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Editorial

GENETICALLY MODIFIED FOODS: AN INSIGHT

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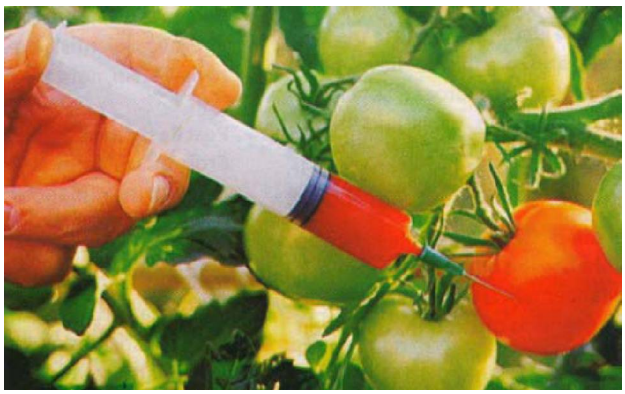
WHAT ARE GM FOODS?

Genetically modified foods are derived from genetically modified organisms. Genetically modified organisms have had specific changes introduced into their DNA by genetic engineering, using a process of either Cisgenesis or Transgenesis. These techniques are much more precise than Mutagenesis (mutation breeding) where an organism is exposed to radiation or chemicals to create a non-specific but stable change. Other techniques by which humans modify food organisms include selective breeding (plant breeding and animal breeding), and somaclonal variation. GM foods were first put on the market in the early 1990s. Typically, genetically modified foods are transgenic plant products: soybean, corn, canola, and cottonseed oil, but animal products have also been developed. In 2006, a pig was controversially engineered to produce μ-3 fatty acids through the expression of a roundworm gene. Researchers have also developed a genetically-modified breed of pigs that are able to absorb plant phosphorus more efficiently and as a consequence the phosphorus content of their manure is reduced by much as 60 percent. Critics have objected to GM foods on several grounds, including perceived safety issues, ecological concerns, and economic concerns raised by the fact that these organisms are subject to intellectual property law.



METHODS

Genetic modification involves the insertion or deletion of genes. In the process of Cisgenesis genes are artificially transferred between organisms that could be conventionally bred. In the process of Trangenesis genes from a different species are inserted, which is a form of horizontal gene transfer. In nature this can occur when exogenous DNA penetrates the cell membrane for any reason. To do this artificially may require attaching the genes to virus or just physically

inserting the extra DNA into the nucleus of the intended host with a very small syringe, or with very small particles fired from a gene gun. However, other methods exploit natural forms of gene transfer, such as ability of Agrobacterium to transfer genetic material to plants, and the ability of lentiviruses to transfer genes to animal cells.

DEVELOPMENT

The first commercially grown genetically modified whole food crop was a tomato (called FlavrSavr), which was modified to ripen without softening, by a Californian company Calgene. Calgene took the initiative to obtain Food and Drug Administration (FDA) approval for its release in 1994 without any special labelling, although legally no such approval was required. It was welcomed by consumers who purchased the fruit at a substantial premium over the price of regular tomatoes. However, production problems and competition from a conventionally bred, longer shelf-life variety prevented the product from becoming profitable. A variant of the FlavrSavr was used by Zeneca to produce tomato paste which was sold in Europe during the summer of 1996. The labelling and pricing were designed as a marketing experiment, which proved, at the time, that European consumers would accept genetically engineered foods.

