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Article

Integrating Biotechnology and Molecular Biology: Advancements and Future Prospects

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Abstract: The quality and nutrition of the food products decide the health status of the global population physically and mentally, not the quantity . After the predictions regarding problems in availability with food and nutritional securities in the coming years, it was expected that these securities could only be possible by achieving rapid and higher genetic gains in food crops having the dual wellness of enhanced quality and nutrition as well as adaptation to adverse agro-climatic conditions. Although ongoing efforts of classical breeding have been partially successful in increasing per production productivity, still new approaches need to be evaluated to accelerate the progress. Available biotechnological interventions could be useful and faster approaches, if integrated with ongoing efforts of conventional breeding. With the success of micropropagation and tissue culture-based interventions in crop species, new dimensions were added by considering biotechnological genomics in agriculture. The last 3 decades' rapid advances in different biotechnological processes, approaches, and technologies have revolutionized the ongoing efforts of agricultural research for an increased tolerance of abiotic and biotic factors on one hand, and the development of the genomic resources of different model and crop plant species on the other hand, expanding better understanding about the evolutionary process of plants at the genome level.

The advances in these technologies were the basis for developing various better editing tools. Besides developing resistance against different abiotic and biotic factors these biotechnological were also useful to enhance the essential quality and nutritional status of food products, as well as understanding resistance genomics. Although partial success was realized through transgenic plants in few cereals and pulses crop species, there was an imprecision and unpredictable adverse effect on biological, biochemical and biophysical factors in some varieties. Specific sequences and tissue-specific problems of these transgenes in developed transgenic plants were the major constraint. Since the last 2 decades, these have been the basis for developing RNAi-mediated host-induced vectors with greater efficiency, specificity and predictability, understanding the mechanisms of resistance, and the molecular strategies of viruliferous pathogens. These approaches could be convenient and more alluring for developing non-toxic, alluring, and environmental benign plants having less off types. Furthermore, the current advanced technology support helps to understand everything beyond the genome, among species, among species and genotype and so on with different important traits. Enormous specificity and sensitivity of technology development have also accelerated the discovery and identification of new alleles or proteins related to biotic factors.

Keywords: Biotechnology, Molecular Biology, Genetic Engineering, CRISPR-Cas9, Synthetic Biology, Agricultural Biotechnology, Medical Biotechnology

Introduction

1. Introduction to Biotechnology and Molecular Biology

Biotechnology is a collection of various knowledge, skills, and techniques that are derived from different branches like genetics, microbiology, virology, immunology, and chemistry & information technology. The relationship between biotechnology and molecular biology is very close. Molecular biology is one of the aspects of biotechnology. This discipline helps to understand biological processes and molecular knowledge. Biotechnology helps plants to grow in unfavorable conditions, disease-resistant plants, quality food production, and rapid detection methods of the pathogen. The study of the largest macromolecules is the key subject of molecular biology. Nucleic acids and proteins have the most complex molecular structure of all known entities in the universe. Determining the structure of these macromolecules is the most critical aspect of understanding events occurring in a living system. The process of working with nucleic acids can be referred to as the molecular biology technique of gene manipulation or recombinant DNA technology which is a powerful new set of scientific tools. This technique is used to understand the structure and physical nature of the gene, such as its location and organization. It is also used for the transfer of gene from one organism to another, regardless of species using genetic engineering or gene knockout. The gene has the information to develop a peptide chain that forms a polypeptide chain, a protein product. The protein or enzyme is the product of a genetic system that determines the phenotypic expression of an organism. The techniques and principles of molecular biology are used to investigate proteins, DNA, and RNA. The gene information is transcribed into the messenger RNA (mRNA), which carries the information from the nucleus to the ribosomal system. Translation of mRNA's sequence information results in the formulation of a specific protein product ensuring gene expression. The application of molecular biology has positive contributions with new hopes in human and animal health [1]. [2][3]

