A Review on Biotechnology and Its Commercial and Industrial Applications

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Abstract

This review states the applications of biology in the technical way. More complex statement can be given since in these days the applications of the biotechnology are developing and very vastly implementing logical studies in present trends. Here in this review we can discuss briefly about the applications and the areas where biotechnology is at utmost level of importance, these applications include three major wings of diffractive studies in biotechnology. Biomaterials are exactly termed as the Allograft, Auto-graft, and Xenograft. Genetic engineering is a major study appended to rule the living being future. The bio-availability of the products from MO’s useful in bioprocesses all around in pharmaceuticals, breweries, small scale industries etc., were said to be enlightened by biotechnological applications.

Keywords: Biotechnology; Genetic Engineering; Bioprocessing Techniques; Biomaterials

Introduction

Contrary to its name, biotechnology is not a single technology. Rather it is a group of technologies that share two (common) characteristics working with living cells and their molecules and having a wide range of practice uses that can improve our lives.

Biotechnology can be broadly defined as “using organisms or their products for commercial purposes.” As such, (traditional) biotechnology has been practices since the beginning of records history. Baking bread, brewing alcoholic beverages, and breeding food crops or domestic animals were the early days’ biotechnology application. But recent developments in molecular biology have given biotechnology new meaning, new prominence, and new potential. It is now Modern biotechnology that has captured the attention of the public. Modern biotechnology can have a dramatic effect on the world economy and society.

Applications of Biomaterials in Biotechnology

Biotechnology of biomaterials is use of metals and chemicals as Biomaterials and bio-soft-materials (bio-nano-composites) like Hydroxyapatite, Zirconia, Alumina [1] used in the dental implants, in turn the production of Hydroxyapatite from garden snail shell (Helix Aspersa) is also an amazing application of biotechnology [2]. Preceding to this Titanium in a process, induces osteoblastic bone marrow stem cells differentiation [3], silicone dispersions in the manufacture of murine ventricular inflating for the Langendorff heart grounding [4], use of Glycine betaine as an effective compatible solute is which maintains fluidity of membranes and protects the biological structure of the organisms [5] under stress is another criteria of biotechnological application. A more recent and promising exploitation of membrane Transglutaminase (mTG) is related to the production of the so-called “Bioplastics” both biodegradable and edible [6]. Development of certain technologies like Response Surface Method (RSM) has made easier optimization of li-pase mediated catalytic activity [7] and critical extraction parameters for Anthocyanin from Solanum melongena [8] and it also made easier for the Mycoprotein production from Fauna like Fusarium venenatum ATCC 20334 [9]. In spite of all these application of Biomaterials there were novel methods being developed for the voidance of microbial adhesion [10], as if creation is not only the criteria of biotechnology but also the protection of the created is also a part, and thus the protection is through the same microbial community which produces microbial bio-surfactants.

Bioactive glass (BAG) S53P4 is a bone bonding biomaterial, osteoconductive and osteostimulative bone substitute with proven antibacterial properties, which is a result and innovative thought of Lindfors NC. (2011). BAG S53P4 was used in treatment of an infected comminuted olecranon fracture. This substitution was monitored and followed up which implied no re-infection [11].

Dragging all these aside nanoparticles have been an imminent issue in the field of biotechnology (Nanotechnology), their interference with the Quantum dots. To have a brief explanation about the quantum dots, a quantum dot is a portion of matter (e.g. semiconductor) whose excitons are confined in all three spatial dimensions. Consequently, such materials have electronic properties intermediate between those of bulk semiconductors and those of discrete molecules [12,13,14]. They were discovered at the beginning of the 1980s by Alexei Ekimov et al. [81]. in a glass matrix and by Louis E. Brus in colloidal solutions. The term “quantum dot” was coined by Mark Reed et al. [82]. Researchers have studied quantum dots in transistors, solar cells, LEDs, and diode lasers. They have also investigated quantum dots as agents for medical imaging and hope to use them as qubits. Preparation of Biocompatible Quantum dots has been formulized [15]. Today Nanomaterials have been designed for a variety of biomedical and biotechnological applications, these Nanoparticles [83] or nanoporous sol-gel particles [84] function-
alized with organic groups can be used as biomarkers, tracer, and drug delivery systems with even all-in-one functionalities [16].