EXAMPLES OF GENETICALLY MODIFIED FOODS

Crops may be modified to increase resistance to pests and disease, increase adaptability to environmental conditions, improve flavour or nutrition profile, delay ripening, or increase shelf life. Many common crops are genetically modified, such as corn, canola, flax, potatoes, tomatoes, squash, and soybeans. Corn and potatoes may be modified with a gene to produce an endotoxin that protects them against the corn-borer pest and the potato beetle, respectively. A soybean can be genetically modified with a gene from a bacterium to make it herbicide resistant. By inserting two genes from daffodil and one gene from a bacterium, rice can be enriched with â-carotene. In the early 1990s, genetically modified tomatoes (FlavrSavr by Calgene, Inc.) were deemed safe by the US, Canadian, and British governments and introduced into the market. These tomatoes were bred to stay firm after harvest so they could remain on the vine longer and ripen to full flavour. However, the tomatoes were so delicate that they were difficult to transport without damage, and the product was pulled from the market in 1997. In 1999, the United Nations Food Safety Agency (UNFSA) unanimously declared the use of rBGH unsafe after confirming reports of excess levels of the naturally occurring insulin-like growth factor one (IGF-1), including its highly potent variants, inrBGH milk and concluding that they posed major risks of cancer. Health Canada also banned the use of rBGH in milk production in 1999, but the hormone is still permitted in the US milk supply. All types of foods and organisms have been genetically engineered: corn, cotton, totmatoes, soybeans, sugarbeets, oilseed rape, maize, salmon, pigs, cows, and the list go on.

BENEFITS

Benefits of GM foods are diversified. Genetic engineering is a vital method, used in crops, to enhance the quantity of nutrients, such as vitamins. Nutritional enhancement is a process, in vogue now. Research is underway in prevention of vitamin A and iron deficiency. Removal of

allergic proteins from peanuts is being studied. Modification in genes results in increased yield with better quality and nutrients. Foods with enhanced antioxidants, such as carrots, that are cost effective and nutritious are produced. Increased shelf life and standing periods results in long lasting vegetables, like tomatoes. Edible therapeutic bananas carrying rotavirus antigens or bacterial antigens are produced by genetic modification. Environmental degradation is prevented by genetic engineering. Genetically modified crops are at decreased risk to attacks by microorganisms and herbicides. This calls for a reduced usage of herbicides and fungicides, making these genetically modified crops, eco-friendly. Residual levels of these products in the environment are thereby, less. It saves the use of toxic chemicals. GM crops can be made resistant to pests, so pesticides do not need to be sprayed on them. This is also better on the environment. It prevents wasted crops. If cannot eat the crops, nothing goes to waste. Therefore farmers, make more money. It could make more money. It could potentially solve hunger. Many people agree that there is not enough food in the world to feed everybody. As genetically modified foods increase the yields of crops, more food is produced by farmers. Of course, others argue that there is enough food to feed everyone, but it is unequally distributed. Others argue that GM crops don't produce higher yields. We can begin to grow foods in different conditions. For instance, strawberries can be genetically engineered to grow in frosts. Other foods that grow in cold climates could be engineered to grow in hot climates (such as Africa where much of the continent doesn't have enough food). Some foods can be genetically modified to contain higher amounts of important vitamins and minerals. Vitamin A deficiencies cause to blindness. In Africa, 5000,000 go blind each year. If rice can be modified to contain more vitamin A, the amount of people going blind will decrease. As more research is done the technology is bound to improve. Researchers are already considering genetic modification to make fish, nuts and plants grow faster.

PEST RESISTANCE

Pest losses from insect pests can be staggering, resulting in devastating financial loss for farmers and starvation in developing countries. Farmers typically use many tons chemical pesticides annually. Consumers don't wish to eat food that has been treated with pesticides because of potential health hazards, and run-off of agricultural wastes from excessive use of pesticides and fertilizers can poison the water supply and cause harm to the environment. Growing GM foods such as Bt corn can help eliminate the application of chemical pesticides and reduce the cost of bringing a crop to market.

HERBICIDE TOLERANCE

For some crops, it is not cost effective to remove by physical means such as tilling, so farmers will often spray large quantities of different herbicides (weed-killer) to destroy weeds, a time-consuming and expensive and expensive process that requires care so that the herbicide doesn't harm the crop plant or the environment. Crop plants genetically-engineered to be resistant to one very powerful herbicide could help prevent environmental damage by reducing the amount of herbicides needed. For example, Monsanto has created a strain of soybeans genetically modified to be not affected by their herbicide product. A farmer grows these soybeans which then only require one application of weed killer instead of

multiple applications, reducing production cost and limiting the dangers of agricultural waste run-off.

DISEASE TOLERANCE

There are many viruses, fungi and bacteria that cause plant diseases. Plant biologists are working to create plants with genetically-engineered resistance to these diseases.

