Infection of Commercial Laying Hens with Newcastle Disease Virus: Differing Responses between Birds Provide Potential for Genetic Improvement through Selection

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Summary and Implications

Exotic Newcastle Disease Virus (ENDV) cause extremely rapid mortality in chickens after exposure to the virus. People rely heavily on poultry to provide protein and income in many places where NDV is not effectively controlled through vaccination and biosecurity. Losses from NDV contribute to worldwide hunger and poverty. It may be possible to use genetic selection to produce chickens that have a stronger immune response in the face of NDV challenge. For genetic selection to be successful, two major elements are required: differences in immune response among chickens and genetic control of these differences. This study clearly demonstrated the existence of both these factors. These findings demonstrate the feasibility of genetic selection to produce chickens that are more resistant to NDV and thereby lessen the burdens of hunger and poverty.

Introduction

The Exotic strain of NDV can cause severe losses due to mortality, in excess of 80%. Newcastle Disease Virus is endemic in many parts of the world including Africa. These regions do not have agricultural infrastructure and outputs on the same scale as in the US, and people rely heavily on poultry to provide protein and income for their families.

Not every chicken responds equally to viral infections, and these differences may be due to genetic differences between individual birds. Therefore it is possible for some chickens to have 'better' genetics than others with respect to viral infection. Animals that respond to infection favorably can be selected as parents to produce the next generation and subsequently improve the response of their offspring to NDV.

One method to determine how well a chicken responds to a viral challenge is to measure antibody level. Antibodies are produced by the immune system in response to infection and help stop the virus from infecting more cells. Chickens that are capable of producing more antibodies in response to NDV tend to recover from the infection quicker and experience less severe symptoms. These chickens are less likely to die from infection and would be able to provide a source of protein and income.

This experiment measured differences in antibody production to NDV across chickens and quantified the genetic control of antibody production.

Materials and Methods

In this experiment, 540 birds from a commercial layer line were infected with a mild (LaSota) strain of NDV at 21 days of age. The virus was administered via an ocular-nasal route. Antibody titers were measured using a commercial ELISA kit before and 10 days after infection.

DNA was isolated from blood samples of all birds to determine their genotypes using the Affymetrix 600k SNP chip. Computational methods were used to estimate how much of the antibody production is determined by genetics of the birds. A calculation known as heritability measures the ratio of variation in phenotype (in this case antibody titer) to the variation in genetics (measured from genotypes on 600k SNP chip).

Results and Discussion

Results showed that all infected chickens produced antibodies to NDV, measured 10 days after viral challenge. A range of titers was observed (Figure 1). The heritability measurement for antibody titer post infection was 0.129 ± 0.087 meaning that 12% of the difference in response to NDV between the chickens in this experiment was due to genetic diversity within the group. This heritability measurement is substantial enough for selection of improved antibody production to be successful.

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Figure 1. Distribution of antibody titers 10 days post infection