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Effects of Genetically Modified corn on human health

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Abstract

Genetic modification is a specific part of gene technology that changes the genetic structure of living organisms, such as animals, plants, or microorganisms. Genetically Modified, is known with such names as Transgenic or Transgenic. In recent years, discussions have arisen about the potential effects of transgenic corn on health There are also discussions about its effect on other insects and other plants due to the gene flow The study was conducted as a systematic double-blind review by searching the Internet at the Google Scholar, PubMed, Science Direct, Medline, Highwire, MD Consult and Scopus databases. From the result of this study, we can come to a Conclusion that any transgenic product is not usable and can have many disadvantages, while some of them are completely safe and usable.

Introduction

According to the World Health Organization, health is a physical-psychological state of affluence, and does not refer to the absence of a disease or disability. The health of humans is fundamental to achieving peace and security, which depends on the highest level of cooperation between people and governments [1, 2]. Health is both the fundamental right of every human being and a social goal, and all governments and organizations are obliged to provide the health of individuals [3]. Several factors affect the health of individuals in the community. These factors are divided into several groups. According to the World Health Organization's recent estimate, 53% of human health depends on their lifestyle and their personal and social habits and behaviors. 16% of our health is related to human biology. The human environment, which includes healthy weather, accounts for 21% of human health, and medical care is responsible for the health of 1% of humans. At the time of the health and the disease, the mental and physical functions of the human being are completely overlapping and can have a positive or negative effect on each other. These three important elements in humans all together live in a community environment that is interacting with the health and environmental integrity of their environment [4-7].

Genetic modification is a specific part of gene technology that changes the genetic structure of living organisms, such as animals, plants, or microorganisms [8]. The combination of genes from different organisms is recognized as recombinant DNA technology and the product is called genetically modified, transgenic or transgenic [9]. The production of commercial crops has become a controversial issue in global trade and development by using various techniques such as gene transfer and the expression of recombinant genes in recent years. The process of this change involves the introduction of an external gene into the genome of another organism and the change in the internal, metabolic and signaling pathways [10-13]. Some of the benefits of transgenic food products include: increasing the quantity and quality of products to increase their micronutrient content, reducing the time to Maturity of seeds, increasing the resistance of plants to pests and diseases, producing recombinant proteins for the production of human and animal medicines, and Drought Resistance [14-17]. The main transgenic products cultivated commercially on the fields are soybean, corn, linseed and rapeseed resistant to pesticides and insecticides. Other commercially cultivated transgenic products include rice with elevated levels of iron and vitamins, various types of plants that can survive in difficult climates [18-20], and bananas that have vaccines Human beings against infectious

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diseases such as hepatitis B [21]. Transgenic plants were introduced in 1983 The industry of crop cultivation began in 1996 with an area of about 7.1 million hectares, later expanded to more than 160 million hectares in 2011. This included 47% soybeans, 32% corn, 15% cotton seeds and 5% cannabis (22-24%) [22-24]. These products have been cultivated over a billion hectares between 1998 and 2013 and are now cultivated in 28 countries [25].

Like all new technologies, the technology of the production of transgenic products poses the risks and challenges that can be known or unknown [26]. In the 1990s, when the technology for the production of transgenic products was relatively new, some concerns were expressed that the mutations that occur during the gene transfer and genetic modification process might create unintended and unwanted changes that could be potentially dangerous [27]. Most controversy and concerns about genetic products on human and environmental health are centralized on , labeling, or food labeling, especially when combined with non-transgenic products, food security, poverty reduction and environmental protection [28-31]. In recent decades, several immunotoxicology studies on transgenic products or proteins expressed by foreign genes have attracted the attention of the world [32, 33]. On the other hand, the World Health Organization (WHO) states that technology should be beneficial to humans, for example: reducing allergenicity and increasing the efficiency and effectiveness of food products. WHO also states that all technologies involved in the food production process should be fully evaluated to ensure food, health and environmental concerns [34, 35].

