

An overview of Transgenic Animals and its Disease Resistant Variety

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Abstract

Foreign DNA i.e DNA from organism having desired characteristic is incorporated into the DNA of the animal, this animal is called as transgenic animal. This is performed by recombinant DNA technology. The desired trait can be observed in the transgenic animal after its DNA is associated with foreign DNA, showing desirable qualities during growth and development. There are some processes to form transgenic animals. In order to survive from several diseases in animals and also human beings animals are modified genetically forming transgenic species so that they can be resistant from certain diseases. The disease models of transgenic animals are designed in order to study diseases of human or designed transformers for production of drugs in their milk that are life saving. There are several applications of disease resistant transgenic animals that are much helpful for the survival of animals and human from many complex diseases. In this study an overview of transgenic animals with their methods of production, their disease resistant varieties and applications of disease resistant transgenic animals are discussed.

Keywords:- Transgenesis, Transgene, DNA, Gene, Recombinant DNA, Stem Cell.

INTRODUCTION

The animal in which foreign DNA is incorporated with the original DNA by genetic engineering is known as transgenic animal. The disease models of transgenic animals are designed in order to study diseases of human or designed transpharmers for production of drugs in their milk that are life shaving. By modifying and revolutionizing medicine and agriculture transgenic technology is able to save no. of lives. Transgenic animals are prepared by Recombinant DNA Technology by injecting foreign DNA into the genome of the said animal. Two kinds of techniques are used for the engineering of these animals are Pronuclear manipulation and embryonic cell manipulation. In the laboratory a transgenic technology has been developed on mice and achieve success. The commonly known gene transfer techniques are DNA microinjection, Retrovirus mediated gene transfer and ES cell mediated gene transfer are utilized to produce transgenic sheep, cattle, pig and other animals. Transgenic animals have the ability to improve agricultural growth rate, disease resistance, mil yield increase, production of wool etc. There are scientific outlook for right and wrong opinions on transgenic animals, are called ethics. The issues of ethical and welfare of animals surrounding technology of animals can only be reduced or ignored by awareness arousal about the quality of the technology. Recently for livestock species genomic sequences are present and large no. of single nucleotide polymorphisms (SNPs) were discovered as a by-product of sequencing. For mapping and gene identification large no. of SNPs used in genome-wide association (GWA) studies. But GWA is successful only in gene identification and monogenic traits mutation but not for resistance and susceptibility of diseases. This traditional strategy is also remain unsuccessful in forming resistance and to fight with infectious diseases of livestock like treatment by antibiotic, vaccination, prevention etc. So genetic engineering made it possible for the livestock to fight against infectious diseases. The primitive and oldest technique known to produce transgenic animals of farm is injecting DNA sequences into the pronucleus of newly fertilized zygotes.

Transgene and Transgenesis

A gene that has been transferred naturally or by artificial means like genetic engineering technology from one organism to another is called as transgene and the process of injection or introduction of transgene is known as transgenesis. This is practised and performed that resulting into transgenic species exhibit new characteristic and variation for bearing the transgene. Transgenic organisms are called Genetically Modified Organisms (GMO) because at genomic level they are modified by collecting DNA of other organism. Some examples of transgenic animals are mice, sheep, cattle, cow etc.



Fig 1:-Genetically modified cows

Fig 2:-Genetically modified pigs

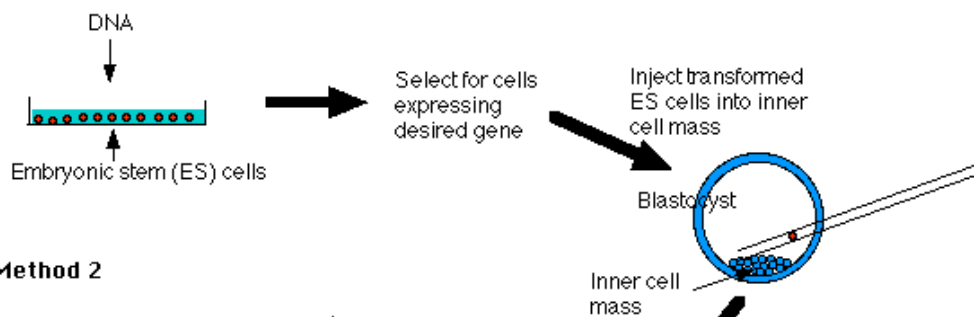
Major Techniques of Transgenesis

a) **DNA microinjection** – The method involves microinjection of DNA of desired characteristic carrying organism of same or different species into the pronucleus of a fertilized ovum .

b) **Embryonic stem cell mediated gene transfer** - This method involves prior injection of DNA sequence by homologous recombination into an in vitro culture of embryonic stem (ES) cells.

c) **Retrovirus-mediated gene transfer** - Gene transfer is mediated with the help of vector or carrier , normally virus or a plasmid to enhance the probability of gene expression.

