

The Role of Biotechnology in Vaccine Development

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Abstract

The following study is based on the role of biotechnology in vaccine development and all of the insights are reliable and chosen from authentic sources. This study has been divided in different parts which are filled with such information which are based on the following subject matter. At the beginning of the study, an introduction has been served within a proper manner and in this section, importance of biotechnology on vaccines development has been served to give an overview on the further results of the subject matter. After the execution of the introduction, important materials and methods have been selected and in the study all the data which have been collected are secondary data by nature. Data has been collected by following qualitative method and cross sectional research design has been selected and executed in a proper manner. Also, the data has been gathered from peer reviewed journals and the journals have been published after the year of 2019. After this, four types of themes have been developed by making focus on the subject matter and the themes are as follows- Notion of biotechnology, Importance of biotechnology in healthcare sector, Significance of incorporating biotechnology in developing vaccines and Challenges faced while incorporating biotechnology in vaccines development.

Keywords

Biotechnology, healthcare sector, vaccine development.

INTRODUCTION

In the era of fusion science and technology implementation, there are important factors by which and all sorts of problems known as biotechnology. **Biotechnology** is an example of **fusion technology** which consists of both **biological science and technology implementation** within its significance. It is a technology that intends to use biological systems, presiding over organisms or parts of this construction or making various products which are suitable for any sorts of business or any kind of education sector [1]. Another aspect about biotechnology is that it is an implementation of biology to construct and maintain upgraded products, procedures and organisms intended to develop human health and society as well.

After the massive strike of global pandemic, the use of biotechnology is increasing at maximum rate and there is massive use of biotechnology in that time of turbulence and this usage is known as **vaccine development**. In the healthcare sector and various types of hospitals, biotechnology intends to give the permit to the researchers to use DNA in an alternative form and develop gene functions and for this reason, **biotechnology** also known as genetic engineering from all types of aspects [2]. It has been often described as biotech which has existed since the initiation phase of civilization with domestication of plants, animals and discovery of fermenting raw products which have been consumed from various kinds of organisms.

Biotechnology can be able to help to produce vaccines starting from crafting and elements explorations procedures and everything requires antigenic and immunogenic components which can ensure impactfulness of the vaccines while it enters within a receiver's body. Biotechnology is specifically crucial in the sector of healthcare and clinical

medicines, where it facilitates the production of **therapeutic proteins** and other drugs which have been highly used in several types of vaccine development [3]. Researchers basically conduct examinations to evaluate the immunogenicity of those vaccinated candidates, their capability to elicit the desired immune responses as well.

MATERIALS AND METHODS

Type of research

For this following study which is based on the importance of biotechnology on vaccine making, has been executed by maintaining several criterion and norms which determine a successful execution of the subject matter. Data or insights which have been collected for this study has a different type which determines the proactiveness of this subject matter. The major type of this research is secondary and the reason behind choosing these types is immensely justified with the execution of the subject matter. The reason behind selecting secondary types is that information and data related to the topic are gathered in this study from relevant secondary sources like journals, articles, and websites.

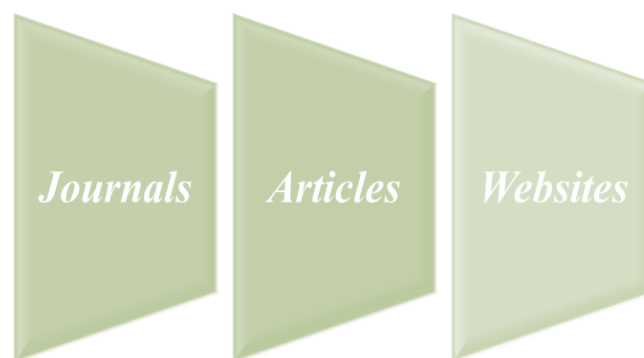


Figure 1: Sources of secondary data

Research design

While collecting the data for this study, there is an important design which has been followed throughout this research work. The design which has been selected is qualitative and by following this research design, the research work has been evaluated and crucial insights have been collected for this study.

