Trakia Journal of Sciences, Vol.1, No 3, pp 13-18, 2003

Available on line at:
http://www.uni-sz.bg

ISSN 1312-1723

Review Article

THE USAGE OF GENETICALLY MODIFIED ORGANIZMS AS A SOURCE OF FOOD

M. I. Soysal*, E.Özkan, E. K. Gurcan

Trakya University, Agriculture Faculty in Tekirdağ, Dept. of Animal Science, Tekirdağ, Turkey

SUMMARY

The availability of Genetically Modified Organizms (GMO's) are increasing. A transgenic organizms or so called Genetically Modified Organizms (GMO) contains stably integrated recombinant DNA in all it's cell . In other words the organizms whether it is a plant or animal or microorganizms has a new piece of DNA spliced into a chromosome in each of its cell. This new piece of DNA typically contains a gene that was obtained from another organizms and was modified so that it would be expressed in the new organizms. Scientist can now be able develop crops with desirable traits more quickly than conventional methods. Scientist can introduce genes that endow plant with traits that could never be achieved through conventional methods presented below a review of some methods commonly employed in producing transgenic organizms followed by an over wiev of same of the many polential ways theese products are used as a source of food. The concept of genetically modified organizms has pulled public attention due to potential risk for human or animal health.

Key words: Genetically modified organizms, Transgenic organisms.

INTRODUCTION

The recent years intense scientific interest have been seen in using genetic tools to obtain higher yields alone or agricultural yields with higly efficient secondary metabolites. Biotechnology in one sense began using natural product more efficient production. The term of genetically modified organizm (GMO) express the organism with partly new genetic content which never existed in recipient genome but transferred another genom even from different species. Technically, application of recombinant deoxyribonücleic acid (rDNA) technics for alteration of genetic content of all kind of organism is called Genetic engineering. Any organizm obtained this way is called Genetically Modified Organizm (GMO). This terms is also synonym with "transgenic organizms" and genetically modified crops (CMC). Transgenic organizm stands for that any organisms which has stably integrated recombinant DNA in all cells.

Living modified organizms (LMO) is also used interchangeably in this purpose. Any product or food obtained through new technics is also called novel food. According to the draft protokol on Biosafety, modern biotechnilogy includes *in vitro* nucleic acid technology and fusion of cells beyond the taxonomic family that overcomes natural physiological reproductive or recombination barriers and that are not technics used in traditional breeding and selection (1). So biotechnology and genetic engineering are often used interchangeably. The products of GMO are subject to application in health sector (antibiotics, insulin, interferon) in agrifood system such as microorganizms, plants, animals and in as a industrial process in waste recycling. Most of technics used in obtaining food include the usage of soil bacteria that produce toxins against some of insects such as Lepidoptere, Diptere, Colodoptera named *Bacillus Thuringlens (Bt).* Bt preparations are used in organic farming as an insecticide. Bt crops are genetically modified to carry genetic material from Bt in order to make crops able to produce Bt toxins known as Delta endotoxin thereby providing protection against insects during the growth stage of the plant. Using this technics Bt corn which capable of protection against European corn borer, Bt-cotton with protection against budworms and ballworms, canola with herbicide tolerant are developped.

Herbicide tolerant gene of organizms enable the farmers to spray wide spectrum

*Correspondence to: Prof. Dr. , M. I. Soysal, Trakya University, Agriculture Faculty in Tekirdağ, Dept. of Animal Science, 59030 Tekirdağ, Turkey, E-mail: misoysal@ttnet.net.tr

herbicides on their fields killing oil plants but the Herbicide Tolerant (HT) crop. Most common herbicide tolerant crops (cotton, corn, soybean and canola) are tolerant to glyphosate and to glufosinate-ammonium. There are also HT rapeseed and cotton which are tolerant to bromoxynil.

Food and Agriculture Organization of United Nations is prepared a web pages for explaning this kind of Biotechnology in food and agriculture (2).

