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A Multicentre Study Report on

Biotechnology from Health to Wealth & Future Challenges-I

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ABSTRACT

Biotechnology is the combination of engineering, science and technology where we could evaluate the application of biological organisms, systems, bioprocesses by various industries to learn about the science of life and the improvement of the value of materials and organisms. Since 20th Century, when five proteins from genetically engineered cells had been approved as drug by the United States Food and Drug Administration (US-FDA), biotechnology grown up a height where we can say the upcoming decade would be of the decade of biotechnology. At the present biotechnology has wider application in the major areas, including health care, crop production, agriculture, nonfood uses of crops and environmental issues. Keeping these facts in our mind we, planed this multicentre study. It was started since 2013; A total 43 selected abstract of studies of BTSPARK-14, and BTSPARK-15 were included to evaluate the present status of biotechnology, its implication in various interdisciplinary and translational fields. Studies were categorized in to four subheads first; past evaluation of biotechnology, second, development of newer biotech concepts, third, biotech process development and fourth was discovery development and implication of biotechnology. It is conclude that there is high need of attention to spread biotechnological process and products among common peoples through the biotechnological professional or researchers.

Key Words: Biotechnology, biological organisms, bioprocess, food and drug administration, BTSPARK.

INTRODUCTION

Origins of "biotechnology" emerge in methods of food production and plant and animal breeding from the uses of bacteria to produce cheese (food preservation), natural enzymes in yogurt, yeast to produce bread, fermentation for producing wine and beer. From past to till date there are 1,473 companies & 198,300 employees, 300 Biotechnology drug products and vaccines are in clinical trials under regulation by the FDA. The application of technology to improve a biological organism, to modify the biological function of an organism by adding genes from another organism, the manipulation of living organisms and organic material to serve human needs, the techniques used by the biotechnology industry and to modify genes and introduce them into transgenic organisms. Recent implications of biotechnology in therapeutics are gene therapy, cancer therapy and stem cell therapy.

"Biotechnology from health to wealth & future challenges," is a multicentre and vast area of study. To understand the theme it has been included recent scientific studies and a pooled analysis was done. The objective of this work was, to establish a network with institutional co-operational exchange of knowledge and material in the area of specialization in biotechnology with the following aims of BTSPARK 2014 and 2015;

- To review the present state of biotechnological facet related to wellness of life.
- To spread awareness for wider implication of biotechnological and interdisciplinary areas among biotechnologist.

METHODS

BTSPARK 2014 and 2015 was the witness of the recent updates by reputed researchers and industries professional in the field of biotechnology. We applied method of selection of studies based on their impact of results of discovery and development.

Data Extraction

The studies included in the form of abstract of invited lectures, working models, static projects on various aspects of biotechnology. Main emerging areas included for data extraction and analysis were, Fermentation & Food Biotechnology, Analytical Techniques & Bioprocess Engineering, Genetic Engineering, Molecular & Cell Biology, Recombinant DNA technology, Bioinformatics, Biochemistry, Immunology, Microbial biotechnology, Cancer biology, Microbial pathogenesis, Microbial Biotechnology, Phage Biotechnology, Newer Biotech Product, Natural product development, Downstream industrial processing and Environmental biotechnology.

Data Categorization

Targeting above areas of study we are able to generate a network of recent knowledge of field of interest that will be helpful for generation of newer ideas of research and development.

Biotechnology Past and Future Display

Biotechnology display includes the application of biotechnology. Total 14 work displays were included in this section under following previously selected areas.

Emergence of Newer Technology and Concepts

A Thorough discussion on new challenging areas of biotechnology was done and it applied for the development of static as well as working models. A total 3 working model and one concept was included for knowledge share.

Studies Involved in Discovery and Development

This section was helpful for of knowledge network development. Total 08 potential studies of BTSPARK 2014-15 were included under categorized database of presentations.

Implication of Newly Discovered Biocompatible Materials

Biomedical Technologists had been developed an excellent biomaterial for joint prosthesis and this work is the witness of "Biotechnology from health to wealth & future challenges," in real sense. In this category single study was included which will be applied in present and having excellent potential to development of biotech market.

RESULTS AND DISCUSSION

The various industrial processes that involve the uses of biological systems are dependent on biotechnological principle. In the collection of microbial and other biochemical processes carried out on an industrial scale biotechnology is involved successfully.

