APPLICATIONS OF BIO TECHNOLOGY IN FOOD INDUSTRY

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ABSTRACT

Biotechnology has introduced a new dimension to Agricultural and Food production in an environmentally sustainable manner. Biotechnology's influence on four principal areas in the food industry is crop and animal agriculture, Bioprocessing, and diagnostics. Using Biotechnological tools we can enhance the growing season, yield, disease and pest resistance of crops and the nutritional content, texture, color, and flavor of foods. By applying transgenic techniques to farmed animals we can improve their health, fitness, efficiency of production, growth and other qualities such as meat and milk. In addition new products, including Biodegradable products, Bioprocessing using engineered microbes, offers new ways to treat and use waste and to use renewable resources for materials and fuel. Using these technology microorganisms can be engineered to convert maize and cereal straw, forest products and municipal waste, and other biomass to produce fuel, plastics, and other useful commodities. The coming generations of biotechnologically developed crop plants show traits such as improved yield, tolerance to abiotic and, biotic stress. They can act as biomass feedstock's for biofuels and "bio-synthetics;" value-added output traits such as improved nutrition and food functionality; and plants as production sources for therapeutics and industrial products. In recent years using Metabolic engineering significant progress has been made in the molecular dissection of many plant pathways and in the use of cloned genes to engineer plant metabolism. Now Scientists are trying to design "Minichromosomes" that carry cassettes of genes, enhancing the ability to engineer plant processes such as the production of complex Biochemical's. The new tools of biotechnology hold promise for meeting the needs of our rapidly growing world population more efficiently, cost effectively and in an eco friendly manner.

Keywords: Transgenic techniques, Metabolic engineering, Bio-synthetics, Bioprocessing, Value-added products.

The series of technologies applied to living organisms or their sub cellular components to develop useful products, processes, or services is Biotechnology. Biotechnology has introduced a new dimension to Agricultural and Food production in an environmentally sustainable manner. Efficient and cost-effective, novel, value-added products can be produced using Agricultural biotechnology. Biotechnology has the potential to increase food production to meet the demands of increasing world population, to improve food quality, to reduce the usage of chemicals in agriculture, to produce disease and pest resistant plants all in an environmentally sustainable manner. This technology can also be used to address food intolerances, to reduce food allergens and naturally occurring toxins in plants.

APPLICATIONS OF BIOTECHNOLOGY:

Biotechnology has its new applications in each of the following food-related areas like enzymes, including the processing of cheese; fermentation, brewing and wine making; agricultural raw materials (e.g.,crop plants, meat, poultry, fish) with improved functionality; and plant cell bioreactors for food ingredient production.

ENZYME PRODUCTION:

Proteases and Carbohydrases are the most commonly used enzymes in food industry. Other enzymes include lipases in cheese making, pectinases in juice processing an α-amylases in retarding bread staling .Two recent, important applications of genetic engineering to enzyme production are α-amylase and chymosin. α-Amylase is the enzyme used in the first step in the production of high-fructose corn syrup (HFCS), a widely used nutritive sweetener derived from cornstarch. HFCS is used in many processed food products and is the principal nutritive sweetener of the soft drink industry. Through biotechnology, Genetically engineered chymosin, the active component of rennet used in the dairy industry to coagulate milk to form curds in the cheese-making process similar to calf rennet was commercially produced. Other applications of genetic engineering for the food industry include production of enzymes like lactase, to break down milk lactose; lipase and esterase, to develop cheese flavor; pectinase, to improve yield, reduce viscosity, and enhance clarification in fruit juice processing and wine making; protease, to serve as a malt substitute when used with barley; and carbohydrases, to facilitate carbohydrate metabolism in low-calorie beer production.

BREWING

Using genetically engineered Yeast,a low calorie beer without requiring the use of added enzyme preparations is produced in Wine Making by Fermentation .Industrial yeast strains used in wine making are genetically engineered to introduce the capability for malolactic fermentation. In the strategy proposed by Snow (1985) and experimentally investigated (Williams et al., 1984), when the malolactic gene of Lactobacillus delbrueckii was introduced into a laboratory yeast strain. malolactic gene was expressed and limited malate conversion occurred.

AGRICULTURAL RAW MATERIALS

Through Plant biotechnology Crops may be specifically improved for functional attributes, such as nutrition, flavor, texture, and processibility. These improvements result in added value to the food processor as well as to the consumer. To generate genetic variability and diversity for traits of interest in crop plants and to construct genotypes with new gene combinations from which new plant varieties are developed, modern breeding strategies use a wide range of genetic tools and germplasm resources and then new plants are selected through a series of trials and evaluations. Cellular level manipulation of organellar genomes for cytoplasmic male sterility (Cocking, 1985) and the introduction of genes controlling self-incompatibility (Nasrallah and Nasrallah, 1985) are the New hybridization systems for production of hybrid seeds. Through Somatic embryogenesis plants can be cloned in large scale.

NEW GENETIC TECHNIQUES.

Crops with desirable traits can be produced by using technologies like gamete culture, protoplast fusion, somaclonal variation, somatic cell genetics, and molecular approaches to gene transfer. Somaclonal variation is a commonly observed phenomenon in plants regenerated from in invitro cultured cells or tissues cells or tissues .It is an efficient method to generate useful genetic variability in several crop plants, notably tomatoes (Evans and Sharp, 1983) and wheat (Larkin et al., 1984).Through Gamete culture haploids and doubled haploids for rapid development of homozygous breeding lines (Baenziger et al., 1984) can be developed. It is used in the generation of several new varieties of rice, tobacco plants. Protoplast fusion techniques are used to produce somatic intergeneric hybrids. New gene combinations among distantly related plant species can be developed by the production of asymmetric hybrids by fusion with irradiated protoplasts. The use of protoplasts to substitute or exchange cytoplasm to generate cytoplasmic male sterile (CMS) lines is of great practical value to plant breeders. Through Gene transfer technology the genetic traits of plants can be manipulated.

