



POSITIVE AND NEGATIVE ROLE OF BIOTECHNOLOGY IN HUMAN LIFE: A REVIEW

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ABSTRACT:

Biotechnology contributed with a wide spectra in human life. The fields like agriculture, medicine, diagnosis, textile, food, environment and many more are highly captivated by various deliberating inventions of biotechnology. Advancement in it could led to the development of cellular engineering, biomaterials, biochips, stem cells, gene engineering and so proceeding rapidly. Due its interdisciplinary nature, it has progressed in all possible branches and have spread wings at social, political, economical, environmental and global levels. In a directive to meet needs of fast growing population, biotechnologists are oftenly engaged in the new invention in various grounds of biology. In some extent, we could achive our goal but some unidirectional and unpredicted experiments of biotechnology triggered some antagonistic and unexpected effects too. Evolution of novel microorganisms leading to new disease, side effects of GM foods, troubling ecological balance, loss of natural gene combinations, developed resistance by pests etc are some ill effects of biotechnology. In the present article, an attempt and approach is made to discuss some positive and negative implications of biotechnological inventions so, that common people can get awared of everything they using for their livelihood. It is expected that, in the near future we should control some harmful trials and accelerate some fruitful investigations by taking care of welfare of human being and surroung environment.

Key words: - *Positive, Negetive, Biotechnology, Environment, GM Foods, Bioplastic*

INTRODUCTION:

Biotechnology, an interdisciplinary branch of biology could successfully make a way in different modern inventions. It involves the utilization of living things like cells and bacteria for production of various products of plant and animal origin for the wlefare of human being. It has the combinations of not only biology but mathematics, physics, chemistry, engineering and so many other disciplines. Now a days, biotechnology and its applications ranges from agriculture, medicine, plant physiology, antomy, seed technology, textile, food, nutrition, pharmaceuticals etc. Modern biotechnology is more progressive and advanced than the old was. Different inventions took place till today could combat rare diseases, controlled environmental pollution, meet hunger, and safer and cleaner industrial manufacturing

processes. The fields like genetic engineering, tissue culture, cloning, disease diagnosis, gene therapy, monoclonal antibodies and so on are the wonderful inventions revolutionised the world. Biotechnology has some drawbacks too like uncertainty, costs of the products, and some etical issues regarding clonning, xenotransplantation, stem cell research etc. In the present article, author has made an attempt to review some positive and negative implications of biotechnology.

POSITIVE ROLE OF BIOTECHNOLOGY

Expansion of world population and fulfillment of all food related needs of human being is the main need of GM foods. Decrease in fertile land due to many manmade calamities like, urbanization, industrilization is main reason of decrease in food production which can be recovered by the use of high yielding genetically modified foods. Conventional

breeding has some loopholes which can be filled by advanced techniques used in genetically modified foods. By keeping above needs in mind GM foods have been developed by using some advanced methods including direct DNA transfer and editing of genomic DNA. The data provided in the article reveals that, GM foods increased food production up to 370 million tons during 1996 to 2012. From 2006 to 2012, the global farm income also increased up to 116 billion dollars Chen Zhang et. al. (2016). This increase in production and income is due to the advanced genetics and resistance to pests and weeds. It is evident that, GM food not only increased the quantity, but it has improved quality of the food. Chemical composition of foods like vitamins, fatty acids, cellulose etc also enhanced in GM foods as compare to natural foods (Key et. al., 2008).

GM foods can also revolutionised the food processing. By some genetic changes in tomato, potato and other food crops, scientists could make insect resistant crops expressing the *bt* gene from *Bacillus thuringiensis* and also improved shelf life and attractiveness in food materials. It is also achieved in animals especially fishes by improving the growth and body mass. For instance genetically modified fish Salmon have the natural full size growth period is 3 years rather GM fish grow fully in 18 months. GM foods also enriched with some therapeutic bacterial and viral antigens, so they may be serve as oral vaccines. (Chen Zhang et. al., 2016, Key et. al., 2008).

Biotechnologists, throughout the world has genetically modified varieties of many food plants like tomato, potato, tobacco, maize, soybean, golden rice and papaya. These plants shows some characters like insect resistance, stronger crops, larger production, environmental protection through minimising green house gas emission, crop protection

from diseases, more nutritious foods, Decreased use of pesticides, more income and less deforestation by increased crop production and decrease in food price (Mathur, 2018).

