

Genetically Manipulated Foods: Is the Human Health Risk, Real or Imaginary?

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ABSTRACT

From when Thomas Malthus propounded his theory of world population growth outpacing food production, rich and poor world populations have continued to grow by leaps and bounds. Efforts have therefore been stepped up to feed the world's 6 billion people by two important events - the industrial revolution and modern biotechnology. These two events have raised the gradient of food production to a near exponential parallel with population growth. Every farmer's dream to have more profits revolves around aspects of i) low seed cost, ii) low wastage from disease, iii) greater resistance to drought, iv) quicker ripening time, v) less need for fertilizer, vi) less need for pesticides and vii) high yield per farmable acre. Because natural selection is tedious and the time to arrive expected results is long, farmers have sought and routed in favour of improved yielding varieties. This quest for modified crops has resulted in an unprecedented vulnerability of the farmers with a range of genetically modified foods much resented by a confused consumer population. "Modified" stands as a misnomer in Genetically Modified Foods (GMF) because some of these foods contain much more than just insertions of genes. Minimally they may contain; viral promoters and transcription terminators, antibiotic resistant markers and reporter genes and the products of these may react in unpredicted ways. "Manipulated" is more appropriate because these crops are made to behave in strange ways at times with consequences beyond our wildest expectation. Cloning is still an imprecise science and even with targeted disruptions, unpredictable reorganization within the genome may lead to the production of strange substances. In line with issues of uncertainty, advocates desire more safety tests, better understanding of risks, and revelation of concealed facts and a down play of exaggerated benefits by industry. It is difficult to judge whether benefits outweigh side effects. We cannot possibly stop the current world trends. However, only rigorous safety controls and checks for short term and long term effects would help minimizing the risks. As we gather the grains, the population would have to be educated on how to cautiously appreciate the benefits of consuming organically/locally grown foods and what stands to take on GMF or products derived from it. Therefore for GMF to be placed on the market stalls, safety tests and compositional studies need to be performed and products labelled so that the informed consumer makes the choice.

RÉSUMÉ

Malgré la proposition de la théorie du devancement de la population démographique sur la production alimentaire par Thomas Malthus, la démographie des populations riches et pauvres du monde ne cessent d'accroître à pas de géant. Dans cette perspective, les efforts ont été accélérés afin de nourrir les 6 milliards d'habitants du monde à travers 2 événements importants - la révolution industrielle et la biotechnologie moderne. Ces deux efforts ont augmenté la production alimentaire à un niveau comparable à l'exponentiel de la croissance démographique. Le rêve de tout cultivateur d'avoir plus de bénéfices tourne autour de : i) Le coût réduit des graines, ii) La réduction de freinte par la maladie, iii) Plus de résistance à la sécheresse, iv) La moindre besoin des engrais, v) La moindre besoin des pesticides ainsi que vii) Un rendement élevé par acre cultivé. Les cultivateurs ont préféré des meilleurs variétés et plus rentables du au difficulté qui existe dans la sélection naturelle et la longue durée des résultats escomptés. La recherche des produits modifiés a donné lieu à une vulnérabilité sans précédent des cultivateurs ayant un grand variété des aliments génétiquement modifiés face à des consommateurs déconcertés. Le terme « Modifié » n'est pas juste en ce qui concerne les Aliments Génétiquement Modifiés (AGM) parce que certains de ces produits contiennent plus qu'une insertion des gènes. Au minimum, ils peuvent contenir des gènes d'origine viral et des terminateurs de transcription, les marqueurs de résistance aux antibiotiques et les gènes rapporteurs; tous qui peuvent agir de manière qui ne peut être déterminée. Au contraire, le terme « Manipulé » est plus apte parce que ces plantes cultivées ont des comportements bizarres avec des conséquences au-delà de toute espérance. Le clonage demeure toujours une science imprécise avec des ruptures imprévues, des réorganisations imprévisibles dans le génome menant à la production des substances inconnues. Sur ce plan d'incertitude, les défenseurs du moratoire demandent plus des tests, une meilleure compréhension des risques, une révélation des effets et faits cachés et la minimisation de l'importance des bénéfices exagérés par les entreprises envers les cultivateurs. Toutefois il est difficile de déterminer si les effets secondaires dépassent les bénéfices. Il est maintenant presque impossible de changer les tendances à l'échelle mondiale. En outre, nous pouvons seulement mettre en place des mesures de sécurité rigoureuse et des contrôles à long et à court terme visant à minimiser les risques. Au cours du temps et de la cueillette des grains, la population doit être éduquée sur comment apprécier les avantages des aliments biologiquement modifié et comment prendre des décisions sur des AGM ou ses dérivés. Ainsi donc, afin de mettre sur le marché les AGM, des tests de sécurité et des études de composition doivent être menés et les produits étiquetés afin d'informer le consommateur.

