready-to-eat mixed greens product and sold under the

[Conscious™ Food](#) brand. The mix can be eaten fresh or cooked. Initial sales will be through PFG ([Performance Food Group](#)), a distributor that serves many institutional and restaurant food service customers as well as convenience stores. Grocery retail sales are expected to begin later this year.

The first US product using NBTs is a [soybean oil](#) developed by Calyxt (using a gene editing tool known as TALENS). It contains “up to 20% less saturated fatty acids” compared to commodity soybean oil, and was commercially launched in 2019.

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## How Pairwise developed its mustard?

Vegetables and fruits are a rare food category for which it is almost always better to eat more. Unfortunately, only a minority of American consumers consume the quantities recommended by nutritionists and other health experts. There are some very nutrition-dense vegetables like kale, arugula, and mustard greens, but many consumers find them too bitter.

The problem is that these and many other plants have a built-in defense mechanism so that when their leaves are chewed by insects or other herbivores, an enzyme called myrosinase is released and it turns a precursor chemical into bitter chemicals called allyl-isothiocyanates. That trait has no real benefit in a farm setting and so Pairwise turned off the gene for myrosinase using their CRISPR-based Fulcrum™ technology. The result is a product that offers a trio of consumer appeals: enhanced nutrition, a pleasant flavor/texture profile, and convenience.

The genetics of making this modification was somewhat complicated in that mustard is a tetraploid meaning that it has four of every chromosome. A total of 17 specific small edits were necessary to develop the non-bitter line. That is a tiny change compared to the diverse [collection](#) of crop plants that have been derived from mustard using conventional breeding (Broccoli, cauliflower, kale, kohlrabi, brussels sprouts, Romanesco, collards, Canola...). Pairwise describes their editing as a “seismic tweak” of the plant genome.

It is interesting to note that this consumer-oriented commercial embodiment of a CRISPR-edited crop is reminiscent of one of the very earliest transgenic crops – the [FLAVR SAVR Tomato](#). The biotech start-up Calgene received a required regulatory approval from the USDA for that crop in 1994, two years before the launches of the major row crop biotech crops like insect-resistant corn and herbicide-tolerant soybeans. Unfortunately, it looked better than it tested, never achieved wide consumer acceptance and was eventually discontinued. Those familiar with the FLAVR SAVR story say that the small tech company didn’t have the experience needed to navigate the complexities of building a profitable business within the fresh produce sector. Then, when the anti-GMO movement gained momentum and filled the internet with mocked up pictures of tomatoes with syringes in them, further development became problematic.

The [co-founders](#) of Pairwise bring decades of relevant experience to their company – CEO Tom Adams from his role as VP of Global Biotechnology at Monsanto and CBO Haven Baker his role as SVP/General Manager of Simplot Plant Sciences. They have contracted with experienced growers and packers in

Yuma, Arizona and the Salinas Valley of California to build a viable supply chain with favorable economics.

The USDA made a determination in [2020](#) that new crop varieties developed with gene editing technologies did not require the intensive regulation and labeling requirements that apply to crops with transgenic traits if the end result was something that could potentially occur through random mutation or cross-breeding. Thus, this “Conscious Greens” product will not have to bear the [“bioengineered” label](#). There is even the possibility that the EU or at least the UK will adopt a similar stance for gene editing.

## Navigating consumer skepticism

That would mark a sea-change in consumers’ perceptions of genetic modification given the backlash over transgenic engineering used to make genetically modified crops (GMOs). Pairwise believes that a genetic engineering label will gradually become a symbol of innovation, health, and sustainability.

A recent [Iowa State University survey](#) of 2,000 residents bears that out. The research shows broad acceptance among future-focused Generation Z and millennials who view science and technology as a key means to solve global problems including food security. Women were twice as rejectionist as men; 60% said they would not eat and purposely avoid gene-edited foods. Those who lean toward trusting the government were more open to the technology; those who lean left and put their faith in activist environmental groups and engage in social media were less sanguine.

Most people are undecided. According to Iowa State Senior Research Fellow Christopher Cummings:

*They have not fully made up their mind about gene-edited foods, but as they learn more about the technologies and products, they will likely move to one side of the issue. I think it will depend on their consumer experience — what kind of messaging they trust and who sends it, as well as what products they encounter.*

Pairwise has taken a clue from the data, choosing to be fully transparent about the technology behind Conscious Greens and making the details available through a QR code link. Its own market research, while not a formal study, found that of the 3,000 people it interviewed less than 1% expressed concern about the fact that Conscious Greens involved genetic modification technology, although many people are oblivious to the criticisms of GM by advocacy groups that swirls on social. In fact, younger consumers found the technology to be a positive since it is used to effectively provide a nutritional advantage.

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The Non-GMO Project puts CRISPR and other editing technologies under the same negative umbrella as transgenics. In effect their “logic” is that the less that is known about what genetic changes occurred the better — therefore they have no problem with the hundreds of crops, from sweet grapefruit to anti-oxidant rich durum, developed in the past using radiation mutagenesis. That is irrational from a science perspective and out of step with the thinking of younger consumers.

There are hundreds of other interesting [gene editing-based crop enhancements](#) in development by multiple companies and public institutions. Pairwise is working on seedless blackberries and pitless cherries, both of which would have obvious consumer appeal. They are also working on edits to support the goal of year-round supply for these and other crops because that have proven consumer appeal.

The next chapter of crop improvements will be ubiquitous in grocery stores in the coming years as genome editing tools enlarge the overall toolbox needed to address the challenges of climate change and food insecurity.

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