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TRANSGENESIS A NEW TOOL IN GENETIC COMMERCE – A REVIEW

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ABSTRACT

Transgenesis is the process of introducing an exogenous gene called a transgene into a living organism so that the organism will exhibit a new property and transmit that property to its offspring. Transgenesis can be facilitated by liposomes, plasmid vectors, viral vectors, pronuclear injection, protoplast fusion, and ballistic DNA injection. This article reviews about the history, techniques and application about transgenic animals, which is useful for the researchers as the preliminary information.

KEY WORDS: Transgenesis, Liposome, DNA, Viral vectors.

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INTRODUCTION

Genetic engineering is a useful technology because it enables animals to produce useful novel proteins. Conventional animal breeding is constrained to selection based on naturally-occurring variations in the proteins that are present in a species, and this limits the range and extent of genetic improvement that can be achieved. Genetically-engineered animals are being produced for two distinct applications: human medicine and agriculture (1).

A transgene is a gene or genetic material that has been transferred naturally, or by any of a number of genetic engineering techniques from one organism to another.

The introduction of a transgene phenotype of an organism. The term *transgene* describes a segment of DNA containing a gene sequence that has been isolated from one organism and is introduced into a different organism. The DNA is incorporated into the organism's germ line. In higher vertebrates this can be accomplished by injecting the foreign DNA into the nucleus of a fertilized ovum.

A genetically engineered or “transgenic” animal is an animal that carries a known sequence of recombinant DNA in its cells, and which passes that DNA onto its offspring. Cloning offers the opportunity to produce 100% transgenic offspring from cell lines that are known to contain the transgene, and further also allows gene targeting whereby researchers are able to integrate the foreign DNA at a specific location in the genome, and thereby have more control over the expression level of the transgene (2).

Transgenic animals are costly to produce and they have high value. The cost of making one transgenic animal ranges from $20,000 to $300,000, and only a small portion of the attempts succeed in producing a transgenic animal. The U.S. Food and Drug Administration (FDA) is the lead agency responsible for the regulation of genetically engineered food animals. Transgenic animal research is subject to existing regulations governing animal research required by The Animal Welfare Act, a federal law which was passed in 1966, to have a program overseen by a committee identified as the Institutional Animal Care and Use Committee (IACUC) to review research protocols involving dogs, cats, rabbits, guinea pigs, hamsters, gerbils, nonhuman primates, marine mammals, captive wildlife, and domestic livestock species used in nonagricultural research and teaching (3).

History

The first recombinant DNA molecules were produced by Paul Berg in 1972. From 1976 the technology became commercialized, with companies producing and selling genetically modified foods and medicines . An example of this is the "super mice" of the 1980s. These mice were able to produce the human protein tPA to treat blood clots. The first transgenic animal, a mouse, was produced in 1981, to determine the genes involved with cancer. In 1985, the first transgenic farm mammal was produced, a sheep called "Tracy".Tracy had a human gene that expressed high levels of the human protein alpha-1-antitrypsin. The protein, when missing in humans, can lead to a rare form of emphysema (4).

Techniques involved in Transgenesis

1. **Plasmids from bacteria**

The most common type of transgenesis research is done with bacteria and viruses which are able to replicate foreign DNA. The plasmid DNA is cut using restriction enzymes, while the DNA to be copied is also cut with the same restriction enzyme, producing complementary sticky-ends, altered DNA is inserted into plasmid for replications.

2. ***Gene transfer technology (6)***

DNA microinjection

The Desired gene construct is injected in the pronucleus of a reproductive cell using a glass needle around 0.5 to 5 micrometers in diameter. The manipulated cell is cultured in vitro to develop to a specific embryonic phase, is then transferred to a recipient females (Fig-1).

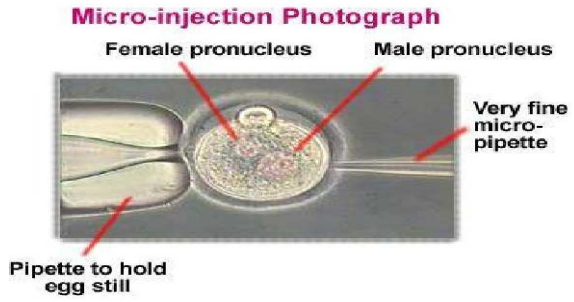

Fig.1. DNA Microinjection

Multipotent stem cell transgenesis

Multipotent stem cells can only differentiate into a limited number of therapeutically useful cell types, nevertheless their safety and relative lack of complexity to as have resulte d in the vast majority of current personalized cellular therapeutics involving multipotent stem cells .

Totipotent stemcell

The manipulated gene construct is inserted into totipotent stem cells, cells which can develop into any specialized cell. Cells containing the desired DNA are incorporated into the host’s embryo, resulting in a

chimeric animal. Unlike the other two methods of injection which require live transgenic offspring for testing, embryonic cell transfer can be tested at the cell stage

1. **Genetically modified organism (7)**

Genetically modified organism (GMO) is any organism whose genetic material has been altered using genetic engineering techniques. GMOs are the source of genetically modified foods and are also widely used in scientific research and to produce goods other than food. The term GMO is very close to the technical legal term, 'living modified organism', defined in the Cartagena Protocol on Biosafety, which regulates international trade in living GMOs (Fig-2).

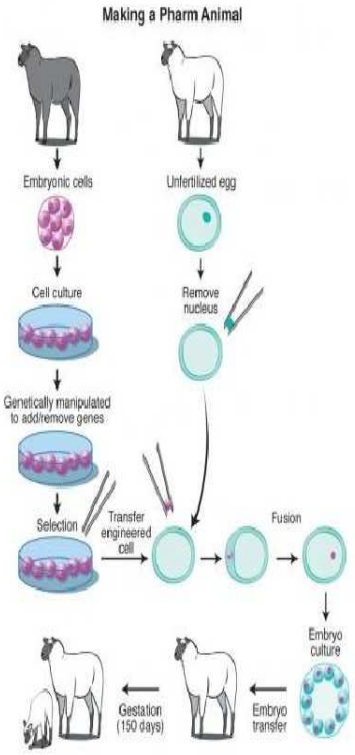

Fig-2.Genetically modified organism

Application of Traansgenic technology (8)

Disease model

Animals that have been modified to exhibit the symptoms and progression of a particular disease.

Transpharmers

Animals modified to express particular protein or suite of proteins in their milk to avoid animal sacrifice when obtaining drug. From the protein drug molecules are derived.

Xenoplanters

Animals that have engineered to not express the foreign antigen that normally prevent the transplantation of their organs in humans.

Food source

Animals that grow bigger or faster to produce more food in shorter time with low resources. Eg. Super pig

Scientific model

Animals producing more or less of a particular protein, study of that proteins were applied in development of biological mechanism.

Conclusion

Transgenic mice have also become increasingly important for biological and biomedical research and have generated a vast amount of vital information about human diseases. Transgenic mice have also become increasingly important for biological and biomedical research and have generated a vast amount of vital information about human diseases. Other transgenic animals, including livestock species, are being produced specifically as biomedical research models for various human afflictions including Alzheimer's disease, eye disease. Even though, transgenic animal research is subject to existing regulations governing animal research. It is yet to be developed, i.e. associated regulatory costs, and the market acceptance issues, animal welfare guidelines, which ultimately result in a commercially-viable industry for products derived from genetically engineered animals.

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