
Food Industry

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Biotechnology-based products and processes will likely have a significant impact on the agricultural and food industries over the next several years. The nature of that impact is as yet unclear, and has the potential for both positive and negative outcomes. Topics discussed as part of the workshops at this year's NABC meeting attempted to provide the basis for beginning to understand the impact of increased use of biotechnology in food production.

The objective of the food industry workshop was to:

- evaluate new market opportunities for biotechnology in the food industry,
- examine social issues, regulations, and ethics as they relate to biotechnology in the food industry, and
- highlight the economic and structural impacts of new products on agriculture.

CREATING NEW MARKET OPPORTUNITIES

Participants were asked to identify the most promising opportunities for new nontraditional products from agricultural biotechnology. Not all participants were in agreement that biotechnology-based products presented new market opportunities, but rather some considered that they presented a threat to traditional products and methods. This concern was primarily based upon the unknown impacts of nontraditional products on the ecosystem, health & safety, and existing markets for traditional products.

Areas of opportunity were identified as (in random order):

- **Increased Food Quality and Safety:** Increased nutritional value, better taste, longer life, and food safety through developments such as packaging indicators. Development of the area of nutraceuticals for added nutritional/health value as well as removal of nutrient absorption properties and natural toxicants.
- **Vaccine Production and Delivery:** Development of agricultural strains for vaccine production and agricultural/food products for vaccine delivery.
- **Increased Producer Productivity:** Increasing producer productivity through higher yield crops, new geographic locations for crops (such as arid areas or marginal soils), and “pharming”. Increased productivity will result in a net increase in the available food supply.
- **Processing for Increased Efficiency:** New and improved methods for food harvesting and processing, as well as the use of food processing by-products for other applications. This area provides great potential for improvement, given that current worldwide post harvest loss is significant.
- **Environmentally Benign/Beneficial Food Products and Processes:** New agricultural crop strains that will not adversely impact the environment and biodegradable/by-product packaging.

Considerable discussion about the drivers of these new areas of opportunity took place. Participants felt that past and present drivers were primarily economically motivated, e.g. producer and corporate profits. Some participants believe that food quality and nutritional value are becoming more important, while others maintained that economics will continue to be the major influence in the development of new areas of opportunity.

Numerous barriers exist in developing new market opportunities, primarily due to:

- **Consumer Acceptance:** The issue of trust and education repeatedly surfaced in workshop discussions. Trust represents the comfort level of the consumer with the expectation that nontraditional food products will or will not be beneficial to them. Consumers are skeptical that government and industry truly have their best interests at heart, and require concrete proof that this is the case. Education is an issue because the majority of consumers are likely not educated about biotechnology-based agricultural and food products. Because of the lack of trust and education, consumers tend not to trust nontraditional food products. Many participants felt that an effort to learn what consumers really think and their key concerns is critical to gaining acceptance of alternate food products.

- **Intellectual Property Rights:** Intellectual property issues create barriers to developing new market opportunities because patents are too broad, inhibiting innovation and entry of other similar developments. In addition, areas that cannot be protected are not as readily developed, such as nutraceuticals, where many substances are widely available. Industry does not want to expend dollars or human resources on development of products that cannot be effectively protected from competition, regardless of the benefit to the public.
- **Complicated/Unpredictable Standards and Regulations:** Lack of definition (in some areas) and cohesiveness of national and international standards and regulations governing biotechnology-based agricultural and food products creates a significant barrier to entry of new products. This lack of international agreement on standards and regulations affects the public trust, in turn slowing the market entry of nontraditional products.

Other barriers to entry include the capital costs associated with changes in infrastructure necessary for new products and processes, the shortage and lack of integration of resources available to develop and market these products and processes worldwide (especially developing countries), and the lack of a comprehensive management/integration system for transferring technologies to the field.

The ability of the industry to overcome these barriers will dictate the future success of biotechnology related food products and processes.

