FACT 2 SHEET

Allergies from GM Food

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EFB

This series of "Fact Sheets" aims to clarify recurring issues that are often invoked inaccurately in the biotechnology debate. They are intended to provide the reader with the essential information and references resulting from the combined contributions of scientists, journalists, industrialists, and governmental, consumer and environmental organisations across Europe.

Allegation

GM food items could pose possible health risks because, amongst other reasons, they may cause allergic reactions. A particular variety of genetically modified Soya, with a Brazil nut gene inserted, was alleged to have been withdrawn from the market after being shown to cause an allergic reaction[1].

Analysis

What are food allergies? About 1–2% of adults and about 5% of children display food allergies, although in the latter many of the allergies disappear spontaneously during adolescence. These allergies may manifest themselves most commonly as urticaria, a burning and reddening of the skin, which may appear within minutes of eating a particular food. They sometimes lead to asthma or intestinal upsets or, very rarely, to anaphylactic shock, the only life threatening symptom of food allergies. Bee or wasp stings more commonly lead to anaphylactic shock. In the general population the prevalence of allergies to pollen and house dust is considerably higher than those triggered by food[2,3]. While an increase in most forms of allergies has been observed during the last two decades, this does not hold for food allergies.

Around 90% of food allergies are induced by peanuts, soybeans, vegetables, fruits, milk, eggs, cereals, nuts, some fish and shellfish. Generally speaking, the allergic reaction is caused not by whole food items, but only by certain components called allergens. Most commonly allergens are proteins, or in fact only segments of proteins (peptides) called allergenic epitopes.

Biologically speaking allergic reactions are misguided defence reactions against invading parasites. Our body uses similar reactions to kill off invaders and sometimes the defences are triggered by inappropriate signals, like certain food items. The messengers telling us of the suspected invaders (or antigenic food molecules) are called antibodies. In the case of food allergies they are antibodies of a particular class. The antibodies are activated when the food item comes into close contact with our blood system, principally in the intestinal mucous membranes. Here the antibodies activate blood cells, which in turn release alarm molecules leading to the well known inflammation (urticaria). Since the immune system varies a great deal from one person to another, people may have very different allergic reactions to the same food items.

How do we find an allergen in laboratory tests? Of the hundreds of thousands of different proteins we take up with food and drink, only very few, perhaps one in 100.000, could actually be allergenic. Some predictions of allergenicity are possible by looking in data banks for structural similarities between known allergenic epitopes and the new protein sequences. In addition, food allergens are nearly always chemically resistant to both mild acid and digestive enzymes. This is so, because food allergens are in reality only allergenic, if they pass intact through the human stomach, so reaching the sensitive parts of the intestine where the allergic reaction is triggered. This property allows for a simple laboratory test: a new protein can only be an allergen if it remains stable for a long time in a solution that is both acid and contains digestive enzymes, a liquid similar to the one present in the stomach. This test is applied to new transgenic crops to be put on the market and has proven reliable with all the transgenic plants that are widely commercialised today[4]. Despite having been grown on 40 million hectares there have been no reports of new allergies from the new transgenic plants.

There are two further criteria for predicting allergenicity of a new protein. One is that in general only proteins present in our diet in large amounts lead to food allergies. In milk, eggs and vegetables it is the dominant proteins that lead to the well known food allergies. Secondly, immunological tests with humans using sera or skin tests can look for specific antibodies.

Taken together, both laboratory and clinical tests can predict with a high degree of certainty whether a protein, that has not been part of the human diet, is going to be an allergen for many people. However, these tests may still occasionally miss a new allergen. This conclusion holds for proteins from all novel foods, not only for GMO-derived foods.

What sorts of new allergens do we encounter? The number of different food items available in industrialised countries has expanded a great deal during the past 50 years. In our supermarkets we find fruits, vegetables and sea food from all over the world, some of which have, in fact, resulted in people developing new food allergies. A case in point are kiwis, which came from New Zealand, but are now planted in many temperate climates around the world. Although the allergenicity of kiwis is well established, nobody would dream of banning them (let alone the highly allergenic peanuts) from our menu cards. Each new food item contains

many thousand new proteins and dozens of major, potentially allergenic proteins.

Do transgenic crops have new allergens? The most widely planted transgenic crops contain one or sometimes two or three additional genes that have been introduced by recombinant DNA techniques. Each of these genes express one particular protein, conferring for example resistance to a particular pest or tolerance to a particular herbicide, thereby making the variety particularly attractive to the farmers, since they need less agrochemicals. Other crops are currently being developed with resistances to drought, high salt or high aluminium levels in the soil etc. Plants are also being modified to make them more nutritious, for instance with increased levels of vitamins, iron, essential amino acids etc. In all these cases the transgenic crops will, in small amounts, express one or more proteins which humans will usually not have ingested before. However, even here a qualification is appropriate. The Bt proteins, which protect maize from attack by the European corn borer, are commonly present in soil bacteria, which we may occasionally ingest. It should be pointed out that the Bt proteins have been sprayed in organic farming for the last 30 years and people will have had contact with them.

Biotechnology allows crop breeders to add new genes to a plant, but also to remove or inactivate a specific gene. This opens the possibility of removing specific allergens so that those people who suffer from a specific food allergy, can again eat that GM food. Such "allergen-free" foods have not yet come on the market, but they are being developed in various laboratories. One group in Japan reported several years ago that they had removed the major allergen from a variety of rice. In the US research is being done to remove the main allergen from peanuts and shrimps[5].

What happened in the Brazil nut incident? Animal feed made from Soya or corn is routinely supplemented by sulphur-containing amino acids, because most plant proteins are low in these constituents. The value of soybeans as cattle feed could be improved if they were modified to have a higher level of sulphur-containing amino acids. Since one of the storage proteins of Brazil nuts is known to be rich in this material, the corresponding gene was transferred into Soya. The experiments were technically successful, but further laboratory studies showed that this particular Brazil nut protein was allergenic to humans. Although this new variety of soy beans was not intended for human consumption, the project was stopped so that there would be no chance of humans even accidentally ingesting this allergenic protein. The product was never marketed and consequently nobody succumbed to an allergic reaction[1]. If the researchers involved in transferring the Brazil nut gene into Soya had looked at the allergenicity of the protein beforehand, this topic would not have come into the public debate.

Conclusion

A new transgenic variety of Soya was developed as an improved animal feed by inserting a gene from the Brazil nut. It turned out in laboratory tests, done before commercialisation, that the new variety was potentially able to cause an allergic reaction in humans and the product was therefore not brought to the market. This shows that laboratory tests are a reliable means of testing GM products or other novel foods for potential allergenicity. Conversely, genetic engineering will, in the future, be able to remove specific genes from crops which may lead to less allergenic foods and thereby improve the life of those suffering from food allergies.

References

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