Correlation among immunocompetence and economic traits in chicken

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ABSTRACT

The correlations within the various immunocompetence traits (antibody response to SRBCs, *in-vivo* response to Con-A, haemolytic complement level in serum) and economic traits (5th, 10th and 20th week body weights, age at sexual maturity, egg weight at 24 weeks of age and egg number up to 40 weeks of age) were estimated as simple product moments correlation in a chicken population. The response in total HA titre showed positive and significant correlation with response in MER antibody titre (0.442) and MES titre (0.519), while the correlation between response in MER antibody titre and MES antibody titre was found to be significant, but negative (-0.536). While haemolytic complement level in serum showed positive correlation with responses in MER antibody titre (0.276), it was negatively correlated with response in MES antibody titre (-0.341) and both the correlations were significant. Other correlations among various immuno-competence traits were small and non-significant. None of the correaltion between immuno-competence traits and economic traits was significant statistically except that between CMI response to Con-A and egg number up to 40 weeks of age, which were negative (-0.360) in direction and moderate in magnitude.

Contains 1 table

Key words : Immuno competence, correlation coefficient, economic traits, chicken

For effective disease control, the genetically determined natural resistance is an important factor. The avian immune system is highly evolved and its efficient functioning is important for resistance to poultry diseases. Both structural and regulatory genetic factors determine the individual's immune competence and ability to attack a particular disease organism. In view of multiplicity of pathogens to which a bird is exposed, an indirect selection approach based on immune response traits may be the best long term strategy for general disease resistance improvement (Gavora and Spencer, 1983; Vander Zipp, 1983b). An independent genetic control for immune response traits representing different facets of immune systems has been established. Hence the relationship among the various immune-systems has been established. Hence the relationship among the various immuno-competence traits is important. Further, the knowledge of relationship of the various economically important traits with the measure of immunocompetence traits is essential for practical breeding. However, assessment of such relationship is difficult as both type of traits are influenced by a wide number of factors.

A total of 93 birds from two specialized populations viz. Naked neck and Frizzle stocks were utilized for present study. Following measures of general immune status were studied at 10-12 weeks of age.

Antibody response to SRBC : The total antibody response to sheep red blood cells (SRBC) was measured on day zero and 7th day post injection using microtitre Haem-aggultination test. The mercapto-ehtanol (ME) test (Martin *et al.*, 1989) was used to measure ME resistant antibody (MER) titre. The ME sensitive (MES) antibody titre was calculated as differnces in total HA titre and MER titre. The responses in respective titres were the results of difference between the antibody titres (Total HA, MER and MES) before and after SRBC immunization.

Cell mediated immune response to Con A : The *in-vivo* cell mediated immune response to Conconavalin A was measured as foot index by injecting 0.5 mg Con-A in 0.1 ml PBS inter-digitally between 3rd and 4th toe of right foot. The left foot received 0.1 ml PBS and served as control. The increase in thickness of interdigital skin of right and left foot was estimated as difference between the thickness on zero hour and after 24 hours and expressed as foot index.

Haemolytic complement level in serum : The method described by Jaiswal and Mishra (1989) with slight modification was used to estimate total haemolytic complement level in serum. Briefly, microtitre plate titration was carried out using rabbit RBCs senstitized with fowl anti rabbit haemolysin. The reciprocal of highest dilution showing 50% haemolysis was taken as titre of complement in serum and the titre was expressed as log 2.

Phagocytic index : Carbon clearance assay, as described by Cheng and Lamont (1988) was used to measure phagocytic activity.

Economic traits

Body weights : The body weight of each bird was measured to the nearest accuracy of 5 g at 5th, 10th and 20th weeks of age.

Egg production : The egg production was measured as the number of eggs laid upto 40 weeks of age.

Age at sexual maturity : The age at the sexual maturity was measured as age at first egg laid by each bird.