Corn is one of the oldest products that humans use extensively in food. Specific strains of this plant have been used for genetic modification to provide optimal agricultural properties, including resistance to pests and herbicides. Transgenic corn with both of these features is now cultivated in several countries [36, 37]. In recent years, discussions have arisen about the potential effects of transgenic maize on health, as well as discussions about its impact on other insects and other plants due to the gene flow [38]. Only one corn species called Starlink is accepted as animal feed in the United States, which also there are discussions about it [39]. In this study, we tried to provide a careful and systematic review of the subject through a systematic review of articles about the various effects of transgenic corn on health.

Methodology

A total of 83 articles were found on the Internet search on the Google Scholar, PubMed, Science Direct, Medline, Highwire, MD Consult and Scopus databases, after a first screening of 54 of them due to the existence of Repetitive cases remained, and in the next screening, after thorough review of abstracts and review of inclusion criteria, 33 articles were finally included.

All in vivo studies and genuine clinical studies in which the effects of one or more species of transgenic corn on one or more human health or animal health determinants were studied were studied and other studies were excluded.

Results:

The results of a systematic review of the impact of transgenic maize on health are described in the following table:

Table 1. Medicinal plants effective on stomach ache in traditional medicine

Row	Title	Author Name	Year of publication	The results of the article
1	A 90-day toxicology study of transgenic lysine-rich maize grain (Y642) in Sprague–Dawley rats [40]	Xiao YunHe and colleagues	2009	No Undesirable respons relevant to dietary, body weight, clinical chemotherapy, hematological problems, macroscopic and microscopic macular pathology problems were observed in the studied rats, and the Y642 lysine-rich corn was recognized as a nutritious and safe corn.
2	A Comparison of the Effects of Three GM Corn Varieties on Mammalian Health[41]	Joël Spiroux de Vendômois and colleagues	2009	The corn studied in this study showed liver and kidney toxicity in the studied rats, and a number of metabolic consequences were identified.
3	A three generation study with genetically modified Bt corn in rats: Biochemical and histopathological investigation[42]	AysunKılıç	2008	No significant difference was found in the relative weight of the organs in the mice, but slight histopathological changes were seen in the liver and kidneys. There were also changes in total protein levels, creatinine and globulin.
4	A three-year longitudinal study on the effects of a diet containing genetically modified Bt176 maize on the health status and performance of sheep[43]	MassimoTrabalza-Marinucci and colleagues	2008	The results showed that Bt176 maize (resistant to insects) did not pose a health danger to sheep during 3 generations.
5	Detection of corn intrinsic and recombinant DNA fragments and Cry1Ab protein in the gastrointestinal contents of pigs fed genetically modified corn Bt11 1[44]	E. H. Chowdhury and colleagues	2003	Gene and protein cry1Ab and gastrointestinal tract in the intervention group were observed and it was determined that the genetic material consumed by transgenic maize was not completely degraded in the digestive system.