FAO supports a science based evaluation system that would objectivelly determine the benefits and risks of each individuals GMO. FAO also proposes a close cooperation with World Health Organization and Codex Alimentarus commision and develop standarts for foods derived from Genetic Engineering such as to consider the labelling of food derived from GMO.

2. Obtaining Genetically Modified Organizms(GMO)

If any organizms (plant, animal or microorganizms has any part of its DNA from either the same or from another species called transgenic, mentioned part of DNA typically contain gene that was obtained from another organizm. The main practical reason of modifing organizms own genom by inserting gene responsible for herbicide resistance or ınsect resistance from different organizms. In order to obtain Herbicide Resistance crop (HRC) and insect resistant crop so called Bt Crops. Due to the name of vector to transfer the resistance fosfor of *Bacillus Thrungiensis* (Bt). This part of DNA of any organisms needs to be modified in order to express in new organizm. The inserted of part DNA of transgenic organism is called also transgene. Genetic engineering deals with how to develop transgenic organism by using recombinant DNA technology.

The concept of genetically modified organizms has pulled public attention due to potental risk for human or animal health. Public opinon has hesitated their ıncreased risk or allergic reactions and risk of having unpredictable toxins that may trigger to the undesirable biochemics reactions in the recipient organizms. Another concerns is due to having little scientific study about their health risk. Public opinion needs safety test techniology technics proving no potential harm. Unfortunatelly there is no adequate test technology to asses the potential harm (3).

Ordinary public opinion are concern of whether the integrated part of recipient genom may cause any health hazard or not since incorparating any organizm's gene to the another organizms genome by using vector requires usage viral promoters, transcription terms-ınators, antibiotic resistance marker genes and reporter genes.

Generally speaking there is a lack of data to evaluate the safety of GMO as a source of food. The reasons of lack of data on the safety of GMO are scarce of publication on GMO food toxicity and risk of patenting GMO crops without animal testing and complexity of evaluating the safety of GMO as a source of food.

Another source of public opinions hesitate are the facts that DNA has not been always fully break down in digestive tract and consequently risks for gut bacteria could took up the genes or GMO's plazmids which lets the possibility of spreading of antibiotics resistance. It is also argued that insertion of gene into genome may cause the unintended expression of full genom due to position effect which implies the toxic allergenic reactions. From industrial point of view to identfy any food or source of food derived from GMO is making compositional comparison between GMO and non GMO. Then substrate equivalence is considered and evaluated.

As it is argued that this kind of comparison is an unsufficient and nonscientific way of taking decisions. More scientific way is to test the producty chemiqually of macro /micro nutriens and known toxins. This tests include molecular diagnostic tests including mRNA finger printing, proteomics and secondary metabolite profiling (4). It is also organized in some countries. In recent years there has been an explosion in the use of GMO's . Nowadays more than 50% of (USA) produced soybeans are classified as GMO. More than 30% of USA produced corn is grown from GMO seeds and overall , more than 25 % of total USA cropland now grow genetically engineered crops . Under current law the Federal Drug Administration (FDA) has ruled that GMO's are equivalent to naturally accuring plants and foods.

Agricultural biotechonology is an emerging field influneced directly by GMO concept. There is a tendency such kind of products increasingly to become a major characteristics of agricultural produce of biotechonology may be come a safe agricultural tool . Recent studies imply that ıt may be harmfull ecological consequences such as the risk of spreading genetically engireered genes to the indigenous organisms and possibility of disrupting naturals systems of pest control and increased toxicity of new

engineered organisms. If they are used as a source of food. The most scared side of GMO concept is creating new weed or virus strains. World wide total area planted with transgenic crop increased from 3 million hectares (1996) to the almost 44.2 million hectares 2000 (5).

Over half of production of soybean, corn and canola in USA , Argentina corn and canola are transgenic varieties. It was argued that in 2000's World Genetically Modified for herbicide resistance and insect resistance are accounted 59 % and 15 % respectivelly (6) .