**Biotechnology in Genetic Engineering**

Genetic engineering is the process of transferring individual genes between organisms or modifying the genes in an organism to remove or add a desired trait or characteristic. Examples of genetic engineering are described later in this document. Through genetic engineering, genetically modified crops or organisms are formed. These GM crops or GMOs are used to produce biotech-derived foods. It is this specific type of modern biotechnology, genetic engineering that seems to generate the most attention and concern by consumers and consumer groups. What is interesting is that modern biotechnology is far more precise than traditional forms of biotechnology and so is viewed by some as being far safer.

In silico analysis and emphasis have been in current research as the comparative insilico analysis and insilico Sequence analysis of ascorbate peroxidase protein sequences from different plant species [17] and glycine betaine biosynthesis genes in Bacillus subtilis [5] were studied respectively. In silico sequence analysis revealed that the GbsA and GbsB sequences of B. subtilis were conserved in many eubacteria. The studies in the findings of the present study may be useful for designing degrage primers or probes specific for APX and possibly presents the first line of defense amongst all the Ascorbate PeroXidase isoforms involved in the cellular antioxidant defense pathway, during exposure to abiotic stresses. A discrete event-based stochastic modeling approach for studying the molecular dynamics of cells has been proposed based on the simulation methodology and present the mathematical formalism underlying the in silico system[18].

Many gene therapies have been reported during last decade, genetic variations and epigenetic patterns in autoimmunity [19] and in Developmental Disorders like ADHD and Endophenotypes [20] have been noted. Epigenetic patterns may have cumulative effects on disease progression and outcome and should therefore be investigated together.

**Ex-vivo gene transfer technology** is also an appended study from that of genetic engineering; this might be through any means of ways like, vector based transfer systems, virus vector based transfer systems and etc. for instance. High efficiency ex-vivo gene transfer to primary murine b-cells using plasmid or viral vectors [21]. Specified gene therapy targeting on LDL cholesterol [22] and CD47- a tissue based thera- peutic targeting [23] has come into an existence due to an astounding debut of gene transfer technique which is a result of biotechnology.

One of the exploring technique in biotechnology is the Metabolite Profiling and Gene Expression, it is now more widely being applied to catalogue all (or most of) the biochemicals associated with an organism’s metabolism (or metabolome) [24]. Metabolic profiling parallels techniques measuring changes in gene expression such as 2-D gel [25] and mass spectrometric protein profiling [26], serial analysis of gene expression [27], and cDNA microarray analysis [28]. Both the meta- bolic and gene expression approaches address the phenotypic plasticity of a particular organism but from different perspectives. There was a registered study on Streptomyces tenjimariensis, [29] and many other organisms.

Cervical cancer is one of the most common cancers in women. Human Papillomavirus (HPV) is the primary cause of cervical, anal, vulvar, vaginal and penile cancers as well as genital warts. Over 120 types of HPV have been isolated with more than 40 of these types infecting the epithelial lining of the anal and genital tracts [30]. The HPV vac-
Biotechnological pertinence in Biosensors and Bioelectronics

Cadmium can cause bone demineralization, either through direct bone damage or indirectly as a result of renal dysfunction [41]. Trace metals such as Pb, Cd, Zn, Cu, Cr and as are potential bio-accumulative toxins in the production system of milk and dairy products [42]. Cadmium may enter the body through food, water, air or absorption through the skin however food and smoking are the main source of exposure in the non-occupationally exposed population [43]. A novel absorption-transmission based, miniaturized fiber optic biosensor has been developed for the detection of cadmium in milk [44]. In contrast to the above, The application of nano-scale materials for electrochemical biosensors has been grown exponentially due to high sensitivity and fast response time [45,46]. For instance, a urea biosensor is being developed, the ordered and self-organized nano-array structures, by dip coating technique [47]. In contemporary to this biosensor study there evolved a parallel study none other a “Nano-biosensor” study, the blend of biosensors and nanotechnology is blatant even from a perfunctory examination of the scientific literature said by Achyuthan K. [48]. Numerous aspects of the anchorage dependent cell functions, including survival, proliferation, differentiation and migration can be regulated by the rigidity of ECM. Adhesions guide these diverse processes both by mediating force transmission from the cell to the flexible substrate and by controlling biochemical signaling pathways [49]. The above mechanosensitivity validations or calculations can be done by the nano-biosensor designs which can become a pioneering research work. Recently cluster analysis methods like multivariate data analysis methods namely hierarchical cluster analysis (HCA) and principal component analysis (PCA) [50] were used to assay the receptor signaling mechanisms which can also be implemented in and as biosensors or more politely nano-biosensors. The findings above lead to Amperometric biosensor [58] basing on enzyme from Brassica napus hairy roots to determine ochratoxin A, is a colorless crystalline compound that belongs to a group of closely related derivatives of isocumarin linked to L-phenylalanine and classified as pentaketides [59].

