

Biotechnology - A Recent Development In Agriculture

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ARTICLE ID: 001

Introduction

Biotechnology may be defined as use of micro-organism, animals, plant cells or their products to generate different products at industrial scale and services useful to human beings.

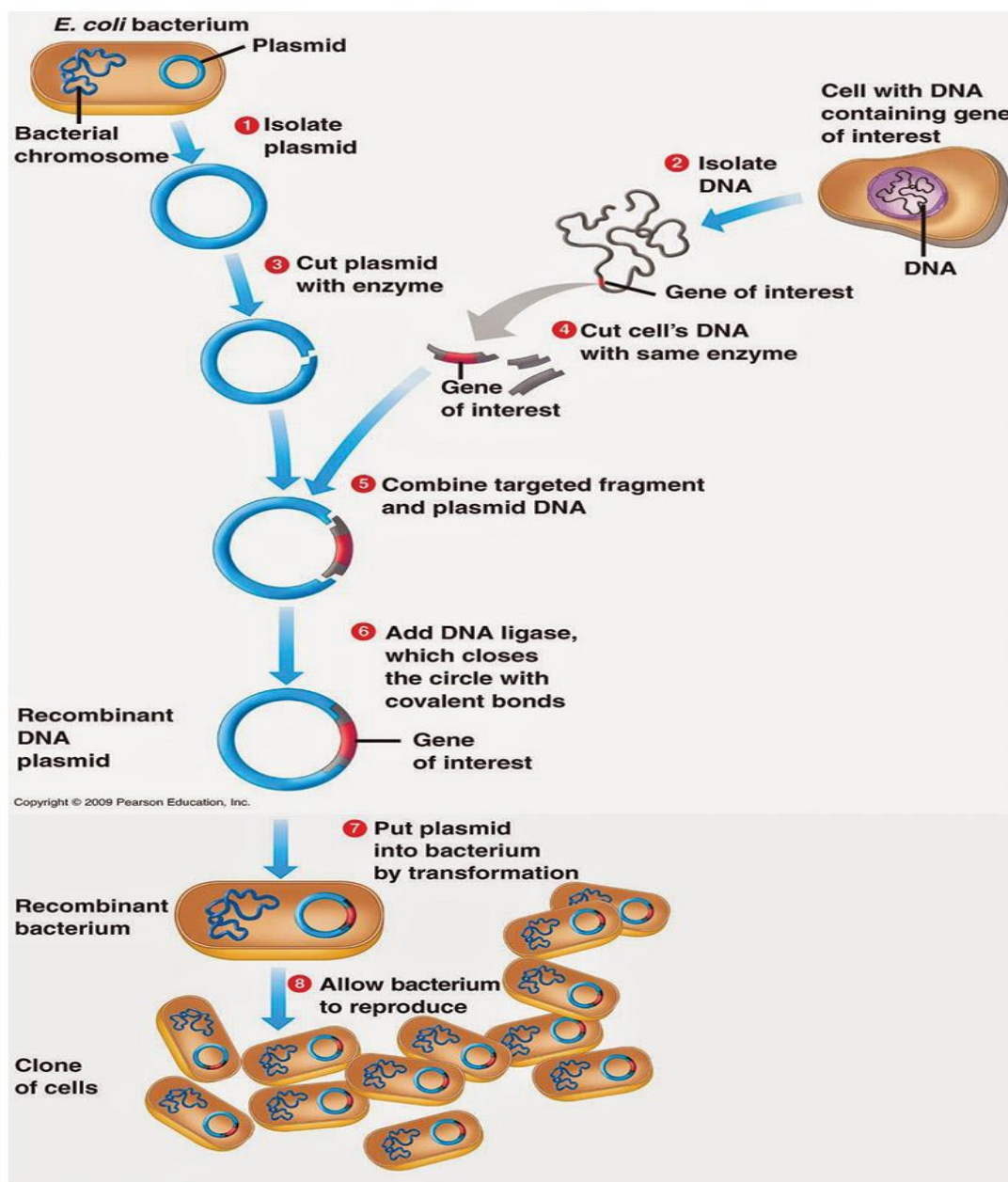
The European Federation of Biotechnology broadly considers biotechnology as “the integration of natural science and organism, cells, parts thereof, and molecular analogues for products and services”.

Old biotechnology is the kitchen technology developed by our ancestors using fermenting bacteria. Traditional biotechnology refers to the conventional technology which has been used for many centuries. Beer, Wine, Cheese and many foods have been produced using traditional biotechnology. Modern biotechnology embraces all methods of genetic modification by recombinant DNA and cell fusion technologies.

Principles of Biotechnology

Modern biotechnology is the results of the following two core techniques-

- 1. Chemical Engineering** – maintenance of microbial contamination free eukaryotic or microbe cell in order to manufacture biotechnological products like enzymes, vaccines and antibiotics.
- 2. Genetic Engineering** – It includes several techniques that facilitate the alteration of genetic material that is DNA or RNA in order to introduce them in host organism.



Representation of Gene Clong and Recombinant DNA Technology

Role of Biotechnology in Agriculture

- 1. In crop production** – With better disease control and increased tolerance to drought and flooding, biotechnology leads to a significant increase in crop production. This just not matches the ever growing demand for food but also helps farmers to lower losses.
- 2. Better crop protection-** the techniques of biotechnology serve as cost effective solutions to problems pertaining to pests. Farmers have been

able to able to transform crops like cotton, corn and potato to synthesize a protein that tackles issue of pest specificity.