Inclusion and exclusion criteria

This study follows a criterion which fixes the success of this topic and the name of those criteria is an inclusion and exclusion criterion which determines the nature of data which has been collected for the research work. In this study, the primary data has been executed and secondary data have been executed as in this study, there are no certain statistical interpretations which can be evaluated with the help of primary data.

Choice of subject

The main reason behind choosing this topic is to highlight the *importance of biotechnology in the sector of clinical medicine and development of vaccines in crucial times of turbulence* such as global pandemic. With the help of choosing this study, the concept of biotechnology has been clarified explicitly and several information regarding biotechnology and its significance to vaccine development has been measured in a proactive manner.

RESULTS

Theme 1 Notion of biotechnology

Biotechnology is not an upgrade norm which can deliver several benefits with two different factors of biological science and technology implementation. The researchers explore this existing for producing foods and also, this technology can be used in the reducing pollution from different sorts of fields of human living. This technology usually implemented living cells to construct or manipulate products for particular reasons like, genetically modified foods, fermenting foods products to produce some innovative product and also, the massive use of biotechnology is to develop vaccines which can be preserved for a long time and additionally, there are less chances of fermentation [4]. Also, this technology has been implemented as a linkage to genetic engineering as a sector in its own right at the initiation of the present healthcare industry massively.

The biotechnology consists of five different branches or phases within which modern biotechnology has been segmented and parts are as follows- human, environmental, plant, animal and industrial. By following these five branches of the usages of biotechnology, this technology helps the society to fight against hunger and disease, make more safety within implementations of various products, effectiveness in cleanliness and mitigates the rate of carbon footprint and saves energy in a more effective manner. The increment in investment and employment in the healthcare sector has been exponential from the past few years [5]. Construction of

modern biotechnology and firms are continuously venturing within areas to represent the disease and to save lives in an active manner. Also, to elevate the productivity within crops, vegetables, cultivation and animals and to develop the quality of foods, feed and fodder to strengthen the tie of biological materials which have been consumed from natural resources.

Isolation of DNA from the donor organism can lead the process of biotechnology and reproduce such products which can be immensely effective for any sorts of sectors. There are some basic principles of biotechnology and the first principle is known as genetic engineering. An underlying aspect about this principle has been implemented in the process of biotechnology and alters the present organism by designing the genetic structure of that organism which includes recombinant DNA technology. Biotechnology procedure has been included in the process genetic engineering and the procedure have been given below-

- Separation of the DNA from the donor organism
- DNA fragmentation implementing some restrictions *endonucleases* and *ligation* of that desired DNA raptures within the vector
- Shifting of recombinant DNA to the host
- Culture of modified cells within a nutrient medium
- Extraction of desired products.

Furthermore, in the process of chemical engineering, the major points of differentiation among biotechnology and chemical engineering is the range of operation as several products which have been made from the process of biotechnology are low extremely low. The reason behind having low traits within the manufactured products is the differentiation of biotechnology from *chemical engineering*. Also, biotechnology enhances the scope within pharmaceuticals and its application has provided effective products in terms of quality and quantity as well. The process of biotechnology has been used in different kinds of zones which gives a proper human living in a successive way. In agriculture, medicines, transgenic animals, aquaculture and antibiotics, this process have been majorly used to produce different kinds of products which would be profitable for human living [6]. In the field of antibiotics, this process of biotechnology helps in manufacturing antibiotics by injecting artificial hormones with the implementation of plants.

Theme 2 Importance of biotechnology in healthcare sectors

Currently, a significant development can be noticed in several healthcare institutions as the entire healthcare sector has concentrated on ameliorating its services to bring changes in human life. Application of biotechnology is considered as a stepping stone for healthcare industry in improving treating and diagnosing procedures [7]. This implication has a great importance in preventing certain diseases that can cause immense harm to human health. In current days, innovative techniques are applied by hospitals to get better results in the field of conducting treatment procedures of patients and in this particular case, the role of biotechnology cannot be denied. Modern biotechnology has

played an essential part in aiding healthcare institutions to launch several diagnostic tools. These tools consist of a huge necessity in identifying diseases which are major reasons for maximum death occurrences.