Biotechnology Past and Future Display

Existing data from past to present & future were compiled as discovery world of biotechnology (Figure 1) which discuss about emergence of the branch to their active implication till now.

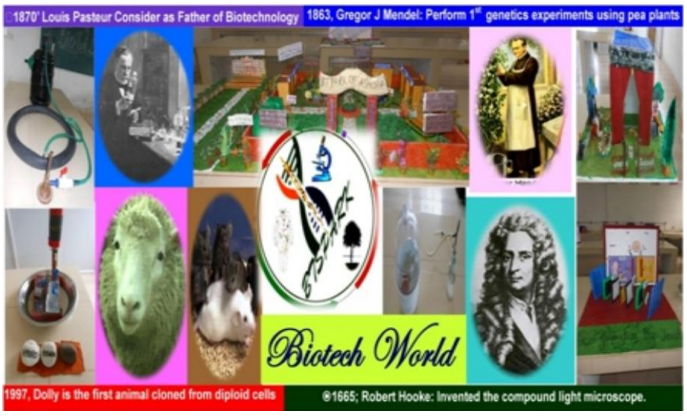

Figure 1: A Representation of Biotech World sinceits emergence to till date.

Biotechnological application in agriculture and food are exploring area for human well fare and implication of newer supplements such as probiotic food and single cell protein. Human health care and disease prognosis is also one of priority area for the researcher. Identification of cancer stem cells in solid tumors and process of cloning are explaining the medical importance of biotechnology.

Few recent fields of biotechnology (Figure 2) such as naobiotechnology, phage technology and production of bio ethanol are opening opportunity for future eco-friendly products and newer biotech market. Because the pollution is our one of problem for healthy survival we could use bioplastic which will be future alternative of plastics. There is several biopolymers are used but study on microbiology of degradation in environment sustain pollutants is essential, so xenobiotics and bioremediation are important for removal of existing polymer through there degradation. Liquid waste management and solid waste management are used for the removal of waste products and safe environment. Monitoring of ozone layer depletion is in beginning and utilization of rain water harvesting system is efficiently in implication. Natural product biotechnology is focusing in extraction of medicinal importance products and dye [1]. We could develop natural product information system for various medicinal importance plants [2].

Emergence of Newer Technology and Concepts

Three working and one static model and a concept was selected and its application was held for the development (Figure 2) of newer researches.

Solar Car: In our universe Sun is one of natural source of energy. Solar car is a specifically example of utilization of Solar energy and would be amazing advancement in future car technology. They would allow for free travel and nearly unlimited accessibility. It utilizes solar energy without any harmful emissions and none of environmental damages. Due to all these advantages, solar car would be the wave of future [3] for eco-biotechnologists.

Hydroponics: Apart from natural resource we are capable to grow plant and vegetables in the industry, farms and factory. Whereas heavy rains or typhoons can ruin agricultural goods grown outdoors, they don't affect indoor production, allowing stable output throughout the year. The output is more than 10 times that of traditional farming [4]. The hydroponics would be newer area for agro-biotechnologists.

Forensic science & DNA finger printing: DNA fingerprinting is one of the great discoveries of the late 20th century, has revolutionized forensic investigations. DNA evidence is easy to obtain because genetic material is found in all human cells. As a result, when we leave behind small biological bits of ourselves, these bits can be used to identify us and link us to the places we have been. As a result forensics is undeniably important to the modern justice system [5].

Biodynamic fertilizer: Bio dynamic fertilizer is more beneficial for agriculture than chemical fertilizer. As it forms strong humus with improve soil fertility and earthworm activity. It is also economical and eco-friendly than chemical fertilizer. Due to shortcomings of chemical fertilizer, farmer should use bio dynamic fertilizer more frequently than chemical fertilizer [6].

Concept of Biotech city: It is an imagination of Emergence Biotech city. A decade before, newly born seed started growing with the dream to mark the technology with the discovery of emphatic and centralized field which evolved as a mother of an era centralized, uniform structure accompanying Bioinformatics, Immunology, Agriculture, Genetics, Production of cheapest fuel and Energy and many more in itself which emphasized the world with its liabilities to care the bud of technology (Figure 2).

Figure 2: Representation of new biotechnological fields.