1.1. Definition and Scope

Biotechnology is a multidisciplinary field which has major impact on our lives. The technology, however, is known since years. It involves either working with living cells or using molecules derived from cells for various applications. Biotechnology has wide range of uses and is often described as 'technology of hope', with potential impact on human health, well being of other life forms and our environment. In the field of human health care, biotechnology has brought paradigmatic changes and has revolutionized both diagnostics and therapeutics. One of the major challenges to the human beings have been the threats posed by the deadly virus infections such as Acquired Immuno Deficiency Syndrome (AIDS), hepatitis and SARS. For many of the diseases, the only affordable treatment available is through traditional drugs and several such diseases have developed resistance to the drugs. With the recent technological advances, and with the models based on DNA chips and host-pathogen protein-protein interactions, the diagnostics of the virus infection are possible in a very short time [1].

Personalized medicine is increasingly being recognized in the human health care system. In many developed countries the adverse effects of the conventional medical treatment are often taken as an indication for switching over to traditional drugs or to alternative health care practices which involve treatment with natural products of biological origin. However, there are certain diseases for which alternative drugs are not available and the treatment is quite expensive. It is in such situation that biotechnology plays a key role in developing affordable treatment. The present chapter will provide basic ideas and understanding of the applications of biotechnology in the human healthcare system. Particular emphasis is provided to the recent developments that have been drastically brought about a revolution in the field of diagnostics and therapeutics [4]. It will demonstrate as to how the biotechnological endeavors and the translational approach are likely to result in fulfilling the needs of the vast majority of the population residing in the third world and under developed countries. Regarding the environment, the increase in the industrialization and urbanization has led to an environment that is loaded with toxic chemicals. It is estimated that several millions of compounds, either naturally purified or synthesized have nicotine-like activity. Bioremediation is a process, in which the natural or recombinant organisms are used for the cleanup of the environmental toxic pollutants. Toxifying the toxic compounds or to have the non-toxic end products are the principle of designing the process for bioremediation. It focuses on the understanding of process of the transgenic plants which detoxify the toxic organic pollutants and the metabolizing of the pollutant by plant. The development of the transgenic plants has the long standing potential in detoxifying polar organics, which are not effectively treated by the biological or chemical means. The process involves the second xenobiotic metabolizing enzymes of Plant 2 system and constitutively over-expressed glutathione-S-transferase gene GSTF2. Generating the basal level expression of the GST2 gene in the Arabidopsis thaliana and the tobacco plants provide the resistance to various toxic industrial chemical. The plant, harvested for 6 weeks, significantly reduces and mobilizes the endosmosed 14C-pendimenthalin to a non-toxic metabolite within one week after transferred to the soil containing the pendimenthalin, which is substantiated by the Soil and Plant Analysis Council standard assay method and detected by HPTLC analysis. [5][6].

Literature Review

Historical Developments

1. What is Biotechnology? Biotechnology is a set of scientific techniques used by industry to produce commercial products or to carry out specialized operations. Molecular biology is a discipline or academic study that is used by various biotechnologies to carry out their objectives. All living organisms have a life system that contains genetic materials that keep all information about how they look and when they need to perform gene replication. Genes are sequences or patterns in genetic material that determine the character of living organisms. In eukaryotes and prokaryotes, genes are mostly made of DNA, which is an assemblage of nucleotide monomers. Sometimes genes are also made of RNA. Genetic information or information in genes is expressed in living organisms from the information contained in the form of nucleotide sequences in genes [7]. The expression of genetic information begins by converting a sequence of nucleic acids in DNA to a sequence of nucleic acids in RNA and is generally in the form of mRNA. Then the information contained in mRNA will be converted to a sequence of amino acids in a protein by the ribosome. Amino acid sequences in proteins express genetic information from DNA. Specifically, one amino acid is coded by the triplet nucleotide of mRNA.

