Estimating Genetic Parameters for Growth and Response to Infection with La Sota lentogenic Newcastle Disease Virus Strain in Local Chicken Breeds in Ghana and Tanzania

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Summary and Implications

The local chicken industries in Ghana, Tanzania and several other African countries are greatly affected by mortalities due to Newcastle disease (ND). We tested local ecotypes/breeds in Ghana and Tanzania for genetic variation in growth rate and antibody levels after infection with a La Sota lentogenic ND virus strain. We identified heritable variation in ND virus antibody levels, and in pre-, and post-infection growth rates, which implies that with selective breeding, genetic improvement is possible. One of the Ghanaian ecotypes had a faster growth rate than the other ecotypes, both pre- and post-infection. We however did not find significant differences between the Tanzanian breeds. Results from this study can be used to improve resistance to ND virus in the local chicken breeds in Ghana and Tanzania, improving food security in these African countries.

Introduction

Local chicken breeds play an important role in the livelihoods of people in both the rural and urban areas of Africa. They are mostly reared by small-holder farmers who depend on them for meat, eggs and as a source of income. One of the main challenges faced by these poultry farmers is Newcastle disease (ND), reported to be the highest cause of mortality in growers and mature birds, causing up to 95% mortality in 4 days. Vaccination is not an adequate means of controlling ND, because of poor husbandry practices, instability of vaccines, and difficulty in obtaining and correctly administering vaccines. Local chicken breeds may vary genetically in their susceptibility and resistance to ND, therefore, enhancing genetic resistance of chickens through genetic selection and breeding could be a good complement to vaccination. In this study, local chickens from three Ghanaian ecological zones (Coastal Savanah, Interior Savanah and Forest), as well as three Tanzanian local breeds (Chingwekwe, Kuchi and Morogoro medium), were challenged with the La Sota lentogenic Newcastle disease virus (NDV) strain, with the aim of comparing the response to NDV challenge between ecotypes/breeds and estimating genetic parameters. Results from the study could then be used to enhance resistance to NDV, thereby improving breeding and production of local chickens in Ghana and Tanzania.

Materials and Methods

Experiments were run separately in Ghana and Tanzania, using the same experimental design. Each experiment ran from hatch to 38 days of age (doa). Full and half-sib families were raised together and pedigree was only recorded on the sires. All birds were raised under the same conditions, with access to feed and water at all times. At 27 doa, blood samples were collected and ELISA was used to quantify maternal antibody levels and ensure that they were at negligible levels. At 28 doa, birds were infected with the La Sota lentogenic NDV strain through nasal and ocular inoculation routes. At 10 days post-infection (dpi), blood samples were collected and ELISA was used to identify and quantify NDV antibody levels in the sera. Body weights were taken at hatch, 7, 14, 21, 28, 34 and 38 doa. Pre- and post-infection growth rates were calculated from these by linear regression of weight on doa. We then estimated heritabilities, phenotypic and genetic correlations, and least-square means for three traits: NDV antibody level, pre-infection growth rate, and post-infection growth rate, using a sire model implemented in ASReml4.

Results

Figure 1 shows the number of birds and least-square means of all traits per ecotype/breed, for both countries. There was no statistically significant difference between the three Tanzanian breeds for any of the traits studied. For Ghana, the Interior Savanah birds were found to have higher pre- and post- infection growth rates than the other two ecotypes, however, there was no difference between the ecotypes for NDV antibody levels. Genetic parameters for Ghana and Tanzania are given in Table 1. Heritabilities for growth rate were very high in the Ghanaian population (~ 0.9), likely due to confounding with maternal effects.

Heritability for NDV antibody level was 0.35. All genetic and phenotypic correlations were positive. For Tanzania, heritabilities were 0.32 for pre-infection growth rate and 0.42 for post-infection growth rate. Heritability for NDV antibody level was 0.08. All phenotypic correlations were positive, but the genetic correlations between growth rate and NDV antibody level were negative. These should however be interpreted with caution, because the standard errors were large.

Discussion and Conclusions

These preliminary results indicate that it is possible to breed for improved growth rate and antibody levels following ND infection in local chickens in Ghana and Tanzania. Differences between breeds and ecotypes were, however, limited For Tanzania, results also indicate that growth rate can be improved through selective breeding, however caution needs to be taken to ensure that there is no negative impact because of the apparent negative genetic correlation between NDV antibody levels and growth rate. Work is ongoing on genotyping all birds for 600,000 genetic markers in the genome, allowing for assignment of dams and identification of genomic regions associated with response to ND.

