Biotechnology and Veterinary Medicine

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Background

Humans have been manipulating the genetic information of plants and animals for more than 10, 000 years. But the genetic information transferred had been limited to the same species or very rarely to closely related species, until recently.

Biotechnology consists of any process where biological entities living or dead are manipulated for economic benefit. Genetic Engineering (recombinant DNA technology) refers to the application of principles of genetics in the isolation, manipulation and expression of genetic material. Recombination involves the insertion of a genetically different piece of DNA into a recipient cell. With the advent of recombinant DNA (r DNA) technology the transfer of information even between phylogenetically unrelated species has become a possibility.

Basic Technique

The process can be explained in terms of editing a document: scissors and glue are used to cut/ copy and paste. We take a sentence (gene) and paste into the DNA of a host (eg. *E. coli).* The bacterial cells divide very rapidly making billions of copies of themselves and each bacterium carries in its DNA a faithful replica of the gene inserted. Each new *E. coli* cell has inherited the inserted gene sentence. The gene of interest is cut using scissors called restriction enzymes and pasted into a vector (eg. Plasmids). The restriction enzymes cut in a very precise manner, a specific base sequence of the DNA molecule. With these scissors used singly or in various combinations, the segment of DNA molecule can be isolated. This segment is pasted into place using an enzyme called DNA ligase in the vector resulting in an edited (recombinant) DNA molecule. When this recombinant vector is inserted into the host, the cell will be able to process the instructions to assemble the amino acids. The new instructions are passed along to the next generation also. A foreign gene thus established in another host is said to be cloned.

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Applications of rDNA technology.

rDNA technology has many applications. Some of them are discussed below.

Development of new and improved vaccines.

Biosynthetic vaccines are formulations containing noninfectious, protective subunit immunogens that are produced by biologic systems. Subunit vaccines evoke protective immune response with fewer undesirable side effects (pyrogenic, allergenic) generally associated with the use of whole agent vaccines. The yield of vaccines is also very high making them economical for general use.

Examples of r DNA vaccines:

Escherichia coli pilus vaccine.

For the protection of swine against enterotoxigenic *E. coli* diarrhea prepared by removal of pilus adhesins from the surface of the engineered strain of *E. coli* for the K88, K99 and 987P pilus adhesins..

Foot and mouth disease vaccine for cattle and sheep have been produced by genetically engineered *E. coli.*

Anthrax vaccine.

The protective antigen gene of *Bacillus anthracis* was introduced into *B. subtilis.*

The gene for pili of *Moraxella bovis* have been cloned and expressed in *Pseudomonas aerugenosa*. Also trials are going on to develop better vaccines for brucellosis and against uncultivable pathogens such as *Treponema pallidum* and *Mycobacterium leprae.*

Other applications include the use of engineered strains of avirulent Salmonella and Mycobacteria to be used as potent immuno adjuvants because of their ability to persist in macrophages.

Many antigens including malarial antigen have been expressed by recombinant

Salmonella typhimurium strains. Intracellular targeting is achieved by Salmonella and the result is greater B and T cell responses to malarial antigen. Multivalent Salmonella and Mycobacterium vaccines that include protective antigens from Brucella, Listeria and Francisella are being developed because these pathogens require a high cellular response.

Production of biologicals for human and veterinary use such as insulin, interleukins etc.

Improving animal nutrition. Attempts are there in constructing synthetic genes and reintroducing into rumen bacteria to change the amino acid composition of these bacteria, so that the microbial protein in the rumen will better meet the protein requirements of the animal, thus reducing the need for protein supplements in the diet.

Diagnosis of infectious diseases using DNA probes.

The DNA of disease organisms to be identified is extracted and bound to a membrane. The nucleic acid probe is prepared by using DNA or RNA of nucleotide sequence known to be unique to a region of the DNA or RNA of the disease organism labeled. The probe is allowed to bind with the membrane. Unbound probe is washed off the membrane. Bound probe is then detected by overlaying the filter with X- ray film, or by scintillation counting for radio labels or by using substrates for enzyme conjugated probes. Facilitates fast, efficient and accurate diagnosis of infections.

Other applications

Genetic screening: Identification of mutations closely associated with diseases.

Etiology of diseases: Finding and cloning a gene involved in disease, sequence the gene, find out what it does.

Gene therapy: genetically alter cells to correct a disease.

Making transgenic animals: animals with more growth hormone (r BST).

Cloning desirable stock: transplant a somatic nucleus into an egg cell. Activate genes that had been inactivated by tissue differentiation (sheep- Dollie).

Production of monoclonal antibodies for immunological assays.

Conclusion:

The r DNA technology is undoubtedly the technique of the twenty first century and it is going to revolutionize the current protocols for the diagnosis and therapy of diseases. Many current drugs will become obsolete. Also the present concepts of animal production.

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(Chorulon/Pregnyl/Life/Profasi) Dose : 1500-3000 IU

Progesterone

Progesterone releasing intravaginal device (PRID). Each device contains 1.55 g progesterone and a 10 mg capsule of oestradiol. One device should be inserted into the vagina and left *in situ* for up to 12 days, with PGF2 alpha administered 24 hours before removal Oestrus occurs 2-5 days after removal.

Intravaginal progesterone release device (EASIBREED). Each device contains 1.9 g progesterone, which should be left in place for 7-12 days with PGF2α treatment at the time of removal.

Prostaglandins and Prostaglandin analogues

Dinoprost (Lutalyse, Dinofertin) 5 ml vials, 5 mg/ml Dose : 25-35 mg i/m or 12.5 mg IVSM

Cloprostenol (Estrumate) 2 ml & 10 ml vials, 250 µg/ml Dose : 2ml i/m or IVSM

Luprostiol (Prosolvin) 10 ml vials, 7.5 mg/ml Dose : 2 ml

Tiaprost (Iliren) 10 ml vials, 3.5 ml i/v or 5 ml i/m ❑