There are several important landmark events that revolutionize biology in terms of understanding genetic information. Some “classical” DNA genetic information pieces are famous, such as the experiments carried by Griffith, Avery, McCarthy, and MacCleod. The experiment shows that DNA is the biological genetic information. Another famous work is about diaretic, Chase, who confirmed that DNA is the genetic material based on different experiment systems. The discovery of the DNA double helix structure is also considered a major landmark in understanding the genetic material [8]. Regarding information on gene expression, one important landmark is the genetic code. The discovery is based on a series of famous decoding experiments conducted by Marshll Nirenberg and Gobind Khorana in the early era of molecular biology development. There are 64 combinational codons; three terminate codons are included in them. Each codon consists of three nucleotides in the gene. However, because the number of triplets in the genetic code is more than the number of amino acids, so many amino acids contain more than one codon. [9][10]

2. Key Techniques in Biotechnology and Molecular Biology

Biotechnology and molecular biology deal with the modification of living organisms and their classification, while microbiology deals with properties regarding microorganisms as well as viruses. These three technologies are used conjointly for elucidating molecular biology, engineering of the present or production of new biomaterials, antibiotics, transgenic species, etc. Conventionally, through cultivation, the desired product or host along with other microorganisms are cultivated. The purities increased thereafter by isolating specific organisms. Later suitable environmental conditions are provided to enhance the growth of the organism whose biomass is of interest to the manufacturer, which is followed by its recovery [11]. Biotechnology is better if it is well integrated with bioengineering and molecular biology. Several lines of biological production that are not feasible, but are possible through modern biotechnological applications, can be achieved. This calls for an understanding of the complete metabolic as well as genetic mechanism of the organism of interest. Bioengineering has now permitted the manipulation of the DNA of the organism with the desired arrangement of genes thereby obtaining high titers of the desired product in the very same organism. Nonetheless mechanistic aspects for efficient production of the desired secondary metabolite would come only after the elucidation of the complete metabolic pathway. To this regard biotechnology, that promises a lot, is under intense scrutiny to speed up the process of discovery of the desired genes and thereby to enhance the quantum of work accomplishment.

To have a mesophyll protoplast in culture, in general, the tissue taken is that of leaf and then it is subjected to isolation of protoplast by breaking the leaf's cell. This is achieved by mixing the leaf with enzyme cellulose, pectinase for the degradation of the cell wall. The blend of cell wall breaking enzymes is diluted with distilled water leading to the liberation of intact cells. These cells again can be propagated in callus culture forming plantlets back. Protoplasts don't have cell walls. The protoplast then is kept in a particular medium along with amino acids; hormones bring about mitosis. The protoplast again divides forming a callus which can be propagated forming a plantlet and then a plant. Such plants are called somatic hybrids, which are created without sexual contact. One plant is called is the "donor of somatic protoplast," and the second "donor of nucleus in somatic protoplast." [12][13]

2.1. PCR (Polymerase Chain Reaction)

The technology to amplify DNA or RNA has been revolutionised by the advent of the polymerase chain reaction (PCR) developed in 1984. PCR is a technique designed to amplify a very small amount of DNA to a detectable level in a short time (in the order of hours). The technique can produce millions or more copies of a single or few copies of a DNA molecule within hours [14]. Initially, the technique developed to amplify short DNA segment, but developments in the field now allow PCR to target, amplify and clone any specific stretches of DNA or RNA in closely related species.

The typical requirement for cloning of a DNA fragment in a plasmid or phage vector need DNA to be present in vast quantity, because the cloned fragments are first inserted into the vector to produce recombinant DNA using ligase, an enzyme that join two molecules by forming phosphodiester linkage between them. After this process the recombinant DNA molecules (vectors) are transformed/transfected into the host and therefore the joined DNA segment required in maximum quantity. To circumvent this problem prior to PCR technology, recombinant DNA technology was utilised to amplify DNA using in vitro methods, cloning of DNA in a phage vector by RCA method. But as mentioned above, it requires prior knowledge of the primer and the detection of amplified DNA segment is time consuming and difficult. On the contrary, the PCR technique does not require prior knowledge of the sequence of the DNA. A small synthetic oligonucleotide primer can be used, and detection of the amplified DNA segment is easily done on an agarose gel stained with ethidium bromide. [15][16]

