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Review Article

AN OVERVIEW ON CURRENT ADVANCES IN BIOTECHNOLOGY

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ABSTRACT

The review presents introduction to biotechnology and its current advances for the production of vaccines, pharmaceuticals, disease resistant plants, cloned animals, to name a few. The last 30 years, have marked incredible expansion in the biological sciences. We have the ability to use genetic information to produce new pharmaceutical products, disease-resistant plants and genetically modified microorganisms for industrial and environmental use.

KEY WORDS: Biotechnology, genetic engineering, Hybridoma cells, Monoclonal antibodies, Future aspects.

INTRODUCTION

Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents. The emerging branches of modern biotechnology include genetic engineering;culture of recombinant microorganisms, cells of animals and plants; metabolic engineering; hybridoma technology; bioelectronics; nanobiotechnology; protein engineering; transgenic animals and plants;tissue and organ engineering; immunological assays; genomics and proteomics; bioseparations and bioreactor technologies. Over the last 30 years, we have seen incredible expansion in the biological sciences. We have the ability to use genetic information to produce new pharmaceutical products, disease-resistant plants and genetically modified microorganisms for industrial and environmental use. But despite recommendations made years ago (Joint Oceanographic Institutions, 1990), marine biotechnology has been left behind. There have been splendid discoveries, nonetheless. Researchers have identified hundreds of marine microorganisms that have the potential to produce pharmaceutical compounds (Jensen and Fenical, 2000; Newman et al., 2000). They have discovered marine invertebrates that can be sources of new pharmaceuticals, cosmetics and nutraceuticals (Faulkner, 2000; Fenical, 1997; Hay and Fenical, 1996). They have experimented with new methods to raise fish, molluscs, crustaceans and algae in aquaculture (Chen et al., 1996, 1997; Neori and Shpigel, 1999, in press). Rapid development of intensive fed aquaculture (e.g., fish and shrimp) in coastal areas throughout the world has raised increasing concerns on environ- mental impacts of such often mono-specific practices (e.g., Wu, 1995; Mazzola et al., 1999). Researchers have also developed new remote sensing methods to detect marine environmental changes (Lobitz et al., 2000; Pascual et al., 2000). But marine biotechnology remains a promise.

GENETIC ENGINEERING- Genetic engineering, also called genetic modification. It can be understood as manipulation of an organism's **genome** using **biotechnology**. New **DNA** may be inserted in the host genome by first isolating and copying the genetic material of interest using **molecular cloning** methods to generate a DNA sequence, or by synthesizing the DNA, and then inserting this construct into the host organism. **Genes** may be removed, or "knocked out", using nuclease

1. GENETICALLY MODIFIED ORGANISMS

Plants, animals or micro-organisms that have changed through genetic engineering are termed genetically modified organisms or GMO Bacteria were the first organisms to be genetically modified. Plasmid DNA containing new genes can be inserted into the bacterial cell and the bacteria will then express those genes. These genes can code for medicines or enzymes that process food and other substrates Plants have been modified for insect protection, herbicide resistance, virus resistance, enhanced nutrition, tolerance to environmental pressures and the production of edible vaccine Most commercialised GMO's are insect resistant and/or herbicide tolerant crop plants genetically modified animals have been used for research, model animals and the production of agricultural or pharmaceutical products. They include animals with genes knocked out, increased susceptibility to disease, hormones for extra growth and the ability to express proteins in their milk

2. HYBRIDOMA TECHNOLOGY -

Hybridomas are cells that have been engineered to produce a desired antibody in large amounts, to produce monoclonal antibodies Monoclonal antibodies can be produced in specialized cells through a technique now popularly known as hybridoma technology. Hybridoma technology was discovered in 1975 by two scientists, **Georges Kohler of West Germany** and **Cesar Milstein of Argentina**, who jointly with Niels Jerne of Denmark were awarded the 1984 Noble prize for physiology and medicine. Generally, the production of one MAb, using the hybridoma technology, costs between $8,000 and $12,000.

