IMMUNOCOMPETENCE TRAITS AND THEIR INHERITANCE PATTERN IN KADAKNATH NATIVE CHICKEN

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ABSTRACT
Economics of poultry production can be improved by reducing input on health care (major investment) and increasing production. It necessitates evaluation and exploitation of immunocompetence traits of germplasm. An investigation was carried out on 174 Kadaknath native chickens, maintained at this institute to evaluate immunocompetence profile. Data on three traits viz., antibody response to sheep erythrocytes and serum levels of lysozyme and IgG, were analyzed by least squares analysis of variance taking sire as random and sex as fixed effects. Sire had significant effect on lysozyme (P< 0.05) and IgG (P< 0.08), but sex on none. Haemagglutination titre and lysozyme and IgG levels averaged 7.93± 0.24, 5.07± 0.29 μg/ml and 12.15± 0.48 mg/ml, respectively. Heritability ranged from medium to high but had higher standard errors. Phenotypic correlations among traits were very low and non-significant. Haemagglutination titre had highly negative genetic correlations with lysozyme level but highly positive with IgG level. The study demonstrated relatively higher immunocompetence profile in Kadaknath chicken. It was also inferred that improvement in general immunocompetence could be achieved by selection for combination of different facets of host’s immune systems.

Key words: Chicken, Kadaknath, Heritability, Immunocompetence

Diseases inflict great economic loss (8% to 10%) to poultry industry (Bootwala, 2005). Resistance to diseases is under genetic control. It is a polygenic trait (Lamont and Dieter, 1990) governed mainly by the immune system and its interactions with many physiological and environmental factors (Gross et al., 1988; Zakarias et al., 2002). Immune system plays a dynamic role in health protection and both genetic and environmental factors contribute significantly (Gavora, 1993). Because of the high cost and residual effects of drugs, the genetic selection for higher immunocompetence and disease resistance provides an alternative approach in breeding programs aiming at improvement of production, productivity and tolerance. Genetic enhancement of the host immune response can increase vaccine efficacy and diseases resistance of the flock (Parmentier et al., 1993; Lamont, 1998). India has rich avian genetic resources. Indian native chicken breeds are believed to possess better immunocompetence, disease resistance and tropical adaptability as compared to the exotic germplasm (Kundu et al., 1999). Among native chicken breeds, Kadaknath is one of the important breeds, inhabitant in vast areas of Western Madhya Pradesh mainly the Jhabua and Dhar Districts and its adjoining areas of Gujarat and Rajasthan. Kadaknath, in its habitat, is popular by its local name “Kalamansi” meaning the fowl having black flesh. Immunocompetence (IC) of birds can be assessed by estimating several traits. Antibody response to multi-determinant sheep erythrocytes, serum levels of lysozyme and IgG are some such traits. Future breeding programmes in chicken target genetic improvement of IC traits along with the performance traits, knowledge of genetic and

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phenotypic parameters of IC traits, factors affecting them and inter-relationships among them is a prerequisite for the same. A few reports are available in the literature on inheritance of IC traits in chicken (Sivaraman et al., 2005) and rare in Kadaknath native chicken (Singh et al., 2009).

Therefore, the present research was carried out with the objectives to evaluate IC traits, ascertain the factors affecting them and to determine their inheritance pattern and inter-relationships in Kadaknath native chicken.

One hundred and seventy four chicks of Kadaknath breed, being maintained at Central Avian Research Institute, Izatnagar (UP), India during 2007 were used in the present investigation. Three immunological traits, viz., response to Sheep red blood cells, serum concentrations of Lysozyme and Immunoglobulin-G were estimated at the age of 6-7 weeks. The antibody response to SRBC was assessed using haemagglutination test (Van der Zijpp and Leenstra, 1980). Serum lysozyme concentration was estimated using Lysoplate assay method (Lie et al., 1986) using lyophilized Micrococcus lysodeikticus (Sigma Aldrich) as substrate. Serum IgG concentration was determined by Single Radial Immunodiffusion (SRID) assay (Manicini et al., 1965). Data collected on immunological trait were subjected to least squares analysis of variance (Harvey, 1990) taking sire as random and sex as fixed effects.

Least squares analysis of variance for various immunological traits (Table 1) revealed that the effects of sire was significant on serum lysozyme concentration (P< 0.01) and serum IgG (P< 0.08), however, sex effect was non-significant (P> 0.05) on all the traits. The least squares means of HA titre, serum lysozyme and serum IgG levels (Table 2) were 7.93± 0.24, 5.07± 0.29 μg/ml and 12.15± 0.48 mg/ml, respectively. Males demonstrated slightly higher HA titre (8.19 ± 0.31) and IgG concentration (12.47± 0.61) but lower serum lysozyme (4.95+ 033μg/ml) concentration than females (7.65 ± 0.33, 11.82± 0.64 mg/ml and 5.18± 0.34 μg/ml).

