CHAPTER 1

Introduction

> It is time to reopen the debate about GM crops in the UK but this time based on scientific facts and analysis. We need to consider what the science has to say about risks and benefits, uncoloured by commercial interests and ideological opinion. It is not acceptable if we deny the world's poorest access to ways that could help their food security, if that denial is based on fashion and ill-informed opinion rather than good science.
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> *Sir Paul Nurse, Royal Society – Richard Dimbleby Lecture, February 2012*

After World War II there was a rapid expansion in food production, supported by advances in agricultural science. This led to an abundance of food in the developed countries, but not in all developing countries. The world population is expected to increase from the current 6.7 billion to 9 billion by 2050. To accommodate the increased demand for food, it has been estimated that world agricultural production needs to increase 50% by 2030 (Royal Society 2009).

As outlined by Ronald (2011) the amount of arable land is limited and is being reduced due to urbanisation, salinisation, desertification and environmental degradation. Another challenge is that water systems are under severe strain in many parts of the world. Thus, increased food production must largely take place on a diminishing land area while using fewer resources. Compounding the challenges are the predicted effects of climate change, limiting crop production and exposing crops to increased damage from pests and disease.

As a result several strategies are being adopted to address these issues, including the improvement of agricultural crops using genetic modification (GM). The first GM (transgenic) crops for food and feed use were introduced in 1996. Later the technique was extended to animals, although the development of superior strains and breeds of animals at this time is still based mainly on traditional selective breeding and cross-breeding techniques.

Genetic Modification and Food Quality: A Down to Earth Analysis, First Edition.
Robert Blair and Joe M. Regenstein.

Genetic modification (GM) can be defined as the manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant deoxyribonucleic acid (rDNA) techniques. This method uses laboratory techniques to introduce specific changes into the genetic code located within the cells so that the succeeding generations possess desired features.

In some cases the inserted genes are derived from another species, in others the genetic change is made by using genes found within the same species or a closely related species. For example, it became possible for the gene responsible for drought tolerance to be identified in one plant, isolated and removed, and inserted into a different plant. The genetically-modified plant then gains drought tolerance as well, and this attribute is passed down to succeeding generations. It also became possible for genes from non-plant organisms to be used with plants. The best known example of this is the use of B.t. genes in maize and other crops. B.t. (*Bacillus thuringiensis*), is a naturally occurring bacterium that produces proteins that are lethal to insect larvae. B.t. protein genes can be transferred into maize, enabling the crop to develop a resistance against insects such as the European corn borer and thus reducing or avoiding the need for spraying with insecticide.

In general, GM has been used to introduce specific traits into plants, such as resistance to insect attack, resistance to virus diseases and tolerance to herbicides.

According to James (2014) the global biotech crop hectarage has increased from 1.7 million hectares in 1996 to over 175 million hectares in 2013, the main crops being maize, soyabeans, rapeseed (canola) and cottonseed. During this 18-year period, more than a 100-fold increase of commercial biotech crop hectarage has been reported. The United States continues to lead global biotech crop plantings at 70.1 million hectares or 40% of total global hectares, but according to the report, more than 90% of farmers (more than 16.5 million) planting biotech crops are small and resource-poor. Of the countries planting biotech crops in 2013, 8 were industrial countries and 19 were developing countries. For the second year in a row, developing countries planted more hectares of biotech crops than industrialised countries. By 2015, it is predicted that more than 120 GM crops (including potatoes and rice) will be cultivated worldwide, with the number of countries growing GM crops and the area planted doubling between 2006 and 2015 (James, 2010).

Although GM has been shown to have important applications with food crops (and animals), the technique is still controversial and continues to raise concerns in several quarters. The main concern is whether genetic modification using rDNA techniques results in harmful attributes in the altered organism, such as allergenicity. A second main concern is whether the nutritional value of the food product is the same.

Food derived from mutation breeding is widely used and accepted since induced mutagenesis is considered a conventional breeding technique. Mutations, defined as any change in the base sequence of DNA, can either occur spontaneously or be induced, and both methods have produced new crop varieties. Crop plants account for 75% of released mutagenic species. In the USA many varieties have been developed using induced mutagenesis, such as lettuce, beans, grapefruit, rice, oats and wheat. Organic farming systems, at least in the USA, permit food from mutated varieties to be sold as organic.

GM technology differs from mutagenesis in that it involves insertion of an alien gene or genes, whereas mutagenesis results in a realignment of the genes contained within the genome of an organism. Mutagenesis also has a longer history of use, although it does involve the use of mutagenic agents such as ionising irradiation. The food regulations in some countries require that only new food products derived using GM techniques, and not mutagenesis, are subject to scientific assessment before being approved for food or feed use. Consequently our review does not include the quality and safety of food products developed by mutagenesis.

Plants and animals may be reproduced by cloning. This technique is not considered to be genetic modification since it does not involve any change in the genetic makeup of the organism. As a result, the evidence relating to the quality and safety of food items produced by cloning is not included in our review.

This book is the first comprehensive text on how GM production methods influence the quality of foods and feeds, based on an unbiased assessment of the scientific findings. Assessments of the religious, ethical and environmental concerns can be found in other publications.

References

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