Genetically Modified Foods and Their World-Wide Impacts

The European Union has typically argued in opposition to genetically modified foods as they are unnatural and may have negative side effects on both consumers and the ecosystem; introducing a new resistance into the environment may lead to overgrowth of certain crops and extinction of vital organisms. Also, since the fruits of genetically modified seeds are infertile due to their modified nature, farmers in underdeveloped countries cannot replant the seeds from their crops and become dependent on buying from large corporations that have the ability to raise their prices unjustly. Conversely, some argue that the addition of genetically modified goods to our crop output can balance out the current decrease in crop yields that are a result of factors such as: drought, a deflection of crops from consumption to biofuel production, and rising energy prices. Additionally, biotechnology companies are hoping to modify seeds to only require minimal amounts of water and fertilizer, thus increasing crop yields in poor, dry regions and potentially minimizing hunger and poverty.

Statement of Problem

Genetically modified foods are controversial in the developed world, seen as beneficial in poor regions, and are a disputed topic that must be addressed for both health and economic reasons. Debate will focus on weighing the benefits and risks of GMOs concerning health, economic, environmental, biodiversity, social and political reasons.

What are GMOs?

Genetically modified organisms, which are also referred to as 'modern biotechnology,' 'recombinant DNA technology,' 'genetic engineering,' and 'gene technology,' are organisms whose genetic codes are altered in order to emphasize certain characteristics of the plant. Modification begins by isolating a specific gene that expresses a desirable trait and inserting it into a plant. The plant then incorporates the gene into its genome; the gene is then managed in the same way as any of the other genes.

Benefits of GMOs

The primary, initial reason for producing genetically modified organisms was to increase productivity. Other important, marketed benefits include: lower price, longer durability, edible vaccines or medicines, and heightened nutritional value.

Increased Crop Protection

GM crops elicit heightened crop protection and therefore an increase in crop production. To do this, a gene for insect or viral resistance, or herbicide tolerance, is inserted into the plant's genome. This inserted characteristic allows plants to ward off harmful predators and thus greatly increase the overall crop production. Greater insect resistance is achieved by incorporating into the plant a gene for toxin production; this toxin is safe for human consumption and this process lowers the amount of insecticide needed to fend off predators. GM plants can become virus resistant by introducing the organism to a gene from a specific virus. The plant builds up a higher level of immunity to the virus and becomes less susceptible to it. Herbicide tolerance can be achieved in a similar fashion by inserting into the plant a gene of a bacterium that is resistant to certain herbicides; this results in a lesser need for herbicides as the plant begins to resist on its own. These new traits

are especially far-reaching in developing countries that lack expensive pesticides.

Increased Yield and Adaption to Unfamiliar Environments

Modifications have also been made to plant genomes for a specific crop to be able to survive in particular environments, such as drought or high-salinity soil. For example, climates across Africa differ considerably, and it can be quite difficult to breed one crop in multiple regions. GMOs can be designed to suit many regional, climactic and environmental surroundings. Crops can also be engineered to require minimal pesticide spraying, thus leading to a reduced occurrence of pesticide poisoning, an increase in crop productivity, and less environmental pollution. On the other hand, there is criticism that pest-resistant GM crops may elicit pest-resistance in the long run, which may lead to evolved species that are no longer deterred by the pest-resistant genes inserted within the GMOs. It is also very important to note that pest-resistant engineered plants scale down labor and energy consumption for farmers. There is less need for pesticides, so the number of treatments can be cut back. This positively affects the plants, workers, communities and ultimately consumers, and minimizes the cost of fuel. This also reduces the exposure of non-target populations to any agricultural pesticides.