APPLICATION OF MONOCLONAL ANTIBODIES:

1. Monoclonal antibodies are widely used as diagnostic and research reagents. They are used in diagnostic kits such as ELISA, Immunofluorescence to diagnose various diseases.
2. Enumeration of human lymphocyte subpopulations, anti-CD3 identifies all mature T lymphocytes, anti-CD4 identifies helper T lymphocyte subset, anti-CD8 identifies cytotoxic T lymphocyte subset.
3. Treatment with a cocktail of anti-CD3 monoclonal antibody and complement kills T cells in human bone marrow before transplantation, thus minimizes graft versus host reaction. Immunosuppression: anti-CD3 depresses T cell function and anti-CD4 induces tolerance.
4. Passive immunization: High titre antimicrobial human monoclonals can passive protection.
5. Blood grouping: anti-A monoclonal provides a more reliable standard reagent than conventional antisera.
6. Diagnosis in cancer: Monoclonal anti-T acute lymphocytic leukemia (ALL) allows differentiation from non TALL.
7. Imaging: Radioactive anti-carcinoembryonic antigen used to localize colonic tumours or secondary metastases by scanning.
8. Treatment of cancers: monoclonal antibody is coupled to a strongly-radioactive atom, such as Iodine-131 to aid in killing the target cancer cells.
9. Purification of antigen: Isolate antigen from mixtures by monoclonal affinity chromatography.
10. Chimeric monoclonal antibodies, which contain human Fc portion, are more useful for human use.

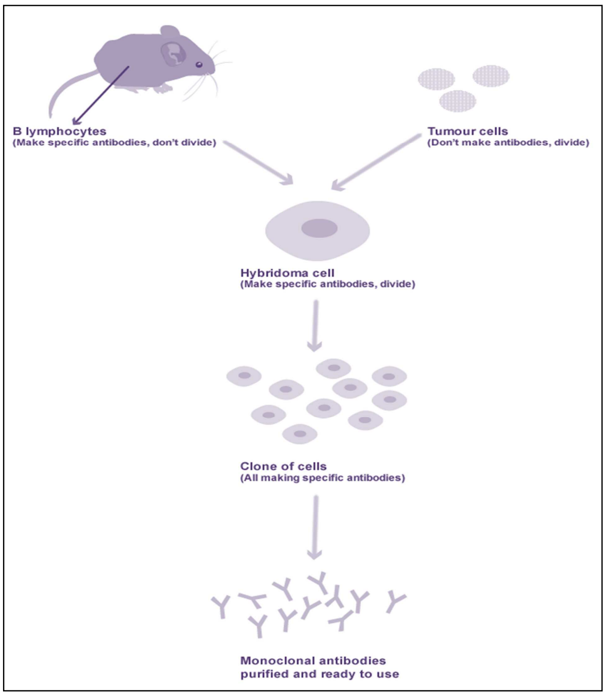

Figure no. 1. Development of monoclonal antibodies

3. MARINE BIOTECHNOLOGY ADVANCES TOWARDS APPLICATIONS IN NEW FUNCTIONAL FOODS

Nowadays consumers are increasingly aware of the relationship between diet, health and disease prevention. It is well known that consumption of foods such as fruits, vegetables, cereals and marine foods rich in polyunsaturated fatty acids (PUFAs) beyond meeting basic nutritional needs, is also fundamental for health promotion and disease risk reduction (Shahidi, 2009). Research studies in the past years have correlated diet and some chronic diseases, therefore highlighting the enormous potential of foods in the prevention and progression of chronic diseases such as atherosclerosis (Casós et al., 2008), cancer (Trottier et al., 2010) and symptoms relief in osteoarthritic patients (Ameye and Chee, 2006). Despite today's consumers being increasingly conscious of food safety, quality and health related issues, populations from the so called developed countries, namely populations from the European Union (EU) and United States of America (USA), still have much to do in what concerns strategies to fight modern age diseases such as cardiopathies, obesity, osteoporosis,

4. NEW HORIZONS IN PHARMACEUTICAL BIOTECHNOLOGY BY MELDING BIOLOGY AND ENGINEERING

In the realm of biologics-based therapeutics, antibodies have shown great clinical value. In the past decade, scientists and bioengineers investigated extensively the potential of antibody-based therapeutics and brought sev-eral lifesaving antibody-based drugs into the clinic. However, a universal solution for treating disease pathologies driven by complex and diverse physiological processes is still to be found. Genomics and proteomics help to improve our understanding of the molecular mechanisms underlying human disease and have provided new opportunities for protein-based drugs to address challenging clinical problems. Natural ligands and receptors, which inherently modulate complex biological processes, have emerged as prom-ising candidates for protein-based drug discovery efforts. Kariolis et al. review the protein engineering strategies, guided by a molecular or mechan- istic understanding of underlying biological principles, which have resulted in next-generation protein therapeutics with the promise of improved safety and efficacy.