2.2. Recombinant DNA Technology

Biotechnology and molecular biology are fast-developing fields in science and each developed field is being used to advance the other. Biotechnology is primarily associated with recombinant DNA, but there are many other applications of biotechnology. Detailed knowledge of biochemistry is providing new insights into physiology. A molecular biologist normally understands cell biology and biochemistry, microbiology and the molecular basis of the action of the drugs. This means that many sciences are being treated as applied fields or split into biochemistry of therapeutics, molecular biomedicine and biotechnology. Secondly, most of the research workers are employed in medical schools or pharmaceutical Chemistry – biochemistry. Pharmaceuticals is big business. There is always a need to develop new and safe therapeutics. The human population increases, as does awareness of health and the demand for more and better therapeutics. The molecular basis of many genetic disorders is now known.

Researchers can identify the protein causing the disease and therefore develop a drug to act as a treatment. This is called rational drug design and depends upon the detailed knowledge of the target protein. Thirdly, many bacterial and viral pathogens are becoming resistant to antibiotics. Bacterial diseases can be treated with protein molecules that inactivate other proteins. If this becomes a plural form, they are called therapeutics. Antibodies are a classic example of therapeutics. They are proteins made by the immune system that will bind to a specific component of a bacterium or virus flagging it for destruction. In terms of rational drug design monoclonal antibodies can be designed that will target and inactivate the pathogenic protein directly. Creating novel therapeutics is another application of biotechnology. More recently vaccines are made with specifically engineered viral capsids, which can be produced in yeast or bacterial vectors. Other cutting edge therapeutics use small interfering RNA. The mRNA directed complementary strand RNA that cleave and so inhibit translation of a disease causing mRNA in humans. It is only recently that the immune system has been discovered to produce interfering RNA naturally. By intelligent design of complementary strands, their introduction into the human can knock out the expression of the disease causing gene. [17][18]

Materials and Methods

3. Applications of Biotechnology and Molecular Biology

Biotechnology is an emerging multidisciplinary field, having a major impact on our lives. In simple words, biotechnology is generation, manipulation, or multiplication of genetic material or molecules by the application of living organisms, for the benefit of other plants, animals, and human beings. It is not limited to the use of DNA recombinant technology, but it is multi-segment participatory technology, including the use of a tissue culture-based molecular biology approach. Biotechnology in the fermentation industry also leads to the production of biotechnological enzymes, antibiotics, and bio-active molecules. The processing of agricultural products, potable alcohol production, biomass products, bio-diesel products are included in the traditional biotechnology process. Modern biotechnology is the use of microorganisms or components for the synthesis of cost-effective, bio-friendly, and economically useful molecules. The incorporation of biotechnology knowledge in agriculture, crops, horticulture, aquatic animals, and disease-related protection and production has numerous benefits. The future thus stands biotechnology acceptance and conscious incorporation in academics. The working principle of biotechnology is the transformation of living organisms by the insertion of recombinant DNA into them. The desired gene is transformed into the characteristic target organism by a vector molecule. [19][20]

3.1. Medical Biotechnology

Progress in genetic and molecular biology over the past years has led to enormous advancement in biotechnological scientific disciplines, particularly with the creation of genetic engineering methodologies. Medical biotechnology, plant agriculture, and bioremediation, as well as technological areas such as renewable energy, have been changed significantly. Presently, scientific and technological efforts are centered on environmental and industrial biotechnology, which includes all the biotechnological processes. These processes might be effectively performed through the use of microbial cultures. Previous technological studies have not addressed in any comparable detail niche-related sectors of biotechnological research devoted to the use of microorganisms. On the other hand, genetic modifications of industrial microorganisms show immense promise as a path to increasing competitiveness in a global environment. Foreign gene expression under regulated promoters in industrial microorganisms safeguards lower costs. The microorganism can be engineered to drive the metabolism to overproduce the desired chemical compound. There are many reports on the utilization of plasmids and phages for gene expression in industrial microorganisms, including the high-level expression of pharmaceutical products [21]. While this approach has been quite successful, the stability of promoter-mediated gene expression over time is often poor. Furthermore, the accumulation of certain metabolic products can be lethal to the producing microorganism. Hence, recent results from integrating vectors in engineered microorganisms are also addressed. The general perspectives and manifestations of the marriage of genetic and molecular biology into biotechnological scientific disciplines are considered. Industrial applications of gene transfer in food processing, brewing, agriculture and forensics, as biocontrol and in the production of plant secondary metabolites, are also discussed. [22][23]