Apart from their, above uses GM plants are also being assessed for the selective removal of pollutants from the soil- a process known as phytoremediation. Plants are genetically engineered to accumulate heavy metal contaminants of the soil such as mercury and selenium. These plants can be grown on the contaminated sites, harvested and destroyed, the heavy metals disposed of or recycled and the decontaminated field can be reused to grow other crops (Key et. al., 2008). A review was published by Wim and Erick (2006) on impact of industrial biotechnology and its applications. In this context, they expected a transition from a fossil-based to a bio-based economy and society. The new biotechnology refers to green chemistry in which renewable resources such as sugars or vegetable oils are transformed into a wide variety of chemical substances like pharmaceuticals, biocolourants, bioplastics, vitamins and food additives. Also industrial biotechnology is used to produce a wide variety of bulk and fine chemicals alike alcohol, lactic acid, citric acid, amino acids, solvents, antibiotics, flavours and aroma, biopolymers, bio-surfactants, alkaloids, bioplastics, steroids etc. Genetic engineering has been applied for many crop plants as well as for many trees that are propagated in the forests. Advantages and disadvantages of plant genetic engineering is remained a centre of public debate. Mathews and Campbell (2000), in their comprehensive review discussed on advantages and disadvantages of genetically engineered trees. Inappropriate transgene may convert plants into a weed that may be harmful for an ecosystem. So, gene transfer should be done

by desirable traits in forest trees. The first group of genes govern agronomic traits i.e. vigour, resistance to pests and diseases and resistance to environmental stresses. The second group of genes govern traits that improve production, efficiency, product quality and product value i.e. genes that render wood for paper making and for construction purposes. The first genetically engineered tree was *Populus* sp. which carrying gene for herbicide resistance gene like *Roundup Ready*. This is the great success of genetic engineering which facilitated weed control during silviculture management of poplars. This experiment leads to increased herbicide pollution and checks soil erosion as well as poplars could successfully compete weeds for water, soil, nutrients and sunlight. Genetic engineered forest trees are also pest resistant due to their improved defence mechanism. Such trees do not need external use of pesticides which is unacceptable due to environmental and financial reasons. The transgene coding for toxin from bacteria *Bacillus thuringiensis* for such genetic engineering programme. Other advantages of genetically engineered forest trees are improved timber quality and density, modified lignin content etc. Food biotechnology is an emerging branch of biotechnology in which taste, shelf life, nutrition and quality of food have been enhanced. GM yeasts and bacteria are used to produce enzymes for the sake of food industry. Haroon and Mobeen (2016), have enumerated some applications of food biotechnology including fermentation, use of enzymes, improvement of food nutrition, yield, enhance the taste. Yeast is the most significant and easily available source for fermentation. Genetically modified yeast is used in production of light wine by the conversion of glucose into alcohol. Enzymes like, α -amylase, protease, catalase, glucose

oxidase, rennin derived from various fungi and bacteria are used in the production of different food products. In order to enhance the nutrition with respect to vitamins and minerals, iron, carbohydrates and lipids of our staple foods genetic engineering of some crops like rice, potato has been carried out. The gene coding for hormone bovine somatotropin is derived from *Escherichia coli* is inserted in the lactating animals could increase 10-12 % milk production. Agriculture biotechnology is the area of biotechnology involving applications to agriculture. Biotechnologists, throughout the world have concentrated on the enhancement of agricultural produce through genetic manipulation and genetic modifications. Ania (2003) in his findings put forth some advantages of agricultural biotechnology. Increased crop productivity, enhanced crop protection, improved food processing and nutritional value are some of the applications of implementing biotechnology in agriculture. The genetic engineering has allowed to identify and to isolate specific genes of the DNA in the donating organism by means of restriction enzymes that acts as 'chemical scissors'. This practice is very important to make agricultural crops more resistant to stresses and diseases, and enhancing the protein, oil and amino acid contents so as to enhance nutritious properties of fruits and grains (Sanchez and Maria, 2003). Petroleum based conventional plastic created various environmental issues like green house gas emission, littering and non-degradable waste generation (Ibrahim et.al., 2017). To conquer these problems, biotechnologists have discovered a new type of plastic known as bioplastic. Bioplastics can be classified into different classes viz. Bio-based, Bio-degradable and Biobased and biodegradable. Biobased bioplastics are made from some renewable resources like starch, sugarcane, hemp etc. which emits very less

