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Genetic studies on primary antibody response to sheep erythrocytes in guinea fowl

V. K. SAXENA,[1] H. SINGH, S. K. PAL AND S. KUMAR

Central Avian Research Institute, Izatnagar, India

Abstract 1. The primary antibody response to sheep erythrocytes was determined by haemagglutination test in guinea fowl. The effects of various genetic and non-genetic factors on immune response to sheep RBCs in guinea fowl were also estimated.

2. The immune response to sheep RBCs was normally distributed in guinea fowl with mean titre at 1·534 ± 0·014.

3. In guinea fowl, effects on titre values of sire and variety (feather colour) were significant whereas sex and sex × variety interaction effects were non-significant.

4. The estimate of heritability for immune response to sheep RBCs in guinea fowl was 0·35 ± 0·17.

INTRODUCTION

Immune response to non-specific multi-determinant complex antigens provide an indication of natural immunity status. Gavora (1990) has reviewed the status of this trait in domestic fowl. Lines selected for high immune response to sheep RBCs were immunologically more sensitive to certain bacterial, viral and parasitic disease-causing agents. Existence of genetic control has been reported for both primary and secondary immune response to sheep erythrocytes (Siegel and Gross, 1980; Miller *et al.*, 1992). Significant effects of hatch, line, sex, and B-group haplotype on response to sheep RBCs have also been reported (Gross *et al.*, 1980; van der Zijpp and Leenstra, 1980; Dunnington *et al.*, 1984; Gyles *et al.*, 1986; Scott *et al.*, 1988).

In this study the genetic aspect of primary antibody response to sheep RBCs in guinea fowl is described.

MATERIALS AND METHODS

Varieties

The purebred stock of 3 varieties of guinea fowl: Lavender (L), Pearl (P) and White (W), generated from one indigenous base population through selective breeding (Singh, 1992) were used.

Mating plan

A total of 330 non-inbred Guncari guinea fowl growers, sired by 30 sires selected at random (10 to 12 offsprings per sire) were utilised in the study. The guinea fowl keets were obtained in 2 hatches of 164 and 166 birds each. All experimental birds were healthy, apparently free from parasitic infestation and received no prophylactic treatment.

Assay technique

The immune response to sheep red blood cells (SRBCs) was assessed at the age of 6 to 10 weeks using a slightly-modified method of Siegel and Gross (1980). Each bird received 1 ml (i/v) of thrice washed 0·5% SRBCs suspension. The antibody titre in the plasma of individual guinea fowl on day 5 post-injection was determined by a haemagglutination (HA) test using 2% SRBCs suspension.

Statistical procedure

The titre values for response to sheep RBCs were transformed into $\log_{10}$ (n + 1). The data corrected for hatch effect were analysed to determine the effects of genetic and non-genetic factors using least squares analysis (Harvey, 1975). the mathematical model used was:

$$Y_{ijkl} = \mu + V_i + (S{:}\,V)_{ij} + Se_k + (Se \times V)_{ik} + e_{ijkl}$$

where, y_{ijkl} = Value of trait on $(ijkl)^{th}$ individual in i^{th} variety, j^{th} sire and k^{th} sex; μ = Population mean; V_i = Effect of i^{th} variety $(i = 1,2,3)$; $(S{:}\,V)_{ij}$ = Random effect of j^{th} sire within i^{th} variety $(j = 1,2, \ldots, 10)$; Se_k = Effect of k^{th} sex $(k = 1,2)$; e_{ijkl} = Random error associated with $(ijkl)^{th}$ observation and distributed normally with mean 0 and variance σ^2.

[1]Present address: Central Institute for Research on Goats, Makhdoom, PO Farah, Distt. Mathura, VP 281 122, India.

Correspondence to: Dr Harpreet Singh, Avian Genetics and Breeding Division, Central Avian Research Institute, Izatnagar, UP 243 122, India.