**Humoral response to sheep red blood cells:** Non-significant effect of Sex on HA titre in Kadakanath chicken observed in the present study is in corroboration with earlier studies in guinea fowl (Saxena et al., 1997) as well as in Indian and exotic chicken (Kundu et al., 1999).

**Serum lysozyme concentration:** The serum lysozyme concentration ranged from 0.60 to 12.91 μg/ml. Although statistically non-significant, females demonstrated higher estimates (5.18± 0.34) than males (4.95± 0.33). Present finding of non-significant effect of sex on serum lysozyme level was in accordance with the report of Sivaraman et al. (2005) in SDL broiler chicken, Kumar (2006) in Aseel native chicken and Singh (2005) in White Leghorn chicken; also reported higher estimates in females than males.

**Serum IgG level:** Serum IgG is the most abundant antibody and constitutes approximately 80% of the total immunoglobulins. The bird’s ability to mount antibody response to antigens is primarily revealed by serum IgG concentration. The average serum IgG concentration was 12.15 ± 0.48 mg/ml. Non-significant effect of Sex on serum IgG level, as observed in this study, was also reported by earlier workers, viz., Singh (2005) in WLH and Van der Zijpp (1983) in WPR chicken, respectively.

**Inheritance and association patterns of immunocompetence traits:** Association among immunocompetence traits viz., heritability (h²), Genetic (r_G) and phenotypic (r_P) correlations among various immunocompetence traits are presented in Table 3.

### Table 1: Least squares analysis of variance of important immunological traits in Kadaknath breed of native chicken

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Mean sum of square (HA)</th>
<th>Serum lysozyme</th>
<th>Serum IgG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sire</td>
<td>22</td>
<td>9.39</td>
<td>12.64*</td>
<td>37.61***</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>10.85</td>
<td>2.02</td>
<td>15.99</td>
</tr>
<tr>
<td>Error</td>
<td>150</td>
<td>7.31</td>
<td>4.72</td>
<td>24.85</td>
</tr>
</tbody>
</table>

*P ≤ 0.08 , **P ≤ 0.01

### Table 2: Least squares means ± SE of important immunological traits in Kadaknath breed of native chicken

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. of Samples</th>
<th>HA titre</th>
<th>Lyso (μg/ml)</th>
<th>IgG (mg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>174</td>
<td>7.93 ± 0.24</td>
<td>5.07 ± 0.29</td>
<td>12.15 ± 0.48</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>93</td>
<td>8.19 ± 0.31</td>
<td>4.95 ± 0.33</td>
<td>12.47 ± 0.61</td>
</tr>
<tr>
<td>Females</td>
<td>81</td>
<td>7.65 ± 0.33</td>
<td>5.18 ± 0.34</td>
<td>11.82 ± 0.64</td>
</tr>
</tbody>
</table>
Humoral immune response (HA titre) and serum IgG level revealed moderate heritability estimates, although associated with high standard errors. High heritability was estimated for serum lysozyme level. The heritability estimates of all immunocompetence traits were associated with high standard errors making them less precise. Similar estimates were reported by Sivaraman (2004) in broiler chicken.

HA titre had highly negative \( r_g \) with lysozyme but highly positive \( r_g \) with serum IgG level. The serum lysozyme had very low and negative \( r_g \) with serum IgG level. The \( r_g \) estimated in present study were associated with high standard errors. Sivaraman et al. (2003) also observed high standard error associated with \( r_g \) among immunological traits in broiler chicken.

Very low phenotypic correlations (\( r_p \)) were estimated among the three immunocompetence traits in Kadaknath native chicken. Sivaraman et al., (2005) also reported that the phenotypic correlation among immunocompetence traits were not significantly different than zero. Singh (2005) reported phenotypic correlations among three immunological traits (HA titre, serum levels of lysozyme and IgG) as positive and low to medium in magnitude in IWB strain of white Leghorn chicken. Kumar (2006) also estimated phenotypic correlations among the three immunocompetence traits (HA titre, serum levels of lysozyme and IgG) in Aseel native chicken, which were positive and low to medium in magnitude.

The study demonstrated relatively higher immunocompetence profile in Kadaknath chicken and improvement in general immunocompetence could be achieved by selection for combination of different facets of host’s immune systems.

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