In the field of clinical medicines, majorly in the process of vaccine developments, biotechnology has been used and in the construction process of several unique techniques for diagnosis, treatment and to get precaution from diseases, biotechnology has been used in an extended manner [8]. It helps in serving the patient with efficient treatments and preventive measures for various diseases with the help of its inventions of novel drugs and recombinant vaccines. **Medical biotechnology** is a type of medicines that implement within the living cells materials to investigate and then manufacture pharmaceuticals and examine products for the wellbeing of patients. These products, which have been manufactured, help to treat and prevent disease in a proactive manner.

Additionally named as medical biotechnology, it plays a major role in the healthcare sector which determines the effectiveness of biotechnology in the medical line and reduces the stress of medicines from the life of patients. Globally diagnose the virus **Ebola**, from the production of Ebola vaccine to chalk out human DNA to horticultural influences, medical biotechnology is producing huge benefits and helps millions of people who have suffered from the **Ebola** virus. In order to survive the fatal condition of the spread of Ebola virus, the Ebola vaccine has been developed with the aid of biotechnology [9]. There are several implementations of biotechnology; it has been worked within genetic examinations, treatments of drugs and development of artificial tissues to survive a little bit. With the help of several benefits in medical biotechnology, there are some upgraded awareness's that have been raised with the growing facilities of biotechnology in the healthcare sector.

From raising several types of ethics and norms, there are plenty of things to fix up and manage when it comes to this rapid industry of medication. By learning about several technical and biological benefits and the awareness surrounding the process, the spread of medical biotechnology can be increased at a certain pace. There are several crucial major medical biotechnology advancements which help the healthcare sector to gain more profit and treat the patient in a suitable manner and reduce the mortality rate at a rapid pace. First medical biotechnology advancement is **CRISPR** which is globally known as **Cas-9** [10]. It plays the role like a pair of molecular scissors and cuts the DNA out of the cell. Generally, CRISPR has been used to expand the strand of DNA and also implemented in medical biotechnology as the massive instruments of gnomes edit within the genetic periphery. This particular tool of biotechnology allows the scientist to use the DNA strands in an alternative manner and renovate the function of genes within an effective manner.

Modified medical sciences might have the capability to heal people with a single touch and ease hectic scheduling of medical procedures at a successive rate. Another instance of medical biotechnology is tissue nanotransfection which

works within a different way. **Tissue nanotransfection** works by injecting some genetic codes within the skin cells which turns those skins within other types of skin cells and modifies the quality of skins and strengthens the bonds between the tissues in an effective manner [11]. It is an extensive example of biotechnology which helps to modify raptures and increases the faith of patients by treating the skin cell better from all aspects.

Theme 3 Significance of incorporating biotechnology in developing vaccines

Vaccination at the right time helps individuals to lead a safe life that is free from diseases. An agent generated from inactivated microbes is contained by a vaccine [12]. Despite microbes this agent consists of subunit (part of surface antigens) and toxins. Recently, several biotechnological innovative traits are incorporated at the time of developing vaccines. Amelioration and application of biotechnology can bring significant diversification in clinical implications. In the modern age, the decrease of contagious diseases can be noticed; however, diseases that are non-infectious are increasing rapidly. It is a great cause of tension for the entire healthcare industry; in this case, application of biotechnology can make positive changes that can also prevent human health from non-infectious diseases.

