

GM CHICKENS; THERAPEUTICS PRODUCTION AND DISEASE RESISTANCE



The chicken industry is worth £2 billion per annum in the UK alone. GM technology offers increased productivity, biosecurity and welfare as well as biotechnology applications in production of protein therapeutics.

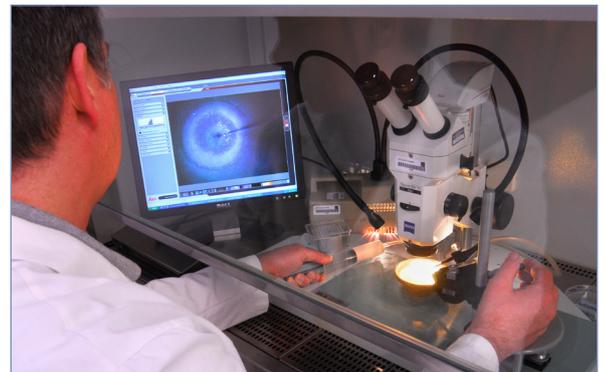
The production of transgenic chickens is technically challenging because embryonic development occurs on the surface of the egg yolk and development to hatch requires incubation in a shelled egg. Professor Helen Sang and colleagues at the University of Edinburgh's Roslin Institute developed a host egg culture system that enabled hatching of embryos after genetic manipulation and constructed lentiviral vectors capable of delivering transgenes to early chick embryos, which were subsequently hatched as healthy chicks.

Chick embryos are valuable models for investigating vertebrate development: they are accessible in the incubated egg and can be manipulated in functional experiments. Professor Sang and colleagues developed a transgenic chicken line ubiquitously expressing green fluorescent protein (GFP) and demonstrated that cells from GFP embryos could be transplanted to normal chick embryos to investigate the fate of transplanted cells, including identifying stem cell populations. This technique was utilised further in collaboration with Roslin colleague Dr Mike Clinton to demonstrate that somatic sex identity is cell autonomous in the chicken.

EGGS AS BIOREACTORS FOR DRUG PRODUCTION



From 2004-2006 Professor Sang and colleagues optimised expression vectors in order to direct synthesis of foreign proteins specifically to the oviduct of laying hens, resulting in incorporation of the protein in egg white. This advance paved the way for expression of biologically active, therapeutic proteins that are expressed exclusively in the oviduct during egg formation and can be extracted from egg white.



PRODUCTION OF GM CHICKENS THAT ARE RESISTANT TO AVIAN INFLUENZA



Genetic modification in the chicken has potential to improve productivity of domestic poultry. Professor Sang and Dr Laurence Tiley (University of Cambridge) undertook a proof-of-principle study, describing generation of transgenic chickens that do not transmit avian influenza when infected with H5N1 virus. Chickens were genetically modified to produce a synthetic decoy RNA derived from a sequence present in all strains of avian influenza, and which interferes with virus replication.

Development of bird flu resistance is being advanced through a BBSRC Industrial Partnership Award and collaboration with a poultry breeding company. The investment is a reflection of awareness by major breeding companies that the technology has potential to deliver genetic improvements in disease resistance that cannot be achieved by conventional breeding. The potential of the GM approach to control avian influenza virus will be assessed while developing the business strategy and investigating the regulatory and public acceptance issues inherent in introducing genetic modification into food production.

Poultry meat is currently the second largest (34%) meat market after pork. Industry experts believe that flu resistant birds would command a premium price in markets in South East Asia where bird flu is endemic.

POLICY AND SOCIAL IMPACT

Sang and colleagues have used numerous opportunities to explain, discuss and debate GM technologies and issues. Forums have included presentations and discussions with school children, public lectures, e.g. meetings of Café Scientifique, and science and arts festivals events.

The generation of birds that cannot transmit avian flu received national and international press coverage. For example, the transgenic birds resistant to influenza were featured on the BBC1 show Countryfile in 2013 with additional articles featuring in BBC Radio Four and BBC World Service programmes demonstrating the mainstream interest in the birds' production.

In addressing the issues of safety, licensing and public acceptance that applications of genetic modification in poultry breeding and production raise, Professor Sang has been an advisor to policy development providing information to the Centre for Veterinary Medicines of the US Federal Drug Administration and the European Food Safety Authority GMO panel.



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