Engineering the Foodchain

GYORGY SCRINIS asks us to look the gift horse of GM wholefoods squarely in the mouth

In the face of strong opposition from civil society groups, farmers and consumers around the world to genetically engineered (GE) foods, the biotech industry has been hoping that the development and heavy promotion of GE foods with some direct consumer or humanitarian appeal will be a way of gaining public and regulatory acceptance of GE products.

Two GE crops with modified nutritional profiles that are currently being developed and trialled are a low-GI (glycemic index) wheat and pro-Vitamin A-enhanced 'Golden Rice'. While low-GI wheat is a product that would be marketed to diabetics and weight-watchers, Golden Rice has been promoted as a way of addressing the problems of malnutrition in the countries of the global South.

These nutritionally modified GE crops may not only be used to overcome public and farmer resistance to GE foods. They are also likely to be stacked with a number of other GE traits that will benefit the corporations that own and control them. At the same time, these essentially reductive approaches to tackling the problems of over- and under-nutrition may ultimately be counter-productive, exacerbating the very conditions that give rise to these problems.

Stacking GE Input and Output Traits

The overwhelming majority of commercially grown GE crops and animals today have had some of their 'input' characteristics modified, which means that genetic modification has changed some aspect of the plant or animal's growth patterns or the farming practices and inputs associated with their production. This 'first generation' of GE crops predominantly incorporated one of two input traits: the trait for herbicide tolerance (herbicide-tolerant crops), and the trait for insecticidal toxin production (Bt insecticidal crops). These two applications are about finding new ways of producing and new opportunities for applying pesticides.

GE crops and animals with altered 'output' characteristics, on the other hand, are those whose end-product characteristics have been modified in some way. These in turn can be divided into those output traits which are designed to meet the requirements of the food distribution — processing, retailing and animal-feed industries for example — and those with output traits that may have a more direct appeal to consumers.

While we can distinguish between these various input and output characteristics, these traits will not stand alone but will ultimately be 'stacked' together into multi-trait seed packages. In particular, output traits such as nutritional-modifications are likely to be stacked together with input traits such as herbicide-tolerance. Farmers are unlikely to be offered the option of single trait 'enhancements', such as choosing a low-GI trait without the herbicide-tolerance trait. Farmers may be tempted to switch to GE seeds — and to accept any price premiums, chemical-inputs and other restrictive conditions of use that come with them — if they perceive that crops with modified nutritional traits generate greater consumer demand or offer a higher market premium.

Aside from these various input and output traits, there is one special trait that practically every GE crop and animal has been stacked with — corporate ownership and control.

Seed corporations may not even charge farmers any 'extra' for these nutritional traits, for they may regard them as their Trojan horses for smuggling in other profitable traits into their seeds. By stacking input and output traits in this way, agri-food corporations hope to capture a greater share of the seed and chemical markets by broadening the appeal of their products to farmers.

Aside from these various input and output traits, there is one special trait that practically every GE crop and animal has been stacked with — corporate ownership and control. As practically all commercially grown GE crops around the world are patented and sold by a small number of trans-national corporations, any GE crops with added consumer or farmer appeal will facilitate the further concentration of ownership and control of the seed and chemical-input industries.

The great irony of these attempts to use genetic engineering techniques to 'improve' and 'enhance' the taste or the

nutritional quality of crops is that they are, to some extent, merely putting back nutrient and flavour that are characteristic of traditional crop varieties lost in the transition to industrial seed varieties and chemical-industrial farming practices over the past century. As we shift from a chemical-industrial to what I call a *genetic-corporate* agri-food system, one of the aims is to selectively reintroduce and sell back to us — one at a time — some of these lost output traits and crop characteristics, while simultaneously intensifying the chemical-industrial agri-food system.

Low-GI Wheat

In Australia, the only broadacre genetically engineered crop being commercially grown is cotton. While not commonly recognised as a food crop, cotton seed oil and other by-products of this GE cotton crop are making their way into the food supply. Although GE canola has been approved for commercial release by the national Office of the Gene Technology Regulator (OGTR), most state governments have moratoriums in place on the commercial growing of GE canola.

The CSIRO, Australia's premier publicly funded research centre, has recently applied to the OGTR for approval of a field trial of a number of genetically engineered wheat varieties with modified nutrient characteristics. The significance of this field trial application is that it would be the first GE food product to be field tralled in Australia that is intended to have directly marketable health benefits for consumers.

