

Retraction of a study on genetically modified corn: Expert investigations should speak louder during controversies over safety

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Summary

Over the past few years, genetically modified organisms (GMO) have gradually become more familiar after numerous reports of problems with GMO safety, such as genetically modified (GM) potatoes disrupting immunity, GM corn inducing tumors, and GM rice being fed to unwitting Chinese children. Every time, these reports cause panic among the population and lead to objections to GMO in various fora. After each incident, the scientific community has delivered its academic appraisal and refuted rumors through slow and cautious investigations and evaluations. Unfortunately, during each event media outlets quickly scare the public about food safety and ignore the ensuing comments from scientists. Although scientists have investigated each GMO crisis and reached scientific and rational conclusions, they have less ability to disseminate information than the media, so the public is not promptly informed of their rational and objective viewpoints as experts. Thus, scientists need greater ability to disseminate information from scientific investigations and evaluations in order to correct the intemperate reporting by attention-seeking media.

Keywords: Genetically modified organisms (GMO), safety, toxicity, allergy, media

Over the past few years, alarm about the safety of genetically modified (GM) foods has spread around the world over Facebook, Twitter, WeChat, and Line. After scientists publish striking research conclusions, these findings are widely disseminated to the public by the media. These research conclusions are then subsequently investigated, evaluated, and corrected by other scientists (Table 1). One alarming report originated with a controversial study on GM corn that was retracted in 2013 after many scientists challenged the scientific rationality of its findings. The study, first published in 2012 in the journal Food and Chemical Toxicology, announced that GM corn engineered to be tolerant to Monsanto's herbicide

Roundup caused health hazards in rats (1). The study reported that the GM corn promoted liver congestions and necrosis, tumor growth, and carried the risk of death.

The study captured headlines around the world with its gruesome pictures of rats that were apparently more likely to develop severe tumors and die earlier after being fed Monsanto's GM corn, regardless of whether or not the corn was cultivated with the herbicide Roundup. In November 2013, the publisher of Food and Chemical Toxicology, Elsevier, explained that it was retracting the study due to concerns about the research methodology following a "thorough and time-consuming analysis". Although a statement from Elsevier emphasized that there was no evidence of fraud or intentional misrepresentation of the data (2), the small number of rats used in the study meant that its conclusions were not definitive (3,4). The Sprague-Dawley strain of rats used in the study are known to have a high morbidity of tumors, but this factor alone was not sufficient to cause the higher incidence and mortality observed in the treated groups (5-8). One year later, the study's authors republished the study in a lesser-known journal, Environmental Sciences Europe (9). However, the story did not end there.

In 2014, Delaney *et al.* fed processed fractions from herbicide-tolerant (DP-Ø73496-4) canola to rodents for 13 weeks to verify the contention that GM foods are

Released online in J-STAGE as advance publication April 21, 2015.

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Table 1. Famous incidents in GM food safety and related controversies

Initiator (Year)	GM foods	Journals	Viewpoints	Criticisms	Ref.
Pusztai A (1999)	Potato	Lancet	Causes abnormalities in development and immunity	Rats were fed raw potatoes and given additional protein, which may have caused the observed effect	(13)
Losey JE (1999)	Corn pollen	Nature	Kills the larvae of the monarch butterfly	Pollen deposition decreases sharply a short distance from cornfields; butterflies were only fed milkweed dusted with corn pollen; numbers of butterflies did not decrease	(3)
Quist D and Chapela IH (2001)	Corn	Nature	Gene enters traditional local crops	Missampling; insufficient data	(4)
Séralini GE (2012)	Corn	Food Chem Toxicol	Promotes liver congestions and necrosis, tumor growth, and carries risk of death	Small number of rats; high morbidity of tumors in SD rats	(1)
Cui YY (2013)	Corn and rice	Documentary film	Toxic and carcinogenic	Statistical errors; subjective bias; weak scientific grounds	(12,13)

as safe as non-GM foods. This study was published in the journal *Food and Chemical Toxicology* (10). That same year, Séralini, the author of the retracted paper mentioned earlier, wrote a letter to the editor suggesting retraction of Delaney's paper. In his letter, Séralini pointed that the "uncontrolled presence of pesticide residues and other GMOs make the study inconclusive" (11). The publisher Elsevier was once again embroiled in a crisis.

Séralini's study was exaggerated by the media and was subsequently criticized by many scientists. A similar incident occurred in China at the same time. Yongyuan Cui, a former host of China's state broadcaster China Central Television (CCTV) who is noted for challenging authorities and mainstream society, questioned the safety of GM foods. Last year, he spent 500,000 yuan (\$82,342) of his own money to travel to the United States (US) to shoot a documentary investigating American attitudes towards GM foods and controversies over genetically modified organisms (GMOs) in American academic circles. The documentary soon reached every media outlet in China. The documentary interviewed Americans in different occupations and reached the conclusion that GM foods were harmful to human health. Cui's considerable influence among the public in China led a large number of Chinese to believe that GM foods were toxic and carcinogenic. However, a few scientists have noted obvious errors in his documentary, such as statistical errors, subjective bias, and weak scientific backgrounds, that render the film unscientific and misleading (12,13). Cui garnered a great deal of attention from the media, but he was dismissed as a source of misinformation by the scientific community in China.