carbondioxide and ecofriendly e.g. Polyethylene and Polyamide. Biodegradable is another class of bioplastics which automatically degrades in the environment without any additives and can be used for one time packaging. For example, Poly- butyrate adipate- terphthalate (PBAT), Poly-Caprolactone (PCL). Poly lactic acid (PLA) and Polyhydroxylalkanoates (PHA) are Bio-based and biodegradable type of bioplastics. (Pankaj kumar and Sonia, 2016) All these different types of bioplastics have some advantages over the conventional plastics. They includes unlimited raw material, biodegradable in nature hence ecofriendly, requires less energy for production, requires less dependancy on foreign oil and nontoxic in nature (Ezgi and Havva, 2015). These bioplastics are now being used in food industry, for water bottles and fruits packaging, in cosmetic industry for different type of beauty product preparation and packaging, Pharmaceutical industry for making gloves, tablete strips, etc and in automobile industry for the preparaion of parts of car.(Pankaj kumar and Sonia, 2016).Among the widely used bio-plastics poly lactic acids (PLA) is most widely used plastic which has found their applications in packaging of both short shelf life products like fresh fruits and vegetables and long shelf life products like potato chips and pasta (Jabeen et.al, 2015). Edible vaccines have received considerable attention from researchers in both academia and industry. Charles Arntzen (who was the first to use the phrase “edible vaccine”), with Hugh Masonand colleagues have pioneered the field with work on hepatitis B and heat labile toxin, B subunit,in tobacco plants and potato tubers. Edible vaccines have been shown to induce good mucosal immune responses (Sibila et.al.,2005). The advantages of developing vaccines in plants are the absence of contamination risk, inexpensive,

large scale production and most importantly the option of producing edible vaccines. The threat of bio-terrorism can also be eliminated in producing plant vaccines (Doddamane et.al, 2018). It is evident that, vaccines are ,most widely used thoroughout the world to minimize the rate of mortality in caused by infectious organisms. But, they have some adverse reactions on some individuals. Edible vaccines can be one of the alternatives of the traditional vaccines as they can overcome the problems associated with traditional vaccines. Edible vaccines can be produced by inserting a desired gene that codes for an antigen isolated from the microbes in to plant by one to different methods. A virus, bacterium or any other suitable vector can be used for the experiment (Joshi et.al, 2011). It can also achieved by biolistic or electroporation method. Some opf advantages of edible vaccines on traditional vaccines are their effective and targeted delivery, elicit mucosal immunity, cost effective in storage, their easy availability, etc. Now a days they are being used to cure gastrointestinal disorders, malarial, measles, rabies, hepatitis B, HIV and Chloera. Edible vaccine can be produced in plants like rice, wheat, tobacco, soyabean, lettuce, potato, banana etc (Nayik et.al., 2016). Edible plant derived vaccines may lead to a future of safer and more effective immunization. They have passed the major hurdles in the path of emerging vaccine technology. This technology would be useful in future for the complex diseases like HIV, malarial etc with which the scientific community still struggling (Lal et. al, 2007).

NEGATIVE ROLE OF BIOTECHNOLOGY-

Margherita (2016), Published a article on potential risks of genetically modified organisms. According to him genetically modiefied organisms though have some advantages, also have some disadvantages. It

is evident that, GMos arises some issues like high prices of patented seeds which have some obligation and prohibition of the traditional practices of saving seeds from previous seasons. This rule creates significant socio-economic and cultural dilemma among farmers. GMOs are also responsible in drastic reduction in crop diversity in the countries like USA, Canada, Argentina and Brazil. It is thought that, GMOs met the problem of hunger and poverty, but according to Margherita, GMOs failed to do so. GMOs also harnessed rules and regulations of patenting and intellectual property rights.