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Row	Title	Author Name	Year of publication	The results of the article
6	Transgenerational effects of feeding genetically modified maize to nulliparous sows and offspring on offspring growth and health1[45]	S. G. Buzoianu and colleagues	2012	It was found that the offspring of cows fed with transgenic corn in the 30, 100, and 115 days after being taken from the milk also had a higher ADG and ADFI, and had a same result with offspring pigs. also body were larger, and the weight of the spleen was lower and the liver was smaller, and also had a deodular depth of the cavity. There was no pathologic effect in the intervention group and also in the serum biochemical tests there was a change in the level except for the change in gamma glutamyl transferase level that decreased in the intervention group. Finally, the results showed that transgenic corn consumption in pigs is not harmful to their health and growth.
7	Answers to critics: Why there is a long term toxicity due to a Roundup-tolerant genetically modified maize and to a Roundup herbicide[46]	Gilles-EricSéralini and colleagues	2013	The final results of the study in rats indicate that transgenic maize GM NK603 and R are not safe for consumption.
8	A long-term toxicology study on pigs fed a combined genetically modified (GM) soy and GM maize diet[47]	Judy A. Carman and colleagues	2013	The results of this study showed that the use of transgenic maize in the intervention group (pigs) caused problems such as weight gain and gastrointestinal inflammation.
9	Comparison of grain from corn rootworm resistant transgenic DAS-59122-7 maize with non-transgenic maize grain in a 90-day feeding study in Sprague-Dawley rats[48]	X.Y.He and colleagues	2008	The results showed that transgenic corn 59122 was safe as non-transgenic maize and this study was done in rats
10	Degradation of Cry1Ab Protein from Genetically Modified Maize in the Bovine Gastrointestinal Tract[49]	Bodo Lutz and colleagues	2005	The study found that the Cry1Ab protein that transports into body with transgenic maize is destroyed by digestion in the cow body.
11	Degradation of Cry1Ab protein from genetically modified maize (MON810) in relation to total dietary feed proteins in dairy cow digestion[50]	Vijay Paul and colleagues	2010	The results of this study showed that recombinant Cry1Ab protein was significantly degraded due to the use of MON810 maize in the digestive system of the dairy cows.
12	Effect of feeding genetically modified Bt MON810 maize to 40-day-old pigs for 110 days on growth and health indicators[51]	S. G. Buzoianu and colleagues	2012	The results of this study showed that long-term consumption of transgenic maize (Bt MON810 maize) did not cause bodily problems or danger to their health
13	Effect of Subchronic Feeding of Genetically Modified Corn (CBH351) on Immune System in BN Rats and B10A Mice[52]	Reiko TESHIMA and colleagues	2009	The results of this study indicated that no anti-immune system and no IgG anti-Cry9C were produced in the body of mice that have used transgenic corn (CBH351)
14	Effects of Feeding Calves Genetically Modified Corn Bt11: A Clinico-Biochemical Study[53]	Nobuaki SHIMADA and colleagues	2006	The results showed that transgenic maize (Bt11) had no negative clinical biochemistry effect on the calves in the intervention group.
15	ELISA method for monitoring human serum IgE specific for Cry1Ab introduced into genetically modified corn[54]	OsamuNakajima and colleagues	2007	The results of this study indicated that due to the use of transgenic maize (MON 810) in serum of Japanese patients with food allergy, no significant level of IgE was produced against Cry1Ab.
16	Evaluation of stress- and immune-response biomarkers in Atlantic salmon, Salmo salar L., fed different levels of genetically modified maize (Bt maize), compared with its near-isogenic parental line and a commercial suprex maize[55]	A sagstad and colleagues	2007	The results of this study showed that there was no significant change in the amount and activity of stressed proteins in the body of fish fed with transgenic maize, while feeding with transgenic corn caused a significant change in white blood cell population.

