Genetically Modified Organism and their Biohazards

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Abstract: In modern era, advancement in biological sciences is occurring at exponential rate. The purpose of these advancements is to combat the problems of food shortage in the world. So Scientists are producing new varieties of crops by modifying their genetic makeup. The aim behind the alteration of genetic makeup of crops is to improve the crop yield by changing the various characters of crops which have direct association with crop yield. Such crops are called genetically modified organisms (GMOs) like "Bt-maize". GMOs came into existence by using biotechnology techniques. In present days, they can fulfill the deficiency of food in the third world countries. But some ethical, social, health and environmental issues arise by introducing the GMOs. These concerns will be discussed in this review and it will also cover the history and introduction of GMOs.
[Hassan Z, Hussain G, Ai Q, Tayyab M, Ali Q and Nasir IA. **Genetically Modified Organism and their Biohazards.** *Stem Cell* 2016;7(3):9-12]. ISSN: 1945-4570 (print); ISSN: 1945-4732 (online). http://www.sciencepub.net/stem. 2. doi:10.7537/marsscj070316.02.

Keywords: genetically modified organisms, Bt-maize, biotechnology, transgenics, biohazards.

Introduction:

Genetically modified organism (GMOs) is a transgenic organism whose genetic material has manipulated by introducing new gene from another source using genetic engineering techniques. Genetically modified organisms (GMOs) are produced in laboratory for desired qualities that are beneficial for both human and environment. There are two main modifications done to create genetically modified organisms (GMOs) the most common modification is addition of one or more genes to the organism's genome and second one is removal or silencing of genes. GMOs are mainly produced for the source of food, medicines and other goods (1, 2). And also used in biological research, experimental medicine, and production of pharmaceutical drug. GMOs have equal importance in both health and agriculture applications, like providing enzyme like insulin, prevention from diseases, like vaccines against the HCV virus (3, 4), in agriculture providing high crop yield, and resistance to insects etc (5-8).

History:

Herbert Boyer and Stanley Cohen are the pioneer scientists that created genetically modified organism in 1973. They take a gene from a bacteria having resistance to the antibiotic kanamycin, inserted it into the plasmid and then induced another bacterium to uptake the plasmid. The bacteria were the first GMO and survive in the presence of kanamycin. Boyer and Cohen expressed genes in bacteria. At the same time another scientist named Rudolf Jaenisch created a transgenic mouse by introducing foreign DNA into its embryo, that is the world's first transgenic animal. In 1983 the first genetically engineered plant was (9). They infected tobacco plant with Agrobacterium and able to transfer the antibiotic resistance gene and through the tissue culture techniques they grow a new plant containing the resistance gene. The mile stone in producing GMOs was the invention of gene gun in 1987, which allow transformation of plants not susceptible to *Agrobacterium* infection.

Biohazards of GMOs:

There are a lot of biosafety issues of genetically modified organism

A. Health hazards

a) Allergenicity:

It is one of the major issue of GM crops which is prohibited by proper channel of various types of tests (10). In allergenicity severe allergic reactions happens like transgenic peas is responsible for several allergic reactions in Australia (11). GM corn expressing BT-endotoxin (Cry9C) and soybean having methionine from Brazilian nut induces allergenicity (12). EFSA (European Food Safety Authority) claimed that Cry1Ab rapidly degraded in stomach and it poses no harm (13), but pertinent to latest research it is degraded slowly in digestive system and might cause allergic reactions (14).

b) Concern in pregnancy:

Latest research revealed that Cry1Ab in the blood of pregnant woman and her fetus crosses the placenta which may cause some complications in pregnancy (15).

c) Hormone disturbance:

There are risks associated with herbicide in GM crops. Round up crops are harmful to animals (16) and cause hormonal disturbance (17). Transgenic Pigs expressing human growth hormone have adverse side effects on body composition, feed conversion and on growth rate (18).

d) **Effects on Hematology**:

It is studied that rats had undergone a significant decrease in red blood cells when they fed GM corn 1507 (19) and GM corn Mon 863 affects the development of red blood cells and modifies the composition of blood in rats (12).

e) Effects on Biochemical Parameters:

Subchronic feeding of GMO rice in rats resulted in decrease in glucose, while cholesterol, trigyceride, and HDLD concentration were higher (20).

f) Mortality:

It is studied that seven rat were dead after two weeks who fed on GM tomatoes (21).

g) Genotoxicity:

"It is toxicity of chemical agents that damages the genetic material within the cell". Genetically modified sweet pepper and tomatoes gives resistance to cucumber mosaic virus and cause no toxicity in animals, but lyophilized GM food reveals different toxic results and there may be morphological changes (22).

B. Environmental Hazards:

h) Toxicity to non target harmless insects:

It is reported that Bt-corn is responsible for highest death rate in monarch butterfly (23). Many studies also conducted on European butterflies and they also get infected with GM crops which are pest resistant (24) and main gene that is responsible behind all these affects is Cry1Ab which is incorporated in Bt-Maize 11 and MON 810. Cry 1F mainly affects non target insects (25). It is also studied that BT-corn severely affects black swallowtails and life span of lady bird beetle was reduced when fed on aphids that were present on genetically modified crops (26).

i) Gene flow:

It is also a very serious concern about GMOs in which transgene will transfer from transgenic plant to wild type giving resistance to wild type crop against which crop is genetically modified for example crop is modified for herbicide resistance (27). In USA and South America herbicide resistance of weed against glyphosate is a mainissue and it is increasing day by day (28, 29).

j) Competition of Alien and non Alien crops.

Alien crops are genetically modified and they have fast rate of maturation and interaction making them dominant in environment over non alien crops which are wild type and in this alien crops are responsible for ecological and economically damageable (23).

k) Toxicity in soil:

Several BT-crops exude toxins in the soil through their roots (30). In the same way their remnants are a source of active toxins in the field (31, 32). There are also some concerns relevant to growing Bt-maize (33-35).

l) Threat to aquatic life

It is supposed that grains or seeds of genetically modified maize may enter the canals (36) and they eventually may become the part of acquatic organism and may cause a serious side effects or toxicity (37).

m) Export concern:

There is a danger about GM crops due to their expensive and long process to come in the market. Engineered and biotechnology techniques which are used for developing a variety are patented that makes the overall GM crops expensive in the market. As a result poor farmers or developing countries are will not avails the access of GM crops.

Conclusion:

Besides a lot of merits of GMOs in agriculture, relatively a more concerns are associated with them. Food toxicity, allergic problems, ecological problems and health issues are some major drawbacks of GMOs. Some new techniques should be developed to replace the conventional biotechnology techniques which are environmental friendly. Further some strict risk assessment measures should be followed to analyze the every aspect of GMOs before commercialization. Synthetic biology can also be used as an alternative tool in minimizing the hazards associated with GMOs.

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8/3/2016