Studies Involved in Discovery and Development

Results of 08 Studies of BTSPARK 2014-15 have been included are given below;

Study 1: Detection of specific antigen BHUP1 for the diagnosis of *Visceral Leishmaniasis* :

Despite several drawbacks, rK39-based rapid immune chromatographic test is widely used for the diagnosis of Visceral Leishmaniasis (VL) in the Indian subcontinent. There is an urgent need to develop a better antigen. In this study biotechnologists were separated crude soluble antigens of *Leishmania donovani* by sodium dodecyl sulfate-polyacrylamide gel electrophoresis and hybridized with pool sera from pre- and post-treated VL patients, 6 months follow-up, endemic healthy (EHC) and non-endemic healthy controls (NEHC) by Western blotting. The sensitivity of enzyme-linked immunosorbent assay (ELISA) with identified protein was 95% (confidence interval [CI] = 89.6–98.01%), whereas the specificity for EHC, NEHC, and different disease groups were 96.3%(CI = 89.8–98.6%), 100% (CI = 95.8–100%), and 97.4 %(CI = 91.02–99.3%), respectively. This specific antigen was subjected to two-

dimensional gel electrophoresis and after tryptic digestion, antigen was characterized by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. Further analysis showed that it is a member of the heat shock protein family of 70 kDa, designated as BHUP1, and has great potential in the diagnosis of VL [8].

Study 2: 'Green Chemistry': An implication in synthetic chemistry:

Over the past few years, the idea of chemistry has been mobilized to develop new techniques that are less hazardous to human health and the environment. This new approach has received extensive attention and goes by many names including Green Chemistry, Environmentally Benign Chemistry and Clean Chemistry. Green Chemistry with its 12 principles would like to see changes in the conventional ways that were used for decades to make synthetic organic chemical substances and the use of less toxic starting materials. By changing the methodologies of organic synthesis health and safety will be advanced in the small scale laboratory level but also will be extended to the industrial large scale production processes through the new techniques.

Green Chemistry would like to increases the efficiency of synthetic methods, to use less toxic solvents, reduce the stages of the synthetic routes and minimize waste as far as practically possible. In this way, organic synthesis will be part of the effort for sustainable development [9].

Study 3: Development of milk cereal based functional food by incorporating *Spirulina* grown under precise/mild stress condition:

In India, we have traditional products touted as functional but have little scientific validation. Therefore in present study an attempt was done to develop milk cereal based weaning food and make it functional by incorporating *Spirulina* grown under mild stress condition. Subsequently the main aim of this study was set a forth to evaluate the chemical and sensory properties as per the mouth feel, taste, texture, flavor, acidity and overall acceptability of the consumers. Considering the increasing popularity of millets, forming the base of the food, the major task is to develop products that can alleviate child malnutrition as well as appeal the health conscious consumers [10].

Study 4: Virtopsy: A new innovation for forensic science:

Modern cross sectional imaging techniques can supplement and may even partially replace traditional autopsy. The century old techniques are still being used, Virtopsy is one step ahead. The aim of the Virtopsy is to validate new approach by systematically comparing the radiologic and surface scanning findings with those obtained at traditional autopsy. Virtopsy consists of body volume documentation and analysis using CT, MR imaging, and micro-radiology; and 3D body surface documentation using forensic photogrammetric and 3D optical scanning. The new method should be able to help determine whether death was the result of natural causes, accident, suicide, or homicide [11].

Study 5: Phytochemical characterization, antimicrobial and reducing potential of *Jatropha curcas*linn against human pathogens:

The present study deals with antibacterial, antifungal, qualitative phytochemical studies, Thin layer chromatography **(**TLC**)** analysis of seed oil, latex, machine oil and presscake of *Jatropha curcas*Linn family Euphorbiaceae. These extracts were subjected to a preliminary phytochemical screening to detect the different chemical principles and its reducing power was also investigated. Antimicrobial activity was evaluated by disc diffusion method and MIC, MBC, MFC was calculated by micro dilution method. TLC was also performed using solvent systems for the analysis of number of constituent in plant extract. The methanolic fraction of latex and cake showed marked antifungal, antibacterial activities against gram-positive and gram-negative bacteria. The phytochemical analysis showed the presence of alkaloid, saponin, tanins, terpenoids, steroids, glycosides, phenols, flavonoids. Reducing power estimation shows that only cake and latex of *J.curcus* has good reducing power as compare to its machine and seed oil as compare to standard BHT. and In future various extract especially cake and latex can be subjected to isolation of the major constituent's antimicrobials and for further pharmacological evaluation [12].