This field trial application is also significant given the strong opposition from farmers and farmer organisations to the introduction of GE wheat in Australia. It could therefore be used to facilitate the regulatory approval and commercialisation of GE wheat. Given that the resistance to GE wheat from the large farmer organisations is largely market driven — based as it is on a concern to protect the GE-free status of Australian wheat in the context of low demand for GE crops worldwide — a GE wheat with more consumer appeal might ease some of these concerns.

The CSIRO's GE wheat varieties have been engineered to contain high amylose starch. This type of starch is considered to have a low GI. Foods with a low-GI score are defined as those that release glucose into the bloodstream more gradually than high-GI foods. Low-GI foods are therefore supposed to better regulate blood glucose levels, and they have been advocated as a way of preventing and treating diabetes.

It is also claimed that by releasing glucose more gradually, low-GI foods make you feel 'fuller' for longer, and on this basis are put forward as a means for eating less and losing weight. The low-GI diet is one of the more popular weight-reduction fad diets that are currently sweeping some parts of the world. If and when this low-GI wheat is produced commercially, it could be packaged and marketed directly to consumers as low-GI flour. But it would more likely to find its way into a range of processed breads, cakes, biscuits and other convenience foods and — with regulatory permission — be used to advertise the health benefits of consuming these foods. Significantly, in December 2003 the Australian government passed legislation permitting health claims to be advertised on food packaging labels.

To the extent that such a low-GI wholefood is primarily used to encourage the consumption of processed foods — foods typically high in fat, sugar, salt, and chemically modified ingredients and additives — it may be counter-productive to the aims of addressing the problems of obesity and diabetes.

The low-GI diet is typical of many other fad and weight-loss diets, such as the Atkins high-fat/low-carb diet. Firstly, these diets generally involve a reductive focus on particular nutrients or biomarkers. In this case the focus is on blood glucose levels and carbohydrates. Secondly, these diets are based on a highly quantitative and calculating approach to food and diets — in this case measuring the GI index of all foods. Thirdly, these diets create a hierarchy of wholefoods — in the sense of distinguishing between good and bad (or better and worse) wholefoods. In this case, wholefoods are distinguished on the basis of their GI index. In fact, a distinction is essentially drawn between good and bad carbohydrate foods, or just good and bad carbs.

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Underpinning and giving credence to this approach to food and diets is the ideology of *nutritionism*, as I refer to it, whereby the chemical-nutrient level of understanding and engaging with food comes to dominate and replace other approaches to food. The understanding of food in terms of its nutrient components has been implicitly — if not explicitly — promoted by the nutrition industry over the past few decades.

But it is the food industry — and now the biotech industry — that has more recently exploited the ideology of nutritionism as a powerful means for marketing its products. Nutrient claims such as '97% fat free' and 'high fibre' are now commonly used to sell a range of processed foods. Even McDonald's uses such nutrient content claims to sell its fast-food products.

The development of the science and technology of genetics intersects with and extends nutritionism in two ways. Firstly, as already noted, through the development of genetically engineered crops with modified nutrient profiles. Secondly, through the emergence of the new field of 'nutrigenomics' — or nutritional genomics — whereby optimal diets will be tailored for individuals to match their genetic profile. Nutrigenomics can be understood as a new form of nutritionism — what I call *genetic nutritionism* — whereby the genetic level of engagement with the body now overlays and frames the biochemical approach to food and the body.

Trojan Rice: Pro-Vitamin A-Enhanced Golden Rice

The most famous and controversial example of a GE crop claiming to have an 'enhanced' nutritional or health profile is the pro-Vitamin A-enriched 'Golden Rice'. The term Golden Rice is derived from the yellowish tinge of this GE rice variety, though it fits well with the golden promises

with which it has been promoted. While it is likely to be a number of years away from being ready for commercial release, the development of Golden Rice was made public in 2000 and has been widely celebrated by GE proponents as evidence of the potential for GE crops to 'feed the world' and address the problems of hunger and malnutrition.

Golden Rice has been genetically engineered to express increased levels of beta-carotene — or pro-Vitamin A. Vitamin A deficiency is widespread amongst the world's poor and malnourished, and can lead to blindness and death. Vitamin A is found in meat, dairy products and fish. Beta-carotenes are converted by the body into Vitamin A, and are found in a wide variety of foods including fresh greens, vegetables and legumes. Eating just one carrot or a small bunch of leafy vegetables daily may provide adequate amounts of beta-carotene.

