Preface

This book entitled "Applied Biotechnology" is designed to acquaint readers with the applied aspects of biotechnology at the international level. For example, a genetically modified food is a food product containing some quantity of any genetically modified organism (GMO) as an ingredient. Some nations have very strong disagreement over genetically modified organisms. For example, the European Union and Japan have enacted labelling and traceability requirements for GM food products, while the United States does not believe these requirements are necessary. Although "biotechnology" and "genetic modification" commonly are used interchangeably, GM is a special set of technologies that alter the genetic makeup of such living organisms as animals, plants, or bacteria. Biotechnology, a more general term, refers to using living organisms or their components, such as enzymes, to make products that include wine, cheese, beer, and yogurt. Combining genes from different organisms is known as recombinant DNA technology, and the resulting organism is said to be "genetically modified," "genetically engineered," or "transgenic." GM products (current or in the pipeline) include medicines and vaccines, foods and food ingredients, feeds, and fibers. Locating genes for important traits—such as those conferring insect resistance or desired nutrients—is one of the most limiting steps in the process. However, genome sequencing and discovery programs for hundreds of different organisms are generating detailed maps along with data-analyzing technologies to

understand and use them. The first commercially grown genetically modified food crop was a tomato created by Calgene called the FlavrSavr. Calgene submitted it to the U.S. Food and Drug Administration for testing in 1992; following the FDA's determination that the FlavrSavr was, in fact, a tomato, did not constitute a health hazard, and did not need to be labeled to indicate it was genetically modified, Calgene released it into the market in 1994, where it met with little public comment. Considered to have a poor flavor, it never sold well and was off the market by 1997. Subsequent genetically modified food crops included virus-resistant squash, a potato variant that included an organic pesticide that kills caterpillars, named after the bacterium that produces it, Bt (NB: the US Environmental Protection Agency classified the Bt potato as a pesticide, but required no labeling), strains of canola, soybean, corn and cotton engineered by Monsanto to be immune to their popular herbicide Roundup, and Bt corn.

There was a brief interlude where Monsanto flirted with introducing a technology called terminator into food crops, which produced plants that grew sterile seeds. Monsanto claimed this was necessary to protect their intellectual property rights, since they were licensing the technology to farmers, and would also have provided a measure of protection against volunteer corn carrying unwanted traits, a major concern that arose during the Starlink debacle. In August 1998 widespread concern, especially in Europe, was sparked by remarks by a leading GM researcher (with 270 published scientific papers to his name), Dr Arpad Pusztai, regarding some of his research into the safety of GM food. In his experiments, rats fed on genetically modified potatoes had suffered serious damage to their immune systems and shown stunted growth. He was vilified by leading British politicians, other scientists

and by the GM companies, not least because his remarks, in a television interview, preceded the scientific publication of his results. Neither his eminence in the field nor his previous enthusiastic support for GM food were enough to save his career. Dr Pusztai was forced into retirement and his research suspended, whilst the British government blocked efforts to repeat his experiments which would have proved or disproved his claims. In May 2005, a leaked report from Monsanto showed that some of its own experiments were raising doubts over the safety of GM food, and in particular seriously called into question the regulatory doctrine of substantial equivalence—that GM food with similar proteins and toxins is deemed no different than conventional food, without further investigation of the effects of any other differences. In Monsanto's research, rats fed on a diet rich in genetically modified corn developed abnormalities to internal organs and changes to their blood, raising fears that human health could be affected by eating GM food.

In 2000, countries that grew 99% of the global transgenic crops were the United States (68%), Argentina (23%), Canada (7%), and China (1%). Although growth is expected to plateau in industrialized countries, it is increasing in developing countries. While some *individuals* may benefit from non-therapeutic genetic engineering, there may be adverse *social* implications. Few resources—particularly those related to medicine and health care—are available to everyone, and allowing the most privileged to engineer themselves or their children to have special capabilities could lead to what some call a genetic aristocracy. Numerous enhancements via genetic engineering have been proposed, including increased memory, intelligence, and less need for sleep, in addition to some peoples' desires to alter their physical appearance. The advantages created by genetic

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engineering, either real or perceived, could lead to new forms of inequality between those with genetic enhancements and those without while also exacerbating current inequalities between rich and poor, men and women, and whites and communities of color. The metaphysical (or "spiritual") implications of genetically engineered humans are vast in scope; e.g., were individual personality shown to be exclusively the result of genetic information acted upon by the environment, the concepts of the human soul and free will could be proven specious. However, could this be shown by the success of actual attempts at genetic engineering any more (or less) than it is shown by what is already known about the roles of genes and the environment in shaping the phenotypical characteristics (including behavior) of living things? Many opponents of current genetic engineering believe the increasing use of GM in major crops has caused a power shift in agriculture towards Biotechnology companies gaining excessive control over the production chain of crops and food, and over the farmers that use their products, as well. Many proponents of current genetic engineering techniques believe it will lower pesticide usage and has brought higher yields and profitability to many farmers, including those developing nations. A few GM licenses allow farmers in less economically developed countries to save seeds for next year's planting.

This book consists of—Biotechnology, Genetic Modification and Cloning; The Human Genome Project: An Overview; Biotechnology in Food and Agriculture: Roles Opportunities, Challenges; and Applied Biotech Products: A Select Study etc. besides a large body of list of acronyms, glossary of relevant terms, extensive bibliography, list of websites and links, for further referencing and research.

—Editor