



New research on the impact of GMOs on health

Although some GMOs have been approved and marketed for several years, there was no body of scientific research on their impact on the biology of living organisms. This is partly because animal feeding trials are not required in the current safety approval process for GMOs in the EU or USA. Only now is a body of evidence starting to emerge from a small number of animal feeding trials into the health effects and progress in the new science of epigenetics. This indicates that genetic engineering is much more unpredictable and risky than traditional breeding.

Animal feeding trials

Recent studies have found a range of serious, unexplained effects from GM consumption:

- an Australian study of GM peas revealed ***immunological effects*** of genetic engineering with the transfer of a 'safe' gene to a different plant species producing allergic reactions in mice¹. A trial by Monsanto also indicated immunological effects with higher white blood cell levels in GM maize fed rats².
- the only long-term feeding trial (24 months, by an Italian team) found GMOs can ***affect key body organs***, changing the cell structure and cell functioning of the liver, pancreas and testes of mice fed Roundup Ready soya³. Similarly, a Monsanto trial found rats fed its GM maize Mon863 developed smaller kidneys⁴.
- a Monsanto trial found GM consumption ***affects the development of the blood*** with fewer immature red blood cells and changes in blood chemistry in rats fed its GM maize Mon863⁵.
- a Russian rat study found apparent ***generational effects*** of GMOs with very high death rates in the young of rats fed GM Roundup Ready soya (56% died) and stunted growth in the surviving progeny⁶.
- a programme of UK studies funded by the Food Standards Agency found that genetic engineering routinely causes a large number of ***random genetic and chemical changes*** in GM plants, the health impacts of which are unknown⁷.
- two UK trials, one with humans and one with sheep, found that when GMOs are eaten some of ***the inserted genes*** move out and ***transfer*** into the gut bacteria⁸.

Additionally, past studies found GM consumption damages the gut wall and is associated with unexplained deaths of test animals:

- studies by three scientific teams of two different GM plants found GMOs have the **potential to cause haemorrhage**. Feeding trials by two teams found that GM potatoes cause lesions in the gut wall of rats and mice⁹, and two US feeding trials found that GM tomatoes cause lesions in the gut wall of rats¹⁰.
- at least two trials of different GMOs found **unexplained deaths** among the test animals, with 7 of 40 rats (17.5%) in a feeding study of GM tomatoes dying within two weeks¹¹, and a 7% mortality rate for chickens fed GM glufosinate-tolerant Chardon LL maize (twice the rate of the non-GM fed chickens)¹².

(It should be noted that these studies were designed to identify health impacts and include **toxicological** studies involving tissue analysis. These are different to the various non-toxicological feeding studies frequently referred to by the biotechnology industry, which are primarily carried out to test commercial aspects of GM feed).

The study of Epigenetics

The actual causes of these effects are not known, but many possible factors could account for them. It has long been known by scientists that the artificial insertion of the genes physically disrupts other genes through the damage caused by the uncontrolled insertion process ('positional effects'). In addition, the chemical functioning of the new gene interacts with the activity of the plants' existing genes and biochemical pathways, and so disrupts the metabolism in unpredictable ways. However, research into the new science of "epigenetics" (meaning 'above genetics') is also now showing that genes account for only a part of the control of the biochemistry of organisms, and organisms have a level of control above genes that interact with genes. The exact details of this interaction between the rest of the organism and its genes are still far from known. However, this more complete understanding explains why genetic engineering is so unpredictable, with different results produced by each attempt and why the products are often unstable.

1. "Transgenic Expression of Bean -Amylase Inhibitor in Peas Results in Altered Structure and Immunogenicity", Prescott *et al*, Journal of Agricultural and Food Chemistry, 53 (23), 9023 -9030, 2005
2. Monsanto's report on its 90-day rat feeding trial of MON 863 submitted to EFSA, the European body which approves GMOs, as part of its application for approval of the maize (1139 pages), entitled "13-Week Dietary Subchronic Comparison Study with MON 863 Corn in Rats Preceded by a 1-Week Baseline Food Consumption Determination with PMI Certified Rodent Diet #5002", 17 December 2002, available on: http://www.monsanto.com/monsanto/content/sci_tech/prod_safety/fullratstudy.pdf. Reviewed by Dr Arpad Pusztai for the German environment agency BfN, in September and November 2004, available on: <http://www.gmwatch.org/p1temp.asp?pid=66&page=1>
3. Malatesta M., Biggiogera M., Manuali E., Rocchi M.B.L., Baldelli B., Gazzanelli G.: Fine structural analyses of pancreatic acinar cell nuclei from mice fed on GM soybean. Eur. J. Histochem., 47:385-388, 2003; Malatesta M., Caporaloni C., Gavaudan S., Rocchi M.B.L., Tiberi C., Gazzanelli G.: Ultrastructural morphometrical and immunocytochemical analyses of hepatocyte nuclei from mice fed on genetically modified soybean. Cell Struct. Funct., 27: 173-180, 2002; Malatesta M., Caporaloni C., Rossi L., Battistelli S., Rocchi M.B.L., Tonucci F., Gazzanelli G.: Ultrastructural analysis of pancreatic acinar cells from mice fed on genetically modified soybean. J. Anat., 201:409-416, 2002; Malatesta M., Tiberi C., Baldelli B., Battistelli S., Manuali E., Biggiogera B.: Reversibility of hepatocyte

- nuclear modifications in mice fed on genetically modified soybean. *Eur. J. Histochem.*, 49:237-242, 2005; Vecchio L., Cisterna B., Malatesta M., Martin T.E., Biggiogera B.: Ultrastructural analysis of testes from mice fed on genetically modified soybean. *Eur. J. Histochem.*, 48: 449-453, 2004.
4. See ref. 3
 5. See ref. 3
 6. Ermakova IV, "Genetically modified soy leads to the decrease of weight and high mortality of rat pups of the first generation", preliminary studies. *EcosInform* 2006, 1, 4-9 (in Russian). A fuller paper is in press: Ermakova IV, Genetics and ecology, in: *Actual problems of science*, Moscow, 2005, pp.53-59 (in Russian).
 7. Food Standards Agency news No. 48, June 2005
 8. Netherwood *et al*, "Assessing the survival of transgenic plant DNA in the human gastrointestinal tract", *Nature Biotechnology*, 2004; Duggan *et al*, "Fate of genetically modified maize DNA in the oral cavity and rumen of sheep", *British Journal of Nutrition*, 89(2): 159-166, 2003
 9. Ewen and Pusztai, "Effects of diets containing genetically modified potatoes expressing *Galanthus nivalis* lectin on rat small intestine", *The Lancet*, 354, 1353-1354, 1999; A. Pusztai, "Can science give us the tools for recognizing possible health risks of GM food?" *Nutr. Health*, 16, 73-84; Fares, N.H. and El-Sayed, A.K., "Fine structural changes in the ileum of mice fed on endotoxin-treated potatoes and transgenic potatoes." *Natural Toxins*, 6, 219-233, 1998.
 10. Unpublished studies carried out for Calgene and at the request of the FDA respectively, in early 1990s, in reviewed "Food safety – contaminants and toxins", CABI Publishing, 2003.
 11. Unpublished study in early 1990s carried out for the company Calgene/the US Government, reviewed in "Food safety – contaminants and toxins", CABI Publishing, 2003
 12. Report for the Chardon LL Hearing: Non-suitability of genetically engineered feed for animals, by Eva Novotny, Scientists for Global Responsibility, May 2002

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Version 039.2 Approved: