Risk Assessment of Genetically Modified Plants: A Review

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Authors’ contributions

This work was carried out in collaboration between both authors. Authors HAN and MH both together designed the study, wrote the protocol and wrote the first draft of the manuscript. Author MH managed the analyses of the study. Author MH managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The health of genetically engineered foods/plants, which is one of the significant issues has been raised in recent years. Various non-governmental organizations and customers recommended that all GM foods before authorization for human consumption should be subject to long-term animal feed studies. The fundamental purpose of this review is to assess the new potential harmful impact/safety assessment of genetically engineered plants for the use of humans. A balance in the number of research groups, depending on their research, a variety of GM crops (maize and soybeans in particular) are varied as for traditional non-genetically modified plants. It is worth remembering that most of the experiments were carried out in biotechnology firms that sell these GM plants. In this review, we discussed in detail the risk assessment of genetically modified plants.

Keywords: GM plants; risk assessment; maize; rice; soybeans.

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1. INTRODUCTION

Genetically engineered technology and publications in recent years have made GMOs a public interest issue and, agencies using GMOs for foodstuffs take the risk of rejection from the consumer [1]. WHO defines GMOs as the genetic organisms modified to a degree not naturally occurring (WHO, 2002). As GM foods begin to be present in our diet, concerns about GM foods have been expressed in health. The most important outcome is the official GM Sources yield equal production and development in the nutrition tier. Difference risk evaluations show the methodology and findings of subject complexity. GM plants have been among the various GMOs in recent years. Much public interest has been drawn about genetically modified plants. The actual notion of GM plants is now widely unknown to the public or what the system benefits and drawbacks, in particular, about their spectrum of applications should be used [2][3]. Two critical areas of the first wave of GM crops concern has arisen, namely environmental risk and risk health for people. With the application of GM plants in the public concern about potential European Union, there will be health problems [4]. The 'safety programs' and the newspapers are reporting the details the accessible scientists are sometimes inaccurate and have unrepresentative proof. Around 15 years since the launch has gone, genetic changes are currently taking place in the food, and new GM products have been included in the current nutritional catalog. However, ten years earlier, it was noted that not enough information was being published about the protection of genetically modified food in general and genetically modified plants in particular. The lack of toxicological reports on harmful health effects was evident [5]. Several recent researches have not been performed by companies of biotechnology producing/marketing such goods. However, we have identified a small number of sources editor's remarks, general reporting, and letters (published in) renowned foreign newspapers [6]. One of the main issues in connection with the absence of research (in science literature at least not published) the application of GM food/plant health test was the definition of "important equivalence." The definition is based on the principle: "if fresh food is considerably similar in composition and physiological characteristics of an established diet considered as safe as conventional foods [7]. While the definition does not constitute an evaluation of protection, it allows that it is easier to recognize potential discrepancies in existing food, and the latest commodity will be included. Currently, the concept of "substantial equivalence," the point of departure, is not an endpoint. If so, this seems very clear and brings the major ones into account discussions over the safety of genetically modified plants. The findings of several GM food studies have indicated that some common toxic effects could be caused. The GM food protection and evaluation are focused on one of the critical concerns that are their inherently harmful products can be observed, causes unintended genetic alteration results [8].

2. GM PLANTS RISK ASSESSMENT

Genetically engineered crops (GM crops) are plants used in agriculture, and genetic modification techniques have been used to alter DNA of these plants. In certain situations, the goal is to add a new feature to the plant that is not naturally present within the gene of plant. Examples of food crops include tolerance to other pests, pathogens, environmental factors, spoilage elimination, resistance to chemical treatments (e.g. herbicide resistance), or enhancement of the crop's nutritional profile. Examples of non-food crops involve the processing of medicinal drugs, biofuels and other industrially valuable products, as well as bioremediation. The present scientific literature on the adverse potential of GM / transgenic foods / plants health / toxic effects have been examined used PubMed (available at http://www.ncbi.nlm.nih) database [9], [10]. We used the first GM food, GM food transgenic, following "key terms" foods, transgenic food toxicity, transgenic health risks food, genetically modified food adverse effects, the toxicity of GM food, health hazards from GM food, health hazards of GM food, GM products, GM drug toxicity, harmful consequences, and GM products food and transgenic diet harmful results. Related quotes specific words such as GM crops, GM products, Generic terms, and conditions not surprisingly, transgenic foods were the most quantitatively significant. Our search was focused on following this preliminary screening the four terms: (a) transgenic foods, (b) transgenic toxicity (c) transgenic food adverse health effects, and (d) transgenic food risk [11], [12]. The number of quotes involving extraordinary rise studies based primarily on public protection, the presentation of GM foods tends to be very tight. Despite this paragraph, It should be noted that search
Fig. 1. Shows the steps of development of genetically modified plant and steps of its risk assessment

terms like "substantial equivalence" not herein considered to prevent misleading data the possible toxicity/safety issues for human GM plant fitness [13,14,15]. Below is the Fig. 1 showing the development steps of GM plant.

3. CORN/MAIZE

We reanalyzed evidence from 90-day toxicity studies in rats' responsibility of Monsanto Corn Transgenic Company MON 863 (a genetically modified corn variety containing a gene for modified Cry3Bb1 protein Bacillus thuringiensis (Bt) maize rootworm. MON 863 was exposed to questions regulatory inspectors in Europe, fully authorized in 2005 [16,17]. MON 863 consumption, slight but dose-related major differences in animal growth for both sexes, decreasing weight by 3.3 percent males and females raise 3.7%. Additionally, hepatorenal symptoms toxicity, with differential sensitivities in males and females, triglycerides have increased by 24–40 percent in females (Week 14, 11 percent, or week 5, 33 percent, respectively). In turn, urinary phosphorus and male sodium excretion 31–35% (week 14, dose 33%), were the most important findings treatment-related versus seven diets tested [18]. It was concluded that longer experiments were important to indicate the nature and extent of pathology. This has been noted that the Monsanto data could not be inferred; it was a good commodity [19]. Assess the Monsanto Company's initial study results, and the Séralini group's reanalysis [20]. Expert's panel concluded that no proof suggesting MON 863 was connected with adverse effects of 90-day rat studies. Statistical results were considered unrelated or of no biological or clinical significance. Since they had no dose-response interaction, reproducibility over time, combination with other relevant changes (e.g., histopathology), the prevalence in both sexes, disparity outside natural variability spectrum, or biological plausibility, the cause and effect [21]. In a recent analysis methodology used in their previous paper reasonable to discriminate against possible false positives and GM-linked effects, avoiding some false-negative results, the best way is for protocols already too limited marketed GMOs. Consequently, the writers announced GM-linked effects ninety-day feeding studies showed toxic effects rather than evidence of toxicity alone. Besides, biologically pointed out that the plausibility of subchronic or
chronic GM food side-effects connected to the new toxin in mammalian regimen or mutagenesis impact of genetic modification was consequently not negligible [22]. Lately, first performed, relative blood and organ system information from experiments rats fed three big GM maize (NK 603, MON 810 MON863) [23]. The investigators found new side-effects for 3 GMOs connected to sex- and often dose-dependent consumption of GM maize, effects primarily linked to the liver and kidney, dietary organs detoxifying but different between the 3 GMOs, for example, new heart, adrenal glands, effects are also observed, hematopoietic organ and spleen. Signs of liver toxicity, probably due to pesticides, have been underlined glyphosate and AMPA appropriate to any GM maize (NK 603, Cry1Ab amended to MON 810 and Cry3Bb1 updated to MON 863) [24]. In inclusion, unwanted metabolic overt or indirect effects unable to prevent genetic alteration. Up to now and at all, this study was not experimentally asked, our knowledge, statistically significant GM dietary impact or pesticide residues GMO containing, also observed in some previously but not in all present research need to treat each case and toxicological studies to date, this method is fairly restricted. Five of the party seems remarkable for carrying out a risk assessment [25]. Only 40 rats each receive 90 days of GM rich diet often tests at the relevance limits) were not independently repeated and continuous. About this, it is important to remember that GMO Working Group on Animal Feeding Recent EFSA reports GMO the 90-day rodent feeding study aimed at trials [26]. The entire food and feed GM focuses primarily on the evaluation of potential toxicological and dietary effects unintended and determine the health and quality of GM crops and food rather than qualitative and qualitative determination. Intrinsic toxicity quantitative of food ingredients identified. Ninety days’ food test has a broad (sensitivity and specificities) capacity to spot possible biological/toxicological effects of well-defined individuals compounds [27]. This should, therefore, be the case the responsiveness of the rat subchronic feeding study can be modeled hypothetically enhanced compound volume for identification anti-nutrients, toxicants, or secondary metabolites, for example. However, for the complete identification of potential unintended effects, the EFSA GMO panel also states it will be genetically modified food and feed, unlikely to have small and low-level substances any measurable (unintended) changes in toxic potential may lead to a review of 90 days of rodent feeding, as under the no observed- the degree of effect (NOEL) and therefore of unlikely human influence standard rates of food consumption [28]. It needs to be referred to as ‘unlikely’ in the EFSA GMO panel a few times in a few lines that might indicate some potentially specific findings of 90-day rodent controlled clinical trials feed and GM food [29].

4. GM RICE

The new health tests of GM-rice are carried out conducted by the community headed by Dr as part of the SAFOTEST initiative. Animal and agricultural science institute Knudsen. SAFOTEST is an EU-wide research approach creation program the 90-day animal research is used to test the health of GM crops. The central health assessment of genetically modified foodstuffs research [30]. Therefore, the Wistar rats, in the 90-day feeding test, the authors compared the transgenic rice KMD1 the non-transgenic wild parental protein Cry1Ab (Bt toxin), xiushui eleventh. 15 mg of Bt toxin/kg was in the KMD1 rice [31]. The average consumption of food was 0.54 mg Bt toxin/kg average weight of the bone.

Animal actions or weight gain were not detrimental. The analysis was observed [32]. Any biochemical and hematological blood tests obtained one week before (examined) Parameters the sacrifice) was significantly different. However, everyone was inside standard reference intervals for race and age rats, and therefore, treatment-related was not considered [33]. On the occasion of sacrifice, number, and macroscopic and histopathological organs are weighed reviews have been carried out. There have been just small improvements. The tests did not indicate any damage or toxicity [34]. The authors tested the results of KMD1 rice on the 90-day study protection was suggested based on knowledge from the analysis unintended. GM crop impact assessment could not be performed without many research groups. In a separate feeding analysis, Wistar rats were given the same community of researchers, a purified diet that contains either 60% of the rice species Galanthus nivalis lectin (GNA lectin) snowdrop or 90 days’ parental rice. Different pathology, genetics, immunology, microbiology and a variety of pathological parameters have been investigated the two diets also reported significant variations between classes.
Though none was considered undesirable, the writers noted that they could not infer the scope of their analysis of GM food's security. It was the same as in prior analysis. Suggested additional group(s) under which gene products are expressed should be integrated in order to be able to spike into the diet determine if the GNA lectin was related to the observed results. SE or GM-rice secondary modifications [35]. Also, in the context of the immunomodulatory effect of Cry1Ab protein SAFOTEST project E-form (PHA-E lectin) from Bt and Phaseolus vulgaris lectin in 28- and 90-day feeding studies, kidney beans were examined Wistar Council, Wistar Boards. Check food, transgenic food, has been feeding to livestock Cry1Ab Protein or PHA-E Conferencing, or Transgenic Rice recombined distilled protein.

Total vaccine rates, cell proliferation caused by mitogen, T-dependent antibody red, and antigen-based reaction to sheep blood cells at the end of the tests, serum antibody reaction, was tested. Dose-related rise of the weight and gross mesenteric lymph node in PHA-E, transgenic rice alone has been found with immunoglobulin A or 0.1% PHA-E readin spiked for 90 days showing the local indication PHA-E influence in the stomach [36]. Any Cry1Ab protein detrimental results an anti-PHA-E and anti-Cry1Ab antibody response have been established through induced both after (control groups) inhalation and inhalation/inhalation ingestion (recombinant protein classes fed individually or in combination with transgenic rice). Transgenic). Finally, it was noticed that there was just a PHA-E lecture. Immunomodulation results after feeding rats for around 90 days of body weight: 70 mg of PHA-E / kg. The first oral reports were recently obtained. Transgenic plant goods, including long-term health assurance 7 Crp (seven primary epitopes from Japanese cedar for human T cells). Allergens in pollen that may be used to manage allergies to pollen people (Cynomolgus macaques) of nonhuman primates twenty-six hours. Singes was granted a high or orally high dose of 7Crp or non-transgenic transgenic rice tests every day by gavage. No adverse behavioral consequences or during the study, bodyweight of animals has observed primates' blood administered for 26 weeks has shown there were few exceptions: no significant hematological differences and between them biochemical principles. Neither pathological there have been signs or documented anomalies. It has been concluded the transgenic rice, including T-cell oral administration Japanese cedar epitopes, did not have any adverse effects every day they were free to feed [37,38,39,40,41, 42,43,44,45].

5. GM SOYBEANS

Regarding the recent safety assessment studies on GM soybean has rather contradicting findings in the scientific literature [46]. In addition to these, two study groups were especially involved in research on soybeans [47]. Delaney data provided by Bred Worldwide, Inc. (Johnston, IA, USA) different GM soybeans have been safe. The party headed by in comparison, the University of Verona Dr. Malatesta showed (Verona, Italy) significant concerns. The herbicide-tolerant soybean DP subchronic feeding study (356043-5) 356043-5. Young adult animals have been fed diets for at least ninety-three days. The isoline monitor or traditional is fed relative to rats. No biologically important, harmful effects have been identified with reference diets rats are fed body-like diets of soybean 356043 [48]. Weight/gain, eating/efficiency, clinical signs, death rate, ophthalmology (sensory response, grip) evaluations clinical anatomy (hematology, coagulation, power and muscle activity), serum and urinalysis chemistry), tissue and small and microscopic anatomy [49], tissue weights. In a feeding studio of 42 days, it was also established that broiler chickens 356043 Soybeans is equal to non-transgenic production nutritionally. The genetic history of soybean is equivalent. performed a subchronic study of high feeding in Sprague – Dawley rat's soybeans oleic acid (DP-305423-1 event). (305423) is one of the following GM soybean produced from gm-fad2-1 gene insertion fragment and gm-hra in the soybean seed germline. No biologically important diet is fed relative to rats in the non-GM regulation animals that have fed 305423 diets have been observed with differences body weight/gain, nutritional efficiency/consumption, death, medical symptoms, or facial findings of toxicity. Moreover, no neurobehavioral assessment, organ, dietary effects have been noted weights, or anatomic or surgical illness [50]. Based on the results, the authors of studies concluded that soybeans were 356043 and 305423 as healthy and nutritious as non-GM soybeans traditional. Also, concerning genetically modified soya, the health of a transformed acetolactate has been tested by Mathesius et al. protein synthase (GM-HRA) used as GM marker soybean [51]. No adverse effect was found to mice following severe GM-HRA oral treatment at
a dosage minimum body weight 436 mg/kg or 28-day dietary in repeated dose doses of up to 1247 mg/kg body weight/day toxicity study. It has been concluded the usage of GM-HRA protein in agriculture biotechnology: biotechnology. Unlike the results above, in a long-term women ‘s study, mice fed GM soybean modified (CP4 bacterial insertion). EPSPS gene for a strong degree of glyphosate tolerance) on liver consequences for aged animals on this diet (until now) 24 months of age) and potential aging intervention to be elucidated, (2008a) found that intake of genetically modified soybeans could be possible affect the biological properties of the liver during metabolism aging method. A variety of hepatocyte proteins, calcium and mitochondria metabolism, pain reaction, and GM-fed mice were presented differentially and suggested a further in comparison to controls, marked expression of senescence markers. Mitochondrial and GM-food mice were found to have hepatocytes nuclear modifications suggesting a metabolic rate decrease [52]. In previous young and adult (2–8 months) hepatocyte studies Age) GM soya bean eaten by women's rats, nuclear shifts involving encoding and splicing systemic constituents pathways of properties have been observed. Moreover, if it is, it would be. The cause(s) of the changes observed can not be conclusively established; it was noticed that when these improvements were found to vanish, GM soybean was supplemented with non-GM. Glyphosate resistance after GM soybeans are used, and the herbicide Roundup containing glyphosate was treated, herbicide residues may have the results found. Therefore, Malatesta handled to prove this theory cultivation of rat hepatic tissues (HTC) 1-10 mm cells cellular characteristics by flow cytometry, fluorescence, and analysis microscopy electron. Under these test conditions, the normal morphology of HTC cells and death rates were not both the impacted organelles and certain cytoplasms [53]. However, enhanced intensity and neuronal cell therapy for HTC diagnosis of a decline in the pulmonary system work. Besides, the nuclei had morpho functions amendments to the encoding reduced / usage of splicing. The authors excluded these other factors herbicide residual existence may be related to the cell changes described in GM-fed mice. However, they are indicated that the harmonization of small effects Roundup amounts on HTC cells suggested the existence of most of the intervening causes with Roundup residues various paths of metabolism. Ultrastructural and immunocytochemical properties of embryos from pre-implantation to verify whether the soy is fed GM or non-GM, mouse the morpho-functional nature of maternal diets may affect structural features of pre-mRNA embryonic ribonucleoprotein [54]. The highways. Morphological studies indicate that the general feature of nuclear embryo components in the groups subjected to GM and non-GM soybean. Immunocytochemical, however, and the results of in situ hybridization suggested a temporary reduction in 2 cell embryos in pre-mRNA transcription and splicing and regeneration from mice feeding GM soybean in the 4-8-cell embryos. In moreover, the maturation of pre-mRNA in both 2- appeared less successful. GM-fed mice's cell and 4–8–cell embryos than GM-fed embryos the pets. In an earlier ultrastructural study of mice feeding experiments. The same work community is responsible for GM soybean, Vecchio et al., it was known in 2004 that the Sm antigen, hnRNPs immunization, both 2 and 5 months old GMfed, SC35, and RNA polymerase II decreased mouse, and at eight months became returned regularly. In genetically engineered mice, the perichromatin granules are larger at all ages considered and increase the density of the nuclear pore. In turn, extensions GM-food mice Sertoli cells were often smooth endoplasmic reticulum the evaluation. The findings of the Malatesta Party are also microscopic cellular shifts due to ultramicroscopic rates GM intake of soybean [55,56,57,58,59,60].

6. CONCLUSION

The review-article was to update the academic paper objectively potential toxicity/health risk of genetically modified plants. The amount of research-based directly on GM health assessment plants is still limited. It is nevertheless necessary to remember that a precise balance in the number of research groups for the first time suggests several varieties, based on their studies GM products are as safe and nutritious, mainly maize and soybean. It should also be noted that most tests indicate that genetically engineered crops are as nutritive as healthy as those obtained from traditional breeding, performed by or related biotechnology firms responsible for marketing these genetically modified plants. This, in any case, represents significant progress compared to the lack of studies in the scientific papers issued by these organizations in recent years. Eventually, the science world will consider all the knowledge objectively and address that which
was not until now, possible. About maize, various experiments have established the transgenic varieties 59122, 1407 fatalities, 98140 2009; 2009. MON 88017 is as safe as 2009 and as secure as they were modern maize protein of conventional standard. Similarly, there is still a theoretical debate about GM soybean safety. There is a strong need for research initiatives to create confidence in the assessment and approval by all the medical authorities for GM foods/plants, the general public, and the community. The latest is particularly many GM foods/plants, the general public, and the approval by all the medical authorities for GM create confidence in the assessment and future improvements in the environments. Finally, we want to conclude that genetically modified plants have great potential for the use of humans, but proper animal trials should be carried out before humans consume it.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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