DOES CONTROL OF ANIMAL INFECTIOUS RISKS OFFER A NEW INTERNATIONAL PERSPECTIVE?

NOVEL CONTROL APPROACHES TO ALLEVIATE THE EFFECT OF THE CHICKEN RED MITE IN POULTRY SYSTEMS

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ABSTRACT

Ectoparasites can be significant pests for the poultry industry. The chicken (or poultry) red mite and the northern fowl mite are the most economically important ectoparasites of poultry globally. These mites can have significant deleterious effects on its fowl host including anaemia, reduced egg production, and egg quality. The chicken mites may also act as a vector for pathogens. Molecular biology techniques such as RT-PCR and RLB can be used to screen red mite populations for a wider range of pathogens. Current mite control strategies rely mainly upon chemical methods, but acaricide resistance has been demonstrated in mite populations, and traces have been found on the eggs destined for human consumption. Therefore there is a need to identify novel methods to control for red mite infestations, especially, if the red mite is proven to be a vector of avian pathogens, and also considering the threat of failing current control measures. Our research group is developing a vaccine against the red mite, analyzing cellular and humoral responses after natural and artificial exposure to the ectoparasite. Studies on plant-derived products to be used as repellents are also part of our biological approach to reduce the impact of the chicken red mite.

INTRODUCTION

The poultry industry is an important sector within agriculture. In Britain alone, it is worth £3.4 (€ 5.4) billion per year. Despite the recent outbreak of avian influenza, the demand for products from this industry is increasing. As a result, the poultry population along with the housing and equipment necessary to keep the birds is also increasing. Modern commercial poultry production systems use high densities of birds inside fully integrated production techniques, and as a result a large number of eggs or birds for meat are produced in small areas...
This particular environment allows for an increase on infestation rates of pests and facilitates the spread of diseases. Production costs are always increased when trying to control for pests and diseases that affect the livestock.

THE CHICKEN RED MITE

The chicken (or poultry) red mite, *Dermanyssus gallinae*, is the most important haematophagous ectoparasite of laying hens in Europe (Chauve, 1998); whereas the northern fowl mite, *Ornithonyssus sylviarum*, is more important in North America. An infestation will cause a reduction in egg laying, blood staining of eggs, anaemia and may even cause the death of the host (Chauve, 1998); resulting in significant economic losses and compromised welfare within poultry flocks. The economic costs associated with the chicken red mite control and production losses have been estimated at €130 million annually for the EU egg industry (van Emous, 2005). The chicken red mite is primarily found on birds at night when it takes a short blood meal of 1 to 2 hours (Chauve, 1998; Kilpinen, 2001). The rest of the time the mites live in small crevices located close to the poultry where they undergo rapid development and reproduction (Chauve, 1998).

Although the importance of the chicken red mite as a direct parasite is well documented, its role as a vector may also be important but it is not well understood. The chicken red mite has been suggested as a possible vector for the transmission (both *in vitro* and directly isolated from the mites) of bacterial agents, such as *Pasteurella multocida, Erysipelothrix rhusiopathiae* and *Salmonella* spp. (Petrov, 1975; Chirico *et al.* 2003; Valiente Moro *et al*., 2007); and viral agents, such as Newcastle disease, fowl pox, and equine encephalitis (Durden *et al.*, 1993, Valiente Moro *et al*., 2005).

Molecular techniques such as the reverse-transcriptase polymerase chain reaction (RT-PCR) and reverse line blot (RLB) have been proven useful for the diagnostic of agents that are being carried by the chicken red mite. Previous work done by our group using these methods suggested the possibility of the presence of *Mycobacterium* spp. inside the chicken red mite. Further studies are being done to define the role of the chicken red mite as a potential pathogen carrier.
The conventional method of control for the chicken red mite is by treating buildings and farm infrastructures with synthetic compounds (permethin, carbaryl, etc.). Nevertheless, it has been reported that the mite has developed wide spread resistance to many of these products (Beugnet et al., 1997). Many synthetic acaricides have also been regarded as environmentally toxic agents that can pass through the food chain, and the use of many of these products is presently being restricted in the EU and other countries (Chirico and Tauson, 2002).

**NOVEL CONTROL METHODS**

Considering the potential role of the chicken red mite as a pathogen carrier, mite resistance to synthetic pesticides, and the restrictions on the use of many synthetic products to control these mites; there is an emerging need to identify novel control methods against the chicken red mite. We are developing two approaches that are currently under investigation: the development of a vaccine against the chicken red mite and the use of plant-derived products as acaricides and/or repellents.

Vaccination with arthropod protein antigens -such as those from the salivary gland or midgut (Titus et al., 2006) - is able to induce significant immunity against infestations. Immunisation of birds with whole chicken red mite antigens in two trials has shown significantly higher IgY titres in immunised versus control groups, although elevated IgY did not significantly reduce *in-vitro* feeding.

Plant-derived products (PDPs) are also been researched as an alternative to synthetic chemicals to control for infestations of the chicken red mite. Several pesticides based on plant constituents are already available for use in certain areas of pest management (Isman, 2006) and may effectively control ectoparasites. In some countries, certain products (such as “Breck-a-sol” which is based on garlic) are commercially available for use against the chicken red mite. The use of PDPs has several advantages over the use of their synthetic counterparts. For example, PDPs generally produce low mammalian toxicity (Isman, 2000), and tend to be non-persistent in the environment. Previous research done on the control of the chicken red mite using PDPs seems encouraging. Kim et al. (2004) used 56 plant essential oils to test for an acaricidal effect on this parasite and found that several of them were 100% effective in killing the mites at a concentration of 0.07mg/cm². We are currently testing a range of plant essential oils as acaricides or...
repellents to be used against the chicken red mite. Results to date have found that 20 out of an initially selected 50 essential oils are effective acaricides (causing at least 80% mite mortality over 24 hours) at a concentration of 0.14mg/cm³.

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*Does control of animal infectious risks offer a new international perspective?* 213

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