Key roles to be played in overcoming barriers and seizing opportunities include:

- Open discussions and involvement with consumers regarding the positive and negative implications of the use of these alternative products and processes. The availability of information and education on the topic will frame these discussions effectively. Mechanisms for assuring that industry will appropriately manage the introduction and control of these products and will deal responsibly with unintended consequences such as creating environmental imbalances. Full disclosure labeling of agricultural and food products produced using biotechnology.
- Worldwide harmonization and streamlining of regulations and standards to increase public trust and create an environment for more efficient introduction of new products and processes.
- Carefully cultivating and maintaining a proper balance between development of patentable and freely available products and processes.

Participants agreed that consumers need to recognize their own responsibility in this issue, educate themselves, and become actively involved in open dialogue and discussion. The public can best play a role if they are educated and aware of the research and development, regulatory, and political issues.

The group's recommendations include:

- *Increased Public Input and Awareness: It was agreed that most importantly, increased public input and awareness must occur. Consumers must be kept informed and provide input in areas such as directions for public research in biotechnology products and processes, regulatory progress and issues, and methods for prevention of unintended consequences resulting from use of these products.*
- *Ensure That Industry Take Clear Responsibility for Risk: Participants also recommended that some mechanism be established for industry to better internalize the risk and establish improved accountability should negative consequences occur, such as the medical device industry in the case of breast implants.*
- *Establish Competitive Research Consortia: Establishment of competitive research consortia to share and leverage knowledge and expertise was felt to be a recommendation that would be successful to the development of new products and processes.*
- *Allocate Monies to Examine Social, Ethical, and Legal Issues: Several participants felt that public and private research and development should include a component for allocation of monies to examine the social, ethical, and legal issues surrounding the topic as is being done in the Human Genome Project.*

SOCIAL ISSUES, REGULATIONS AND ETHICS

Participants were asked to identify the most important public concerns with new agricultural biotechnology products. The following were identified as most important:

- **Safety and Health:** Concerns over the safety of biotechnology-based food products, the potential for allergens, and the potential for decreased nutritional value contribute to the general public concern over these products.
- **Lack of Control/ Fear of the Unknown:** Considerable discussion took place on this topic, and included concerns over the irreversibility of introducing genetically engineered materials into the environment, the lack of control over such a release, and the potential disruption and impact on the ecosystem.

- **Structural Changes in Agriculture:** This concern is centered around the structural changes that will likely occur as a result of increased agricultural engineering, and include the evolution of monopolies and consolidation of the food supply through vertical integration, the impact on small to medium sized farming operations, the political implications resulting from a consolidation, and the potential for “new use” agriculture to compromise our ability to feed the world.

Conversely, those features most likely to be viewed as positive by the public include;

- **Increased Food Quality:** Genetic engineering will provide products with increased nutritional value, longer shelf life, and more cosmetic appeal.
- **Improved Food Safety:** Advances in technology will decrease the use of pesticides through development of disease resistant strains and improve food safety through longer shelf life and the inclusion of contaminant indicators in food packaging.
- **Maintain a Low Cost Food Supply:** Higher yielding, disease resistant crops, more efficient processing methods, and longer shelf lives will help to maintain a low cost food supply.

The use or intended use of alternative products raises ethical issues that need to be addressed before acceptance can be achieved. Our responsibilities in addressing the ethical issues in biotechnology have dramatically increased due to the speed of change and the potential for much greater consequences than in other areas. Among the ethical issues to be considered are:

- **Playing God:** Considerable concern was expressed regarding the issue of the sacredness of life and the right of scientists to alter traditional life forms. Should we cross natural barriers in creating or modifying life forms? Greater concern was expressed over altering animal life forms than plants, but each present significant ethical issues.
- **Ownership of Life Forms:** Who owns the genes and germplasm resulting from biotech research? Are these life forms patentable?
- **Technology for Technology's Sake:** Should we use a technology simply because we can? Should we not return to traditional methods? We have a greater understanding of traditional methods, why not use that understanding to achieve our objectives rather than pursuing a controversial technology area?

