Genetically Modified Organisms

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Abstract— GMO (genetically modified organism) is the result of a laboratory process where genes from the DNA of one species are extracted and artificially forced into the genes of an unrelated plant or animal. This technology include; nucleic acid hybridization, recombinant DNA, RNA, PCR, cell culture and gene cloning techniques. The studies are divided into three groups of properties transferred to the transgenic plant. Up to 59% herbicide resistance characteristic of the transfer, 28% resistance to insects and the virus seems to be related to quality characteristics of 13%. Transgenic crops are not included in the commercial production of each product, mostly commercial plant is soybean, maize, canola and cotton.

GMO has advantages and disadvantages, which we explain all of them clearly in full text, from this topic worldwide researchers divided into two groups as like countries. Some researchers thought that the GMO has lots of disadvantages and not to be used, some of the researcher has the opposite thought. If we look the countries law about GMO, we should know Biosafety law for each country and union. For the Biosecurity, the problems caused by the transgenic plants, including Turkey, to minimize 130 countries on 24 May 2000, "the United Nations Biosafety Protocol "signed nudes.

This review will examine the ways of producing GM plants, how GM plants may effect on human health both directly through applications targeted at nutrition and enhancement of recombinant medicine production but also indirectly, through potential effects on the environment. Finally, it will examine the most important opposition currently facing the worldwide regulations of this technology

Index Terms— biotechnology; GMO (genetically modified organism); molecular marker; biosafety; GMO advantages, GMO disadvantages

1 INTRODUCTION

Plants with favourable characteristics have been produced for thousands of years by classic breeding methods. Desirable traits are selected, combined and propagated by repeated crossings over numerous generations. This is a long process, taking up to 15 years to produce new varieties (Southgate et all.,1995). Genetic engineering not only allows this process to be dramatically accelerated in a highly targeted manner by introducing a small number of genes, it can also overcome the barrier of sexual incompatibility between plant species and vastly increase the size of the available gene pool (Karlsson, 2001).

Transgenic (GM) plants are those that have been genetically modified using recombinant DNA technology. This may be to express a gene that is not native to the plant or to modify endogenous genes (Bennett et all., 2004). This process may be called either Genetic Engineering (GE) or Genetic Modification (GM); they are one and the same. The term "genetic modification" is used both commonly and legally to refer to the use of recombinant DNA techniques, in ways that are not possible or desirable in nature, to transfer genetic material between organisms. This concept of genetic modification brings about alterations in genetic makeup and in the properties of the organism developed (Dilsiz, 2009). This technique using genetic engineering is highly mutagenic and leads to unpredictable changes in the DNA and the proteins produced by the GMO that can lead to toxic or allergic reactions (Karsty, 2004).

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Isolating the identification of genes, gene transfer between reproduction made of the same or different species are common threads running on the genetic engineer. This technology includes; nucleic acid hybridization, recombinant DNA, RNA, PCR, cell culture and gene cloning techniques (Davison, 2010).

Today, approximately 99% of the transgenic plants have an important place in the agricultural sector. They are mostly produced in the USA, Canada, Argentina and China. The first performed gene transfer in transgenic crops was a characteristics of long shelf -life tomatoes.

This first transgenic product tomato is Savor the Flavor and it has been on the market since 1996. After long shelf life tomato Savor Flavor was produced, agriculture engineers started to work on corn, cotton, oilseed rape, potato and they produced this product too (Denli, 2010). Nowadays, almost all of the products has an option with GMO or without GMO. Feeding human and animal, clothes sector mostly use GMO products by the way.

Use of GMO products divided people and scientist into two different groups. One group totally avoid to use GMO, another group doesn't against and avoid to use GMO. Scientist who avoid to use GMO, think that it has important damage to human and animals life, but the other scientis group who don't avoid to use GMO think that there is no evidence to prove GMO's products damage in human and animals life. Both scientist group has some evidence about GMO products benefits and damages for the human and animals life, fort his reasons scientist need more time and do more research to find the truth.

World population increasing day by day and agricultural fields getting smaller for this reason feeding human and animal we should improve agricultural product yield and quality. Scientist trying to solve this problem and one solution way is moleculer biotechnology which is including the methods of

GMO too. Before decide to support or against the GMO, should know the GMO protocols and it effects.

This protocol has been prepared in addition to Cartagena Biosafety Protocol entered into force on September 11, 2003. This protocol GMOs in general use by addressing the risks to human health, biodiversity and sustainable transboundary movement of all GMOs that may affect the prevention, transit covers were dealt and use. Under this protocol we have to know the, "US Regulations GMO", "European Union Regulations GMO", "Turkey Regulations GMO". These three different protocol has different applications and rules.

