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Germ Cell Manipulation and Transgenic Fowl

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Research in the fields of life science, pharmacology, and biomedical engineering has created a large demand for transgenic animals, which are advantageous for producing experimental model animals, protein production in transgenic bioreactors, and xenotransplantation donors. Cell and gene manipulation have become pivotal components in the production of transgenic animals. Thus, transgenic research has proceeded in two directions: (1) to effectively manipulate various types of animal cells without decreasing viability, and (2) to manipulate genes of interest without altering normal gene function. In the case of cell manipulation, optimized technology is important to maintain cell characteristics and to increase the efficiency of chimera production. In chickens, the combined technologies of germline chimera production and pluripotent cell manipulation are routinely applied to produce transgenic avian species.

During the last decade, avian species have become a major target for animal transgenesis because of their significant technical merits. The generation time for bird is short (e.g., 5 months in the chicken), and a transgenic line can be established from founder animals in a relatively short period. In the case of the chicken, a fertile rooster can produce enough semen to inseminate more than ten hens every 3 days, and the recipient hens are able to lay approximately ten fertile eggs after insemination. Mature hens can lay at least 330 eggs yearly. Chickens are the easiest domestic animal to maintain because of their size and traits. Most importantly, the relatively simple composition of egg proteins significantly decreases the cost of protein purification after transgenesis, which guarantees better profit yields for transgenic bioreactors that produce target proteins through genetic manipulation of eggs. For these reasons, chickens have assumed an important position in the mass production of human proteins. The phylogenetic position and the relatively compact genome structure of the chicken also contribute to the potential benefits of the chicken transgenic system. However, prominent differences in embryogenesis between mammals and birds necessitate different strategies to use these advantages efficiently.

Recently, various techniques using avian transgenesis that have become established transgenic biotechnologies. Relevant technologies for primordial germ cells (PGCs) and

testicular cells are at the center of our studies, because these cell types are essential components of both embryo- and testis-mediated transgenic systems. This systemprovides enormous benefits in advancing animal biotechnology and aids in the development of unique technologies for bioreactor production and experimental model development. The various advantages of avian transgenesis are derived from the genetic and physiological characteristics of this organism, although several physiological properties have impeded the development of an efficient transgenic system.

Collectively, the avian itself is a good model for several diseases, but aviantrans-genesis could also provide additional models for specific applications in medical research and biotechnology. In addition to these advantages, the avian has various merits in comparative genetics, and the unique *in vitro*-like *in vivo* system enables the observer to monitor various developmental events through eggshell windows during embryogenesis. For these reasons, it is important to develop avian-specific techniques for gene and cell manipulation that will further improve the usefulness of this model system for both human and animal welfare.

Key words) ***primordial germ cells, transgenesis, chicken, quail, therapeutic protein***