Malthus and Food Supply Panic

Thomas Malthus, the English political economist who lived from 1766 to 1834 and later published his thoughts on populations and food supply had postulated that poor populations would have to limit family size or food supply would have to increase significantly to maintain the equilibrium otherwise the world would face famine (UC Berkely). Since then, rich and poor world populations have continued to grow by leaps and bounds. Efforts have therefore been stepped up to feed the world's 6 billion people. For the world to have caught up with feeding its population, two major events have occurred; the first of them is the industrial revolution and the second is the modern biotechnology. These events have raised the gradient of food production for it not to intersect that of world population growth (Fig 1). Famine has not brought about a reduction in population except in little pockets where drought and war have exacerbated famine and killed some. Today more food is produced per farmable acre and this has resulted in Thomas Malthus being considered a pessimist in some sectors.

Every farmer's dream - a Nation's difficulties

Every farmer's dream is to have more profits. Profits to be realized revolve around aspects of i) low seed cost, ii) low wastage from disease, iii) greater

resistance to drought, iv) quicker ripening time, v) less need for fertilizer, vi) less need for pesticides and vii) high yield per farmable acre. While traditional biotechnology has yielded measurable gains, natural selection is tedious and the time to arrive expected results is long. Farmers have therefore sought and routed in favour of improved yielding varieties for the above reasons. These improved varieties have therefore been those that are genetically modified to give it properties it naturally would not have or would have taken more time to develop. This quest for modified crops has resulted in an unprecedented vulnerability of the farmers. Scientists have served as the gateways for the introduction of the new science - modern biotechnology. They have made hurried conclusions often not subjected to peer review and adequate control. The range of products that arrive the market therefore have resulted in undesirable effects in some areas for some foods.

"Modified" is a Misnomer

Genetically modified foods (GMF) contain much more than just insertions of genes. Minimally they may contain; viral promoters and transcription terminators, antibiotic resistant markers and reporter genes. Modified is actually a misnomer because the engineered genes have products that may react in unpredicted ways. "Manipulated" is more appro-

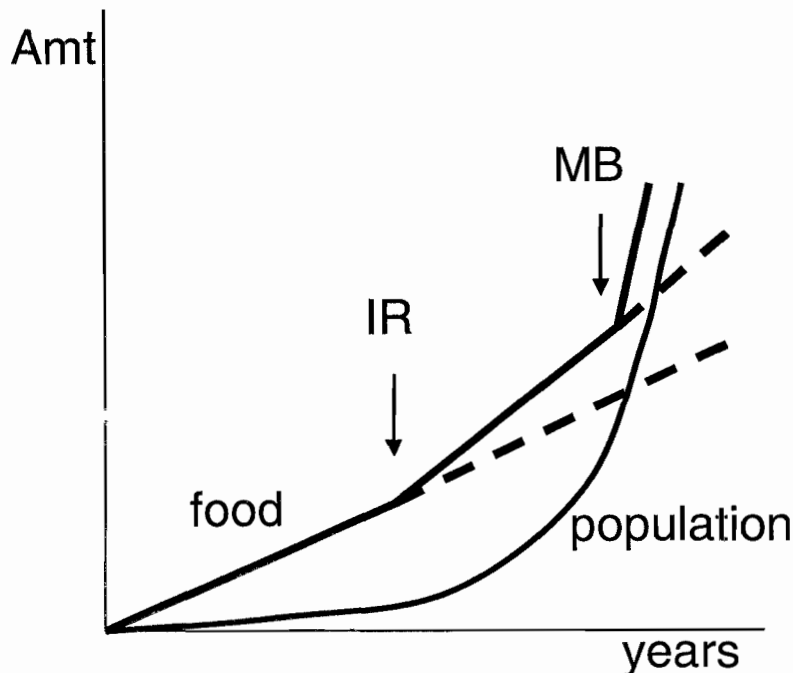


Fig 1.: World Trends in Population Growth & Food supply

Legend: IR - Industrial Revolution, MB - Modern Biotechnology, Amt - Amount

priate because these crops are made to behave in strange ways and since each protein is part of a complex of interactions of thousands of others, a slight alteration may have consequences beyond our wildest expectation. DNA though transient in the gut or the environment, do stay there long enough to be able to enter the cells of the host. Because genes are rarely broken down fast, there is the possibility that antibiotic resistance may be acquired in the human population especially as the often used genes are those frequently used as antibiotics to treat human microbial infections.