Day by day increasing GMO interest can be listed as follows; Use in the health area (Organ transplantation, gene therapy, vaccines and drug),Use in the industrial area (vitamins, monoclonal antibodies, vaccines, anti-cancer compounds, anti -oxidants, plastics, fibers, polyethers, human blood proteins, and are used to produce carotenoids, emulsifiers, sweeteners , enzymes , food preservatives structure is used as a flavor enhancer or color changer),Use in agriculture (Herbicide resistance, Resistance to insects, Viruses, bacteria, fungi resistance to disease, Extend shelf life, Improving quality, Drought , salinity, resistance to extreme conditions such as frost, Improve the nutritional value and quality), we explain all this methods step by step in this research.

The debate about risks of GMOs (Genetically Modified Organism) is driven by many forces. First of all, there is a multifaceted scientific debate about the different effects of such organisms in the environment. What negative effects could be expected with respect to a wide-range use of GMO in agriculture? These scientific debates are relevant up to now, but there is still no scientific solution for the conflicts. Moreover, a debate about the inherent scientific limitations arose under the topos of 'non-knowledge' (Akgünes, 2012). But there is a political solution. If one looks at the far-reaching political and scientific debate about the Precautionary Principle (PP) then one can find an answer to the question how to decide under conditions of uncertainty or non-knowledge.

Ways Of Producing Transgenic Crops

The studies about the properties transfered to transgenic plants are divided into three groups. Up to 59% is herbicide resistance, 28% resistance to insects and the virus and 13% quality characteristics (Denli, 2010).

A. Physical Methods

-Microenjection

In this method, the genes to be transferred in the cytoplasm or the nucleus with using pipette under a microscope. This method is used mostly zoological objects (Sticklen, 2005).

-Electroporasyon

The protoplasts are placed in solution within a short time after the DNA segment located in the high voltage (550V / cm). Electric current makes small holes in membrane and make the cell permeable. The DNA segment come from around here after this hole is closed and DNA stays inside the cell membrane. The protoplasts were removed from the solution by transfer to the regeneration of transgenic plant formation is provided. This technique is performed through gene transfer pollen lately.

- Biolistic techniques

In this technic, rhe nucleus , mitochondria and plastids are used to transfer genes into the DNA.

B. Chemical Methods

- Calcium phosphate transfection

C. Using Vectors

A number of techniques exist for the production of GM plants. DNA molecule which is transferred to the plant is defined as the vector. The most commonly employed are the bacterium *Agrobacterium tumefaciens*, which is naturally able to transfer DNA to plants, and the 'gene gun', which shoots microscopic particles coated with DNA into the plant cell. (Karsty, 2002). Generally, individual plant cells are targeted and these are regenerated into whole GM plants using tissue culture techniques. Three aspects of this procedure have raised debate with regard to human health (Brandt, 2003).

- The use of selectable markers to identify transformed cells
- Transfer of extraneous DNA into the plant genome (i.e. genes other than those being studied)
- The possibility of increased mutations in GM plants compared to non-GM counterparts due to tissue culture processes used in their production and the rearrangement of DNA around the insertion site of foreign genes.

Some bacterial strains, give their plasmids into host plants. DNA molecules of the restriction enzyme can cut through certain areas of plasmid DNA with the help of a new DNA fragment after that a host of new parts on the plasmid DNA to be transferred into the plant chromosome. For this method generally used Agrobacterium tumefaciens as a vector.

Worldwide Biotech Production

According to the ISAAA (International Service for the Acquisition of Agri-Biotechnology Applications), GM seeds were used in 1,7 million hectares in 1996, but nowadays it is increasing and reached 160 million hectares by end of 2012. GM's are the rapid technology of our recent history, they were produced 94 times more than classical methods (Wehling, 2006; Lynas, 2013).

In 2011, GMO was produced by 29 countries. 19 of them were developing and 10 of them were developed coun-

tries. Each of the first 10 countries engaged in the production of 1 million hectares of GMO, GMO products have grown more in the field, and they have achieved broad-based global growth which will allow them to expand in different fields in the future.

In 2011, compared to 2010, 1.3 million additional farmers and seed companies has been produce GMO's products and it was increased the producers of GMO. Nowadays the total of producers of GMO's product is 16.7 million (8%). Also in 2011, the production of GMO products leadership in the world was USA with 69 million hectares of cultivation area. Share in total products of GMO products amounted to approximately 90%.