A critical review on the promise and problems of GM foods have been published by Chen Zhang et.al (2016). They summarized some benefits and potential problems of GM foods. According to them, genetically modified foods are uncertainly affects on human health and environment. Consumer are in anxiety regarding the less knowledge about biological techniques involved in the development, improper dissemination, ethical principles and adequacy of evaluation of genetically modified food. There three major risks of GM foodson health, including toxicity, allergenicity and genetic hazards which arise from three potential sources, the inserted gene and their expressed proteins, secondary or pleiotropic effects of the products of gene expression and the possible disruption of natural genes, in the manipulated organism. GM foods are also grounds some ecological risks including developed resistance by pest, weed and insect towards the pesticides, weedicides and insecticides respectively. Overuse of chemical pesticides and insecticides kills major types of pests which results in the increased number of minor pests. This shift may be responsible for the shifting of pests from genetically engineered plants to nonengineered undaunted species. This change finally disrupts entire

food chain. Overuse of antibodies in medical science gradually develops resistance in pathogenic bacteria against antibiotics.

GM foods may effectes allergic reactions, not fully environment friendly, affects biodiversity by dynamic changes in food chains and Decreases antibiotic efficacy. They may have unusual and unnatural taste, partially unsafe to consume, rises conflicts, can be misused as a weapon by enemies, give rise new diseases and somewhat costly than traditional foods (Mathur, 2018).

Key et. al., 2008, carried out a study on GM plants and concluded that, GM foods are not harmful to human health, because according to him millions of people consuming such foods have not shown any types of ill effects. However, potential toxicity of the protein expressed in a GM food should be assessed. Also, potential allergenicity to the novel gene product also checked thorough analytical tests. Because some GM foods can show allergic effects of human health. The allergic effects of GM foods can be screened by using some model animals like mouse. Genetically engineered forest trees have some potential environmental risks which cause economic and social loss. The scientific studies undertaken by scientists reveals that genetically modified forest tress has some side effects like transgene spreading by horizontal gene transfer which are responsible for becoming many exotic plants weedy. Enginnered sterility, hazards of resistant biotypes and altered multi-trophic processes causes negative impact on ecosystem((Mathew and Campbell, 2000). Ania (2003), has enlisted some potential risks of agricultural biotechnology which includes, some health related issues (Allergic and toxic nature of GM crops, antibiotic resistance), some environmental issues (Potential gene escape and superweeds, impacts on nontarget

species, insecticide resistance and loss of biodiversity) and some social issues (safety and regulation of GM foods). Bioplastics are the new biotechnological invention derived from biological resources is most significant and safe than the conventional plastics. People now started relay and use bioplastics but facing some problems which can be overcome by some efforts. Some disadvantages of bioplastics are, misconceptions, higher costs as compare to conventional plastics, Recycling of different types of bioplastics is not possible, no government support and limited supply of chemicals etc. (Pankaj kumar and Sonia, 2016) and lack of legislation (Ezgi and Havva, 2015). Edible vaccines could have a best alternative to traditional vaccines which causes some adverse effects in some individuals. But edible vaccines which are produced in some plants may have some disadvantages like, possibility of development of immunotolerance to the vaccine protein of peptide, consistency of the dosage differs from plant to plant, generation to generation, protein content, patients age, weight etc. Stability of vaccine also differs from plant to plant. Some foods containing edible vaccines like potato cannot be eaten raw and needs to cook can denature vaccines. Vaccine fruit and normal fruit cannot be differentiated which may cause misadministration of vaccine which could lead to tolerance (Joshi et. al., 2011).

CONCLUSION:

Biotechnology has successfully established its way through the many needs of human being. It is widely being used to fulfill all the basic requirements of human being including food, medicine, agriculture, health and so on. Genetically modified plants are proved to be boon to fulfill all the needs of growing population. In agriculture, GM crops are very superior than traditional crops in respect to

disease and stress resistance, nutrition and yield. Bioplastic is very fruitful discovery of biotechnology which will be responsible to control ever increasing plastic pollution. Edible vaccines have the ability to overcome the drawbacks of traditional vaccines. Not only this, different biotechnological inventions in textile, industry, food, enzyme technology and pharmaceuticals have played very crucial role in the welfare of human being. Still biotechnological products have some disadvantages too. GM foods though, increased yield, and nutritional potential of plants, it shows some negative effects like allergy to some individuals. In agriculture increased pest resistance, disturbance in food chain, uncertainty of GM crops are some issues related to environment. The products like bioplastics have some disadvantages like recycling, high cost and limited supply. Edible vaccines though a boon for medical science, it also has raised some issues like consistency of dosage and changing nature with different plants. But the intensity of advantages is more than the disadvantages. Some negative effects can be easily overcome by wide research in the field.

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