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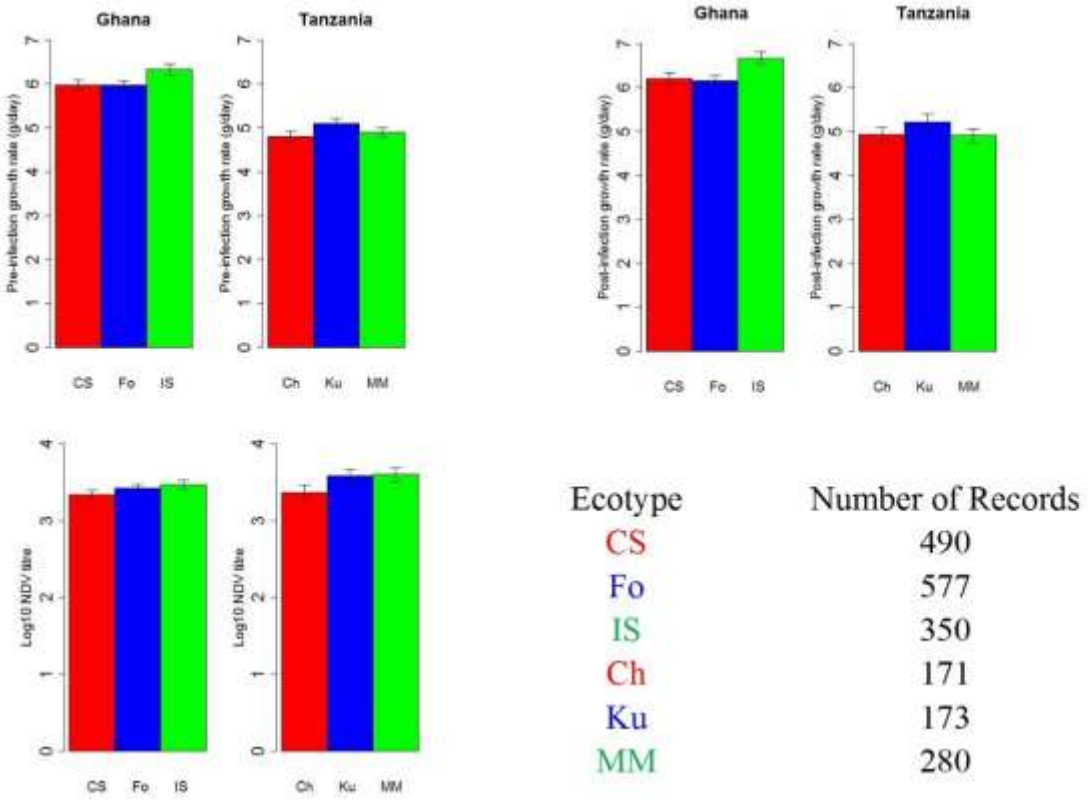

Ghanaian ecotypes: CS: Coastal Savanah, Fo: Forest, IS: Interior Savanah;

Tanzanian breeds: Ch: Chingwekwe, Ku: Kuchi, MM: Morogoro medium.

Figure 1. Number of records and least-square means (bars represent standard errors) for pre-, post-infection growth rate and NDV antibody level in different ecotypes/breeds of Ghanaian and Tanzanian local chickens.

Table 1. Estimates of genetic (below diagonal), phenotypic (above diagonal) correlations, and heritabilities (diagonal). Standard errors of estimates are in brackets.

	Pre-inf. GR (g/day)	Post-inf. GR (g/day)	Log10NDV titer
Ghana			
Pre-inf. GR (g/day)	**0.93** (0.15)	0.94 (0.004)	0.05 (0.03)
Post-inf. GR (g/day)	0.98 (0.008)	**0.89** (0.14)	0.07 (0.03)
Log10NDV titer	0.35 (0.18)	0.44 (0.15)	**0.35** (0.10)
Tanzania			
Pre-inf. GR (g/day)	**0.32** (0.10)	0.94 (0.01)	0.07 (0.04)
Post-inf. GR (g/day)	0.83 (0.09)	**0.42** (0.13)	0.04 (0.04)
Log10NDV titer	-0.93 (0.74)	-0.86 (0.60)	**0.08** (0.09)

Pre-inf. GR: pre-infection growth rate calculated from body weights at hatch 7, 14, 21 and 28 days of age.
Post-inf. GR: post-infection growth rate calculated from body weights at 28, 34 and 38 days of age.
Log10NDV titer: Log_{10} of the NDV antibody titer