The comtroversy wiev of multinational companies as a main supporter of usage of biotechnically produced such GMO meds carefully planned introduction of such factors to the organisms should reduce or eliminate the enormous crop losses due to weeds , insects pests, and patogens . They are also arguing that the effect of reducing the usage of agrochemials due to gaining resistance by means if transferred gene is benefical for environment (7).

Another arguments is this pests show rapid genetic evolution in resisting the pesticide charecteristics of GMO . The spread of transgenic crops decrease the crop diversity by promoting monocultures which leads.to the ereosion of genetic diversing .

In other words farming only one crop may cause economic risk and hunger due to genetically homogeneous area may be more vulnerable to the harmfull effect of environment.

Farmers have many opportunities to earn their life and to combat with harmfull effects of pests other than producing GMO as a working area and to make organisms resistant.

It is necessary to decide whether to attempt altering the genetic structure of organisms can also be the of utility and profit or not . The risks with transgens are may they transform wild (weed) organisms in to the more worse organisms by means of gene flow among them or not. Considering that 2000 transgenic herbicide resistant organisms were planted on 74 % of the 44.2 million hectares deosted to transgenic crop (5).

Moreover the repeated use of transgenic crops in an areas may results in cumulative effect such as accumillation of the toxins in the soil and there is risk toxins from GMO active in the soil decreasing the fertility of soil. In conclution agricultural biotechnology is driven by profit not by scientific research.

The available independently generated scientific information suggest that (8).

1) The massive use of transgene organisms poses substantial potential risks from an ecological point of wiew.
2) The ecological effect are not limited to pest resistance and creation of new breeds or virus strains.
3) Transgenic crops can produce environmental toxins the move through the factor and also may up in the soil and water effecting invertebrates and probably ecological processes such as nutrient cycling.
4) There is no method to estimate the results from massive usage of such crops (16).

All genetically modified organisms contain genetic element from package DNA. There are part of artificial genetic elements used to ensure that the inserted genes will be accepted by the genetically manupulated organism also the genes for pecticide protection like *Bacillus thuringlens* (Bt) gene and most herbiside tolerans genes contain such DNA.

The public opinion afraiding of the risk of this DNA contain a genetic plants that may stimulute the immune system to start sequence of reaction ledding to inflamations. Animal experiments that exposure to these genetic extremes may lead to information artritis , and lymhoma (a malignant blood disease).

Further more it has been demonstrated that DNA is not broken down in gastrointestinal tract to extent formely behind ingested DNA sequencies large enough to contain whole genes have remained intact and entered the blood and tissues . This means there are reasons to suspect that eales GMO foods may increase the risk for contracting said disordes. No research has been done to exclude this possibility.

There are many safety tests on commercial GMO as crops are conducted. In USA test results on geneticaly modified tomato which was produced by inserting [Kan^r] genes into tomato has appeared on Internet (9). Consequently it has been expressed that GMO modified and parent tomotoes were to be substantialy equivalent.

Studies on GMO maize shoved that two lines of chardon LL herbicide resistant GMO maize expression the gene of Phosphirothricin Acetyl Tiansleruce Enziym (PAT-PROTEIN) showed significant differences in content, compained with maize , GMO maize. In other word, these two type of maize substantialy different. Consequently GMO maize express Pat protein may adduce unacceptible health risk.

It is argued that allergen content increased when soybean were genetically modified . To make the soybeans herbicide resistant the

gene of 5- endyruuyshikimote-3- phosphate syntetaze from *Agrobacterium* was used in spite of safety tests claim there were no differencies between GMO and commel lines due to use of in appropriate statistics, several significant . Differences between GMO and control lines were observed in studies on GMO patatoes , GMO rice , GMO cotton. It has been demonstrated that rats had mediocre weight gain when fed GMO soybean , GMO corns, GMO Peas showed no harmfull effects or animals but that doesn't mean they are good so urces for humans.

Allergies are major concern with GMO foods especially if ingredients are not labelled in packaged food . There are no reliabie was to test GMO foods for allergies .