3.2. Agricultural Biotechnology

Overpopulation is the key cause of food and fodder scarcity. Indeed, there is continuous starvation and undernutrition in developing countries. Biotechnology can play an enormous role in increasing healthy plants with a lot of efficiency and crop maquis. Agricultural revolutions have been driven by biotechnological progress. During crucial times, it is probable to satisfy famishment by managed research and progress in the agricultural sector [24]. For example, the "Green Revolution" is responsible for easy and perfect crops using biotechniques. Biotechnological approaches are used for changes in genes in an organism, making it efficiently provided. It presented great excitement about the utilization of transgenic technologies for the better crop in the agricultural field. Agricultural biotechnologies are being exploited for the growth of crops to improve fighting handful, extended space efficiency, enrichment of thoughtful portion, and advancement of aromatic quality and transcriptional improvements. Elsewhere agriculture, biotechnologies have been worked out for the invention of pesticides, insecticides, and biofuels, the replication of desire parts, and bioinformatics-based methodologies. The transferal of tissues in plant biotech is one of the major progress and discoveries in Plant Biology in the last decade. Biotechnological strategies are now consolidated for genetic manipulation with wildfire control and genetic transformation in fruits, flowers, herbs, and vegetables. Gemma callus mediated regeneration is hardened for rolled innovation of cereal crops and food crops such as peanut cotyledons [7]. Eco-mindful agriculture apparatus biotechnological techniques for plant defense with microbial pathogens, nematodes, conflicts, and biotic venturing. Biopesticides, bio-chemicals, and bioherbicides are innovated utilizing biotechnologies. Biolubrication and Biofungicides handle for powdery and grounding conflictions diseases. Transgenic Bt crops are the universal use to control confounding insects in crop productions. Amplicity of patents on the genetic modification of crop plants for a better trait of agricultural esteem have been proposed and authorized. The perception advanced in plant genetic make-ups also help in biotechnology-based promotions. Rizhophagus fungi have a great regimen on plant biotechnical paradigms for seed birth and crop enhancements. Apparatus convention genetic modulations are Enu, Gene-cis, and Vita-cis effects for biorestricted gene amending. Networked biotechnologies will reap strong accomplishments in plant genetic make-ups, aging, to crop adornment in agriculture. The sequencing of the plant genome has been immensely successful by adopting a biotechnological protocol. On the other, prokaryotic genomes have been furnished in genomics resources. The ado of progressing methods will dramatically reinforce plant genetic-saving introductions. Adapted to increased environmental galvanizing, drought and strain tolerant cultivars have been generated broadening the range of carrying plants, the compounding of residues thicks due to its species-specificity has remained reliquated while the growers are forming a bactericidal resistance. Parasexing is the non-pigmentary geneates for to ensure that transformants are free of residual transfer attendant genes of either antiviral pivots are shirming to induce the involved agents of infertile crop plants. Subatomic agro-nanobiotechnology rehearsal to assured agricultural developments will only companion matters. A predictive method for biotechnological evaluations modestly discusses the burgeoning macroeconomic modification. Fully-developed agricultural land permitting higher-density feed cultivation with pleasant guttural instances.