Before assessing the role of biotechnology in the development of vaccines, it is important to justify the significance of vaccine development in a proper manner. In the present situation, there are no vaccines to protect against two main worldwide killing viruses which are known as Malaria and HIV. Vaccine is an example of biological products which have been provided to several individuals to intensify the immune systems towards the strike of bacterial infections and helps to prevent the strike of pathogens in a proactive manner [13]. Also, vaccines can contain a particular type of pathogen that has been decayed or antigens elements of those specific pathogens, generally proteins have been found on the surface of a cell. Usually a protein has been found on the surface of skin cells or can be found within such particles which can be viral by the antibodies within the immune system.

The strategies of modern biotechnology like, genetical engineering and cell culture, activates and impacts the manufacture of rapid and financially developed vaccines to provide quick recovery for the patients. Main purpose of using biotechnology in the production of vaccines has been used to prevent infectious diseases for the patients. It includes introduction of chosen genes within plants and body cells and then inducing these altered plants to produce the encoded proteins [14]. Also, with the help of such vaccines which have been produced genetically, activates the rate of immunity against disease for which, stereotypical vaccines and treatments have not worked within human bodies and helps the patients to get recovered from severe types of chronic diseases. Biotechnology has been implemented within three different ways to produce vaccines and the ways are as follows- differentiation of authentic implementation of

a particular monoclonal antibody, assistance of cloned gene for synthesis of an antigen and synthesis of the peptides which might be implemented as vaccines.

Furthermore, in reverse vaccinology, the use of biotechnology is intense to make a vivid impact on medical science and the process of vaccine development. The generic concept of reverse vaccinology is that whole pathogenic genomes can be cloned and monitored by incorporating bioinformatics procedures to extend the genes in a proactive manner. Also, the functional genomic approaches like, microarrays of DNA, proteomics and comparative analysis of genomes have been implemented to identify the virulence aspects and the candidate of novel vaccines in a certain manner. Generally, the foremost attempt of reverse vaccinology starts with ManB vaccines and however, it has been implemented in several types of bacterial vaccines like, resistance of antibiotics, *Staphylococcus aureus* and *Streptococcus pneumoniae* [15]. These upgraded types of computational approaches intend to give the permit of predicting all types of antigens, independent about the abundances and immunogenicity while spreading the infection within the skin cell of the human body. These are the major usages of biotechnology in vaccinology of modern medical science.

Therefore, it can be rather stated that the production of vaccines by implementing biotechnology is an extensive factor which has been practiced by the healthcare sector and the importance of biotechnology in vaccine development has been practiced by most of the medical practitioners in a successive manner. Currently, there are no such vaccines to secure against one major virus which is the cause of global pandemic, *Corona virus* and however, present scientific benefits have enhanced the similarity of constricting new and developed vaccines from this fatal disease.

Theme 4 Challenges faced while incorporating biotechnology in vaccines development

In the present situation of the medical healthcare sector and up gradation, there are several challenges that might be raised within the healthcare institutions and can make a pause between the procedures of vaccine development. Challenges that can be raised within the present strike of global pandemic, the Covid-19 vaccine uplifts involving the problems of providing affordability, accessibility and potential of acceptance at both a country level and an individual level as well [16]. Vaccines are within a large healthcare intervention which has been recognised to the humankind to save lives within a proactive manner. Although, by incorporating biotechnology, it has been taken up widely that in high income countries from the present era, vaccines of *smallpox* have been made and applied successfully to reduce the rate of this disease. However, there are some crucial challenges of implementing biotechnology in vaccine development and the first challenge is the lack of technology implementation in the healthcare sector for the safety of the patients.

Incorporation of biotechnology in an ancient sector can be applicable as the key player of changing all the stereotypes and can give a quick head start to the process of vaccine development which is a crucial factor to save a patient's life. The issues of vaccine development for low resourced settings begin with these baseline challenges of technological implementation and however, there is no certain training related to incorporating biotechnology within the field of medical science [17]. Certainly, there are several mechanisms related to tissue protein injection which need proper types of technology incorporation. Also, there are immensely less trial phases of vaccines which is actually an important step to be fulfilled at any cost.