In medical and health care applications it was always desirable to perform pre-processing and conditioning on the sensor raw output before data acquisition. Based on this requirement, biosensor was proposed and designed using conducting polymers and nano-materials which were having In-situ Signal Conditioning Electronics that eliminates need for additional on board hardware circuitry. A work focused on Optimized Design of Smart Sensor using Conducting Polymer and Gold/Silver/CNT Nanocomposites Polyaniline (PANY) has been selected as the Conducting polymer on which surface CNT thin layer will be deposited using Sol-Gel technique [51]. A detailed design of an optical biosensor using polymeric waveguides intended for blood glucose concentration measurements was presented [85]. Besides this, a novel integrated optic accelerometer employing a cantilever on a silicon substrate is proposed [86], which has wide variety of appliance not only in optics but also in silicon based organism and that can be used for the detection of sensible parameters when it’s basic platform of silicon is used. An analysis is carried out to demonstrate the feasibility of the proposed sensor in a cohort study, terming it’s diligence in optic sensor technology, we can make its alliance in the field of Biotechnology.

All biological molecules and cell organelles are chemo-mechanical controlled systems known to every biologist. It is an inter-disciplinary art to activate them and work as an electronic device [52]. This logic lead to construction of micro tubule (MT) molecule which is modeled to function as a diode in electronic parameters.

Besides all the above developing an Immunosensor is a task related to (or) dependent on immobilization of antibody molecules, which becomes a influential factor for successful fabrication of immunosensors [53]. This involves Screen-printing technology.

Photoacoustic imaging technique have been developed which works on combinatorial approach of ultrasound spatial resolution and intrinsic rich optical contrast, which penetrates deep into the tissues [54,55] with acoustic ultra sounds and which promises the a very special detection tool in diagnostic medicine [56]. By the way to determine a general motor program Thomas JR et al. [57], demonstrated all aspects of overhand throwing, using a 12 camera Vicon motion analysis system. This is a cohort study on the motion by using bio-electronic signals.

Biometrics and Biostatistics in Biotechnology

When there is a rare disease in a population, it is inefficient to take a random sample to estimate a parameter. Instead one takes a random sample of all nuclear families with the disease by ascertaining at least one sibling (proband) of each family techniques like maximum likelihood method [61,62], ANOVA are helpful [63]. In epidemiological and clinical research bias analysis is used for the principal stratum direct effect in the presence of confounded intermediate variables [64]. For occurrence rates of certain recurrent events such as disease infections and discuss nonparametric comparison of several treatment groups two test procedures are developed using statistics [65]. In pediatric quality of care Bayesian Analysis using power priors are used [66], even longitudinal data obtained by Gibbs sampling can be calculated by Bayesian quantile regression [67]. Three types of statistical methods, distance based, quantit and regression methods, are applicable to point data, i.e. data collected at the individual level, including precise measures of subject residential location is used in geographic spatial epidemiology [68]. Exploratory factor analysis (EFA) and Principal Component’s analysis (PCA) have both been important tools for researchers for a long time and have become increasingly common and accessible to computing. For this to resolve binomial logistic multiple regression helped [69]. Testing for the homogeneity of density functions of circular random variables is useful in many biotechnological settings like paleocurrents trends [70]. A colon cancer study in which the investigators wished to assess the efficacy of adjuvant therapy on recurrence of cancer and death for patients with resected colon cancer, for this General Cox Transformation Model for Recurrent Events Data is applied to calculate the recurrence [71]. In automatic fingerprint identification system, various statistical methods are implemented in the algorithms used [72]. Probabilistic framework and associated statistical inference methodology is used in analysing the microarray data obtained from confirmatory experimental studies of gene expression in Saccharomyces cerevisiae using Affymetrix Genechips® [73], even Least square [74] method is also used. Using only the transcription network structure information, a probabilistic model was developed that computes the probabilities with which a pair of genes responds simultaneously (SR) or differentially (DR) to a random network perturbation [75]. Various other methods like survival function in log-logistic distribution, proportional odds regression [76], Exact Waiting Time Survival Function [77], Parametric and Non-Parametric Models [78], Logistic regression [79], for vectors and integration in gene therapy Peaks height distribution is used [80], are also used.
Conclusion