Results and Discussion

4. Current Advancements in the Field

Ever since Johann Friedrich Miescher, in 1869, discovered Deoxyribonucleic acid, or DNA, as a new biological molecule, there has been a growing interest in elucidating both its structure and function. stated that the Transforming material is DNA. demonstrated the phenomenon of horizontal gene transfer also known as transformation through DNA. It was in 1949 that made some fundamental observations that ultimately led to the understanding that DNA composition was species specific. It was that in 1949 characterized sickle cell anaemia as a molecular disease, the first such description of a disorder. The most important advancement in the fields of biotechnology and molecular biology has been the discovery of the double helical model of DNA by in 1953. The isolation of DNA Polymerases by in 1958 and the RNAse-H in 1972 were other significant discoveries in the field of molecular biology. In 1960, was first to introduce the hybridization techniques, which were further suitable for identification of the close gene, for complementarity and for genome characterizations. Also in 1960, coined the term Biotechnology as described to a recombinant organism for favorable use.

The development of molecular biology as a discipline has rapidly grown since this discovery, and it has been the most rapidly growing biological discipline of the last quarter of the 20th century. Now, it is a multidisciplinary area at the intersection of science and technology and has enormous potentiality to explore knowledge and create wealth. The definition of molecular genetics by best describes the discipline as the science which attempts to understand biological activities at the molecular level, by elucidating all the interaction occurring between constituent molecules of living organisms. Substantial advancements have been made in the discipline of molecular genetics since the last quarter of that century. Here, in this perspective an attempt has been taken to discuss some landmark discoveries in molecular genetics. The earlier works are general backgrounds of molecular genetics as a discipline, and attempts to promote a deeper understanding of the contents to follow [25].

4.1. CRISPR-Cas9 Technology

The CRISPR–Cas9 system originally represents "Clustered Regularly Interspaced Short Palindromic Repeats", which are specific DNA sequences located in prokaryotic genomes, and CRISPR associated nuclease 9 (CRISPR–Cas9) resulting from Cas9 gene translation protein [26]. The CRISPR–Cas9 system is composed of a synthetic guide RNA (sgRNA) and nuclease Cas9. The two components of the CRISPR–Cas9 system form an RNA-guided endonuclease, which introduces site-specific DSB at a particular genomic site. The gene-editing has three impacts on the host genome. The Non-Homologous End Joining (NHEJ) repair system or Homology Directed Repair (HDR) system uses the homologous DNA template to repair damaged DNA. If the template DNA is supplied, this is the strategy for selecting the desired gene modification. Researchers can detect the paralogs of the target gene and create 20 bp sequences starting with the 5′-NGG-3′ PAM in the spacer region.

Today, CRISPR–Cas9 technology has become comfortably one of the most powerful tools for gene-editing, which can be orchestrated to process a comprehensive range of genetic modifications in any host, count human, plant, bacteria, fly, zebrafish and rat [27]. The lesson for budding studies is to select the mainly proper cell categories to attempt the gene-editing process to improve accuracy and dodge off-target effects. This experiment is a high-value transcript of a pilot antibody to gene-modify in cells relevant to the study of Epstein-Barr virus infection and lymphocyte tropism. Aspired to make the drug of interest with genetically modified immunity, token cell lines followed by genetic transformation, can consider testing. Sheep and goat genomes were altered to express encoded biologics under mammary gland-specific promoters. A strategy should be implemented in the future to exploit genetically modified animals as bioreactors for biomedicines. The essay here is an analysis of genome sequencing on genetically modified antibodies that were incurred in an attempt to stimulate the scope of the lymphocyte transformer and upcoming research goals. In the future, if the cells are prepared for trial with CRISPR/Cas9, default primers for identifying drug inserts are ready. There is a quickly arising intersection involving the manipulation of the genetic regulation of biological organisms and the engineering of living gene and inorganic systems in this foundation here.

