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REVIEW PAPER

r-DNA TECHNOLOGY IN HUMAN HEALTH

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ABSTRACT

In human life r-DNA technology make a unique impact. R-DNA technology is an industrial process. This technology is uses in the specific research on DNA for practical applications. R-DNA technology refers to the joining together of DNA molecules from two different species that are inserted in a host organism to produce new genetic combination. In environment, science, medicine, agriculture, industry, food supply- these are the most important application of r-DNA technology . r-DNA technology creates a huge impact on pharmaceutical technology and human health. Otherside it also creates a revolutionary changes in the field of drug delivery and medicine that are just hallucinatory. Treatment of many disease by replacing damage and disease genes in the body with new genes done by rDNA technology. R-DNA technology gift Humulin, which is the first marketed health care product. After that recombinant human insulin become available using fermentation in microorganisms (bacteria and yeast). Insulin replacement therapy make a level which helps to patients who is suffering type 1 and advanced type 2 diabetes mellitus.

Keywords: - *rDNA technology, pharmaceutical technology, human health, diabetes mellitus, Humulin, insulin*.

INTRODUCTION

Human health is a state of complete physical, psychological and social wellbeing. rDNA technology make a magnificent role in improving health condition by developing new vaccines and pharmaceuticals. The treatment strategies are also improve by developing monitoring devices, diagnostic kit and new therapeutic approaches. [1]

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Recombinant DNA technology refers to the joining together of DNA molecules from two different species that are inserted into a host organism to produce new genetic combinations that are of value to science, medicine, agriculture and industry. On the other hand rDNA is the general name for a piece of DNA that has be created by the combination of at least two stands[2] In 1973 , first rDNA molecules were generated by Paul Berg, Herbert Boyer, Annie Chang and Stanley Cohen of Stanford University and University of California Sun Francisco.[3]

Milestones of Recombinant DNA:

Some milestones of recombinant DNA technology have been summarized as below:

1976 – First prenatal diagnosis by using gene specific probe.

1977 – Methods for rapid DNA sequencing, discovery of split genes and somatostatin by rDNA.

1979 – Insulin synthesized by using rDNA; first human viral antigen.

1981 – Foot and mouth disease viral antigen cloned.

1982 – Commercial production of coli of genetically engineered human insulin, Isolation, cloning and characterization of human cancer gene.

1983 – Engineered Ti-plasmid used to transform plants.

1985 – Insertion of cloned gene from Salmonella into tobacco plant to make resistant to herbicide glyphosphate; Development of PCR technique.

1986 – Development of gene gun.

1989 – First field test of genetically engineered virus (baculovirus) that kills cabbage looper caterpillars.

1990 – Production of first transformed com.

1991 – Production of first transgenic pigs and goats, manufacture of human haemoglobin, first test of gene therapy on human cancer patients.

1994 – The Flavr Savr tomato introduced; the first genetically engineered whole food approved for sale. Fully human monoclonal antibodies produced in genetically engineered mice.

1997 – World's first mammalian clone (Dolly) developed from a non-reproductive cell of an adult animal through cloning by nuclear transplantation.

HOW rDNA MADE: [4]

There are three different methods by which Recombinant DNA is made. They are Transformation, Phage Introduction, and Non-Bacterial Transformation. Each are described separately below:

a. Transformation

The first step in transformation is to select a piece of DNA to be inserted into a vector. The second step is to cut that piece of DNA with a restriction enzyme and then ligate the DNA insert into the vector with DNA Ligase. The insert contains a selectable marker which allows for identification of recombinant molecules. An antibiotic marker is often used so a host cell without a vector dies when exposed to a certain antibiotic, and the host with the vector will live because it is resistant.