In fact, there are a number of similar arguments emerging every day in the field of GMOs. Problems occurring in the field of GMOs are, to a large extent, the result of the gap in scientific rationality and the

common wisdom of the public and the media. This gap has placed scientists in a weaker position to educate the public than media reports. In 2013, Flipse and Osseweijer (14) examined reports on GM foods in major English-language media over the previous 15 years, and they found that GMO-related reports had increased during GMO-related incidents, such as the study in the *Lancet* by Pusztai, a Scottish scientist, suggesting that GM potatoes were harmful to health (15); a study by Losey *et al.* in *Nature* indicating that the death of monarch butterfly larvae was related to GM corn (3); and a study by Quist and Chapela indicating that GM corn with transgenic DNA had contaminated traditional corn in Mexico (4). Although all these studies were not accepted by most scientists, they made a great impact on the media. Scientists and biotechnology companies are always slower at disseminating information than the media since they have to spend more time investigating in order to avoid criticism. As a result, the media had lost interest when scientific conclusions were ultimately reached. Thus, there is an imbalance in the influence that information from the media and scientists has. Solitary reports usually deliver incomplete information to the public, and thus lead to misinformation.

During the incidents mentioned earlier, numerous media reports overwhelmed the faint voice of the scientific community. However, the media cannot provide solid evidence to solve problems with GMO safety. To the contrary, experts following scientific methods supply evidence. Here, previous crises concerning GM foods will be reviewed and how scientists investigated these incidents and what scientific conclusions they reached will be described.

The earliest study to question GMO safety was one by Pusztai *et al.* (15). Pusztai announced the study's results on a TV show in 1998. The study fed rodents unaltered potatoes, similar potatoes laced with lectins,

and GM potatoes (2 lines with the same gene added) producing their own lectin, and results indicated that rodents fed GM potatoes had abnormalities in development and immunity. However, this finding was questioned by a committee of researchers from the Rowett Institute and the Royal Society. The committee pointed out the following problems: the rats were fed raw potatoes, which contain various toxins; and the protein content in the 2 lines of GM potatoes differed, so protein content had to be supplemented. Thus, the committee suggested that Pusztai's data did not support his conclusions. Although Pusztai published his paper in the *Lancet*, the journal included a letter citing the doubts of the committee in the same issue. Several other research groups subsequently reported that they were unable to verify Pusztai's findings.

In 1999, John Losey, an entomologist from Cornell University, published a study in the journal *Nature* (3). The study reported that corn pollen containing the *Bacillus thuringiensis* (Bt) gene can kill the larvae of the monarch butterfly. This study induced an intense discussion about the ecological safety of GMOs. The study's findings were scrutinized by fellow scientists and the U.S. Environmental Protection Agency (USEPA) since the study was performed in the lab and not in the field. Thus, the US EPA asked several entomologists to evaluate this study. They concluded that GM corn pollen did not harm the larvae of the monarch butterfly for three reasons: *i*) corn pollen is too heavy to spread over 5 meters from cornfields, *ii*) monarch butterflies do not usually eat corn pollen and they lay their eggs after pollen is released by corn, and *iii*) there are actually large quantities of monarch butterflies in fields in the eastern and central US. Following the study, research groups studied the butterflies further and observed them in the field, and their findings agreed with the conclusions of the US EPA.

Soon after the monarch butterfly incident, David Quist and Ignacio H. Chapela, scientists from University of California at Berkeley, published a study in the journal *Nature* (4). They reported that GM crops had been detected in areas where GMOs were prohibited in southern Mexico. If true, the study indicated that genes from commercial GM crops were introgressing into traditional local crops. However, their study was questioned by several fellow scientists. After other researchers pointed out several mistakes in the study, such as missampling and insufficient data, *Nature* retracted the paper.

A point worth mentioning is that Losey's and Quist's papers were tentative in tone. If not for the intervention of the media, these studies would only have occasioned an internal discussion within the scientific community. Even though the media intervened and fanned a furor that eclipsed an academic discussion, the scientific community followed its own logic to discuss, evaluate, and ultimately refute those studies. Interestingly,

news about Quist's paper is still on the website of the University of California at Berkeley, but the news also mentions that the study was retracted and feature links to sources contradicting its findings.

As Flipse and Osseweijer pointed out, the process of academic evaluation is too slow and judicious to match the pace of the media, but academics have sufficient power as experts to influence decision-makers to follow rational and empirical principle when formulating policy. When considering the introduction of GM crops, decision-makers should also be sure to take the public's will into account. Therefore, the scientific and expert opinions of the scientific community should be effectively conveyed to the public and information from scientists should be disseminated as widely and as loudly as that from the media. This will help the public to receive balanced information to make rational decisions should controversial issues arise again in the future.

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- (Received March 12, 2015; Revised April 11, 2015; Accepted April 15, 2015)