



## **Open Meeting**

# **GM Foods: are they safe to eat?**

**23 January 2003**

**The open meeting was organised by the BA for the GM Science Review which is part of the National Dialogue on GM.**

**This report was prepared by Rachel Tonkin on behalf of the BA and submitted to the GM Science Review Panel.**

## **GM Foods: are they safe to eat**

### **Popular Summary**

The first open meeting of the GM Science Review was held at the Science Museum, London, on 23 January, as part of the three-strand government strategy for a public dialogue on the future of GM in the United Kingdom. The subject of this meeting was GM Food Safety.

It was generally accepted that although the tests for GM foods currently in place in the UK are reliable, more research needs to be done into the area of the use of animal models to look for any risks from eating GM foods. Similarly, although allergenicity testing can predict whether a GM food is a likely allergen, scientists admit that they only partially understand why some proteins are allergenic. Even well-known allergens like peanuts and milk, are not yet fully understood.

The issue of antibiotic resistance as a result of GM techniques was clearly explained and their continued use challenged, although the view that the use of antibiotic resistance marker genes is not absolutely necessary to genetic modification was confirmed by the speaker on gene transfer, Dr John Heritage.

The overall debate raised some questions over the safety of GM foods, on which differing views were expressed. Members of the audience, consisting of scientists, interest groups and concerned members of the public, were given the opportunity to express their views in a lively and informative discussion with the scientists and representatives of the GM Science Review Panel.

This open meeting was the first of a series of nationwide discussions that contribute to the review of the state of scientific knowledge and understanding of the safety of GM foods and crops in the UK.

A report on the science of GM is being produced by the GM Science Review Panel, representatives of which were present at the open meeting to challenge and question the speakers from the scientific community.

## **Introduction**

The safety of genetically modified (GM) foods was the subject under debate at the first open meeting of the GM science review, held at the Science Museum, London, on 23 January 2003. The open meeting is part of the nationwide scientific debate, intended to establish the state of knowledge and understanding of the science of GM.

Speaking at the meeting were four scientists involved in GM research in the areas of regulation, the potential increase of allergens, gene transfer and unpredictability of GM processes. Members of the audience were also invited to participate in the lively, informative and occasionally heated debate that followed.

The open meeting consisted of presentations, questions from representatives of the GM Science Review Panel and an audience discussion. The results of the meeting are reported thematically rather than chronologically to aid clarity, this includes the questions from the audience at the end of the meeting. Questions which lay outside the themes are summarised at the end of this report.

## **Background**

In order to produce genetically modified crops, genes are transferred from bacteria, viruses and plants to change the crops in certain ways in order to make them resistant to disease or insects, or tolerant to weed killer, for example.

But is GM food safe to eat?

The GM Science Review aims to engage with public concerns about GM and review the current state of knowledge underlying those concerns.

Professor Sir David King, Chief Scientific Advisor to the government, is chair of the GM Science Review Panel whose job it is to summarize the state of scientific knowledge, concerns and areas of uncertainty on the issues.

## **Main findings**

Detailed information was given by the scientists about the main concerns of the GM debate: the procedures in place to test the safety of GM foods; the potential of an increase in allergens as a result of GM; the issue raised by antibiotic resistance marker genes; and also the unpredictability of GM processes.

At the open meeting it was generally accepted that although the tests for GM foods currently in place in the UK are reliable, more research needs to be done into any way in which the use of animal models could help to determine whether there was any hazard for humans in eating such foods. In the area of

allergenicity, it was acknowledged that testing can determine whether a GM food is a likely allergen, but it was admitted that the actual allergenic proteins, even of known allergens like peanuts and milk, are not yet fully understood.

The issue of antibiotic resistance as a result of GM techniques was clearly explained and the continued use of antibiotic resistance genes challenged at the meeting, although the view that antibiotic resistance marker genes are not absolutely necessary to genetic modification was confirmed by the speaker on gene transfer.

The meeting also included a discussion of the unpredictability of GM plant breeding with regards to variation, but it was accepted that this also occurs with traditional plant breeding methods.

