FORUM

GENETICALLY MODIFIED PLANT FOODS - HOPES AND FEARS

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The revolution in DNA science and technology is affecting society in many ways, including through our legal system. DNA identification is an important technique in criminal law. It also affects medical practice, life insurance and concepts of ethnicity. The ability to identify, isolate and multiply an individual gene and insert it into the nucleus of another organism is already producing cheaper and purer medicines, for example insulin, and now it poses very difficult questions for agriculture and our choice of plant-derived foods.

Genetically modified (GM) carnations are on the Australian market, however, no-one is especially interested in them. The GM plants we are disturbed about are those used to make our foods. When it comes to unknown agents changing our foods in new ways that we do not understand, people get so concerned that they are likely to take some action outside their routines. This has happened with GM food plants. The scientists and agricultural companies that introduced the first set of GM plants never anticipated the strong - and effective - reaction from ordinary consumers and their retail suppliers. There are a number of likely benefits from GM food plants but also a well-known list of possible dangers. Consequently, this contentious issue has the effect of polarising opinions.

ANTICIPATED BENEFITS

The first set of GM food plants were introduced with the intention of improving the yield for farmers of major crops, such as soya, maize (corn), cotton and potatoes, by reducing the effects of weeds and damage from insects. Some contain a gene (sourced from a soil bacterium), making them resistant to the weed killer glyphosate (Roundup), so the field can be sprayed and weeds do not need to be dug out. Other GM plants contain the Bt gene (sourced from another soil micro-organism, bacillus thurmigenesis), which produces a chemical that is toxic to predatory insects but harmless to animals including humans. It is already used as an insecticide spray, allowed in organic farming. In the GM plant the gene to make the Bt toxin has been

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incorporated in the plants genetic material so there is continuous protection against susceptible insects.

An additional benefit of GM foods is that they could be used to help combat problems caused by a continued increase in the world's population. As a result of factors such as water shortage, soil erosion and urban sprawl the area of arable land available is unable to keep pace with population growth, and so an alternative is necessary. The availability of GM foods provides this alternative, however, this remains something that is guarded against. Major supermarkets have announced they will not stock or sell GM foods or foods with GM ingredients and government food regulators, in Australasia and the European Union, have brought in mandatory labelling.

OBJECTIONS

There are numerous objections to research into and use of GM foods. Primarily, it is argued that the process is not natural.

> Then God said Let the Earth produce fresh growth, let there be on earth plants bearing seed, fruit-trees bearing fruit each with seed according to its kind.
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> So it was; the earth yielded fresh growth, plants bearing seed according to their kind and trees bearing fruit each with seed according to its kind; and God saw that it was good.[1]

This could have moral and religious implications. The possibility of moving animal genes into plants, for example from the winter flounder fish into tomato plants, making them frost resistant, is disturbing to vegetarians and may offend religious food laws. For Prince Charles whether to pursue GM technology is therefore of vital importance.

> Are we going to allow the industrialisation of life itself? The capacity of GM technology has brought us to a crossroads of fundamental importance... The answer... will affect far more than food we eat; it will determine the sort of world we and our children inhabit.[2]

Multinationals are controlling agribusiness vertically and globally. Monsanto for example owns the seed (Roundup Ready), tolerant of Monsantos herbicide (Roundup). GM seeds, though their novel genes are natural, are patented. Farmers that use GM seed have to contract with the seed company not to grow the seeds they harvest. The Australian lay panel[3] believed that ethical considerations must

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1 *New English Bible*, Genesis 1, 11-12.

2 HRH The Prince of Wales, 'My 10 fears for GM food', *UK Mail* (London), 1999.

3 First Australian consensus Conference on Gene Technology in the Food Chain,. <http://www.abc.net.au> at 12 March 1999.

assume a prominent role in decision making about gene technology. Should life become a commercial property through patenting?

GM crops, particularly those patented by multinational agricultural companies, will not help peasant farmers in developing countries. They cannot afford the premium for GM seeds that cannot be reused after harvest. GM crops are likely to increase the take-over of subsistence farmers' land by rich farmers. For Rosemary Stanton, arguments that it will help to feed the world's starving people are unsupportable.[4] Politics, poverty and greed prevent the equitable distribution of food, and the cost associated with patents on genetically engineered plants are already furthering the disparity between rich and poor. GM crops are likely to destroy the diversity, the local knowledge and the sustainable agricultural systems in developing countries.

The first generation of GM foods - those permitted in Australia or applying for ANZFA approval - have no advantages to consumers. We did not ask for this, and there are obvious risks to the environment and perceived potential risks to consumers who eat them. There has been no pull from the consumer to have GM products. In fact, GM foods could be harmful to consumers, although, this is yet to be proven. Despite this lack of solid evidence, consumers in Europe cannot forget mad cow disease (BSE). The scientists got it wrong then, and there are no guarantees that this will not occur again. People might be allergic to a new protein or one transferred with the desirable gene, even though this is not showing up in the tests of permitted GM foods, and in some GM plants the new gene is often not expressed in the edible part of the plant.