Transgenic technology does not include all kinds of plants. It just works on the commercial products like soybean, maize, canola and cotton. According to the data of 2009; 70% of the soybeans grown in the world, 46% of cotton, 24% of corn and 20% of canola consist of transgenic plants (Denli, 2010).

Most used GMOs Crops; Alfa alfa, canola, cotton, rice, sunflower, sorgum, sugar beet, carrot, onion, patato, tomato, banana, melon, cherry, olive, tobaco, garlic, palm oil, grapes, bean, lettuce.

Uses Of GMO Products

In many countries especially developed ones, GMO's are studied, labs are founded and trying to find new forms is getting more. This is an expensive technology which needs special laboratories and researchers whose majors are biotechnology and agriculture. The researchers are divided into 3 groups of Genetically Modified Organism depending on the used field (Denli, 2010).

- Use in the health field

Organ transplantation, gene therapy, vaccines and drugs, (vitamins, monoclonal antibodies, vaccines, anti-cancer compounds, anti –oxidants, surgery materials, anti-alergic medical tools

- Use in the industrial area

Plastics, fibers, polyethers, human blood proteins, and are used to produce carotenoids, emulsifiers, sweeteners, enzymes, food preservatives structure is used as a flavor enhancer or color changer, drugs bottle, storage system.

-Use in agriculture

Herbicide resistance, Resistance to insects, Viruses, bacteria, fungi resistance to disease, Extend shelf life, Improving quality, Drought, salinity, resistance to extreme conditions such as frost, Improve the nutritional value and quality create new population, varity, new animal, plant, fruit and vegetable species.

Most applications are for crop plants, and the genetic modifications are for commercially important agronomic traits—mostly herbicide tolerance and insect resistance (Burke, 1997). These agronomic traits are determined by single genes and are therefore easiest to manipulate. In contrast, characteristics such as flavour, texture, and processing qualities tend to be determined by multiple genes and are much more difficult to manipulate (Anderson, 1998).

- To increase the amount of products in existing species (Ozcan et all., 2001).
- Reduce post-harvest losses
- Products cold, hot, make more tolerant towards factors such as drought and salinity,
- Products to prevent the reduction of soil fertility
- To improve the nutritional value of food
- To reduce the use of pesticides by pest -resistant crops
- Develop alternative resources for industry
- Improve biodiversity for breeding
- Need less nutriton planting
- Resistan crops fort the insecticides

Development of Herbicide Resistant Transgenic Plants

Aim of this study is after application of the herbicide used affects weeds, but are unaffected crops. There are 3 different methods for this study.

- Modification of the target molecule
- The overproduction of the target molecule
- Detoxification active substance (Kaiser, 2001).

The Advantages Of GMO's

- Reduction of the starvation in the world
- Lowering the production cost
- Ensuring human beings' access to food
- Be more effective in fight against plant diseases and pests
- Ensuring increase in economic efficiency
- Provision of increased product quality and shelf life
- Prevention of environmental pollution
- The protection of groundwater resources
- Benefiting from milk sterilization fetishism goat milk etc.
- Increase of the efficiency of feed efficiency
- Increased activity in the digestive animal feed (Kaiser, 2001; Denli, 2010)

The Disadvantages Of GMO's

The possible adverse effects on human health, environment and socio- economic risks caused by them resulted in some consumers' and scientists' having an opinion against GMOs.

Allergenicity reactions and toxic effects

- Carcinogenic Effects
- Formation of antibiotic resistant microorganisms
- Changes in food safety and quality
- Cancer cells can be increase
- Need new canser cure (Gay and Gillespie, 2005).
- Unhealthy Animals and Animal Products (Anderson, 1998).

Environmental Risks

- Effects on soil structure

- Change in flora and fauna
- Change the growth seasons of the plants
- Effect on useful insects
- Water pollution
- Biodiversity problem
- Wild animals life
- Lost local species
- Chage the forest habitat
- Change the weather (rain, snowy time)
- Destroy epidemic and endemic plants populations
- Reason of mutations
- Change of agriculture system

Socio-Economic Risks

- Costliness
- Uniform types and drug use
- Use of technologies that restrict genetic use
- Mixture of type
- Being a producer of transgenic variety
- Small seeds companies ends
- Create one and big boss
- A group of people can decide all agriculture activities
- Active uses of Genetic Use Restriction Technologies"
- Big counties has big power and can be control small countries
- Increase poor people populations.

Biosafety

Due to biosecurity reasons, 130 countries including Turkey signed he United Nations Biosafety Protocol on 24 May 2000 to minimize the problems that the transgenic plants caused. In addition to this protocol, Cartagena Biosafety Protocol was prepared and came into force September 11, 2003. In general this protocol includes the bad effects of GDO on human health (Denli, 2010; Artık et all., 2010).

