'Kill switches' could make genetically modified food more palatable

December 8 2015, by Clare Taylor

Credit: Scott Hart/Flickr, CC BY-NC-ND

In the US you can buy and eat genetically modified apples that don't go brown, potatoes that are less likely to cause cancer, and – as of recently – salmon that grow faster. But in Europe, 19 out of 28 member states have banned the growing of genetically modified crops altogether due to public concerns.

Selective breeding to produce crops and animals with desirable characteristics has been around for centuries. But in each case we don't know which parts of the organism's genetic code are responsible for the improvements. Genetic modification, on the other hand, allows us to breed organisms with specific characteristics by precisely inserting sections of DNA into their genetic code.

Genetically modified organisms (GMOs) offer a number of advantages to farmers and crop growers. But there are also public concerns about GMOs, ranging from their potential effects on human health to their dominance by large corporations. When I debated the use of genetically modified bacteria this summer at the Edinburgh Fringe Festival, for example, I found the audience's main concern was the potential for GMOs to escape and contaminate the environment.

So what if science could fix this? Recent progress in GM technology has seen scientists engineer "kill switches" that are designed to act as an emergency stop mechanism for GMOs. These are pieces of inserted genetic code that create characteristics intended to prevent a GMO from surviving and reproducing if they "escape" from a contained site, such as a field of GM crops, into the wild.

No survival in the wild

One type of kill switch involves making GMOs dependent on nutrients not found in nature. Two independent pieces of research published in early 2015 essentially redesigned *Escherichia coli* bacteria to require synthetic versions of nutrients essential for survival and growth. If these genetically recoded organisms (GROs) were to escape into the "non-contained" environment, they would be unable to get the nutrients they needed, effectively activating the kill switch causing them to die.

In another elegant approach, researchers from the Massachusetts Institute of Technology (MIT) have developed two new kill switches known as "Deadman" and "Passcode". The system uses both switches to control the organism. Passcode allows the organism to detect specific changes in the environment. This then activates Deadman, which causes the organism to start producing a potent toxin that kills its cells.

The authors have demonstrated that different environmental signals, such as the gain or loss of a particular sugar nutrient source, can act as the control mechanism. This gives scientists some design flexibility when creating new kill switch systems for GMOs. The current research is based on bacteria, but in practical terms this technology could allow us to programme any GMO to "self-destruct". For example, it might be possible to design GM crops that were programmed to die if they escaped from the growing area.

Wiping out the DNA

One issue still to be addressed though is that when some organisms die, their DNA can persist in the environment. In bacteria this can be a problem because certain bacteria can take up DNA from the environment by a process called natural genetic transformation. If the DNA led to beneficial characteristics, it could be assimilated into the bacteria's genome to create a natural GMO. The answer to this particular issue may lie in other recent work that described a kill switch based on CRISPR technology.

CRISPRs are short sequences of DNA found in bacteria that are the remnants of a previous viral infection used to help the immune system. If a bacterium encounters the same infection again, the CRISPR system can recognise the virus and recruit a DNA-degrading enzyme that cuts up and destroys the invading viral DNA.

Researchers from MIT have used the CRISPR concept to create a kill switch that effectively erases DNA from GM bacteria. In this case, the code inserted into the GMO included the short sequences recognised by the CRISPR system. When the input signal for the kill switch was activated, CRISPR targeted and destroyed the inserted DNA, essentially returning the organism to its former non-GM state. Combining this system with other kill switches could allow scientists to be confident that neither a GMO nor its DNA could persist outside of a contained environment.

These developments demonstrate that scientists designing GMOs have taken on board public feedback. The question remains whether kill switch technology will address the concerns about the "escape" of GMOs and "contamination of the wild". It is certainly a step in the right direction.

This story is published courtesy of The Conversation *(under Creative Commons-Attribution/No derivatives).*

Source: The Conversation

Citation: 'Kill switches' could make genetically modified food more palatable (2015, December 8) retrieved 3 May 2024 from https://phys.org/news/2015-12-genetically-food-palatable.html