Row	Title	Author Name	Year of publication	The results of the article
17	Evaluation of transgenic event 176 "Bt" corn in broiler chickens[56]	J Brake and colleagues	1998	The results showed that 176-derived "Bt" corn consumption did not have any harmful effect on broiler chickens.
18	Fate of Maize Intrinsic and Recombinant Genes in Calves Fed Genetically Modified Maize Bt11[57]	Chowdhury EH and colleagues	2004	In this study, it was found that cry1Ab protein, released in calves by transgenic maize (Bt11), was significantly degraded in the digestive system and the cry1Ab recombinant gene was not introduced into the PBMC and calf tissue.
19	Feeding Value of Corn Silage Estimated with Sheep and Dairy Cows Is Not Altered by Genetic Incorporation of Bt176 Resistance to Ostrinia nubilalis [58]	Y.Barrière and colleagues	2001	in this study No significant difference was found between protein levels, fatty acid and coagulation proteins in cows milk that consume Rh208 and Rh208Bt . Finally, transgenic maize (Bt176) was found to be harmless to dairy cattle.
20	Genetically modified feeds in animal nutrition 1st communication: Bacillus thuringiensis (Bt) corn in poultry, pig and ruminant nutrition [59]	Aulrich K and colleagues	2001	The results of this study showed that there was no significant difference between the cows that consumed transgenic maize and the cows that consumed normal maize .
21	Influence of transgenic corn (CBH 351, named Starlink) on health condition of dairy cows and transfer of Cry9C protein and cry9C gene to milk, blood, liver and muscle [60]	YONEMOCHI C and colleagues	2003	The results showed no histopathologic change and no body weight change due to consumption of transgenic maize (CBH 351) in cows body. Also, at the end of the experiment ,there were no trace of the cry9C gene and protein in the blood, milk, liver and muscle of the cows
22	Lack of detectable allergenicity of transgenic maize and soya samples [61]	RitaBatistaBS and colleagues	2005	Based on the results of this study, no allergic reactions to transgenic corn (MON810, Bt11, T25, Bt176) were found in human subjects.
23	Long term feeding of Bt-corn – a ten-generation study with quails [62]	Flachowsky G and colleagues	2005	The results of this study showed that transgenic maize consumption in the quail population had no harmful effect on health and meat and eggs.
24	Long-term feeding of genetically modified corn (MON810) — Fate of cry1Ab DNA and recombinant protein during the metabolism of the dairy cow[63]	PatrickGuertler and colleagues	2010	The results of feeding cows with transgenic maize (MON810) showed that cry1Ab gene was not found in the stool specimen of any cows and this crop was detected safely
25	New Analysis of a Rat Feeding Study with a Genetically Modified Maize Reveals Signs of Hepatorenal Toxicity[64]	Séralini GE and colleagues	2007	The results showed that transgenic maize (MON863) dose-dependent changes in weight and cause toxicity to the liver and kidney in rats
26	ORIGINAL ARTICLE: Effects of long-term feeding of genetically modified corn (event MON810) on the performance of lactating dairy cows[65]	Steinke K and colleagues	2010	The results of this study showed that transgenic maize (Bt-MON810) does not have any harmful effects on the body and milk of cows and is considered safe.
27	Reduced Fitness of Daphnia magna Fed a Bt-Transgenic Maize Variety[66]	Bøhn T and colleagues	2008	The results of this study showed that the use of transgenic maize (Bt-maize) reduces fitness in the intervention group (Daphnia) and its toxic for them
28	Report of an Expert Panel on the reanalysis by SÃ©ralini et al. (2007) of a 90-day study conducted by Monsanto in support of the safety of a genetically modified corn variety (MON 863)[67]	Doull J and colleagues	2007	The results showed that feeding mice with transgenic maize (MON 863) does not cause harm to the intervention group.
29	Results of a 90-day safety assurance study with rats fed grain from corn borer-protected corn[68]	B.G.Hammond and colleagues	2006	Based on the results of this study, transgenic maize (MON 810) was recognized as a safe and nutritious corn in the body of rats.

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Row	Title	Author Name	Year of publica-tion	The results of the article
30	RETRACTED: Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize[69]	Gilles-EricSéralini and colleagues	2012	The results of this study in rats showed that transgenic corn consumption causes kidney nephropathy as well as the risk of developing a tumor. Biochemical experiments have shown that transgenic maize consumption causes chronic kidney disorders and leads most of damages to kidney.
31	Subchronic feeding study with genetically modified stacked trait lepidopteran and coleopteran resistant (DAS-Ø15Ø7-1xDAS-59122-7) maize grain in Sprague-Dawley rats[70]	Laura M.Appenzeller and colleagues	2007	Based on the various experiments carried out on transgenic maize (59122 × 1507), this maize was found to be a completely safe and nutritious food in the body of rats.
32	Thirteen week feeding study with transgenic maize grain containing event DAS-Ø15Ø7-1 in Sprague–Dawley rats[71]	Susan A.MacKenzie and colleagues	2009	Based on the results of various experiments, this study found that transgenic maize (1507) was completely safe and nutritious in rats

Conclusion

Often the goal of genetic engineering in plants is to transfer one or more genes to the plant, which, if successful, gives a new feature to it, and this new feature is not commonly found in plants of the same family. For this reason, the gene transfer or the genes responsible for this property, sometimes found in non-family plants or even other living creatures, such as a bacterial species, will not be realized through conventional cropping practices. Examples of the use of transgenic plants with traits such as resistance to a pest, disease or drought can be found in modern agriculture. Transgenic plants in the pharmaceutical industry are also used for the industrial production of some compounds with medical application.

Genetic modification can bring many beneficial properties to different plants, including resistance to herbicides, resistance to pests, resistance to inappropriate weather conditions, higher yields, etc. All of them lead to high economic interest and the greater use of these products, while some types of these products present a potentially serious risk to humans, it can be concluded as a general conclusion that studies show that all transgenic products are not harmful, and some of them are completely safe.

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Conflict of interest

The authors declared that they have no conflicts of interest.

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