However, other nutrients, such as fats, may also need to be present in the diet for the beta-carotene to be converted to Vitamin A. Vitamin A deficiencies are the result of a narrow diet lacking in adequate quantities of these foods. This includes those who consume a diet of mostly rice and not much else. People eating such inadequate diets are likely to be suffering from a range of Vitamin and nutrient deficiencies, not just Vitamin A deficiency. Rather than addressing the problem of poor people's access to diverse and adequate diets, or even access to vitamin supplements, the rationale of the developers of Golden Rice is to offer people yet more rice, but with the beta-carotene supplement built in.

There have been a number of questions raised as to whether Golden Rice is capable of addressing Vitamin A deficiencies among malnourished, rice-eating populations, even within the incredibly narrow terms in which it has been conceived and promoted. For example, based on data supplied by the developers of this crop, Greenpeace have estimated that a person may have to eat several kilograms of this rice per day to raise their Vitamin A levels to adequate levels. Golden Rice crops with higher concentrations of beta-carotene are, however, reported to be in development.

A more pressing issue relates to the ownership and control of Golden Rice and the tricky pathway via which it might find its way into the mouths of the malnourished. While Golden Rice was developed primarily by publicly funded research institutes, the patents and the rights to commercialise it have been acquired by Syngenta (formerly Astra-Zeneca), now the world's largest agrochemical corporation and the third-largest seed company. The terms of this corporate handover are meant to ensure that poor farmers in the South will have 'free access' to these seeds, though the exact terms of this agreement have not been spelt out. But there may also be heavy restrictions on the way these seeds are used, including a prohibition on exporting rice containing the patented Golden Rice genes, and potential penalties for the deliberate or accidental cross-breeding with Golden Rice varieties.

One of the primary agendas of the giant seed-chemical-biotech corporations is to get patented genes into as many seed varieties, countries and farmers' fields as possible. Golden Rice may be used as a strategy for gaining control of local rice markets while masquerading as humanitarian aid.

On top of this trait for corporate control, it's worth asking what other input traits will also be stacked into this Trojan Rice when it is eventually commercialised. The trait for herbicide tolerance to Syngenta's herbicides? Perhaps the 'Terminator' trait for rendering seeds from the resultant crop sterile and therefore not re-plantable?

Golden Rice represents a typical case of technical-fix reductionism. The one-food/one-enhanced-nutrient approach of Golden Rice does not address any of the real causes of a lack of access to an adequate diet for those suffering from Vitamin A deficiency. But for critics, the concerns surrounding Golden Rice are not merely that it won't be able to eliminate Vitamin A deficiency to any significant degree, nor that it may distract attention from other existing and more realistic ways of addressing this problem. The real danger is that Golden Rice may ultimately be used to perpetuate and exacerbate the very conditions that give rise to a lack of access to an adequate diet for the most vulnerable people and communities.

The inadequate diets leading to Vitamin A deficiency can, to some extent, be attributed to the narrowing of the diversity of crops and crop varieties that has followed the penetration of chemical-industrial agriculture into the Third World in recent decades (through the Green Revolution). The diversity of legumes and vegetables grown and consumed at the local level has partially given way to the expansion of grain staples such as wheat and rice and other cash crops that have been grown for export markets. The increasing use of chemical insecticides and herbicides also increases uniformity in farmers' fields by eliminating some of the 'weeds' and other plants and animals that served as food sources for the poor. If Golden Rice genes are engineered into Green Revolution-type seeds that are highly input-dependent, and thereby facilitate the further entrenchment and extension of large-scale monocultural and capital-intensive agricultural production, the likely outcome will be to exacerbate the food insecurity of the poor in these regions.

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While all the focus has been on its potential benefits for the malnourished, once Golden Rice is commercialised Syngenta may be more interested in promoting this rice to more affluent consumers as a Vitamin A-enhancing nutritionally modified food.

The engineering of GE crops with modified nutritional traits is ultimately a means for aligning the demands of health and nutrition-conscious consumers with the requirements of the genetic-corporate agri-food system.

Gyorgy Scrinis is a Research Associate at the Globalism Institute, RMIT, and spokesperson for Friends of the Earth on GM foods.