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"A Review On Recombinant Dna Technology: Importance And Progress"

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ABSTRACT
Assuredly, the recombinant DNA technology has emerged to improve the quality of human life. In this paper, definition, procedures, types and applications of recombinant DNA technology have been described. There are three different methods of recombinant DNA technology; transformation, non-bacterial transformation and phage introduction. The recombinant DNA technology has several applications in various fields such as agriculture, public health, gene therapy, environmental science and pollution research, clinical pharmacy and development of hormones and vaccines.
Keywords: Recombinant DNA, Biotechnology, Genetic engineering.

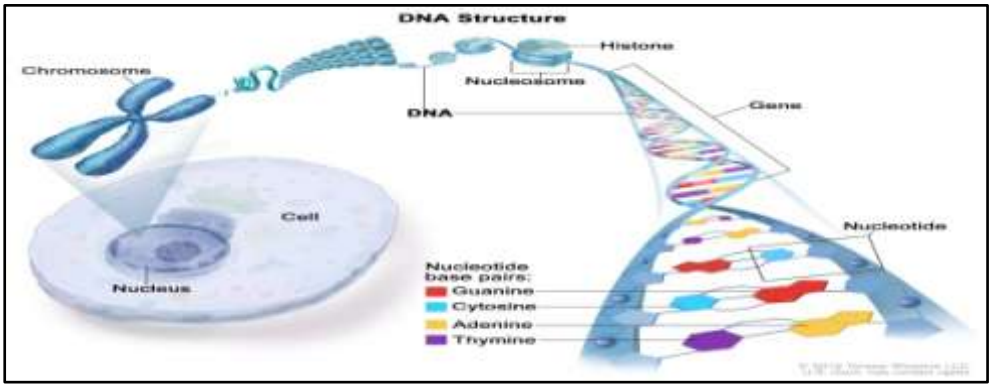
I. INTRODUCTION

Improving the quality of human life is the ultimate goal for every nation. Generally, the human life is influenced by three main priorities; scarcity of the food, health issues and environmental complications (Khan et al., 2016). Numerous human health related problems are considered the most critical factor associated with deterioration of human life quality. Several diseases such as HIV, malaria, T.B. and dengue are threatening human life based on the global statistics from (Khan et al., 2016).

Structure and function of DNA

Dioxyribonucleic Acia (DNA) is a molecule located in the nucleus of the cells and is the storage of the genetic information about an organism. It is responsible for control the development and function of the living organism. The DNA transfer the genetic information through the generations. Chemically, the DNA consists of three main components; phosphate group, sugar (ribose lack oxygen) and nucleotide base of purine or pyrimidine as pairs adenine (A) paired with thymine (T), and guanine (G) paired with cytosine (C) (Hayward, 1991). The bonding of these three components produced a "double helix" structure as shown in Figure 1. This structure was discovered by James Watson and Francis Crick on 1953. The sequence of nucleotides (C,T,G,A) comprises what we call it "gene" which is translated intro a specific protein through a process of protein synthesis with involvement of ribonucleic acid (RNA) and ribosomes.

Figure 1: Structure of the deoxyribonucleic acid (DNA). Adapted from the National Cancer Institute (NIH) at https://www.cancer.gov/publications/dictionaries/genetics-dictionary/def/dna



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Recombinant DNA technology

On the emerging technologies in the field of molecular biology is the recombinant DNA technology (rDNA). This technology becomes widely applicable in various fields (Figure 2). It is the corner stone in improving the health through developing new medications and vaccines as well as other pharmaceutical products. Moreover, it plays an important role in advancing diagnosis and treatment with enhanced diagnosis kits, assessment tools and new therapeutic strategies (Ullah et al, 2015; Jackson et al., 2018). An example of important recombinant DNA products is the insulin. Production of human insulin and erythropoietin was performed using genetically modified bacteria (Lomedico, 1982; Bhopale and Nanda, 2005; Khan et al., 2016). The recombinant DNA technology involves several steps of altering the genetic materials in vitro to achieve better and enhanced features in the living organisms or their products (Figure 3). This technology starts with inserting DNA fragments from various sources with favourable gene sequence and expression into adequate vector, which is in most cases bacteria (Galambos and Struchio, 1998; Hayward, 1991).

The earliest effort to produce the recombinant DNA (rDNA) was carried out by several scientists; Paul Berg, Herbert Boyer, Annie Chang, and Stanley Cohen from Stanford University and California University San Francisco in 1973 (Khan et al., 2019). However, there was a contradiction in application of recombinant DNA in producing human-health related products with concerns about interfering with original human DNA and adverse effect of these products (Bazan-Peregrino et al., 2013; Khan et al., 2016). Since that era, several progress steps have been achieved globally in this technique especially in the mid of 1980s as high number of products were produced including hormones, vaccines, therapeutic products and diagnosis kits (Almeida et al., 2011; Bazan-Peregrino et al., 2013).