Furthermore, another notable challenge which can be raised within incorporation of biotechnology in the process of vaccines development is that clinical trials using biotechnology in vaccine development. After facing that issue of technology implementations, this challenge has been addressed by the concern of lacking the counts of trials in testing the prepared vaccine. Because of the lack of trials of that vaccine, it becomes difficult to judge the effectiveness of biotechnology in vaccine development from all aspects. Apart from this issue, there is another issue which can be raised within the process of vaccine development is lack of funding and revenue resources [18]. Biotechnology cannot be affordable by different healthcare institutions and for the reason of adopting a poor type of biotechnology, the process of biotechnology can cause massive decay within the process of vaccine development.

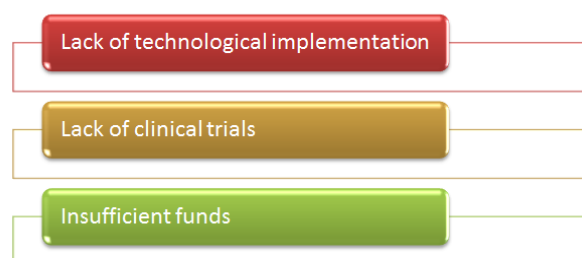


Figure 2: Challenges faced while incorporating biotechnology in vaccines development

DISCUSSION

The study has been surrounded by a core subject matter which is based on the role of biotechnology in vaccine development and in this study; all the insights have been selected from authentic sources which are related to the subject matter directly. By following and maintaining the depth of this topic, there are four themes which have been developed in the following study. All of the themes are related to the following subject matter and each theme has been constructed by depending on the core of this topic and the selected subject matter is an example of biotechnology within the healthcare sector for developing vaccines in a proactive manner.

In this study, the first theme is based on introduction to biotechnology in the development of vaccines within the healthcare sector and in this section; an elaborated chart of biotechnology has been discussed. At the beginning of this section, the basic definition of biotechnology has been served by elaborating it as a fusion technology within the healthcare sector. The reason for calling it fusion technology is that it has both the touch of biological interference and technology implementation which denotes a massive inclusion within several healthcare institutions in an effective manner. Furthermore, in this section, branches of biotechnology have been showcased within this study which is an important part of biotechnology and the branches are as follows- human, environmental, plant, animal and industrial.

Second theme has been depicted as the importance of biotechnology in the healthcare sector and it has been represented that biotechnology is a crucial part in the present day's healthcare sector. A massive usage of biotechnology has depicted which medical biotechnology and it is a key player in making any sorts of vaccines in an effective manner. The third theme is based on the significance of incorporating biotechnology in developing vaccines and certainly in the present situation, and in the time of global pandemic, the use of biotechnology is increasing to produce a maximum amount of vaccines to get protected from the attack of any sorts of fatal diseases. Finally, the last theme is based on the challenges faced while incorporating biotechnology in vaccines development and in this section; three major issues have been flaunted. The issues are as follows- lack of technology implementation, lack of clinical trials and insufficient funding in using biotechnology in vaccine production.

CONCLUSION

This study is the highlighted form of representing the role of biotechnology in vaccine development and all of the insights which have been collected for this study are reliable and all of the sources are collected by following the depth of the subject matter. At the beginning of this study, an introduction over the topic has been served to depict the importance of biotechnology and make the readers understand about the concept of biotechnology in the present situation of the healthcare sector. Also, in this section, an overview of the importance of biotechnology in vaccine development by representing the branches of biotechnology has been represented by collecting several insights related to this following subject matter.

Later on, the crucial and needed material a method has been selected and implemented in a proper manner which flaunts validity and reliability of the subject matter in a proactive circumstance. In this study, secondary data has been collected by following qualitative methods and all the insights have been gathered from authentic resources which serve all the information about biotechnology and vaccines development. Also, all the data have been selected from such resources which are mainly peer reviewed journals and have

been published after the year of 2019. Furthermore, the main focus has been made on the topic and four different themes have been developed which includes the challenges of incorporating biotechnology in vaccine development.

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