Consequently, we need more and better testing methods before making GMO foods available for human conception.

RESULTS AND DISCUSSION

FAO has settled web pages on biotechnology and supports science based evolution system that would objectivelly determine the benefits and risks of each individuall GMO . This calls for a cautions case by case approach to adress legitimate concerns for biotechnology of each product or process prior to its release . However FAO is also aware of the concern about the potential risks passed by several aspects of biotechnologies (2).

Tıssue culture has applicability potential in food sector for products of secondary metabolites . Combining biochemistry with genetic engineering gain increase the yield of natural ingredients such as potential source of natural food color, flavour, and aroma ingredients and improve the economics of tissue culture (10).

The Institute of Food Technologist has revieved the scientific and policy issues concerning food derived from GMO. and concluded that the safety of food derived from GMO is adequately assured by science-based prodedures effectively used by Federal Drug Administrations of USA and breeders (11).

First genetically engineered animals as fish called GE fish presently requestig uppervail from FDA to marked to consumer (12)

New Zeland 's consumer for education about genetic engineering constructed a guide to genetic engineering as thirteen myths of genetic engineering and (inform the public that cross pollination occurs between GE crops and non GE crops and their wild relatives in this way resistance to meet killer example might be transmitted to weeds making them more difficult to control (13).

British Physicist who won 1995 Nobel prize said "My worry is that other advance in science may result in other mean of mass destruction may be more readily available even than nuclear weapons." Genetic Engineering is quite a possible area , because of these dread full development that are taking place there .

Generally the aim of modifie organisms targated to the herbicide resistance, vitamin enrichment to make organisms more large size and more robust in unsufficient environment and to give the organisms to be able to produce Bt toxin (natural insecticide found in *Bacillus thriengiens*). For instance golden rice variety of crop obtained GMO has gained two gene one from bacterium as beta carotone (precursor of vitamin A) and one from another organizm (14).General outlines of modified organizm' s genom are deciding which genes to insert into the host plant then the gene from selected organizms must be isolated , purified and cloned in order to be inserted in to the host plant. Two process of insertation exists. Agrobacterium and the particle gun. Tumor Inducing (TI) plasmide naturally found in soil bacteria called *Agrobacterium tümefaciens* used as a vector of carring the desired genes into the organizms. In natural way of cycle of *Bacillus thringiensis* . Bacterium injects the plasmid into the plant cell . A piece of the plasmid called T-DNA intergrates in to the plant genome . Genes on the plasmid piece encode tumor inducing proteins and transforms the organizms which cause crown galleries in the plant (15).

Ti plazmid of ring shaped organel conponents necessary to help it to intetgrate into host cell is genome consisted DNA itself the substructure of Ti plazmid consisted replication origin T-DNA transfer region , Napalin utilization region . Tumor production region and Nopaline syntesis region the T-DNA part of this plasmid consisted of tumor production region and napalin syntesis region so after the result of process of transformation of T-DNA from T-DNA from donor genome to the cell of host genome and subsequent growth of the host plant is realized by cultured the cell of crown' gaileries.

The particle gun method includes , gold or platinyum particle coated with (Ti) plazmid and than injected into the host cell during the first step of proces outlined in agrobacterium methods are applied in the species where Agrobacterium methods did not work such as corn, rice, patatoes . Principally agrobacterium method favoured due to not inserding genes pandomly in the host cell's

genome where us particle gun method cause inserting material not in preciserly spot in host cell's genome.

Table 1 and 2 shows the developped countries are not practising theese technologies much comparing with developing or non developped country. In spite of theese technologies are discovered in developped country probably due to public avereneis they are not using such products.

It is argued more information and esteblishment of international administrative agencies focussed particullary on this topic such as codex alimantaries of U.N. are needed.