The vector is inserted into a host cell, in a process called transformation. One example of a possible host cell is *E.Coli.* The host cells must be specially prepared to take up the foreign DNA. Selectable markers can be for antibiotic resistance, color changes, or any other characteristic which can distinguish transformed hosts from untransformed hosts. Different vectors have different properties to make them suitable to different applications. Some properties can include symmetrical cloning sites, size, and high copy number.

b. Non-Bacterial Transformation

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. In microinjection, the DNA is injected directly into the nucleus of the cell being transformed. In biolistic, the host cells are bombarded with high velocity micro projectiles, such as particles of gold or tungsten that have been coated with DNA.

c. Phage Introduction

Phage introduction is the process of transfection, which is equivalent to transformation, except a phage is used instead of bacteria. In vitro packaging of a vector is used. This uses lambda or MI3 phages to produce phage plaques which contain recombinants. The recombinants that are created can be identified by differences in the recombinants and non-recombinants using various selection methods.

GOALS OF rDNA TECHNOLOGY: [5]

1. To make desired alterations in one or more isolated genes.
2. Interpretation of hereditary disease and related cures.
3. Alternating the genome of an organism.
4. Artificial synthesis of new genes.
5. Enhancement of the human genome.
6. Isolation and characterization of genes.

IMPORTANCE OF rDNA TECHNOLOGY: [4, 6]

From the 21st century rDNA become more important as genetic diseases become more prevalent and agriculture area is produced. In the last few years rDNA has been gaining more importance role. Some importance are given below---

1. Production of insulin.
2. Recombinant vaccine (Hepatitis B)
3. Germ line and somatic gene therapy.
4. Better crops (drought and heat resistance)
5. Plants that produce their own insecticides.
6. Production of clotting factors.
7. Prevention and cure of cystic fibrosis.
8. Prevention and cure of sickle cell anemia.
9. Production of recombinant pharmaceuticals.

How rDNA technology work:

The technology work by altering the phenotype and organism. Here a genetically transformed vector is incorporated with the genome of an organism. Genes where this foreign DNA is inserted is regarded as a recombinant gene, and this hole process is called rDNA technology.[7]

APPLICATIONS OF r-DNA TECHNOLOGY:

1. **Food and agriculture**:

   Several important enzymes like lipase, amylase, etc. are make various roles and important application in food industry. [8] Enzymes are prevent the immigration of microbial organisms. Lysozymes are the effective agents to get rid of bacteria in food industry. It is suitable agent for food items including cheese, fruits, vegetables and meat to be stored as increase their shelf life. To increase the shelf life of food product lysozyme imbue the fish skin gelatin gels

and inhibit different food spoiling bacterial growth. By the help of glucose oxidase salmonella infantis,S.aures,B.cereus,clostridiumperfrings,L.monocytogenes,campylobacterbjejuni,yersinia enterocolitis and some other food spoiling microorganisms can be inhibited.[9,10,11]

By the help of genetic engineering tobacco plants are able to produce human collagen. HBV vaccine production in plants, the oral vaccination concept with edible plants has gain polarity due to this innovative invention.[12] In plant evolution chloroplast genome sequences are important and phylogeny Rpl22 is considered to be transferred from chloroplast into nuclear genome. In delivery of proteins from cytosol to chloroplast- a gene containing peptide plays an important role.[13,14,15] Beans, potato, sugar beet, squash and many other plants are being developed with desirable characters, for example, tolerance of the herbicide glyphosate, resistance to insects, drought resistance, disease and salt tolerance.[16]

2. **Monoclonal antibodies:**

A monoclonal antibody is an antibody made by cloning a unique white blood cell. Monoclonal antibodies are produced by Hybridoma technique.[17] A monoclonal antibody,T84.66 can affectively function to confess antigen Carcinoembryonic, which is still appraise and convincingly characterized market in cancers of epithelia.[18,19] One type of monoclonal antibody known as PIPP is specific for human Chorionic gonadotropin recognition. The production of full length monoclonal antibody and seFv and diabody derivatives was made possible in plants through transgenes is and agro infiltration in tobacco transformed transiently.[20] Joining of lymphocytes or beta cells with myeloma cells, the resulting substance is called Hybridoma. Against different viral infections this type of antibody are used to produced vaccine.[17] A full length humanized IgG1 known as anti-HSV anti-RSV, which can function as the recognizing agent for herpes simplex virus (HSV)-2-glycoprotein B, has been express in transgenic soybean and Chinese Hamster Ovary (CHO) cells.[21]