To promote sustainable development, use of GMO's must result in effects in environmental, social and economic systems that on the whole are beneficial for man and nature. Any policy claiming to promote biosafety and sustainable development must operationalise the concept of sustainable development and its three dimensions (Phillips, 2013). In the case of commercialisation of GMOs, a process connected with scientific uncertainty and with disputes in society, at least three principles are of importance for sustainable development: the precautionary principle, the polluter pays principle and the principle of public participation respectively. In what follows, these three key biosafety principles will be further oper-ationalised with respect to commercialisation of GMO's.

U.S.A. Regulations of GMO

In the USA, US Department of Agriculture (USDA), the Consumer Protection Agency (FDA), Environmental Protection Agency (EPA) is responsible for the assesment of GMO's risks to the environment, human and animal health. Production of GM crops, import and export services and marketing are done with the permission of one or more of these units. However, the commercial development of GMO production and marketing approval is given by the US Department of Agriculture Animal and Plant Health Inspection Unit (APHIS). The company consults APHIS for the permission, after long years of trial, if it does not seem dangerous to environment and human health, permission is given to the producing company.. In the US, GM products that are mostly approved are corn, soybeans, potatoes, cotton , tomato and wheat (Bardakcı, 2009).

The United States, for its part, has a splintered approach to overseeing GMOs and insufficient coordination between the three regulating agencies. One of the regulating agencies, the Food and Drug Administration, takes the position that GMOs should be regulated as ordinary food, regarding them as GRAS (generally recognized as safe) and has never subjected GMOs to food safety reviews. Another regulating agency, the Department of Agriculture (USDA), approved most applications for biotech field releases, and, by some accounts, has never denied an application from Monsanto. And that's not even the worst of USDA's regulatory shortcomings and we documented the agency's more significant failures in our articles here. Similarly, the Environmental Protection Agency's (EPA) oversight is also heavily criticized for, among other reasons, having industry bias, relying on questionable industry studies and ignoring adverse impact on non-target animals (Lynas, 2013).

GMO European Union Legislation

All EU countries have ratified the biosafety protocol and are in full accordance with the labeling of these products. However, the stiffness of these regulations are different in each country For instance, while Spain is more flexible about planting transgenic corn, Germany and Belgium are very strict about it. EU countries have applied different directives concerning GMOs from 1990 until today, lastly 90 /22 / EEC was adopted as the main directive on this issue.

The EC Directorate-general for agriculture and rural development states that the regulations concerning the import and sale of GMOs for human and animal consumption grown outside the EU provide freedom of choice to farmers and consumers [23]. All food (including processed food) or feed which contains greater than 0.9% of approved GMOs must be labelled. As of 2010 GMOs unapproved by the EC had been found twice and returned to their port of origin (Davison, 2010). First in 2006 when a shipment of rice from the U.S. containing an experimental GMO variety (LLRice601) not meant for commercialisation arrived at Rotterdam, the second time in 2009, when trace amounts of a GMO maize approved in the US were found in a non-GM soy flour Cargo (Hogan, 2012). In 2012, the EU imported about 30 million tons of GM

crops for animal consumption (European Commission, Health and Consumers, 2014).

Biosafety Law In TURKEY

The purpose of the Biosecurity Act adopted in 2010 is to prevent the risks that may result from genetically modified organisms and products using modern biotechnology with scientific and technological developments to protect human, animal and plant's health, the environment and the biological diversity, to establish a biosafety system in order to ensure the sustainability and implementation and to monitor these activities

This Act includes the researches, development, processing, releasing on the market, monitoring, use, import, export, transport, handling, storage, packaging and labeling of genetically modified organisms. According to the Biosafety Law, considering human, animal and plant health, and biodiversity conservation can use the import-export of taking GMOs or products considered experimental purposes genetically with the release of the launch of the indoor use of the modified micro-organisms will be made according to the scientific basis of risk assessment.

If the risk assesment results show that the product will not do any harm, the applications are accepted and this permission is valid for ten years. In addition, the law includes the features of the competent authorities which are capable of researching, the Gmos which will be used for research, their importation and the conditions of use (Biosafety Committee, 2013).

According to the Biosafety law;

- The placing on the market of GMOs and products without approval
- Using it against the committee decision or making it used
- Production of genetically modified plants and animals
- Use outside the purpose and scope of the area determined by the Board launch
- GMOs and products used in infant formulas and baby foods and young children supplementary foods are prohibited.

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