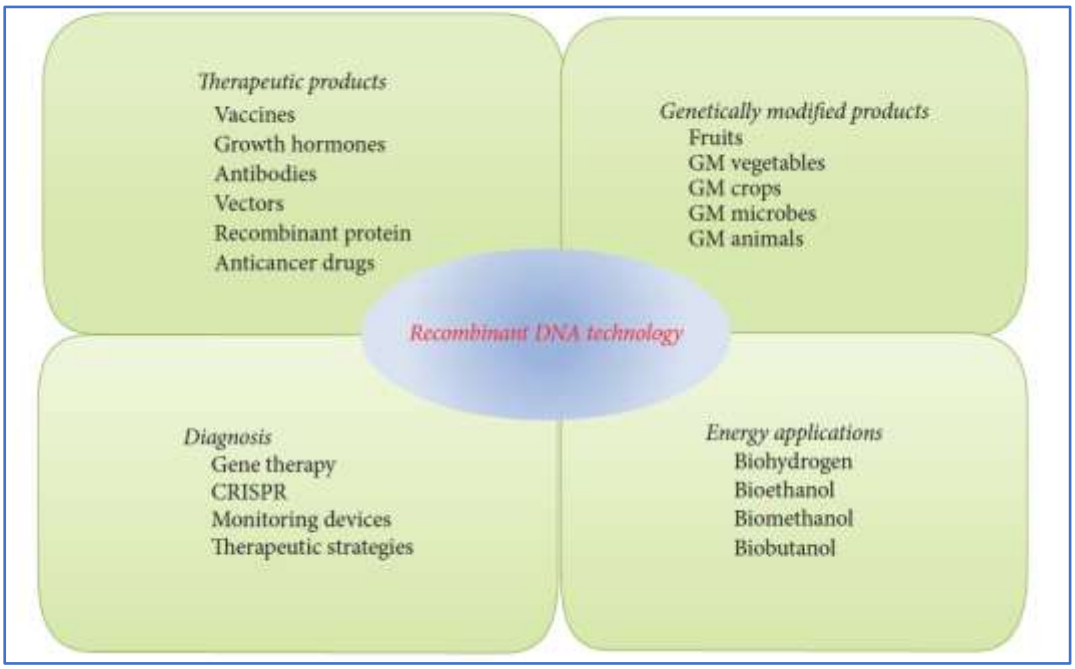

Figure 2: Various applications of recombinant DNA technology (adopted from Khan et al. 2016).

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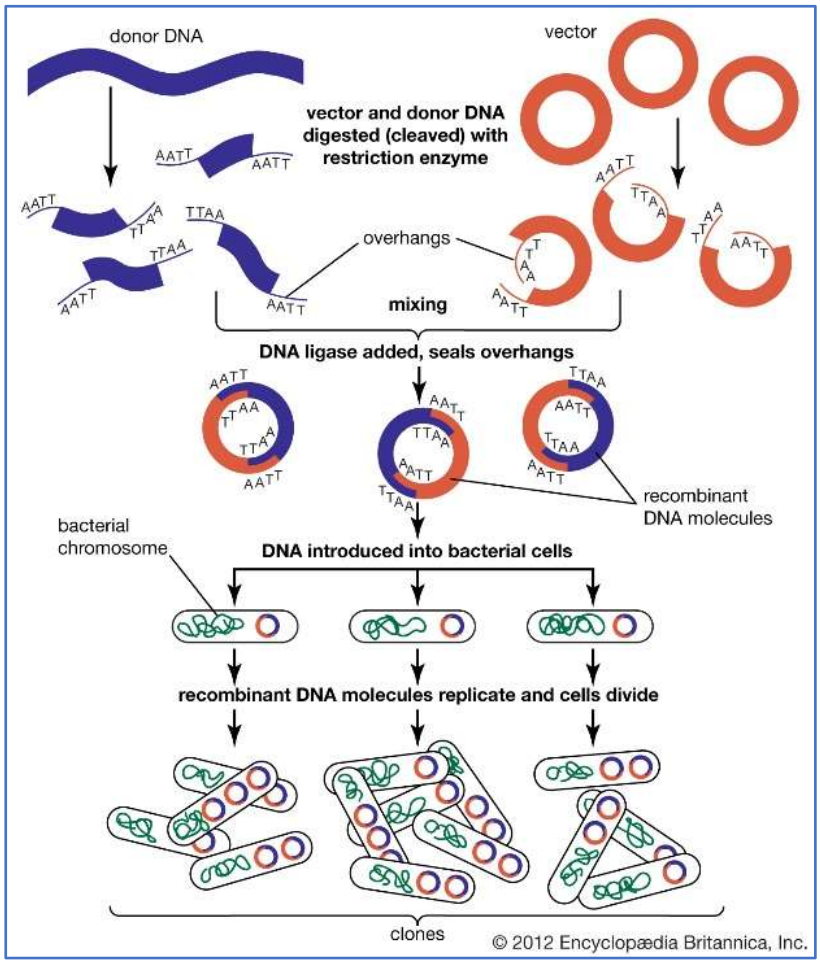