5. PROSPECTS FOR THE USE OF PLANT CELL CULTURES IN FOOD BIOTECHNOLOGY

The advantages offered by cell culture production sys-tems should be appealing to the food ingredient and dietary supplement industries. Guaranteed GMP and consistency of product are both key issues for these industries. Moreover, some of the most desirable com-pounds are found only in small amounts in specific plant tissues, such as saffron spice compounds in the stigmas of Crocus flowers . Microbial cell cultures are already an established part of food industries, whether for bio-transformation in dairy fermentation or the production of recombinant chymosin for the cheese industry. In a notable recent advance, metabolically engineered yeast has been used to produce commercial omega-3 eicosapentaenoic acid products, to substitute for those derived from fish. Biotransformation applications have also been demonstrated using plant cell cultures, for example the use of Vanilla planifolia or Capsicum frutescens cultures to transform the ferulic acid substrate to vanillin. Thus, in theory, plant cell cultures offer a route to controlled large-scale production of food ingredients.

6. BIOTECHNOLOGIES APPLIED TO THE CHARACTERIZATION, CONSERVATION, AND UTILIZATION OF GENETIC RESOURCES FOR FOOD AND AGRICULTURE

For biotechnology applications to succeed, they should complement conventional conservation and breeding activities and build upon existing and active programs. Conventional breeding has provided enormous benefits in the past and will continue to do so in the future. For example, domestication of aquatic and forest species is relatively recent and they have not been genetically improved to the same extent as crop and livestock species. They may, therefore, derive particular benefits from the use of conventional breeding. Further, relevant components of production and market systems, as well as socioeconomic, environmental, and cultural considerations, should also be taken into account before the decision to apply a particular biotechnology is made. Biotechnologies per se are not the solution, but when integrated with ongoing, appropriately designed conservation, breeding, and development programs, can be of significant assistance in meeting the needs of an expanding and increasingly urbanized population while maintaining the diversity of genetic resources.

7. ADVANCES IN IN CHEMICAL INDUSTRY

Chemical industry is large. The world’s chemicals production in 2002 was in excess of 1.3 trillion. This industry consists of four major subsectors: basic chemicals, specialty chemicals, consumer care products, and life science products. Biotechnology impacts all these sectors, but to different degrees. Demarcation between sectors is not clear cut. General characteristics of these sectors are outlined in the following sections (OECD, 2001b). Basic chemicals or commodity chemicals represent a mature market. Most of the top 50 products by volume of production in this category in 1977 were still among the top 50 in 1993. During this period, the relative ranking by production volume of the products in this category remained largely unchanged (Wittcoff and Reuben, 1996). The basic chemical industry is characterized by large plants that operate using continuous processes, high energy input, and low profit margins. The industry is highly cyclical because of fluctuations in capacity utilization and feedstock prices. The products of the industry are generally used in processing applications (e.g. pulp and paper, oil refining, metals recovery) and as raw materials for producing other basic chemicals, specialty chemicals, and consumer products, including manufactured goods (textiles, automobiles, etc.) (Swift, 1999).

FUTURE ASPECTS

The past few decades have seen a very rapid rise in the number of plant and animal scientists using the techniques of cell, tissue, organ culture for plant and animal improvement. The discovery of restriction enzymes which led to the development of a variety of gene technology and it is considered to be the greatest scientific revolution of 21stcentury.Nature has provided a complete store house of remedies to cure all ailments of mankind. In the past three decades there has been a dramatic increase in the scientific work supporting the clinical benefits through biotechnology. Some of the renowned hospitals have established stem cell banks. India has a large network of institutes and laboratories, backed by reputed universities and vast pool of scientists working in small group on various biotechnology projects. As a result, we are deriving al lot of benefits from GMO crops such as Golden Rice Bt cotton, Hormones, Enzymes, Vaccines and Antibiotics etc. In spite of the great advancement in science and technology, still the mankind is suffering from serious diseases, pollution, ill-health, poverty etc. Globalization, Industrialization, Urbanization, advancement of science and technology and non-judicious exploitation of natural resources have resulted in various serious consequences threatening the very existence of mankind. There is a possibility of large areas of land being inundated by the rising level of sea water as a result of global warming due to enormous quantities of emission of toxic gases like CO, CO2, SO2 and NO2, etc. Owing to ozone-depletion dangerous rays are reaching the earth which can produce unpredictable evil-consequences such as Tsunamies, Earthquakes, and Whirlwinds resulting in loss of life and biodiversity properties. Man is dumping wastes all over the earth. Though he is aware of the evil-consequences of non-biodegradable hazardous materials such as plastics, polyethylene etc., he is producing them in inestimable quantities. The entire atmosphere is polluted and days are not far away when good air, good water and good environment are non-available. New diseases arise all of a sudden and spread in epidemic and pandemic proportion taking a heavy toll of life in their wake. Food production is declining and there is a serious threat of famine. Energy crisis is already looming large and it is time to turn to biodiesel and other renewable energy sources such as wind, tides, sun etc. The growth of biotechnology leads to increasing popularity towards plant-based drugs in pharmaceuticals, nutraceuticals, functional foods and even cosmaceuticals in the global market. Thus biotechnology research could help the country carve a niche for itself in modern biotechnology including Genomics and bio-informatics, Agriculture and Plant biotechnology, Molecular medicine, Environment and biodiversity and bio-fuel and bio-instrumentation. ustainable development ensuring food, nutritional, health, environmental and livelihood security of the people by harnessing the powers of biotechnology would be a dream of the scientific community. Translating these dreams into reality would give a major impetus to our socio-economic progress. Time-bound, mission mode, result oriented projects to be taken up for: utilisation of the full potential of the genomics revolution for humankind, plants, animals and microbes; to develop new vaccines, diagnostics, drugs and drug delivery system; to produce a large number of low-cost, affordable small proteins and therapeutics using the plants and animals as bioreactors; to engineer crops with enhanced nutritional status, biotic and abiotic resistance and introduce precision farming with new quality traits for productivity enhancement; and to develop environmentally friendly technology packages for pollution control, biodiversity conservation and restoration of damaged ecosystems. Long term support would continue for basic research on all aspects of molecular biology, genetics and genomics, proteomics and neurosciences. Well-defined missions to develop products, processes and technologies addressing the problems of the nation would be launched.