## **Regulatory Process**

Prof. Derek Burke, former chair of the Advisory Committee on Novel Foods and Processes (ACNFP), began the evening's discussion with a detailed and enthusiastic explanation of the Committee's work, clarifying its role in advising the Government on the safety of novel foods introduced to the UK market.

A novel food is defined as any food which has not been consumed in the European Community before May 1997; this includes all foods, not just those which have been genetically modified.

As a result, the ACNFP's role in the GM debate is vital, as it ensures that all GM foods and processes are thoroughly tested to the same standards before being approved.

The Committee is made up of experts from universities and research institutes and contains a consumer and also an ethical advisor. The Committee works in a transparent and accountable way.

Cases are examined individually and the committee uses highly-refined decision trees to aid the identification of key questions. With regards to GM foods, the objective is to identify whether any of the modifications made could affect the safety of the food in any way.

Prof. Burke addressed the question of whether the regulatory system in place in the UK is stringent enough to allow GM crops to be grown in Britain. Some argue that GM foods are tested more thoroughly than non-GM foods, while others believe they have not been tested enough.

But Prof. Burke is confident of the Committee's ability to test novel foods, "Not all cases that were submitted have been approved. But of those that have been, including the GM foods, none have been found to be harmful in use."

There is also some concern among the general public, as was evident in the open discussion at the end of the meeting, that the regulatory procedures for testing the safety of GM products may vary between different countries

It was explained that the process in the UK is now a part of an EU-wide process which differs in two important respects from that in use in the USA. Firstly, in the USA only the product is assessed whereas in Europe both the product and the production process are assessed. Secondly, in the USA the company concerned is given permission (or not) to market the product but remains responsible for any adverse effects of their product. In Europe the responsibility falls back to national Governments.

### **Antibiotic Resistance (Gene Transfer)**

The issue of antibiotic resistance genes is a highly controversial element of the GM debate and was raised by the second speaker at the meeting, Dr John Heritage, senior lecturer in microbiology at the University of Leeds.

Some members of the general public and the scientific community alike are concerned that the potential exists for the genes used in genetic modification to have further implications or knock on effects.

Many GM plants contain antibiotic resistance marker genes which are inserted into the plants so that scientists can tell when they have successfully inserted new traits into the plant.

The main concern regarding antibiotic resistance genes is that they could be transferred into bacteria in the gut of animals or humans, or even bacteria in the environment.

Many bacteria have the ability to pick up genes from their surroundings and to pass these on to other species of bacteria, including those which cause disease. This brings with it the fear that some diseases will become resistant to antibiotics or even lead to the creation of so-called 'super bugs'.

Dr Heritage discussed the results of the tests carried out in his laboratory on chickens and sheep to determine whether these antibiotic resistance genes can be transferred from GM maize fed to the animals to the bacteria in their gut.

The experiments were carried out when approval was sought for the production of GM maize which contained an insect toxin to prevent it being attacked by caterpillars.

The results of the tests indicate that in the animals fed on GM maize, the antibiotic resistance gene in the maize behaves like any other plant DNA and is digested and is therefore unlikely to be picked up by the bacteria in the gut.

However, as a member of the GM Science Review Panel pointed out, the number of animals used in the tests was relatively small, using only five chickens, and only a single-dose feeding of GM maize was tested.

Dr Heritage agreed that more extensive tests need to be carried out in this area, and admitted that the potential for antibiotic resistance genes to be passed into the human food chain could not be altogether ruled out.

He also challenged the fear that gut bacteria, which are potentially capable of causing disease in humans or animals, could become resistant to many important antibiotics due to the use of these particular antibiotic resistance marker genes.

He argued that antibiotic resistance occurs naturally—as in the case of penicillin when a resistant strain of bacteria was discovered only weeks after the introduction of the antibiotic into clinical practice—and he has carried out tests which show that over 50% of the UK population is already carrying gut bacteria that are resistant to the antibiotic ampicillin.

The occurrence of natural resistance to certain antibiotics can be seen as an argument against the concern about using antibiotic resistance genes in GM foods and processes. As Dr Heritage explained, “We can’t rule out the potential for gene flow in the gut, but compared with the huge amount of usage in human medicine, this is where the selective pressure for resistance occurs.”