Study 6: Molecular detection of *Pseudomonas aeruginosa* from water samples using amplification of the Exotoxin A (ETA) gene:

Pseudomonas aeruginosa, a bacterium included in the list of water borne pathogens by WHO in their Guidelines for Drinking Water Quality. *P. aeruginosa* causes critical insinuation in animals as well as humans especially in children and immune-compromised patients. PCR was use to detect. All the three water samples were PCR positive for ETA gene and showed 369-bp fragment on 1.6 % agarose gel electrophoresis. The identity of the amplified 396-bp fragment was confirmed by sequencing. Specific primers amplified the ETA positive *P. aeruginosa* genomic DNA, whereas other species of *Pseudomonas* and GC-rich bacteria did not yield any 396-bp fragment. The findings suggest that water from these sites poses a health risk to communities that rely as primary sources for domestic, pet and subsistence irrigation use. Regular monitoring of the water microbiological quality and public health education to avoid consumption of untreated water are vital to ensure the reduced waterborne disease burden in low-income countries [13].

Study 7: Effect of exogenous proline on growth, fluorescence and as accumulation in *Sonalum melongena* L. seedlings grown under arsenic stress:

Arsenic (As) is anthropogenic priority pollutants of air, water, and soil liberated mostly via industrial processes such as mining, burning of fossil fuels and also the use of pesticides and herbicides hence it causes substantial decline in crop productivity. Therefore, strategies are needed to control and minimize entry of As into plants. Proline (Pro) is

a vital amino acid and also acts as plant growth regulator by activating various signaling processes which scavenge free radicals, buffering cellular redox potential, thereby giving beneficial effects to plants. This study was carried out to understand the mechanism of protection of plants under metal stress by proline. The experimental design included two levels of As treatments (5 and 25 µM As) and proline (25 µM Pro) to determine whether the adverse effects of As on plants are eased by Pro supply. After 20th day of seed germination seedlings were acclimatized in Hoagland's nutrient for 24 h. After this, As and proline treatments were given. After 7 days of As and Pro treatments, seedlings were harvested and various parameters were analyzed immediately. The growth, pigments were declined in As dose dependent manner. Furthermore, the fluorescence characteristics (JIP-test): φP_0, Ψ_0, φE_0, PI_{ABS}, ABS/RC, TR_0/RC, ET_0/RC and DI_0/RC, were also affected in As dose dependent manner, however, the effect was more prominent on PI_{ABS} and DI_0/RC. In Pro treatment φP_0, Ψ_0, φE_0 and PI_{ABS} of PS II were increased while energy flux parameters (ABS/RC, TR_0/RC, ET_0/RC, DI_0/RC) were decreased. Pro treatment exhibited an ameliorating effect on these parameters and significantly alleviated the growth by decreasing As accumulation in root and shoot of tested plant [14].

STUDY 8: Effect of 28-HomoBrassinolide and Salicylic acid on the growth, chlorophyll fluorescence and antioxidant potential of *Solanum melongena* L. seedlings exposed to cadmium:

The enhanced human activities increased the level of heavy metal cadmium (Cd) in our environment which causes great loss to crop productivity. Hence, the present study was undertaken with view to study the ameliorating effects of phytohormones i.e. 28-HomoBrassinolide (HBL) and salicylic acid (SA) on *Solanum melongena* L. seedlings exposed to Cd. The seedlings were grown in environmentally controlled condition under two levels (3 mg Cd kg^{-1} soil: Cd_1; and 9 mg Cd kg^{-1} soil: Cd_2) of Cd stress. After foliar application of HBL and SA, 30 days-old seedlings were used to analyze the various parameters. Both the doses of Cd declined the growth, photosynthetic pigment contents and chlorophyll fluorescence parameters such as Fv/Fm, Fv/F_0 and $Fm/F_0$when compared with control seedlings. In addition, Cd also decreased oxidative stress by decreasing malondialdehyde (MDA) content in seedlings. However, with exogenous phytohormones (HBL and SA) application the damaging effects on these parameters was significantly ameliorated and the ameliorating effect was more pronounced under HBL treatment. Major improvement in radical scavenging potential as attested by the antioxidant activity assay using DPPH (1,1-diphenylpicrylhydrazyl), along with increased contents of total phenolics, protein and carbohydrate suggest a major influence of HBL and SA application in mitigating cadmium-induced oxidative stress in test seedlings. The study further pointed out that foliar application of HBL and SA may improve the quality of vegetables which were even grown under metal contaminated sites [15].