Nutraceuticals

Engineered crops can also serve as nutraceuticals – functional foods that can provide nutritional supplements to prevent diseases, or can be produced for consumers with food allergies. For example, significant portions of developing populations do not receive adequate amounts of Vitamin A; the deficiency is serious and causes blindness, as well as about 3 million deaths annually. Rice is a key staple in these regions, so scientists have incorporated the vitamin into the engineered rice genome to address this issue. Another example of nutraceuticals can be found in tomatoes with added lycopene, an antioxidant that can help prevent and treat prostate cancer and heart disease. Nutritionists believe the future of engineered crops will lead to foods with higher content of necessary supplements and nutrients.

Edible Vaccines

GMOs also have the ability to function as edible vaccines or medicines that are inserted into daily food sources and consumed with ease. Vaccinations in developing countries pose several problems in their method of administration: there must be trained staff, injected vaccines are costly, they require cooled environments, and needles carry the risk of spreading infections. Edible vaccines can eliminate all of these dangers. These modifications are still in the early stages. There are still key problems that must be addressed concerning edible medicines, including appropriate dosage and determining how growing these crops will affect surrounding environments.

Ensuring Safe Foods

There are particular foods that, over the years, have been deemed unsafe. A species of lentil, *Lathyrus sativus* accounts for causing neurolathyrism, a crippling neurological disease. Modified plants can create safer variations on these crops, reducing unnecessary illnesses and diseases.

Bioremediation

Genetically modified organisms can also be engineered to break down waste materials into

less toxic, or even non-toxic, materials in the environment. This process is called bioremediation and can clean away sewage, pesticides, heavy metals, and nuclear waste. An organism can be modified to thrive in unnatural conditions, such as the yellow poplar's ability to grow in high levels of mercury, and then convert the toxic waste into a much more manageable, less toxic state.

Health Risks

Despite the many potential benefits of GMOs, the organisms carry several risks that must be discussed. The dangers include: unexpected gene interactions, cancer risks, allergenic potential, horizontal gene transfer (HGT), and antibiotic resistance.

Unexpected Gene Interactions

Unexpected gene interactions are unanticipated reactions between the GMO and another organism. For instance, some animals change weight after being fed a genetically modified diet. These changes may be associated either with the specific mutated gene within the GM food, or with a side effect of consuming the gene.

Cancer Risks

Cancer risks most likely develop from the higher pesticide residue on GM plants compared to non-GM plants. In 1996, the US National Academy of Sciences predicted that federally-acceptable amounts of pesticide residue on foods would result in about one million types of cancer in the next 75 years. Several engineered genes placed in GM plants have high associations with cancers.

Allergenicity

Allergenicity may be due to the reactions of the human body with the modified, inserted proteins, or caused by interactions with the regular protein. This results in a new antigen. The allergenic potential of GMOs is a major issue as there are no reliable tests to detect the allergenicity of a food. There is a concern that modifying organisms may lead to creating new allergens.

Horizontal Gene Transfer

Horizontal gene transfer (HGT) is any process in which an organism integrates new genetic material into its genome. HGT is the transfer of genetic information between species in the same generation, while vertical gene transfer is the movement of DNA between generations within the same species (from parent to offspring). Diseases like mad cow, Ebola, and AIDS, most likely traveled from animals to humans; for this reason, it is thought that approximately one fifth of GMOs with modified genes from viral pathogens may create new viral strains with unknown characteristics. Genes from GM crops can potentially transfer to cells of the human body, or to bacteria within the human gastrointestinal tract, thereby causing adverse effects within the human body. This is a particular concern if genes from antibiotic-resistant plants transfer to the human body and cause human health problems. If this is the case, antibiotics will have no effect on the bacteria.

Antibiotic Resistance

Some GM plants receive antibiotics in their early stages of genetic modification in order to select for the gene construct, such as resistance to antibiotics. Thereafter, the antibiotic-resistant gene can transfer to other organisms by the method of HGT. Although no cases have been reported,

there is the potential for the antibiotic-resistant gene to transfer from the GM plant to the human gastrointestinal tract via HGT. The case has not yet been reported, but the United Nations' World Health Organization and the Food Agricultural Organization believe that antibiotic resistance transferred to humans via HGT is a potential threat posed by GMOs.