At the meeting Dr Heritage also pointed out that there is a potential concern that antibiotic resistance genes in GM plants are amplified in novel ecological niches where the genes are not normally found. This is an area where more research is needed before reassurance may be given.

It is argued by some scientists that antibiotic resistance marker genes are not essential to genetic modification and this was raised by a member of the GM Science Review Panel. Dr Heritage agreed that it was not absolutely necessary to use these genes and admitted that alternative selectable markers are now available.

### **GM and allergenicity**

Another area of public concern is that the production of genetically modified foods will bring with it an increase in food allergies. Dr Clive Meredith, Head of Immunology at BIBRA International Ltd, an independent advisory organisation, highlighted the three main concerns and explained the process that proteins undergo in order to determine whether or not they are likely allergens.

The most prominent concern is that a novel GM protein will turn out to be a new food allergen. Additionally, there are concerns that the GM process might bring about the introduction of an existing allergen and also that it might cause the potential of existing food allergens to be modified.

There are no current examples of the modification of existing allergens but, hypothetically, an unintended effect of the GM process might be an increase in levels of chemicals within the food. In turn, this could increase the absorption of proteins, including allergens, from the diet.

An example of the potential problem of allergenicity brought about by genetic modification is the attempt in the early 1990s in the United States to develop a GM soya for animal feed. Scientists wanted to raise the level of methionine in the soya, and therefore a protein from the Brazil nut with high levels of methionine was inserted into the soya.

During the safety evaluation process, however, it was discovered that individuals allergic to Brazil nuts were also allergic to the modified soya and so product development was stopped immediately. The safety evaluation process involved tests on allergic individuals to cover the likelihood of the GM soya passing into the human food chain.

Although, as Dr Meredith pointed out, this showed the reliability of the safety tests, it also raised concerns as to whether the same types of screening procedures are in place across the world.

As a result of this discovery, a number of strategies were developed by international organisations to try and predict the allergenicity of GM foods. Decision trees were developed that ask whether the source of the modified gene is known to be allergenic or not.

If the source of the gene is known to be allergenic, then a series of tests can be run to determine whether the expressed protein is a likely allergen.

When the source of the gene is not a known allergen, then a series of tests are used, including tests on individuals with allergies to botanically related species for example, pepsin resistance assays and animal models, and the allergenicity of the protein can then be defined.

Despite all the tests available, however, scientists still cannot be absolutely certain that a GM protein is or is not an allergen. They can only say that it is a likely allergen or that it has a low, medium or high probability of being allergenic.

Dr Meredith is confident that the strategies used to test the allergenic potential of GM foods are adequate for existing or cross-reacting allergens, but believes that tests on GM foods containing novel proteins where there has been no previous human exposure would certainly benefit from validated animal models.

But perhaps more crucially, Dr Meredith believes that there is a need for further understanding of the relationship between protein structure and allergenic potential, "We are still only beginning to scratch the surface of the understanding of this quite complex interaction."

The question of whether all novel foods in the UK have been tested for allergenicity was raised by a member of the GM Science Review Panel. For example, kiwi fruit (not a product of genetic modification but of conventional plant breeding), which were introduced into the UK several decades ago, were later found to be allergenic. Although not all foods currently in our diet have been tested, any foods novel to the UK in future will undergo allergenicity testing.

A member of the audience raised the issue of labelling of potentially allergenic foods. She was concerned that the possible allergenicity of GM foods would be harder for people to trace as the origin of the allergen may be unrelated to the product in which it ends up.

Dr Meredith thought it highly unlikely that this would be the case, however, as all potential food allergens would be assessed on a case-by-case basis and if they were found to be allergenic would be labelled accordingly.

### **Genetic interaction and levels of uncertainty**

The debate about GM food brings with it the issue of genetic interaction and levels of uncertainty. A new GM crop is made by introducing a novel gene or genes into the plant that is being engineered. As a consequence, the genes involved may interact with other genes present in the plant in novel and unpredictable ways.

The possible consequences of these unexpected effects were raised by the final speaker, Dr Peter Lund, senior lecturer in the School of Biosciences at the University of Birmingham, "Genes and gene products, that is proteins, do not act in isolation, ... they are known to interact with each other in extremely complex and at the moment rather poorly understood ways."