Implication of Newly Discovered Biocompatible Materials

Layered double hydroxide (LDH) nanohybrid was discovered with Poly (methyl methacrylate) (PMMA) based bone cement. The materials have been with greater mechanical strength and biocompatibility as grouting material for total joint arthroplasty. Bivalent magnesium has been replaced with trivalent aluminium with various mole ratios, keeping the layered pattern of the LDH intact, to cater the effect of varying substitution on the property enhancement of the nanocomposites. The thermal stability of bone cement has increased by more than 30°C in presence of 1wt% of nano LDH homogenously distributed in the matrix bone cement by creating inorganic thermal barrier out of LDH dispersion. The superior bioactivity and biocompatibility of the nanocomposites as compared to pure bone cement has been established through hemolysis assay, cell adhesion, MTT assay and cell proliferation fluorescence imaging [16].

It includes, but is not limited to the industrial aspects of genetic engineering and there manipulations (Figure 3). Most important areas of biotechnology are fermentation technology (production of antibiotics), hybridoma technology (production of monoclonal drug ex trastuzumab such as vaccines) [17], agricultural technology (plant and animal transformations for development of newer species) [18] and genetic engineering/recombinant DNA technology (Cloning) [18] and site directed therapy (Dendritic Therapy) [19] etc.

Figure 3: Biotechnology process, product development and correlation with other branch of biological sciences.

Because the incidence of diseases such as cancer, diabetes, hepatitis, tuberculosis and many more are keep increasing worldwide and its exact explanation is required for diagnosis, prognosis and treatment [20]. Biotechnology explains; these are may be due to genetic aberration [21], epigenetic changes [22], over / suppress expression of gene [23] environmental effect, diet, socio-economic factor sand various types of infections such as *Helicobacter pylori* and their species [24, 25, 26] *Salmonella Typhi* (S. Typhi) and Mycobacterium etc. [27] etc. We could evaluate the expression of inflammatory molecule newer therapeutic

options such as Bacteriophage Therapy able to kill Superbugs [28, 29]. Biomedical chemical modifications are accelerated with proper evaluation of cell study and the uses of biomaterials in different modified forms [30]. In the plant system various useful plant sequences are available and utilize for identification of newer subspecies such as *Arthrospira maxima* MLS2014 will be identified targeting 16S ribosomal RNA gene [31], partial sequence and may be used for various bioprocess [32] and its strain identification [33].

Figure 4: Data interpretation using advance subject of bioinformatics and explanation of unsolved queries.

New challenging area of biotech product development is based on natural product chemistry such as secondary metabolite and their derivatives are actively used in chemotherapy [1, 2]. In the field of agriculture evaluation of major determinants in soil nutrients are possible which will be helpful for good quality production of agro products. Researchers could evaluate site directed gene expression of various proteins and their interactions which will be able to unfold molecular mechanism of gene pathway [18]. Result of this analysis showed that biotechnology are vigorously involved in from human health care (Figure 4) and wellness of our society and implies attention for multi-centric studies.

CONCLUSIONS

It is conclude that the introduction to biological databases accelerates scientific process, where does a researcher turn to find information about a particular biological task? In active implication integrated genetic databases are maintained by a number of private and government organizations e.g. National Center for Biotechnology Information (NCBI) in Washington, D.C. The eminent of BTSPARK were encouraged our biotechnology scientists, faculty professionals, our student of this stream and industries representative. We conclude that the clear impact of biotechnology is on various scientific fields including agri science, plant Science, animal science, human and medical science, environmental science, health and bioremediations and encouraged to analysis of large database of biotechnology in near future.

DEDICATION

This article is dedicated to late **Er. Shivendra Ranjan Mishra** (25th Feb. 1982 – 4th Aug. 2012).

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Prof. Lal Mani (Ph. D.)	Managing Director
Dr. Anurag Mishra (Ph. D.)	Director Pharmacy,
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