Most crop plants can now be efficiently transformed either through Agrobacterium- mediated gene transfer (Horsch et al., 1985), direct DNA transfer by uptake into protoplasts (Potrykus et al., 1985), or microinjection (Crossway et al., 1986). viral genes (e.g., the tobacco mosaic virus coat protein) expressed in plants to confer resistance, bacterial genes (e.g., EPSP synthase) for herbicide tolerance (Comai et al., 1983), and insect genes (e.g., luciferase) for visual tracking and expression of transferred genes in situ (Ow et al., 1986) are introduced for better crop production.. Examples of food industry applications are improved texture and cooking properties of rice, enhanced sweetness and mouth feel, e.g., creaminess of sweet corns, and antistaling characteristics of wheat flours for baked goods. Several strategies are being pursued to improve the essential amino acid balance of cereal grains and legume crops required in human and animal nutrition.

Molecular approaches are also making progress. Larkins (1987) reported that several laboratories are modifying seed storage protein genes by inserting specific sequences or making specific base substitutions to produce endogenous seed storage proteins containing higher levels of the limiting amino acids. Another approach involves either enhancing the expression of endogenous genes coding for nutritionally rich proteins or introducing seed storage protein genes from heterologous species to improve the amino acid balance (Rao and Singh, 1986). Several groups (Rattray, 1984; Sharp, 1986) are manipulating lipid biosynthesis to improve oil content and to modify triglyceride composition to enhance value (e.g., the production of coconut type oils in soybean or rapeseed). In plant cell technology, methods to transform cereal crops such as rice and corn (Fromm et al., 1986; Potrykus et al., 1985) and to regenerate plants from protoplasts (Abdullah et al., 1986) were recently reported. Soybeans, which have proven to be very resistant to cell culture manipulation, can also be regenerated (Collins et al., 1985). Thus, key techniques are now in place for most important food crops.

ANIMAL BIOTECHNOLOGY:

Most of the current applications of animal biotechnology are related to the production of (Evans and Hollaender, 1986); bovine growth hormone work, vaccine production, disease prevention, and embryo manipulations (sex selection, twinning, embryo storage, and transfer). Transgenic farm animals are yet to be developed in the future. Biotechnology's influence on four principal areas in the food industry is crop and animal agriculture, Bioprocessing, and diagnostics. By applying transgenic techniques to farmed animals we can improve their health, fitness, efficiency of production, growth and other qualities such as meat and milk. In addition using this technology new Biodegradable products are produced.]

BIOPROCESSING

Bioprocessing using engineered microbes, offers new ways to treat and use waste and to use renewable resources for materials and fuel. Using these technology microorganisms can be engineered to convert maize and cereal straw, forest products and municipal waste, and other biomass to produce fuel, plastics, and other useful commodities. The coming generations of biotechnologically developed crop plants show traits such as improved yield, tolerance to abiotic and, biotic stress. They can act as biomass feedstock's for biofuels and "bio-synthetics;" value-added output traits such as improved nutrition and food functionality; and plants as production sources for therapeutics and industrial products. There are several technical, regulatory, and perception challenges in Developing and commercializing plants with these improved traits. Both the panoply of traditional plant-breeding tools and modern biotechnology-based techniques will be required to produce plants with the desired quality traits.

METABOLIC ENGINEERING

A complimentarily of both traditional and novel techniques, is needed to metabolically engineer plants to produce desired quality traits. Metabolic engineering is generally is the redirection of one or more reactions to improve the production of existing compounds, produce new compounds, or mediate the degradation of undesirable compounds. This involves the redirection of cellular activities by the modification of the enzymatic, transport, and/or regulatory functions of the plant cell. Significant progress has been made in recent years. Significant progress was made in understanding of many plant pathways.

By using genomics, proteomics, metabolomics a number of new approaches are being developed to counter some of the problems in metabolic engineering. Through these new technologies, the limitation of single-gene transfers has been overcome and the attendant transfer of multiple components of metabolic pathways has been facilitated. For example, it is now possible to design "minichromosomes" that carry cassettes of genes, enhancing the ability to engineer plant processes such as the production of complex biochemicals. This system has an added advantage from a commercial perspective in that these methods circumvent problems with traditional approaches which not only limit the amount of sequences transferred but also may disrupt native genes or lead to poor expression of the transgene, thus reducing both the numbers of transgenic plants that must be screened and the subsequent breeding and other related steps required to select a suitable commercial candidate

CONSUMER ACCEPTANCE

Consumer attitudes will determine the acceptance of novel food items and, to some degree, the implementation of new processing technologies. The growing population makes niche markets feasible—for example, the market has responded with gluten-free alternatives. Consumer attitude is very important in the introduction and adoption of technologies.

CONCLUSIONS:

Our modern food system is very complex and has been changing continuously in time and space.Through Biotechnology, advances in agriculture and food science and technology have provided reduction in nutrient deficiency-related diseases; enhanced food safety and consistent quality; decreased home food-preparation time; a large variety of delicious food choices; reduced food waste; lower household food costs than ever before; food and meal convenience options; products specifically formulated to meet the nutritional needs of specific subpopulations; and efficient global food distribution, which can be exploited in times of natural and man-made disasters. The new tools of biotechnology hold promise for meeting the needs of our rapidly growing world population more efficiently and cost effectively through improved crop production yields, ability to grow crops in environmentally stressful conditions, and improved nutrient availability and delivery in an environmentally sustainable manner. Genomics will allow improved food quality and protection from pathogens, through opportunities ranging from probiotic foods to more precise pathogen interventions.

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