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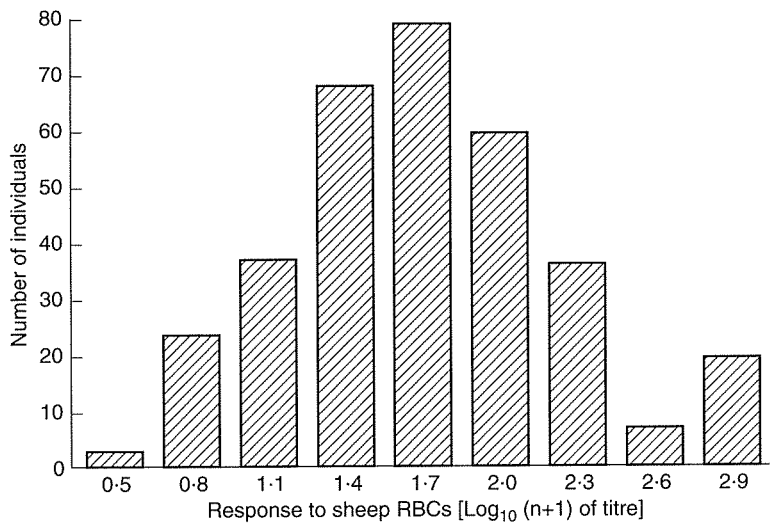

Figure. *Histogram showing frequency distribution for response to sheep RBCs in guinea fowl.*

RESULTS

Immune response titre values to SBRCs on day 5 post-injection showed a normal distribution pattern in the experimental indigenous guinea fowl population (Figure 1). The mean titres in guinea fowl were $1{\cdot}534 \pm 0{\cdot}014$. Significant differences were observed between varieties and sire families, but effects of sex and interaction (Sex × variety) were non-significant (Table 1). The highest and lowest average titre values were observed in white and lavender birds, respectively (Table 2). The heritability estimate obtained from 30 paternal half-sib families (K value = 10·9) for response to sheep RBCs was $0{\cdot}35 \pm 0{\cdot}17$.

DISCUSSION

Humoral immunocompetence, observed as mean titre for response to sheep RBCs in guinea fowl ($1{\cdot}534 \pm 0{\cdot}014$), was comparable to those reported in different domestic fowl populations (Gross *et al.*, 1980; van der Zijpp and Leenstra, 1980; Ubosi *et al.*, 1985) and the high line selected by Dunnington *et al.*, 1984.

The three plumage colour varieties had significantly different responses to sheep RBCs. These stocks had undergone mass selection for growth characters for many generations. Differences in sheep RBCs response in lines/strains/varieties of domestic fowls selected for antibody response, susceptibility to neoplasms and egg production have also been reported (Gross *et al.*, 1980; van der Zijpp and Leenstra, 1980; Ubosi *et al.*, 1985; Gyles *et al.*, 1986) though there was no difference in lines of broilers selected for rate of feathering (Dunnington *et al.*, 1987). The effect of sex on response to SRBCs, was non-significant. Results reported for sex effects in domestic fowls have not been consistent (Siegel and Gross, 1980; van der Zijpp and Leenstra, 1980; van der Zijpp *et al.*, 1986; Dunnington *et al.*, 1987).

The significant sire differences, moderate heritability estimate ($0{\cdot}35 \pm 0{\cdot}17$) and normal distribution of response to sheep RBCs in guinea fowl (Figure) indicate the existence of a distinct additive genetic component. Comparable heritability values have been reported for domestic fowl populations (Kim *et al.*, 1987; Pinard *et al.*, 1990). Recently, Miller *et al.* (1992) confirmed the quantitative nature of this trait in domestic fowl, existence of significant control through autosomal dominant structural or regulatory genes has also been postulated (Siegel and Gross, 1980; Ubosi *et al.*, 1985).

Table 1. *Least squares analysis of variance for response to sheep RBCs in guinea fowl.*

Source of variation	DF	Mean sum of squares
Variety	2	2·253**
Sires × Variety	27	0·487**
Sex	1	0·362
Sex × Variety	2	0·050
Error	297	0·238

**$P < 0{\cdot}01$.

Table 2. *Factorwise least squares means and standard errors for response to sheep RBCs in guinea fowl*

Factor	N	LS Mean ± S.E.
Overall	330	$1{\cdot}534 \pm 0{\cdot}014$
Variety		
White	101	$1{\cdot}705 \pm 0{\cdot}073$
Pearl	117	$1{\cdot}454 \pm 0{\cdot}070$
Lavender	112	$1{\cdot}439 \pm 0{\cdot}073$
Sex		
Male	182	$1{\cdot}499 \pm 0{\cdot}048$
Female	148	$1{\cdot}568 \pm 0{\cdot}051$

The results reported here suggest that the genetic determination of primary immune response to SRBCs in guinea fowl is additive, as for domestic fowls.

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