3. **Gene therapy:**

Gene therapy is the most important approach in the field of genetic engineering for human beings. Here transfer of specific genes into human body to correct various diseases.[4] In health services gene therapy is a advanced technique with therapeutic potential.[22] Adrenoleukodystrophy (X-ALD) and X-linked disorder are is possible through the expression of specific genes transferred by lentiviral vector, based on HIV-1[23] Various cancers including skin, lung, urological, gynecological, gastrointestinal and neurological tumors as well as pediatric and hematological malignancies tumors have been targeted through gene therapy. In recent years/days cancer gene therapy has become

more advanced and it's efficacy has been improve.[24]

4. **Human insulin:**

Human insulin is a laboratory product which is growing within E-coli bacteria. It describes synthetic insulin which mimic like insulin in humans. Basically insulin is a hormone, made up of proteins. Insulin is an essential hormone produced by pancreas and release from beta cells in the islets of Langerhans. Human insulin is safer than traditionally prepared drug. This hormone plays an important role in controlling diabetes, by the help of decreasing glucose level in the body. [25,26]

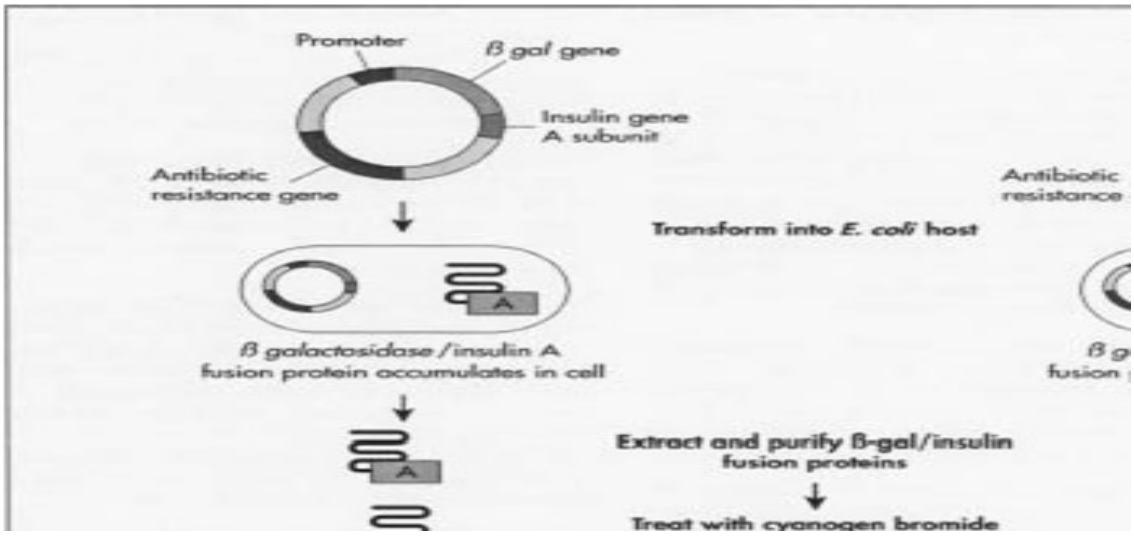

Figure 1: Production of recombinant insulin in *E.coli*

5. **Health & disease:**

By the help of rDNA technology cure wide spectrum of diseases and improving health condition. Some following approach of rDNA technology for improving human health ---Gene therapy, investigation of drug metabolism, Chinese medicine, Production of antibiotics and their derivatives, etc. rDNA technology also make various methods for the prevention of a number of disease like Cholera, AIDS etc.[4,27]

6. **Human growth hormone**:

Human growth hormone is a polypeptide hormone. It is responsible for reproduction, growth of the cell and regeneration in humans as well as animals.[17] By the help of rDNA technology bacterial cell like E-coli produced different fine chemicals like somatostatin, insulin, somatotropin.[4] Through rDNA technology onside In vitro production of human follicle – stimulating hormone (FSH) are possible , other side reproduction treatment through stimulating follicular development is also possible. Most interestingly combination of r-FSH and

Luteinising Hormone (LH) was made successful to enhance the ovulation and pregnancy. Human growth hormone are able to treat Dwarfism disease. [28,29]

7. **Antibiotics:**

An antibiotic is a type of antimicrobial substance or antibacterial agent for fighting bacterial infections or bacteria. Some important antibiotics are – penicillin, streptomycin, tetracycline, novobiocin, bactracin etc. Production of antibiotics by microorganisms are very effective against different bacterial, viral or protozoan disease. Antibiotic medication are huge amount of used in the prevention and treatment of such interferons.[4,30]

8. **Interferon:**

Interferons are a group of soluble glycoprotein that are produced and released from cells in response to virus infection and other stimuli. Interferons are produced from the virus infected cells and it is glycoprotein in nature. It helps to treat cancer like hairy cell leukemia and using E.coli interferon alpha issued to treat lymphoma and myelogenous leukemia. Otherside interferon also contain antiviral and anti cancer properties.[4,17]

9. **Production of transgenic plant and animals:**

Produced transgenic plant or the genetically modified plants is possible by the help of tools and techniques of genetic engineering. Resistance to herbicides, insects or viruses are the main qualities of transgenic plant which have been developed by genetic engineering.

For production of transgenic animals, desired genes are interested into animal. The method of rDNA technology aids the animal breeders to increase the speed and range of selective breeding in case of animals which helps for the production of better farm animals. so, it has good effect on economy. Otherside, by the help of transgenic animals produced certain proteins and pharmaceuticals compounds which also have good impact to economy.[31,32]

10. Environment:

In the protection of environment Genetic engineering makes a contribution in various ways. It occurs during microorganisms are identity and filter manufacturing waste before introduced into the environment. In the development of bio indicator rDNA technology are used where bacteria have been genetically modified as bioluminescors that give off light in response to several chemical pollutants. It is also use for measurement of the presence of some hazardous chemicals in the environment.[6,33]

11. **Production of commercially important chemicals**:

By the help of rDNA technology in fermentation technique various commercially important chemicals are produced. The commercially important chemicals are alcohol, alcoholic beverages, organic acid like acetic acid, citric acid etc. The other commercially important chemical like vitamins also produced by microorganisms.[4]

12. Forensic sciences:

Forensic science largely depends on the technique called DNA profiling or DNA fingerprinting. By the help of rDNA technology in forensic center largely on the ability of DNA analysis to identify an individual from blood strain, hair and other items recovered from the crime scene. Various problems like parentage and identify the criminals are solved by DNA fingerprinting. [34]

13. Vaccine:

Vaccine are the chemical preparations containing a pathogen in attenuated or inactive state that may be given in the body to enhance the production of antibodies against a particular antigen. Recombinant vaccine have more specificity than conventional vaccines. The example of some vaccines are cholera, malaria, rabies, polio, hepatitis, smallpox etc. rDNA technology makes vaccine, biologically synthesized for give effectiveness against numerous serious disease caused by viruses, bacteria and protozoa. Many scientists develop vaccines easily by cloning the gene used for protective antigen protein. rDNA technology develop various viral vaccines these are most useful today's life. They are – Herpes, Hepatitis, Influenza, Foot and mouth disease.[4,17,35]

CONCLUSION:

rDNA technology has been grown more in the last 15 years than other field of science. rDNA technology Produced variety of products which are used for medical purpose, that is helpful in every aspect of human life. Recombinant proteins are widely used as reagents in laboratory experiments and to generate antibody probes for examining protein synthesis within cells and organisms. It is changing field and play a key role in preventing genetic diseases, producing target medicine which are needed to be dealt for the betterment of the rDNA technology future.

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