Whatever the synthesis from bioprocess may be, whatever the material used as biomaterial, whatever organism which is “GE” i.e “Genetically Engineered”, whatever the sensor or the receptor in the field, there is a relation between each research studies; that is nothing but the field of biotechnology. This is the key role player subject in the present trend studies. Here in this review I overviewed on the diligence of biotechnology in main track streams of biotechnology like biomaterials, biosensors, genetic engineering, biometrics, biostatistics and finally bioprocesses. Here I feel I have reviewed relatively close once and have claimed that the processes or phenomenon described in each sub-heads in the present review contains peculiar applications of techniques in biotechnology, the above mentioned are very fast growing industries commercially, despite facing some problems in genetic engineering. These days biotechnology has been developed in such an extent where, the preservation of human Adipose tissue [60] can be done accordingly commercial, despite facing some problems in genetic engineering.

References

1. Yousefpour M, Askari N, Abdullah-Pour H, Amanzadeh A, Riahi N (2011) Investigation on Biological Properties of Dental Implant by Ce-TZP/A2O3/HA Bio-nano-composites. J Biotechnol Biomaterial 1:105.
2. Singh A, Purohit KM (2011) Chemical Synthesis, Characterization and Bioactivity Evaluation of Hydroxyapatite Prepared from Garden snail (Helix aspersa). J Biotechnol Biomaterial 1:104.
3. Miller A, Wright GL (2011) Fabrication of Murine Ventricular Balloons for the Langendorff Heart Preparation. J Biotechnol Biomaterial 1:101. http://www.omicsgroup.org/2155-952X/2155-952X-1-101.php
4. V, Palmieri A, Girardi A, Farinella F, Carinci F (2011) Trabecular Titanium Induces Osteoblastic Bone Marrow Stem Cells Differentiation. J Biotechnol Biomaterial 1:102.
5. Rajan LA, Vinodhini K, Rajalakshmi Y, Umashankar V (2011) Molecular Cloning and In Silico Sequence Analysis of Glycine Betaine Biosynthesis Genes in Bacillus subtilis. J Biotechnol Biomaterial 1:103.
6. Porta R, Di Pietro P, Sorrentino A, Marinelli L (2011) Promising Perspectives for Transglutaminase in “Bioplastics” Production. J Biotechnol Biomaterial 1:102a.
7. Syamal Kumar MW, Salina MR, Sili Salhah O, Hanina MN, Mohd Baseeruddin AR (2011) Optimization of Lipase Catalyzed Synthesis of Nonyl Caprylate using Response Surface Methodology (RSM). J Biotechnol Biomaterial 1:106.
8. Thiruvavukkarasu A, Nithya R (2011) Response Surface Optimization of Critical Extraction Parameters for Anthocyanin from Solanum melongena. J Bioprocess Biotechniq 1:103.
9. Hosseini SM, Khosravi-Darani K (2010) Response Surface Methodology for Drying and In Silico Sequence Analysis of Glycine Betaine Biosynthesis Genes in Bacillus subtilis. J Biotechnol Biomaterial 1:103.
10. Rodrigues LR (2011) Novel Approaches to avoid Microbial Adhesion onto Biomaterials. J Biotechnol Biomaterial 1:104a.
11. Lindfors NC (2011) Clinical Experience on Bioactive Glass S53P4 in Reconstructive Surgery in the Upper Extremity Showing Bone Remodelling, Vascularization, Cartilage Repair and Antibacterial Properties of S53P4. J Biotechnol Biomaterial 1:111.
12. Brus LE (2007), “Chemistry and Physics of Semiconductor Nanocrystals”. Retrieved 2009-07-07.
13. Norris DJ (1995), “Measurement and Assignment of the Size-Dependent Optical Spectrum in Cadmium Selenide (CdSe) Quantum Dots, PhD thesis, MIT”. Retrieved 2009-07-07.
14. Murray CB, Kagan CR, Bavendijk MG (2000) Synthesis and Characterization of Monodisperse Nanocrystals and Close-Packed Nanocrystal Assemblies. Annual Review of Materials Research 30: 545–610.
15. Li Y, Hu M, Gi B, Wang X, Du Y (2011) Preparation and Characterization of Biocompatible Quaternized Chitosan Nanoparticles Encapsulating CdS Quantum Dots. J Biotechnol Biomaterial 1: 108.