A more focused concern is antibiotic resistance. To test if the desired new gene has been successfully inserted into the plants genome a second marker gene is attached so that successful implantation can be recognized. Antibiotic resistance is a useful marker gene. Multiple tiny pieces of the treated plant are grown on tissue culture and if there is an antibiotic in the culture medium the little plants that survive have been successfully transformed. The enzyme for antibiotic resistance would normally be destroyed by cooking, but it is just possible that the resistance gene could pass through to the large intestine and transfer to resident bacteria there. GM plants are now being developed without using antibiotic resistance markers.

With large scale growing of herbicide resistant crops, more extensive use of herbicide sprays, especially from the air, is anticipated. This can lead to further loss of wild plants and habitat for animals. On the other hand resistant weeds (superweeds) could develop, spread by pollen from GM crops, such as canola, to neighbouring weeds of the same botanical family (cruciferae). Widespread growth of insect resistant GM crops could lead to more rapid evolution of resistant insects (superbugs). Prevention of insect resistance relies on ringing the changes in pesticides that farmers and horticulturists use.

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4 Rosemary Stanton, 'Letter: GM food – no solution to starvation', *Sydney Morning Herald*, 28 June 1999.

Finally, GM food crops are based on a concept of fighting rather than adapting to the ecology. As Rivkin[5] argues, instead of engineering our plants in isolation from ecosystems in a defensive way, we could find ways to better understand how traditional varieties fit into local ecosystems. There will be plants over millions of acres producing biodegradable plastics, chemicals and vaccines, all encoding for specific genes that can jump and fix for herbicides, pesticide and viral resistance in weedy relatives. We are placing living things in the environment where there is no evolutionary history on how to accommodate them. There are many examples of this in Australia, including the introduction of the cane toad, rabbits, foxes, Patterson's curse, lantana, and many other imported species that have caused considerable problems.

THE PRESENT POSITION

It is estimated that 44,000,000 hectares in the world were growing GM crops in 2000. (This is 110 million acres or an area 440km x 1,000 km). Most of the GM cultivation is in the USA, with Argentina second and Canada third in GM area. The USA has approved commercial use of 52 different GM crops, the most important of which are soybean, maize (corn), cotton and canola, as well as potatoes, tomatoes, sugar beat and rice. In the USA, GM crops do not have to be labelled or segregated from non-GM crops. This has obvious implications for consumers, and Australian food manufacturers cannot be sure whether maize, soybean, canola, cottonseed or potato products imported from North America contain GM products or not.

Attitudes are different in Europe. The major supermarkets, responding to consumers' anxiety, aim not to stock products that might contain GM foods unless they are clearly so labelled, and not to sell meat and chicken unless they have been raised on GM-free feeds. EU and national regulatory agencies have been cautious and slow in approving GM foods and insist on labelling.

In Australia in 1999, it was discovered that foods with genes altered in the laboratory were being grown in the USA and heading our way unlabelled. Most people have great difficulty in comprehending the science of extracting DNA, recognizing individual genes, multiplying them and inserting them into the genome of a different species. Our food authority, ANZFA, was working through applications from Monsanto, Aventis and Novartis for permission to grow nearly 20 different GM crops in Australia and market their food products. The criterion was whether the composition of the GM food is substantially the same as the traditional food (in allergenicity, toxicity and nutritional value) using data from the respective seed company and laboratories contracted to them. Despite a large federal Government investment in Biotechnology Australia for a public awareness campaign, so many ordinary voters contacted their MPs that the State and Federal Health Ministers (who oversee ANZFA) decided that GM foods must be labelled in

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5 Jerome Rivkin, 'Apocalypse When?' (1998) *New Scientist* 34.

Australia, even if there is no evidence that their chemical composition differs from their traditional, non-GM counterpart. The ANZFSC (Australia and New Zealand Food Standard Council) Ministers made it clear that the labelling of GM foods was not a safety issue, rather an initiative to give consumers the information necessary to make informed choices. However, some people may have ethical, environmental, religious or other reasons to avoid GM foods.[6] From the end of 2001 foods grown in Australia however must be labelled if they are substantially from GM plants. There are these (reasonable) exemptions:

- Refined foods where the novel DNA or protein is no longer present, eg vegetable oils, sugars
- Processing aids (enzymes, yeasts, cheese setting agents, hormones)
- Food additives (colours, flavours)
- Foods prepared at the point of sale - takeaways and restaurant meals.

