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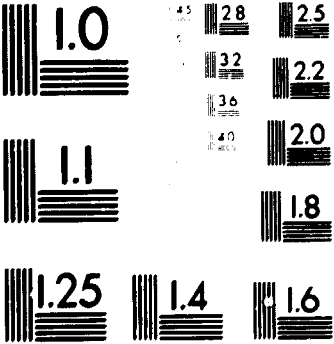

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GENETIC ENGINEERING IN VETERINARY MEDICINE*

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Genetic engineering is one of our newest technologies. As a result of this advance, some have stated that we are on the verge of a medical revolution based on developments of recombinant DNA technology, gene splicing, or genetic engineering.

The production of human, animal and viral proteins, hormones, enzymes and interferon in microorganisms or tissue cultures has moved from theory to reality and the technology is being applied at an ever increasing rate. Genetic engineering is the technology of the 1980s.

Man has been changing the genetic make up of plants and animals for many years through selection and breeding. As more is known about the genetic code and its deciphering, man can now recombine the DNA of unrelated organisims and make an artificial but useful molecule.

The basic knowledge or technology necessary for recombinanat DNA procedures has been developing steadily for decades as we have learned more about the molecules that make up microbes and the genetics that govern their production.

Three specific events were necessary before production of products by bio synthesis could be attempted. The first occurred in 1953, when Watson and Crick proposed the DNA structure of molecules. Their description of the famed double helix enabled scientists to fully understand the genetic blue prints for assembling anything from bacteria to man. The description of the model for DNA structure provided a basis for further exploration and understanding of molecular biology. The second pre requisite was the improvements in methods and knowledge about chemical and enzymatic manipulation of DNA. It produced a basis for seperating large genomes into small segments which could not only be reproduced, but the sequence of the thousands of base pairs on such segments could be precisely determined.

With this knowledge about the molecular structure of genes and enzymes which could cut the gene at predetermined sites, scientists were now ready for the third development, recombining genes and cloning into "factories" for production.

The bacterium E. coli, one of the most studied microorganisms known to microbiologists, is one of the most commonly used "factories" for production of genetically engineered products. The technology is available to remove plasmids, (Extra chromoscmal bacterial DNA) from the bacterium, cut it with special enzymes, and splice in other pieces of genetic material from another organism. When the newly reconstructed plasmid is reinserted into the bacterium, it produces the product for which it was coded. In addition to E. coli other organisms are also used as host organisms and these include Bacillus subtilis, streptomyces spp and animal tissue cultured cells and viruses eg. vaccinia.

i. Some Genetically - Engineered Animal Vaccines being developed

The potential for application of genetic engineering is highest for the animal diseases caused by viruses. This is possible because more viruses have been studies at the molecular level.

Biosynthesized Sub-Unit Vaccines

It has been demonstrated with several viruses and bacteria that individual proteins which are isolated from the surface of microbes can induce production of neutralizing antibody and protect against challenge with the infectious agent. These short pieces are referred to as subunits. Some of these are in commercial production, as, for example with influenza.

These results with natural subunit vaccines have caused scientists to attempt to place the gene of immunizing proteins into an expression system so that enough of the immunizing protein can be produced and formulated into vaccines. One such product being researched is a subunit vaccine for Foot and Mouth Disease. The protein primarily responsible for immunity has been isolated and the gene cloned into an expression plasmid of E. coli, reinserted into E. coli and expressed when the bacteria was propagated.

Other animal viruses on which research is underway to produce polypeptides by gene cloning include Rabies, Infectious bovine rhinotracheitis, Transmissible gastroenteritis of swine, Riff valley fever, Vesicular stomatitis, Pseudorabies Parvovirus of dogs and Blue tongue. Success has been reported in several instances of cloning and expression, but commercial vaccines are not yet available.

Genetic engineering is also being applied to the preparation of protein vaccines against bacterial diseases. Enterotoxigenic E. coli contain pili on its surface which are made up of proteins. Distinctive immunogenic strains have been isolated for swine and calves and the genes for these proteins have been cloned and expressed in other bacteria. Commercial vaccines from these products are available in Europe and the United States.

2. Interferons for Animals

Interferons are a heterogenous group of proteins divided into three classes, alpha, beta and gamma. They have been shown to modulate several immunological reactions including antibody production. They are produced in a variety of cells and can be induced by chemicals, viruses, bacterial products, antigens, antigen-antibody complexes etc. More recently interferon has been produced by recombinant technology in E. coli in amounts sufficient for study against some neoplasms, immune disorders and infectious diseases. Much remains to be learned about their mode of action, and therapeutic effectiveness.

Monoclonal antibody

Cells which will grow in perpetvity , so called lines of cells which are usually cancerous, can be fused with other cells which have been primed to produce antibody of a predetermined specificity. Such antibody is referred to asmonoclonal because it is a homogeneous population of identical molecules, or is produced by a hybridoma resulting from the fusion of an antibody producing cell with a cancerous cell. Uses of such antibody are not yet fully explored but include purification of antigens, analysis of antigenic sites on microbes, diagnosis and treatment of diseases e.g. B-cell malignancies, T-Cell leukemia.

Animal Growth Hormones

The gene for growth hormones from cattle and chickens have been cloned in E. coli. Studies are currently underway in beef and dairy cattle and in poultry, but information concerning their usefulness has not been disclosed. Clinical trials in man indicate usefulness in treating dwarfism.

Conclusion

It is clear that the last 10 years have provided some very important scientific developments that are likely to play a significant part in livestock production. The developments in genetic engineering provide considerable hope and cautious optimism in the field of vaccine production against several major diseases of livestock. Its application is of particular interest to the tropical world in the production of vaccines against anaplsmosis, babesiosis, trypanosomiasis, leishmaniasis etc. all very important livestock diseases. The application of this technology to Trinidad and Tobago may not be considered a priority at this time of our development process. However, if we are to benefit from the advances of high technology, we must develop a human resource base of trained and dedicated scientists, well equipped and funded, with the capability of utilizing appropriate high technology for the advancement of livestock production.

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