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A therapeutic role for viruses

Modified animal cold viruses (adenoviruses) that ferry natural immune boosting molecules into cells have the potential to improve the health and growth of livestock raised under intensive conditions.

A team of scientists led by Dr Adrian Hodgson of CSIRO Animal Health has found that 'adenoviruses' carrying a protein called gamma-interferon can stimulate an animal's immune system when introduced into cells lining the nose, eyes, lungs or stomach.

Hodgson, who manages the division's Vaccines and Therapeutics Program, says gamma-interferon is a member of the 'cytokine' family of proteins which regulates the immune system in response to vaccination or disease.

Normally, when an infectious agent enters the body, 'T-cells' respond by producing gamma-interferon. This in turn causes a cascade of other immune responses designed to fight off infection.

These responses can be triggered by using an adenovirus to ferry gamma-interferon into animals before they become sick. It has the effect of putting the immune system 'on alert' for a swift response to future infection.

'When animals are under intensive livestock conditions disease can spread easily,' Hodgson says.

'What we're finding is that you can treat animals with gamma-interferon and more generally increase their health by boosting their immune system, giving them a greater degree of natural immunity to infectious agents such as viruses, bacteria or parasites. So when an infectious agent comes along, the animal's immune system is "primed" and can react faster.'

A potentially profitable side-effect of this increased immunity is that the animals gain weight faster on the same amount of food.

'We've seen a 10% increase in body weight in chickens,' Hodgson says. 'They exceed the growth rates of commercial chickens fairly early on, following the therapy, and this increased productivity is sustained through their life cycle.'

Cytokines such as gamma-interferon could provide an effective alternative to the use of antibiotics for disease prophylaxis and growth promotion.

'The increasing occurrence of antibiotic resistance in bacteria which infect animals and humans is resulting in pressure to reduce the use of antibiotics in animal feeds,' Hodgson says. 'We now have a biological remedy that could have the same outcome.'

But the greatest excitement surrounds the adenovirus technology, which is expected to produce new vaccines for a range of animal diseases. CSIRO has already developed experimental vaccines for infectious bronchitis in chickens and classical swine fever in pigs, which provide over 90% and 100% protection respectively.

The adenovirus vaccines differ from conventional vaccines in that they use a live virus rather than a mixture of protein fragments from an infectious agent. Genes from infectious agents, or genes coding for therapeutic proteins such as cytokines, are inserted into the adenovirus DNA. Once inside the target cells, the genes are 'turned on' and produce proteins that trigger an immune response or other beneficial effect.

The live virus delivery is recognised by the immune system as being like a natural infection, and so stimulates long-term immunity. This means an animal often need only be vaccinated once. Using adenoviruses specific for each animal species prevents transfer of the virus from animals to humans. Hodgson says adenovirus vaccines are also self-limiting, ensuring carcasses of vaccinated animals are free of the virus.

Adrian Hodgson and Mike Johnson of CSIRO Animal Health: using modified cold viruses to boost the animal immune system.

'The virus might last one week in the body, and then the immune system will clear it completely,' he says.

Adenoviruses also provide a flexible delivery system, through drinking water or food, by injection, or by inhalation of a spray.

'Adenoviruses target the mucosal surface of cells, so they're ideal to deliver molecules to mucosa such as the gut and lung,' Hodgson says. 'You can inject it if you want to, but with 40 billion chickens processed globally each year, it's easier to deliver it in food or water. The same method can be used for pigs.'

In the future, CSIRO hopes to put several different therapeutic vaccines into the one virus, producing a single vaccine that protects against a number of different agents.

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Contact: Adrian Hodgson (03) 5227 5120, email: Adrian.Hodgson@dah.csiro.au.

Wendy Pyper