Method 1



Method 2

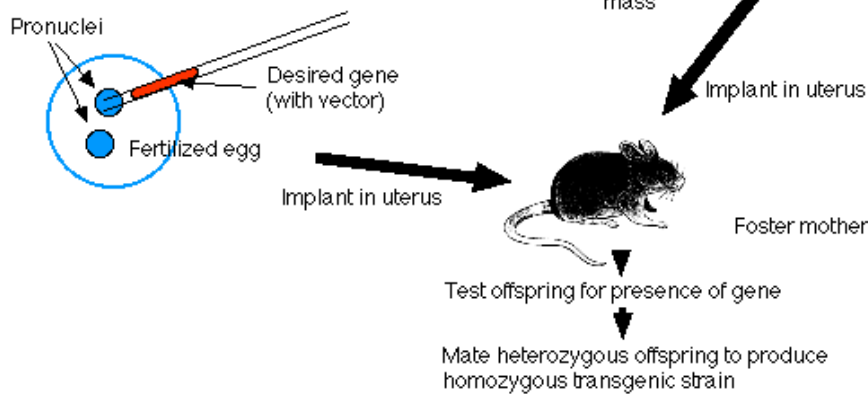


Fig 3:- Embryonic stem cell method

Recently used techniques of transgenesis

Lentiviral Transfer of oocytes and zygotes: The method is performed to rescue from the disadvantages of virus mediated gene transfer containing gene silencing of transgenic locus and lower expression levels . So lentiviral based method is employed by scientists recently from their report that these vectors have multiple advantages they can infect the non-dividing cells and can bear large amounts of transgene which shows stable expression in the cell where it is introduced .

Chimeric Generation by pluripotent cells injection: Embryonic cells with pluripotent cells have the potential in production of organ and germ cell after injection into the blastocysts. Like embryonic stem cells there are another type of cells like primordial germ cells are used in production of number of farm animals and chimeric animals without the contribution of germ line , this is reported in swine.

Disease resistant transgenic animals

a) **Neurogenerative disease resistant transgenic animals:-** Due to misfolding of “prion “protein some neurogenerative diseases occur in animals like spongiform encephalopathy (BSE) in sheep, bovine spongiform encephalopathy in cattle etc . By “gene knock out” of prion protein through recombinant DNA technology generate prion protein free livestock and thus become free from neurodegenerative disorders. RNA interference is the technique that involves in knocking down of the desired gene by the formation of double stranded DNA construct and suppress its expression. The RNAi method has valuable application because of its functioning of gene knock down of transgenic animals so that they can survive from RNA having viral infections like swine fever and most important is the recent SARS-COV-2 disease.

b) **Bacterial disease resistant cattle:-** In the mammary gland of cow a bacterial disease known as Mastitis occurs that effects the quality and quantity of milk produced in the cattle . So transgenic cattle had been produced by scientists to express the protein known as lysostaphin which can kill the bacteria of disease by breaking their walls.

c) **Disease resistance in fishes:-** Catfish are frequently suffering from microbial infection and often death . Cecropin B is a small protein which is expressed in *Hyalophora cecropia* moth that has anti-microbial properties . Cecropin gene have been prepared by scientists to express transgenic catfish that provides resistance against microbial infections.

d) **Disease resistant cattle against Brucellosis:-** A deadly zoonotic disease Brucellosis that transmits in animals limitlessly and even through humans also. A huge no. of animals in America Bison area have been affected very badly and the cattle which are grazing acquire the infections causing to occur abortions , fertility rate and milk production is reducing . Thus transgenic cattle provides protection and prevention against this disease.

Applications of disease resistant transgenic animals**Disease models**

For vaccine production and development of drugs disease diagnostic, its study and understanding the disease is much necessary. So transgenic method is applied broadly to formulate disease models for clearing and understanding causes and influences of human diseases. Eg:- mouse with different cancers or cystic fibrosis were produced by recombinant DNA technology. These models provide awareness into the disease and further highly effective in drug improvement and treatment.

Understanding gene functions: As mouse or rat has the genetic composition almost similar with humans so the models of rat or mouse are prepared and chosen for producing genetically modified organism alteration of gene as such gene knock out, or gene knock in or gene damaging. This models help in understanding the complex functions of gene and its role in development of human and diseases.

Therapeutic proteins and antibodies production: Horse, goat, cow, are those animals which are genetically modified to develop and produce some important beneficial chemical substances like antibodies and therapeutic proteins which helps to treat human diseases. Eg:- Transgenic cow producing egg proteins into its milk so that these transgenic animals having therapeutic reagents formation are called as “walking pharmacies”.

Xenotransplants production: Some transgenic farm animals are developed by scientists by gene “knocking out” which is responsible for eliminating immune responses and organ rejection when inserted in the human body. Eg:- Knocking out of transgenic pig organs can then be used for transplantation of organ in humans. This technology can solve the problem of shortage of organ donor and can save many people.

CONCLUSION

From the first transgenic technology had been generating excellent output for human beings by producing disease resistant animals, therapeutic proteins. Superior breeds quality, xenografts. Transgenic animals have important role in medical field as they have complete ability to produce disease resistant variety of the original species and this disease resistant varieties of transgenic animals are of great use having multiple applications in medical fields and improve medical research, provide many advantages. Significant to maintain ethical standards for effective usage of the method of transgenesis for betterment and improvement in human welfare. There are also some disadvantages and same chance of forming hazard that may harm the human and ecosystem if the technology is misusing.

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