Table 1. Number of Genetically Modified Organizms in Developping Countries

Region	Experimental Phase	Field Trials	Comercial Phase	Not specified	Total
Asia	91	48	6	49	194
Africa	12	9	2	-	23
Latin America and The Caribbean Sea	87	108	5	-	200
Europea	16	2	-	-	18
Near East	4	11	-	-	15
Total	250	188	13	49	500

Source: http://fao.org/biotech/inventary_admin/dep/default.asp

Table 2. Number of Technology Releated with GMO in Developping Countries

Region	Total Technologies Under Experimental Phase	Total Technologies Under Field Trial	Total Technologies Under Comercial Phase	Total Technologies Under Not specified	Total
Asia	146	9	19	117	291
Africa	207	1	16	--	224
Latin America and The Caribbean Sea	258	255	18	1	532
Europea	158	49	12	--	219
Near East	71	1	6	--	78
Total	840	315	71	118	1344

Source: http://fao.org/biotech/inventary_admin/dep/default.asp

REFERENCES

1 European Commision on Agriculture Working document. Economic Impacts of Genetically Modified Crops on the Agri-Food Sector (Glossary / http://europa.eu.int/comm/agriculture/index_en.htm).

2 Food And Agriculture Organization of the United Nations 2003.http://www.fao.org/biotech/stat.asp.

3 Arpad-pusztai, 2003 . http://www.action/bioscience.org

4 Kuiper, H.A. Noteborn H.P. JM. and Peijenburg A.A.C.M. (1990) Adequacy of Methods for Testing Safety of Genetically Modified Foods. The Larcet , 354, 1315-1316) http://www.btinternetrom/~nlpwessex/documents/gwocarto.htm .

5 James , C. (2000) Global Reviev of commercialized transgenics crops : 2000, Internatioanl Service for Dequisition of Agribiotech Application . I.S.S.A. Briesfs no: 21-2000

6 Alteri, M. A. (200). The Ecological Impacts of Africultural Biotechnology. An Actionbioscience.org.Original Article Agroecology of Dept. of Env. Sci. Policyard Management. , Univ. of Calif. Barkeley, USA. (http://www.cnr.berkeley.edu

7 Krimsky, S.; R.P. Wrubel , (1996). Agricultural Biotechnology and Environment Science , Policy and Soil Issues , Univ. of Illinois Press. Urbans.

8 Alteri, M. A. (2002). The Ecological Impacts of Agricultural Biotechnology. An Actionbioscience.org.Original Article Agroecology of Dept. of Env. Sci. Policyard Management. , Unio. of Calif. Barkeley, USA. http://www.cnr.berkeley.edu.

9 Alliance For Bio Interarity Website http://www.biointegrity.org (1991) Including Calgene FLAVR SAVR ™ Found To Report Pp 1-604 İnt . Res Ard Dev. Corp Test Report Pp 173-1738 / Conclusion of the Expert Paner Regarding The Safety Of FLAVR SAVR ™ Tometo ENVIRON .

Arlington VA.USA Pp 2355-2382 Four Week Oral (Intubaton) Toxicity Study in Rats By IRDC. Pp 2895-3000.
10 Havkin, D. F.; R. Dorn and T. Leustat (1997) . Tissue Culture for Production of Secondary Metabolite Food Technology. Inst. of Food Tech. November 1997.
11 Anoniymus, (2000). Backgrounder by the Institute of Food Technologist , www.ift.org , A.L. Parsby Media Relations Manager , at I.F.T. 221, N. Lasavle st. Chiacago, 12.60601, Genetically Modified Organisma, January 2000.
12 The Center For Food Safety http://www.foodsafetynow.org/ .
13 Consumers for Education About Genetic Engineering http://www.prorev.com/genetic.htm.
14 Department of Biology , Davidson College , Davidson NC 28036 http://www.bio.davidson.edu /people/vecase.biologyoftransgenicorganizms. 2003 .
15 200, Biotechnology Gods Brough Backgrounder http://persephone.agcompurdeu.edu /agcom /news /backgra/biotech_edu.htm/ .
16 Cuming, J. 2001. The Fate of Food Genes and DNA CpGM Motif and Its Impact , University of Western . Ontario, Canada.