- **Research Funding:** Given the controversial nature of this area, should public monies be used to fund research in biotechnology?
- **New Product Decisions:** Who really decides which products are developed and introduced in the market? Are negative social and ethical issues overlooked in the rush to profits? Should the economic/profit motive be the sole driver, or should social issues factor much more strongly in the equation?

Can regulation provide some level of control over the types of products developed and introduced, and will it help to ease some of the ethical concerns? The public has the right to know the origin of the products they are consuming, whether they are genetically-engineered or contain other additives and by-products. Consumers are asking questions such as “Why are genetically-engineered products not labeled?” and “Does the industry have something to hide?” Legislation requiring explanatory labeling of genetically-engineered food products will have a positive impact on how the industry is viewed. Public opinion plays a key role in acceptance or rejection of nontraditional food products, and can help determine the ultimate outcome through public interest groups, the media, and other public forums.

ECONOMIC AND STRUCTURAL ISSUES

The introduction of new products and processes in the food industry will pose economic and structural issues to all facets of the industry. Discussions on this topic centered around the impacts of new products on agriculture and food processing, how farmers can best prepare for changes, and what partnerships can be developed to take advantage of opportunities. Economic and structural issues are difficult to address, however, due to the broad underlying issues of markets, societal developments, and politics. In addition, dealing with a multi-national/global industry on a national level presents tremendous difficulties.

Potential impacts of new products on agriculture being adopted by the marketplace include:

- **Horizontal Integration:** New classes of agricultural products will provide linkages and involvements with other sectors, including pharmaceutical, energy, and environmental. This will potentially provide additional or modified income sources for producers. This expansion into other industrial areas could also impact negatively our ability to feed populations, should land use be increasingly diverted to nonfood agriculture.
- **Vertical integration:** Control of food production is likely to lead to consolidation in the industry, which may lead to greater control over

the food supply by the industry and reduced availability in the types and varieties of products. Because of agricultural production exclusively for export use, large multinational farming organizations will likely have less interest in maintaining the overall quality of the land and those communities producing agricultural products, leading to displacement of native populations. Industry, by nature of market forces, tends to take a short-term, profit-oriented approach and does not place significant value on the long-term, public good aspects of their actions.

- More dependable food sources with increased nutritional value and safety will likely result through new agricultural and production processes.
- Resistant Strains: Increased use of biotoxins will likely cause very strong selective pressure for insect and disease resistance, potentially resulting in super strains, and devastating impact on agricultural production.
- “Quick Fix “ approaches may distract attention from the broader social and ethical issues, such as more effective distribution of food products to starving populations.

In preparing for this new model of agriculture and food production, the question of what the farming model will look like in 15-20 years needs to be considered. Will it be more highly industrialized with a small number of multinational conglomerates controlling agriculture and producing the bulk of the food supply? Will the small to medium size farming operation survive and thrive? Participants expressed the view that farmers can best prepare for the future by:

- *Staying Informed: Farmers must educate themselves on the technologies available, as well as the political and regulatory climate that exists, and keep up to date on current and anticipated impacts and opportunities.*
- *Get Involved: The voice of the farming community is becoming unified, and will gain effectiveness as the numbers of those involved increases. Participation in the political and developmental process is a necessity.*
- *Consider Alternatives: If vertical integration does occur, farmers must be prepared to seek alternative ways to survive and thrive. These include teaming up to form co-ops or other partnership operations which can compete with large industry, and developing production and distribution alternatives such as community shared agriculture (CSA) and organic farming.*

Biotechnology-based agricultural and food products and processes have the potential for tremendous impact on our society. The question of whether that impact is positive or negative is cause for considerable debate in all sectors. Our society has evolved to the point where we tend to focus on those short-term solutions to the detriment of the potential long-term, global impacts of our actions. We cannot afford to take that approach in the biotechnology sector, as the stakes are too high. A holistic, balanced approach is necessary by all parties involved to assure a proper balance for the future. It is our responsibility to consider the fundamentals first, and continuously maintain a focus on the global issues and impacts in order to assure a successful future. In the area of biotechnology, the definition of a successful future is still open.