3. **Increase in nutrition value-** It has enabled farmers to produce crops with a higher nutritional value and enhanced flavor and texture. For instance, the technology has made it possible to cultivate soybeans with high protein content, beans with more amino acids and potatoes with starch.
4. **Fresher produce and better taste-** It further helps to improve the taste and flavor of crops by enhancing the activity of enzymes present in plants. Also it helps in keeping the yield fresh for longer.
5. **Chemical tolerance-**Most farmers rely on herbicides to control the growth of weeds which often leads to soil erosion. However in genetically engineered food is resistant to a variety of chemicals, including herbicides; as a result, the scale of soil erosion is significantly low.
6. **Disease resistance** - Viral infections spread by insects are often difficult to contain, and also the use of insecticides tend to pose to threat to both soil and quality of produce. Nonetheless, genetically modified plants are less susceptible to viral infections and make it easier for farmers to contain crop damages.

Some Advancement:

Genetically Conferred Trait	Crop Modified	Genetic change
Products approved		
Herbicide tolerance	Soybean	Glyphosate herbicide (roundup) tolerance conferred by expression of a glyphosate-tolerant form of the plant enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) isolated from the soil <i>bacterium A. tunefaciens</i>
Insect resistance	corn	Resistance to insect pests, specifically the European corn borer, through expression of the insecticidal protein cry1AB from B.T

Altered fatty acid composition	Canola	High laurate levels achieved by inserting the gene for the ACP thioesterase from the California bay tree <i>Umbellularia californica</i> .
Virus resistance	Plum	Resistance to plum pox virus conferred by insertion of a coat protein (CP), gene from the virus.
Products being developed		
Vitamin enrichment	Rice	Three genes for the manufacture of beta-carotene, a precursor to vitamin A, in the endosperm of the rice prevent its removal (from husks) during milling.
Vaccines	Tabacco	Hepatitis B virus surface antigen (HBsAg) produced in transgenic tobacco immune response when inject into mice.
Oral vaccines	Maize	Fusion protein(F) from Newcastle disease virus (NDV) expressed in corn seeds induces an immune response when fed to chickens.
Faster maturation	Coho salmon	A type 1 growth hormone gene injected into fertilized fish eggs result in 6.2% retention of the vector at one year of age, as well as significant increase in growth rates.

Related work of Biotechnology in Agriculture :

Micro Propagation of Disease -Free Plants Like Banana Micropropagation represents a means of regenerating disease- free banana plantlets from healthy tissues. It has all the advantages of being a relatively cheap and easily applied technology. (Milu, 2008)

Agriculture On Acid Soils – Improved cultivars that are tolerant of aluminium can be developed alternatively. Rye exhibits a fourfold increase in aluminium tolerance over wheat. (Kole, 2011)

Fortification Of Crops-Certain crops are enriched with nutrients to reduce the malnutrition children in developing country. ‘**Protato**’ which is genetically engineered potato in India produces about one-third to one half more protein than usual, it also have substantial amounts of all the essential amino acids such as lysine and methionine. Similarly **Golden rice has been** genetically engineered to produce beta-carotene the precursor of vitamin A. so it can be used to recover the vision problem caused by vitamin A. (Ye *et al.*, 2000)

Pest And Herbicides Resistant Cultivars- The common soil bacterium *Bacillus thuringiensis* (Bt) genes have been inserted to build up a particular protein in cotton crop. This protein is toxic to certain insects such as pink boll worm (*Pectinophora gossypiella*). As, a result of **Bt cotton varieties** have superior yield performance over a wide range of growing conditions.

Breeding and reproducing in Aquaculture- Reproductive biotechnology in fisheries provides opportunities to increase growth rates and improve the management of farmed species and to limit the reproductive potential of genetically engineered species.

Artificial Insemination (AI) and Multiple Ovulation/Embryo transfer in Livestock- Advancement in artificial insemination (AI) and multiple ovulation followed by embryo transfer (MOET) have already had a major impact on livestock improvement because they trigger up the process of genetic improvement, reduce the risk of disease transmission and expand the number of animals that can be bred from superior parents. (McCullough *et al.*, 2008).

Production of Biofuel By agricultural wastes- Biofuel are great substitution of fossil fuels. Many agricultural wastes such banana plants are used in India. As banana pseudostem is commonly available to be used as lignocellulosic substrate. *Aspergillus ellipticus*, *Aspergillus fumigatus* and *Saccharomyces cerevisiae* are used in pretreatment saccharification of cellulosic substrate.

Diagnostics and Epidemiology- Advanced biotechnology based diagnostic test such as ELISA and PCR make it possible to identify disease causing agents and to monitor the impacts of disease control programmes to a degree of precision not previously possible.

Use of Biofertilizers- Biofertilizers made as crops seed coated with different microorganism as example *Penicillium bilaii* involve in dissociation of phosphate in soil so roots can easily absorbed and similar way associated with use of Rhizobium which involves in nitrogen fixation.

Conclusion

Agricultural biotechnology applications are held helpful in sustained food production. Biotechnology is a complement not an alternate for many areas of conventional agricultural

research. It offers a variety of tools to improve our understanding and management of genetic resources for food and agriculture. As by reducing the cost of production by reducing the need of pesticides spray and fertilizer, development of new varieties that produce high yield and possess tolerance to abiotic stress. The application of biotechnology provides the researchers with new knowledge and tools that make the job more effective and efficient. The biotechnology also strikes the challenges of environment which affecting the agriculture directly or indirectly.