The new standard allows any one ingredient in a food to contain up to 1% of GM material where its presence in the ingredient is unintended. The words genetically modified should appear on the package. The other regulatory aspects of GM food crops concern farmers. First, before a crop plant is approved and accepted it has to be grown in trial plots in different soils and climates in the country. Here the seed company can assess which GM plant is competitive in rigour and yield with existing varieties and what are the best growing conditions. Australia and some other countries insist on strict conditions for these trial fields. They must be quarantined by prescribed boundaries from other crops to prevent spread of the GM plant or pollination of other crops or weeds.

Farmers who grow GM plants have to sign contracts with the seed company that determine how they grow the crop, that they cannot use the harvested seed, and that they take precautions to prevent development of resistant insects. Disputes have arisen and there have been legal cases about:

- Insecticide drift to a neighbouring farm
- The GM crop failing
- Insect resistant GM cotton badly affected by the boll weevil
- Seed company employees finding the plant growing on a farmers land in subsequent years.

All these situations mean that chemical methods for recognition of GM plants and foods must be developed, available and reliable although the change in composition is tiny and in some GM plants the novel gene is not expressed in the edible portion. These recent disputes over GM foods are part of the larger debate about farming methods and globalisation. The first generation of GM food plants have met stronger antagonism from the general public than the seed companies and their scientists expected.

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6 ANZFA Fact Sheet 'Labelling Genetically Modified Foods', 31 May 2001.

FUTURE POSSIBILITIES

Investment continues into GM research. This is primarily in the United States, but also occurs in Australia, through funding from the federal Government. Our nation could really benefit from genetically modifying plants so they can grow in saline or in semi-desert ground or from modifying Australian native fruits (Aboriginal or bush foods) to make them more suitable for commercial production.

If you are a farmer, you are faced with the question of whether you will pay for GM canola seed that should give you a higher yield (but might not), or continue growing non-GM canola for which there is a good demand in Europe, and so a better price. Equally, if you are a food manufacturer you must consider whether to pay extra to source non-GM ingredients. Consumers must consider whether to pay more for a food that declares it is not genetically modified (a description without legal definition or guarantee) on the package or buy a product that says nothing and might well contain GM ingredients. There are also questions as to how the multinational seed companies will modify their research and development policy. And whether the USA will move towards the EU position, or vice versa. The future is impossible to predict but is likely to be complex and confused.

At least one GM plant has been developed, Golden Rice, which seems to be an example of the best that biotechnology has to offer the developing countries of Asia.[7] Golden Rice has genes (from daffodil) to instruct the rice plant to make beta-carotene in its endosperm. Beta-carotene is a yellow pigment, naturally present in green leaves, including the rice plants (but not in its grain) that has vitamin A activity. This GM food was developed in the Swiss Federal Institute of Technology, with funding from the Rochefeller Foundation and the EU and it is to be available at low cost to farmers in South East Asia who need it most. The cover of Time Magazine claimed, 'This rice could save a million kids a year'.[8] Vitamin A deficiency is a priority nutrition problem in South East Asia.

A US-EU Biotechnology Consultative Forum with eminent agronomists, consumer representatives, ethicists, biotechnologists, ecologists, food researchers and intellectual property advisers from 8 countries on its panel and chaired by Ruud Lubbers (former Prime Minister of the Netherlands) and Cuthberto Garza (Professor of Nutrition, Cornell University) made 23 recommendations for the fair and orderly progress of biotechnology with respect to agricultural plants. This document should be studied and applied by all companies and authorities involved with genetic modifications in agriculture and food.

The consultation urged the US and EU authorities to work together, to establish mandatory labelling requirements for products containing novel genetic material, to have pre-market examination and a detailed plan for monitoring environmental

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7 Xudong Ye, Salim Al-Babili and, Andreas Kl_ti, et al 'Engineering the provitamin A (§-carotene) biosynthetic pathway into (carotenoid free) rice endosperm' (2000) 287 *Science* 303.

8 *Time Magazine*, 7 August 2000.

questions. For risk assessment and management, the ethicists and social scientists should be involved as well as the expected toxicologists, molecular biologists and plant breeders. The US and the EU should commit themselves to stimulating global sustainable agriculture and foster modern agricultural technology in the developing countries. The countries should set up a global dialogue on an intellectual rights regime that would provide a fair return on research investment and also support sustainable agriculture for the developing world. Developing countries should have fair and equitable access to new biotechnologies and products. They should not be forced to grant intellectual property rights that could prevent farmers freely replanting saved seeds or public breeders from freely using particular varieties as initial sources of variation.

As the present US government shows little interest in cooperating on international treaties about the environment, we cannot expect cooperation on GM crops in the near future. Globalisation means it is going to be very difficult to keep unlabelled foreign GM foods from entering our shores and our foods. We can only hope that potentially beneficial GM crops will prosper and that environmentally dangerous ones will not be taken up by most farmers. While benefits could certainly arise from the development and use of GM foods, there remain justifiable concerns that indicate the space taken up by organic fruits and vegetables in European supermarkets is likely to continue to expand.