Environmental Risks

One of the fundamental risks that GMOs pose to their surrounding environments focuses on the technical manipulation of the genetic material within the modified plants. For instance, the modified gene within genetically engineered feed may have a negative influence on the feed's composition, which consequently may carry adverse effects to the animal that consumes the feed. Other environmental risks include pesticide toxicity on plants and animals and provisions that restrict the spread of GM seeds and pollen from escaping and influencing non-GM crops and the surrounding environment. Environmental risk assessments are carried out over GM crops and the environments that encompass them, and could possibly receive mutated genes. Risk assessments of GMOs and their impact on the environment are concerned with the GMO's characteristics, the GMO's stability within the environment, and the environment's response to the organism's introduction. The mutated organism is also looked at for any unintended side effects it may have had on its surroundings.

Threats to Biodiversity

Inability to Adapt

The potential threat of GMOs' disturbance to the world's biodiversity is grave. Slight advantageous and disadvantageous modifications and mutations within individual organisms lead to evolution over time. Therefore, by inserting a new gene into an environment by a method that is not evolutionary, the environment is obliged to reproduce it whether or not it works in unison with the environment. In the process of evolution, spontaneous mutation of traits allows the organism a period to adapt to the environment with its new mutated gene. In GMOs, a modified gene surpasses the feedback mechanism of its surroundings to express itself whether or not it is advantageous to the environment. The exogenous gene that has been inserted into the GMO disturbs the network of natural evolutionary processes. For example, the genetically modified soybean contains an added gene that consequently hinders its ability to grow in warm temperatures. When the modified seed is planted in soils where temperatures exceed 45 ú C, the stem is unable to grow and wilts; the metabolism and production of lignin were altered, so the plant is unable to physically hold itself up; simply put, its harmony is destroyed. Inserting modified genes into organisms that have undergone long evolutionary processes to become suited to their environments runs the risk of creating organisms that are unable to adapt, and as is exemplified by the GM soybean plant, become disadvantaged.

Gene Flow

Another biodiversity concern focuses on potential gene flow from GM crops to non-GM crops. This flow of engineered DNA to wild populations can affect local genetic diversity. Although there is potential for gene flow between non-GM crops as well, the consequences of GM crop gene flow are much greater; modified DNA

may infringe on the process of natural selection, thus disturbing the ecosystem in many unpredicted ways. On the other hand, critics do not believe that any potential gene flow is different from what humans have been doing with organisms for centuries. For example, the rhododendron, which has naturally grown in Portugal and Spain, was introduced into the UK years ago, where it became a menace to the environment and negatively impacted its surroundings. With this viewpoint in mind, human intervention in nature and natural selection is age old and the introduction of GMOs is no different.

Social and Political Differences

Unreachable Techniques and Technologies for Developing Countries

There has been much debate on the social and political consequences of GMOs on developing countries. The techniques and technologies used in genetic engineering are not necessarily suitable for developing countries' farmers: these farmers have much lower incomes, thus rendering the more expensive process of genetic modification out of reach for them. Developing nations may, also, be cautious to alter their current and future export markets by introducing a method of growing that may not be sustainable for their country. If these nations are to proceed and use genetic modification methods, they are also obliged to have the necessary infrastructure for the processes that complies with EU standards for traceability and labeling.

Potential Mutations of Food Staples Leading to Food Shortages

The introduction of genetically modified crops into developing regions allows for gene transfer to other crops; this issue is especially important in developing nations because they are the world centers for growing food staples such as rice and maize. If these crops become altered, there could be mass food shortages, unemployment, resistant weeds, and the extinction of native crops.

Increase in Unemployment

GM crops could be harmful to developing populations because as they require less labor and weeding; this minimizes necessary agricultural workers and increases unemployment. Conversely, a crop that requires less work could be very beneficial to communities with shortages of farm laborers. In these communities, the children leave their education to work the land, which can negatively impact their future quality of life.