4.2. Synthetic Biology

Synthetic biology was defined during the 1980s as "the synthesis of artificial forms of life," a notion that has largely been dislocated by the New Biotechnology emblematically materialized in the Human Genome Project (HGP) that in 2000 brought the characterization of human genetic code. The work of Venter et al. culminated in the development of a synthetic cell is often cited as the flagship of the anticipated landing on "synthetic life." Life, understood at the cell level, is a multiscale nested hierarchy of biological systems and processes eminently based on the Central Dogma of Molecular Biology. This theory established a clear distinction at the molecular level between informational polymers, with DNA storing genetic information in the form of a code read by RNA, which in its turn gives rise to proteins responsible for cellular structure and function modulation [28]. On the other hand, the basic unit of life is the cell, with the capacities of genetic heredity and evolution as unique hallmarks. As early as 1899, the Boston Herald reported the work of famous biologist Jacques Loeb as the "creation of life" by using a room full of chemical solutions. His experiments of the time were mainly based on his earlier invention of artificial parthenogenesis: embryonic development was induced by treating sea urchin eggs with inorganic salts. The reductionist view of life, deeply shaped by molecular biology over the last sixty years, opened up new opportunities that have been further leveraged by the staggering progress of biotechnology. A new discipline emerged and, during the second half of the 20th century, the field of genetic engineering consolidated. This marked the beginning of a third era in the history of biotechnology and the advent of synthetic biology as recently defined. Just as the first and second era have unfolded in venture of more efficient fermentation, genetic engineering and metabolic engineering settled the foundations for a new tide, the lines of which were (and are) shaped by the aforementioned major breakthroughs and others [29].

Conclusion

5. Future Prospects and Emerging Trends

Biotechnology, employing an area of applied science with traditional biology to produce goods and services aided by living organisms, has flourished dramatically in recent times. The successful enactment of the Human Genome Project has provided a thrilling development of genetic and molecular bio-information within a short period. A recent study concerning the most frequently received bacterial meningitis in newborns was able to precisely predict the outcome of treatment by in silico approach. In the forthcoming era, hospitals may deposit individual scaffolds and a blood sample to a server to foresee the causative agent and successful drug treatments. Phenylketonuria, the classical single-gene hereditary disorder, takes place once in every 15,000 births worldwide, with specific mutations in genes acting on the phenylalanine metabolism. Now, due to current developments in biotechnology, suspected newborn infants are investigated for 29 different mutations together with T513C. Hospitals will not be required to isolate and amplify DNA from newborns' blood sample but will also feed whole blood to a test strip. The microarrays on the test strip will employ UID-system to independently screen multiple mutations by many probes concentrating on the personal one. After analysis of the array images and interpreting results, the information will be directly transmitted to a server to store patient history, and also it will send the compulsory drug combination.

All living systems consist of genetic materials, DNA and its products RNA and proteins. Without studying these macromolecules, it is impossible to comprehensively understand inheritance, gene regulation, developments, and diseases of organisms. DNA is a unique and essential information carrier in all living organisms. With the advancement of modern chemistry and biology, scientists have begun to look at life from the perspective of genetic information, thus the discipline of genetic engineering (GE) was founded. This discipline has created very powerful new biotechnology, and a number of new disciplines such as molecular biology and biotechnology have emerged. These have merged into a second generation biotechnology: a revolutionary technology, which can even change the biodiversity of the biosphere and food productivity in a radical way. The biodiversity and productivity of any biotas, including the biosphere, is determined by the gene pool, and gene pool is determined by information carrier of the genes-DNA molecules. GE utilizes the capability of DNA as an information carrier of functional genes across the same or different species barriers. Together with gene cloning, the chemistry of DNA has completely revolutionized biology, leading to the development of the discipline of molecular biology and still fundamentally changing all life sciences. Biotechnology is based on principles of biology and chemistry and monetizes this through genetic engineering, molecular biology, tissue culture and bioinformatics to mention just a few disciplines. Its industrial applications, including manufacturing of organisms like vaccines, antibiotics, and biofuel, and as well as genetically modified organisms, has numerous ethical implications. A broader consideration of Biotechnology, considering the natural source and uses spanning the pre-historical to present day, shows that the historical and societal context is critical to understand its various implications. The advent of genetically modified organisms, gene patenting, and designer babies has been facilitated by a scientific approach that does not take into account fundamental ethical considerations such as the nature of life and the environment.

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