Genetic modification is not a precise technique. There is no control over exactly where the genes are inserted among the plant's own genes and as a result there is potential for unexpected outcomes if normal genes are disrupted or the foreign gene does not function properly. Further unexpected consequences may arise from interactions between the products of the novel gene and other gene products within the cell. Such unexpected consequences have indeed been described in the large literature on GM plants.

This possibility raises concerns about the potential for these novel interactions to cause changes in the plant's metabolism that might produce substances that are toxic, allergenic or otherwise detrimental to human health and therefore questions whether the current regulatory process in the UK is sufficient to identify this potential.

It must be stressed, however, that although such harmful effects are formally possible, there is no documented evidence of them having occurred. It is also important to acknowledge that this uncertainty is not just unique to GM, it can also arise from classical plant breeding methods; for modern plant breeding

techniques regularly include methods designed to increase the amount of variation present in the plant.

Before a new variety of plant can be released into the market, it has to go through many generations of testing and evaluation which are specifically designed to weed out any potentially unpredictable effects.

Dr Lund addressed the question of whether these effects are more likely to arise with GM methods than with classical breeding methods, but explained that it was not really an easy question to answer as it depends on the type of cross that is carried out.

He summarised this by saying, "All the methods that we use to generate the food that we eat and that we have been using since time immemorial are ones that will produce things which we can't necessarily predict, and that's because of the extraordinary complexity of the systems that we are dealing with."

Despite this, he still believes that although the tests carried out by the ACNFP are rigorous to try and pick up these sorts of problems, more research needs to be done into the effects of life-long consumption of GM products, although methods for doing this are not currently available.

More powerful techniques, however, are being developed with regards to protein and metabolic profiling which, once they start to become more accessible, will eventually be integrated into the regulatory process.

This means, however, that as scientists begin to gain a higher level of understanding of novel products, they will begin to need the same level of information for foods currently in our diet in order to make comparisons; these have not yet been established.

Despite the concern about possible unexpected effects from GM foods and the time spent investigating these, it is important to remember, as Dr Lund mentioned, that there are many foods that we already eat which we know are unhealthy for us, and in some cases, may even be hazardous.

It is also the case that many foods already present in our diet would immediately disappear from the food chain if they were put through the current regulatory procedures for novel foods; this includes things like coffee, peppers, tomatoes and even the trusty potato.

Dr Lund was optimistic about the progression of scientists' understanding of relationships between different proteins and hopes that one day they will be able to make more predictive judgements about the structure and behaviour of novel proteins.

A member of the GM Science Review Panel raised his concerns about the possible disappearance of coffee if it were to be tested in the same way as novel foods, and questioned whether this should actually happen. But as Dr Lund explained testing every food item present in our diet would be practically

impossible. We will have to live with the inconsistency that novel foods will always be subject to stringent tests. If these tests were also applied to existing foods, it would result in many of these foods disappearing from the supermarket shelves.

In relation to the possible unpredicted effects of GM, a member of the audience was concerned that the issue of toxicology had not been discussed. He was assured that toxicology tests are an inherent part of the procedures undertaken by the ACNFP.

Several members of the audience brought up the issue of relative risk and how the risks for GM could be quantified. However, Dr Lund explained that, "There is a difference between risk that you can accurately quantify and risk that people are prepared to accept. It would be possible to establish a baseline risk, which might satisfy the scientific community, but it wouldn't really help the public debate that much."

The audience discussion at the end of the meeting raised several issues related to the GM debate, most notably the argument that GM introduces genes that have never occurred in our food chain before and therefore cannot be equated with conventional foods.

Other concerns raised by members of the audience include the possibility of contamination between GM and organic crops and whether the GM industry would increase its use of novel proteins to avoid the issue of allergens. Although the meeting was focussing on the science of GM, the political aspects were raised by some of the audience, in particular the justification for Zambia rejecting GM foods.

Overall, it could be said that although the tests in place in the UK are adequate to determine the safety of novel GM foods, scientists themselves agree that more research needs to be done, especially in the areas of allergenicity and gene transfer.