Basic Research in New Biology and Biotechnology

- Genomics
- Bioinformatics
- (c)Basic biological phenomena with potential application
- Agriculture, Plant and Animal Biotechnology
- Environment and Biodiversity
- Medical Biotechnology
- Biofuels
- Bioprocesses, Product Development, and Bioinstrumentation
- Human Resource Development
- Creation and Strengthening of Infrastructure in Existing Institutions and setting up new Institutions
- Biotechnology for Societal Development
- Biosafety, Ethical and Proprietary Issues
- Basic Research in New Biology and Biotechnology

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REFERENCES

1. Jensen PR, Fenical W. Marine bacterial diversity as a resource for novel microbial products. J Ind Microbiol 1996;17:346– 51
2. Brant DA, Buliga GS. Chemical structure and macromolecular conformation of polysaccharides in the aqueous environment. In:Colwell RR, Pariser ER, Sinskey AJ, editors. Biotechnology of marine polysaccharides. Proceedings of the Third AnnualMIT Sea Grant College Program Lecture and Seminar. Washington (DC): Hemisphere Publishing, 1985. p. 30– 73.
3. Mazzola, S., Mirto, S., Danovaro, R., 1999. Initial fish-farm impact on meiofaunal assemblages in coastal sediments of the Western Mediterranean. Mar. Pollut. Bull. 38, 1126–1133.
4. Nagler, P.L., Glenn, E.P., Nelson, S.G., Napolean, S., 2003. Effects of fertilization treatment and stocking density on the growth and production of the economic seaweed Gracilaria parvispora (Rhodophyta) in cage culture at Molokai, Hawaii. Aquaculture 219, 379–391.
5. Bridges W. Gathering of animals: an unconventional history of the New York Zoological Society. NY: Harper and Row, 1974. p. 481.
6. Gallo-Meagher M, Telg R, Simmen R, Burkhardt J. Workshop A: roles of academia, industry, and government. NABC News2000; 19:4-5, 11.
7. Glaziou P, Chinain M, Legrand A-M. Clinical toxicology of ciguatera poisoning. In: Meier J, White J, editors. Handbook of clinical toxicology of animal venoms and poisons. Boca Raton (FL): CRC Press, 1995. p. 59– 74.
8. Guy CL, Irani T, Gabriel D. Workshop C: food and environmental issues associated with the biobased economy of the 21st century. NABC News 2000; 19:8-11.
9. Hansen JE, Packard JE, Doyle WT. Mariculture of red seaweeds La Jolla: California Sea Grant College Program, University ofCalifornia, 1981 (42 pp.).
10. Hay ME, Fenical W. Chemical ecology and marine biodiversity: insights and products from the sea. Oceanography 1996;9 (1):10–20. rottier H, Franco EL: The epidemiology of genital human papillomavirus infection. Vaccine 2006; 24(suppl 1):S1–S15.
11. Trottier H, Mahmud S, Costa MC, Sobrinho JP, Duarte-Franco E, Rohan TE, Ferenczy A, Villa LL, Franco EL. Human papillomavirus infections with multiple types and risk of cervical neoplasia. Cancer Epidem iol Biomarkers Prev 2006; 15(7):1274-80.