16. Menas B (2011) The Importance of Nanotechnology in Biomedical Sciences. J Biotechnol Biomaterial 1:105e
17. Pandey S, Negi YK, Marla SS, Arora S (2011) Comparative Insilico Analysis of Ascorbate Peroxidase Protein Sequences from Different Plant Species. J Bioengineer & Biomedical Sci 1:104.
18. Ghosh S, Ghosh P, Basu K, Das SK, Daefler S (2011) A Discrete Event Based Stochastic Simulation Platform for ‘in silico’ Study of Molecular-level Cellular Dynamics. J Biotechnol Biomaterial S:001.
19. Hedrich CM (2011) Genetic Variation and Epigenetic Patterns in Autoimmunity. J Genet Syndr Gene Ther 2: De2.
20. Archer T, Berman MO, Blu M (2011) Epigenetics in Developmental Disorder: ADHD and Endophenotypes. J Genet Syndr Gene Ther 2:104.
21. Moghimi B, Zolotukhin I, Sack BK, Herzog RW, Cao O (2011) High Efficiency Ex Vivo Gene Transfer to Primary Murine B Cells Using Plasmid or Viral Vectors. J Genet Syndr Gene Ther 2:103.
22. David RS, Jeff Sl, David DR (2011) Therapeutic Targeting of CD47 to Modulate Tissue Responses to Ischemia and Radiation. J Genet Syndr Gene Ther 2:105.
23. Li R, Zhao H, Ko KWS, Cormier S, Dieker C, et al (2011) Gene Therapy Targeting LD1 Cholesterol but not HDL Cholesterol Induces Regression of Advanced Atherosclerosis in a Mouse Model of Familial Hypercholesterolemia. J Genet Syndr Gene Ther 2:106.
24. Mendes P (2002) Emerging bioinformatics for the metabolome. Brief Bioinform 3: 134-145.
25. O’Farrell PH (1975) High resolution two-dimensional electrophoresis of proteins. J Biol Chem 250: 4007-4021.
26. Aebersold R, Mann M (2003) Mass spectrometry-based proteomics. Nature 422: 198-207.
27. Velculescu VE, Zhang L, Vogelstein B, Kinzler KW (1995) Serial analysis of gene expression. Science 270: 484-487.
28. Schena M, Shalon D, Davis RW, Brown PO (1995) Quantitative monitoring of gene expression patterns with a complementary DNA microarray. Science 270: 467-470.
29. Denery JR, Cooney MJ, Li QX (2011) Diauxia and Anti microbial Growth Phases of Streptomyces Tenjimariensis: Metabolite Profiling and Gene Expression. J Bioengineer & Biomedical Sci 1:105e.
30. Steben M, Duarte-Franco E (2007) Human papillomavirus infection: Epidemiology and pathophysiology. Gynecologic Oncology 107: S2-5.
31. Shehata MF, Pater A (2011) Human Papillomavirus (HPV) Vaccine: Is it worthwhile?. J Biotechnol Biomaterial 1:103e.
32. Norris SK, Nguyen CK (2008) The human papillomavirus vaccine in canada. Canadian Journal of Public Health. Revue Canadienne De Sante Publique. 99: 114-116.
33. Trottier H, Franco EL (2006) Human papillomavirus and cervical cancer: Burden of illness and basis for prevention. The American Journal of Managed Care 12: S462-72.
34. Lee T, Amore TD (2011) Membrane Separation Theoretical and Applicable Systems. J Bioprocess Biotechniq 1: 102e.
35. Gopalakrishnan KK, Detchanamurthy S (2011) Effect of Media Sterilization Time on Penicillin G Production and Precursor Utilization in Batch Fermentation. J Bioprocess Biotechniq 1:101.
36. Augusto da Costa AC, da Silva Lino LA, Hannesch O (2011) Total Microbial Bioengineer & Biomedical Sci 1:104.
37. Trottier H, Franco EL (2006) Human papillomavirus and cervical cancer: Burden of illness and basis for prevention. The American Journal of Managed Care 12: S462-72.
38. Lee T, Amore TD (2011) Membrane Separation Theoretical and Applicable Systems. J Bioprocess Biotechniq 1: 102e.
39. Mueller M, Wilkins MR, Banat IM (2011) Production of Xylitol by the Thermotolerant Kluyveromyces marxianus IMB Strains. J Bioprocess Biotechniq 1:102e.
40. Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of Burdock TJ, Brooks MS, Ghaly AE (2011) A Dehydrogenase Activity Test for Measuring the Growth of
