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Genetically Modified Organisms and Genetically Modified Food Project

Genetically Modified Organisms are described as ones in which the genetic material, DNA, has been altered artificially instead of by natural means of breeding and natural selection or recombination. New genes are added to the existing genome through processes in genetic engineering where the new genes may or may not come from another species or kingdom of life. When the new acquired gene comes from the genome of another species this is referred to as a transgenic organism which is a subset of genetically modified organisms. Genetically Modified Organisms (GMO) has not just been restricted to food. Experimentation has been done to introduce genes from new species into the nuclei of the embryo in vitro and then implant the embryos back into females.

The goals of making plant genetically modified is so they will be resistant to insects and disease to increase high crop yield. Two common soil bacteria that are used to insert new genes in plants are plasmids from Agrobacterium tumefaciens, which uses a Ti plasmid to insert gene of interests and then the plasmid is inserted into the plant, and Bacillus thuringiensis (Bt). Bt, unlike the Gram-negative Agrobacterium tumefaciens, is a Gram-positive bacterium and is used differently in that they have genes that encode for crystal proteins called delta endotoxins. The genes that code for these proteins, one protein is Cry1Ac, are isolated from Bt and inserted into a plasmid which can then be used to transform the plant cells. The plant cells will then code for the delta endotoxin proteins which protect against European and southern western borer, various worms including the tobacco budworm, cotton bollworm, and roundworms, as well as many types of beetles. Protection against these insects and disease increase the potential yield of the crop. The process of implanting vector DNA into the plant DNA happens by cutting a resistant gene of interest from a foreign species, inserting this gene into a vector with antibiotic resistance gene, amplifying the plasmid with the new gene and coating it with tungsten or gold coated particles and then taking a shooting gun which release plasmid coated particles into the plant cells which then transform the plant cells and the plants grow to expresses the gene.

What type of crops rank in the highest percentage of foods that are genetically modified? Stable cash crops that produce the most amount of volume and income for farmers are crops that are most widely genetically modified. These cash crops include soy, corn, canola oil, and cotton. Highly processed foods can include amounts of any of the first three such as foods with corn products, cornmeal, high fructose corn syrup and oil such as chips, bread and fried foods, as well as soy products such as salad dressings and meat substitutes. Recently there has been scientific evidence and practice in genetically modifying fruit and grains to insert antigenic genes into plasmids to create edible vaccines. However, there is much more interference from the digestive system that causes the yield of the antigens to be low and more research is still needed.

There are numerous benefits to genetically modifying food. The first and primary is the environmental factor. Instead of spraying pesticides and herbicides which can be harmful to the environment and to people nearby breathing in the chemicals, drinking the water and consuming the product, these crops are able to protect themselves from insects and disease through their own gene expression. Another benefit comes from the cost savings in and increased crop yield. Farmers can spend less money on machinery and chemicals and produce more food. Increased crop yield cause for increased employment opportunities for those living in developing countries. GMO foods have also been able to fortify crops with essential vitamins as well such as “Golden Rice” which is fortified with beta-carotene that is converted to Vitamin A, an essential vitamin to human health.

What are the ethical and health issues associated with GMO? Cross pollination of modified genes with that of other plants with modified genes and normal crops can produce plants and weeds that are harmful to agriculture. There may be evolution of pests that become resistant to the toxins produced through gene expression of GMO. There has been little research on the affect of marine environments and on fish. Little is also known about the long-term effects on the human health and the environment.

Testing for GMO can be done in two ways; through enzyme linked immunosorbent assay (ELISA) which is difficult process to use for high processed food so using polymerase chain reaction (PCR) instead can help detect GMO. Testing for GMO using PCR can amplify certain sequences that are associated with genes used in GMO foods. If you have a length of gene in which you are trying to amplify you can add the primers specific to those genes and then perform PCR to amplify them. If the DNA does not have the GMO genes, then those sequences will not be amplified by those primers designed for GMO sequences. Although the majority of GMO have similar gene sequences, around 85%, there are still some GMO foods with other sequences that would need to be identified, but you can assume that if analysis of your PCR indicates no bands associated with the nucleotide length of your GMO gene of interest then the food is not genetically modified.

What is important in research in the future? We need to continue to perform research on the long-term effects of GMO food consumption and whether there are risk factors that may cause disease or cancer in the long-term. We must also continue research in ways to modify foods to include essential amino acids that to children in developing countries which can only provide carbohydrate rich diets and disorders arise from inadequate protein from these essential amino acids.