Probable Effects of GM Foods

Cloning is still an imprecise science especially in the ways that require DNA particle delivery through blasts unto cells. Even with targeted disruptions, these may unpredictably reorganise and lead to the production of allergenic substances. Besides allergy, there exists the possibility that GMF may effect the human systems through inserted promoter genes that may promote activities of undesired genes resulting in increase or decrease of some enzymes or toxins. Our minimal mastery of proteomics of the new foreign or inserted genes from bacteria, viruses or animals placed in plants may result in mutagenic or carcinogenic substances. New proteins/chemicals may produce post-harvest effects accentuated by post harvest processing. As such, new molecules may combine during cooking and produce undesired products with new metabolic effects. These effects are not just imaginary because a few reports demonstrate that i) manipulated yeast which was meant to increase fermentation produced an unexpected metabolite methyl-glyoxal in toxic and mutagenic concentrations (Inose and Murata 1995). Secondly, proteins from a Brazillian nuts put into soybean caused strong allergy in people allergic to the nuts and who never had problems with soybean (Nordlee *et al*, 1996). Four genes for tryptophan production engineered into bacterium produced minute quantities of a toxin that killed 37 people and sent some 1500 people to the hospital with serious neurological and autoimmune disorders (Mayeno *et al*, 1994).

Moratorium Advocates are wary of procedures

In line with issues of uncertainty, advocates desire a suspension of GMF. The reasons advanced include a scarcity of safety tests, poor understanding of risks, concealed facts and exaggerated ben-

efits by industry. Advocates require that GMF should undergo the same evaluation and acceptance conditions as for clinical trials of drugs, for the health risks. The hasty extrapolations from animal models to humans have not been predictive and require that some of these trials be conducted on human volunteers. Of course, this means sacrifice and very long term studies to conduct with very large sample sizes. The wish of these advocates is at least to see consumer labels on GM Foods. Furthermore, there is a growing suspicion of the regulatory bodies owing to the fact that some of the Food and Drug Administration (the main regulatory body in the USA) staff had also worked at or have shares at Monsanto (the lead US backed GMF industry in the world). This makes the advocates wary about the fact that conflict of interest could lead to complacency and this would place the vulnerable populations which include children and mother, especially girls of child-bearing age, aged-populations and immuno-compromised individuals at great risks side effects.

Soybean products make up 60% of food products in supermarkets. Monsanto's Round-up Ready Soybean (RRS) has no published data on effects of insecticide treatment, yet Round-up (herbicide), the most widely used in Africa induces effects that are totally undesirable. Glyphosate sprayed soybean raises its estrogen levels and consumption by young girls results in abnormal hormonal levels. RRS was even approved and introduced into the food chain despite abnormal levels of fat in milk of cows fed with this food. For most of these companies reports are usually of the format such that without a trained eye one may not recognize the PR language used. For example, these statements on careful reflection points out something is not said: *although mild reactions persisted..., mild changes occurred..., unresolved issues were minimal..., no significant alterations were noticed although... and "substantially equivalent..."* etc. Advertisements that lure farmers into the purchase of these seedlings, more often than not bear messages such as: *"genetic modification is like breeding", "this seed is a farmer's dream" and "farmers realize higher gains"*.

Health Risks are Real – No Half-Measures on GMF

For GMF to be placed on the market stalls, safety tests including acute toxicity tests with clinical chemistry and blood parameters as well as histology, an-

thropometric and urinalysis need to be performed. Compositional studies that compare between GMF and non-GMF have to be performed on plants with same growth, harvest and storage condition with an accepted and agreed margin of variability. Allergenic studies measuring IgE levels, immunoblotting, sequence homologies of the 200 known allergens is no longer enough for conclusions of such complex nature. Nutritional and toxicological studies with currently with an inadequacy of tests on known macro/micro nutrients and toxins need to be improved with more modern techniques of analysis. These GMF need to be investigated for digestibility and intestinal transit, storability, post-harvest, and post processing modifications. For foods that may result in physiologic and behavioral studies, animal models may be required even for *in vivo* analysis for gut proteolytic products rather than *in vitro* proteolysis analysis. Much needed new techniques such as mRNA fingerprinting, functional proteomics, secondary metabolite profiling and new toxicological methods to assess low-concentration-high-activity metabolites should be employed.

As We Gather the Grains

Cameroon needs to analyze the risk for its populations. First by

- making an inventory of GM foods/products in the stores.
- require consumer labels on GM foods and products.
- reinforce the capacity of its local scientists to conduct these tests.
- reinforce the functioning of a national food regulatory body and
- encourage our institutions to join in the maintenance of germplasm bank.
- assess the residual risk in GMFs.

As we gather the grains, the population would have to be educated on how to appreciate the benefits of consuming organically/locally grown foods and to take on GMF or products derived from it cautiously. It is imperative for us to take the appropriate steps to preserve the germplasm of traditionally grown crops. There is the need to protect our vulnerable farmers from agricultural infiltration from unscrupulous biotechnologists. There is evidence that GM foods may create unexpected effects which would be detrimental to health. It is difficult to judge where benefits outweigh side ef-

fects. We cannot possibly stop the current world trends. However, only rigorous safety controls and checks for short term and long term effects would help minimizing the risks.

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