COLD RESISTANCE

Unexpected frost can destroy sensitive seedlings. An antifreezegene from cold water fish has been introduced into plants such as tobacco and potato. With this antifreeze gene, these plants are able to tolerate cold temperature that normally would kill unmodified seedlings.

DROUGHT RESISTANCE

As the world population grows and more land is utilized for housing instead of food production, farmers will need to grow crops in locations previously unsuited for plant cultivation. Creating plants that can withstand long periods of drought or high salt content in soil and groundwater will help people to grow crops in formerly inhospitable places.

NUTRITION

Malnutrition is common in third world countries where impoverished people rely on a single crop such as rice for the main staple of their diet. However, rice doesn't contain adequate amounts of all necessary nutrients to prevent malnutrition. If rice could be genetically engineered to contain additional vitamins and minerals, nutrient deficiencies could be alleviated. For example, blindness due to vitamin A deficiency is common problem in third world countries. Researchers at the Swiss Federal Institute of Technology and Institute of plant Sciences have created a strain of "golden" rice containing usually high content of β-carotene (Vitamin A). Since this rice was funded by the Rockefeller Foundation 14, a non-profit organization, the institute hopes to offer the golden rice seed free to any third world country that requests it.

PHYTOREMEDIATION

Not all GM plants are grown as crops. Soil and groundwater pollution continues to be a problem in all parts of the world. Plants such as poplar trees have been genetically engineered to clean up heavy metal pollution from the contaminated soil.

HARMFUL EFFECTS

Despite the many advantages to genetically modified foods there are many disadvantages. The main disadvantage is the potential it could have on human health. The new genes that are put in food could be resistant to certain antibiotics; if we eat them the effectiveness of antibiotics could be reduced. New allergens could be transferred to other foods. For example, if a gene from peanuts was taken and put in a tomato, people allergic to peanuts could be allergic to tomato. Most importantly, researchers can't actually prove whether genetically modified foods are 100% safe because normal toxicology tests don't work for food. There are many environmental problems involving genetically modified foods. These are mainly about pollination of plants. of genetically modified plants pollinate non-genetically modified plants this could spread them

into the wild, where they could compete with other plants. this would upset the balance of nature, as these plants could easily take over. Plants that are made resistant to chemical herbicides could pollinate with weeds. This would be disastrous because then new, stronger sprays would have to be developed to counter them. This would increase ground and water contamination, something genetically modified plants are supposed to prevent.

ENVIRONMENTAL EFFECTS

Last year a laboratory study was published in Nature 21 showing that pollen grains from

Bt corn caused high mortality rates in monarch butterfly caterpillars. Monarch caterpillars consume milkweed plants, not corn, but the fear is that if pollen from Bt corn is blown by the wind onto milkweed plants in neighbouring fields, the caterpillars could eat the pollen grains and perish. Although the Nature study was not conducted under natural conditions, the results seemed to support this viewpoint. Unfortunately; Bt toxins kill many species of insects larvae indiscriminately; it is not possible to design a Bt toxin that would only kill crop-damaging pests and remain harmless to all other insects. This study is being examined by the USDA, US Environmental Agency (EPA) and non-government research groups, and preliminary data from new studies suggests that the original study may have been flawed. This topic is the subject of acrimonious debate, and both sides of the argument are defending their data vigorously. Currently, there is no agreement about the results of these studies, and the potential risk of harm to non-target organisms will need to be evaluated further. Just as some population of mosquitoes developed resistance to the now banned pesticide DDT, many people are concerned that insects will become resistant to Bt or other crops that have been genetically-modified to produce their own pesticides. Another concern is that crop plants engineered for herbicide tolerance and weeds will cross-bred, resulting in the transfer of the herbicide resistant genes from the crops into the weeds. These 'superweeds' wold then be herbicide tolerant as well. Other introduced genes may cross over into non-modified crops planted next to GM crops. The possibility of interbreeding is shown by the defence of farmers against lawsuits filed by Monsanto. (Source: Internet, The Times of India and Monthly Educational Magazines).