Figure 3: Steps showing engineering of a recombinant DNA molecule

Consequently, this quick approach of DNA technology offers a fast and reliable tool to investigate the genetic expression and the nature of mutations through introducing these genes into eukaryotic cells. This is was the first step in inserting the insulin gene inside a simian virus (Lomedico, 1982). Similarly, the growth of the tumor was supressed by adenoviral vector coding the human endostain (Lomedico, 1982). On the other hand, long acting proteins have been produced through rDNA technique including the genetic sequence of glycosylation site (Almeida et al., 2011; Khan et al., 2016). Simply, the DNA recombinant technology was a revolution in the genetics, medicine and molecular biology fields where hundreds of products have shown to be specific, effective and reliable for treating several human diseases and deficiencies (Black, 1989; Khan et al., 2016).

Methods of rDNA technology

Generally, the recombinant DNA is produced in three methods. These methods are;

Transformation

Firstly, a fragment of DNA is to be selected and injected into a vector. Secondly, that DNA fragment will be cut into smaller pieces by using restriction endonuclease enzymes and attach "ligate" with cohesive enzyme called "DNA ligase". This fragment of DNA has a unique marker which allows for future identify cation of the recombinant molecules. The vectors will be inserted into a "host cell" and this is called transformation. The host cell is mostly bacteria of Escherichia coli (E.coli). The DNA fragment should identifiable to differentiate between transformed hosts from untransformed hosts

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Non-Bacterial Transformation

This method is quite similar to above transformation except using no bacteria as vector. The DNA piece will be injected using microinjection techniques directly into the nucleus of the cells. This is a process very similar to Transformation, which was described above. The only difference between the two is non-bacterial does not use bacteria such as E. coli for the host.

Phage Introduction

The third method is phage introduction or transfection which is almost similar to transformation except that phage (a virus that attacks bacteria) is used instead of bacteria. The most common phages used in this method is a lambda or MI3 phages to carry the recombinant DNA.

Current Research progress in rDNA

Recombinant DNA technology is developing at a fast pace, especially during the last two decades. New approaches, techniques and products have been developed widely in several fields including medicine, agriculture, environment and food industry (Khan et al., 2016).

Applications

Food and Agriculture. Recombinant DNA technology has major uses which made the manufacturing of novel enzymes possible which are suitable in conditions for special冗ed food- processing

Food and Agriculture. Recombinant DNA technology has major uses which made the manufacturing of novel enzymes possible which are suitable in conditions for special food-processing.

Agriculture and food industry: The recombinant DNA technology and techniques have been applied widely in producing new enzymes in order to enhance the food processing and preservation. Several crops have been genetically modified to endure the drought or unfavourable conditions using the recombinant DNA techniques.

Public health: Recobinant DNA technology have numerous applications in diseases treatment and enhancing the quality of health and life.

Genetic engineering and gene therapy: Gene manipulation and therapy advanced drastically with promising therapeutic techniques through using recombinant DNA technology. The most notable example is producing the human insulin.

Production of antibodies and monoclonal antibodies: The antibodies and their dervatives have been produced widely through the recombinant DNA technology.

Health and Diseases. Recombinant DNA technology has a wide spectrum of applications in treating diseases and

improving health conditions. 琯e following sections describe

the important breakthroughs of recombinant DNA technol-

ogy for the improvement of human healt

Environmental science and pollution: Recombinant DNA technology has contributed effectively to solving several environmental issues and reducing the associated pollution problems. Bioplastic and releasing genetically modified microbes are good examples.

Clinical pharmacy and drug metabolism: The recombinant DNA technology enables the researchers to investigate the drug metabolisms to evaluate the effectiveness and retention time of drugs in human body.

Development of hormones and vaccinations: The process of production of hormones and vaccines has been facilitated with using the recombinant DNA technology.

II. DISCUSION

Recombinant DNA technology is a revolution in biotechnology which contributes in developing new pharmaceutical products, hormones, ezymes and treating numerous health, agricutlrue and environmental problems. The genetic engineering involves recombinant DNA in which a selected gene can be cloned or/or manipulated. These genes being cloned are trascripts of function, character, enzyme or hormones in human body. It can be performed using state-of-art technologies and tools in which can be applied either in vitro or in vivo. In this review paper, this emerging technology has been reviewed based on available literature to increase the knowledge about this evolutionary technology which will drive human civilalization into an advanced level.

III. CONCLUSION

The recombinant DNA technology has significant impact in improving the quality of human life. It has several applications in different facets of human life. The most important output of this technology is developing the human insulin which saves millions of humans around the world. It has wide spectrum of applications in treating diseases and improving health conditions. The present review describe the important breakthroughs of recombinant DNA technology for the improvement of

human heal applications of Recombinant DNA technolog, food and agriculture.

CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

IV. ACKNOWLEDGEMENTS

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