Shift Focus from Modifying Farming Techniques to Adopting GM Tactics

By focusing on adopting GM crops into their agricultural lifestyles, developing countries are overlooking many other methods of improving their agricultural system. Some ideas include: fostering international and national policies, enhancing seed production and distribution, and encouraging improved farming practices.

Bloc Positions

European Union

Several countries, including Germany, France, Austria, Greece, Hungary and Luxembourg, announced a ban on the cultivation and consumption of MON810 maize, a genetically modified form of maize that is toxic to certain pests. The company, Monsanto, produces the crop, and holds the patent to the modified organism

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Africa

African countries look to how GM crops will improve food security in their nations. GMOs have the potential to improve food security by: increasing crop yields, producing crops that can survive under harsher conditions, heightening the nutritional and medicinal value of food, and improving the storability, or shelf-life, of foods. Conversely, African nations must be cautious of: relying on GM seeds, the impact of the cost of producing GM crops, the implications of expensive research and development processes, the impact of GMOs on local biodiversity.

Asia

While large corporation and governments worldwide center on the safety and morality of farming GM crops, more Asian farmers continue to shift to harvesting GMOs. In the end, it appears Asian farmers are primarily interested in GMOs because they have increased harvests and seed qualities. On the other hand, some farmers are fearful of pest resistance. For example, a farmer in southern China details that he used 80 percent less pesticide on his GM cotton crop, but it was infested by bollworms before it blossomed. Also, the swift decrease of certain pests allows for the overpopulation of other insects.

This World Health Organization committee at the UCBMUN Conference 2010 will center on each nation weighing the benefits and risks of GMOs: we will collectively analyze how they impact countries around the world with key focuses on health, safety, economies, environment, biodiversity, and social and political impacts. The risks and benefits of genetically modified organisms are, not limited to those detailed in this background guide and each country is urged to adopt the emotions and reasoning of its respective point of view in order to find the potential, specific impacts of GMOs.

Bibliography

Hug, Kristina. "Genetically modified organisms: do the benefits outweigh the risks? ." *APÞVALGINIS STRAIPSNIS* 44.210. 07. 2007 Web.7 Aug 2009. <http://medicina.kmu.lt/0802/0802-01e.pdf>.

Kanter, James. "WTO gives EU more time on genetically modified foods." *The New York Times* 22. 11. 2007 Web.7 Aug 2009. <http://www.nytimes.com/2007/11/22/business/worldbusiness/22iht-gmo.4.8441828.html?_r=2>.

"20 Questions on Genetically Modified (GM) Foods." *World Health Organization*. World Health Organization.7 Aug 2009 <http://www.who.int/foodsafety/publications/biotech/20questions/en/>.

"Genetically Modified Organisms (GMOs) and the Environment." *Iowa Environmental Council* 12. 08. 2000 Web.7 Aug 2009. <http://docs.google.com/gview?a=v&q=cache:HxWRHhqd7PQJ:www.iaenvironment.org/documents/ppGMOs.pdf+gmo+environment&hl=en&gl=us>.

"EU Grapples With Crop Stance." *Forbes* 23 April 2009: n. pag. Web. 4 Oct 2009. <http://www.forbes.com/2009/04/22/crops-genetically-modified-food-business-oxford.html>.

Cleveland, Cutler. "Opportunities and risks of genetically modified crops in Africa." *Encyclopedia of Earth* (2007): n. pag. Web. 4 Oct 2009. <http://www.eoearth.org/article/Opportunities_and_risks_of_genetically_modified_crops_in_Africa>.

Hepeng, Jia. "GM Crops - Asian Farmers Have Their Say." *Global Envision*. 21 November 2007. Mercy Corps, Web. 4 Oct 2009. <http://www.globalenvision.org/library/6/1792/>.