Egg weight : Egg weight was meaured on each individual bird to the nearest of 1 g accuracy. Average of three consecutive eggs laid during 24th week of age was taken as the egg weight.

The data was corrected for differences among the genetic goups by fitting least square constants (Harvey, 1975). The correlation coefficient within and between immunological and economic traits were calculated as simple product moment correlation as described by Snedecor and Cochran (1989).

The correlation within between the various immunocompetence traits i.e. antibody response to SRBCs, *in vivo* response to Con-A, haemolytic complement level in serum and economic traits *viz.* 5th week body weight, 10th week body weight, 20th week body weight, age at sexual maturity, egg weight at 24 weeks of age and egg number up to 40 weeks age were estimated as simple product moments correlation and have been presented in Table 1.

The response in total HA titre showed positive and significant correlation with response in MER titre (0.442) and MES titre (0.519), while the correlation beween response in MER antibody titre and MES antibody titre was found to be significant, but negative (-0.536). While haemolytic complement level in serum showed positive correlation with response in MER antibody titre (0.276), it was negatively correlated with response in MES antibody titre (-0.341) and both the correlation were significant. Other correlation among various immune-competence traits were small and non-significant. None of the correlation between immunocompetence traits and economic traits was signficant statisticaly except that betwen CMI response to Con-A and egg number up to 40 weeks of age, which were negative (-0.360) in direction and moderate in magnitude.

The response in total HA titre on 7th dpi showed highly significant positive relationship with response in MER as well as MES antibody titre, while the response in MER antibody titre showed significant, but negative relationship with MES antibody titres. These relationship were very much expected in view of their known inter-relationship. Vander Zijpp and Leenstra (1980) reported negative genetic correlation between MER and MES antibody titres.

The cell mediated response to Con-A was found to have non significant relationship with humoral response to SRBC in the present study and these findings were supported by the earlier reports from Lassila *et al.* (1979), Vander Zijpp (1983a), Vander Zijpp and Nieuwland (1986), Cheng and Lamont (1988) and Saxena (1993),

Table 1. Phenotypic correlation within and between the immunocompetence and production traits in chicken

Traits	RESTHA	RESMER	RESMES	COMP.	CMI	BW5	BW10	BW20	ASM	EW	EN
RESTHA	1.000	0.4424**	0.5195**	-0.0833	0.1242	0.1018	0.1222	0.1748	0.1056	0.1144	-0.2392
RESMER		1.0000	-0.5365**	0.2759**	-0.0342	0.1424	-0.0120	-0.0156	0.0687	-0.1176	-0.1114
RESMES			1.0000	-0.3412*	0.1495	-0.0399	0.1265	0.1793	0.0339	0.2198	-0.1189
COMP.				1.0000	0.0712	-0.0012	-0.1142	-0.2291	-0.1550	-0.0044	0.0312
CMI					1.0000	0.0315	0.0052	-0.0447	-0.1160	0.0805	-0.3600**
BW5						1.0000	0.5475**	0.4178**	0.0440	0.1532	-0.2363
BW10							1.0000	0.6755**	0.0435	0.1183	-0.2026
BW20								1.0000	-0.0999	0.0831	-0.0823
ASM									1.0000	0.2553	-0.1867
EW										1.0000	-0.0996
EN											1.0000

RESTHA = Response in total HA titre, RESMER = Response in ME resistant antibody titre, RESMES = Response in ME sensitive antibody titre, Comp. Haemolytic complement titre in serum, CMI = Cell mediated immune response to Con-A, BW5 = Body weight at 5th week of age, BW10 = body weight at 10th week of age, BW20 = Body weiht at 20th week of age, ASM = Age at sexual maturity, EW = Egg weight at 24th weeks of age, EN = Egg production up to 40 week of age, ** = Significant at P<0.01, * = Significant at P<0.05

which also revealed non-significant association between CMI response to mitogens and antibody response to SRBCs.

Total haemolytic complement levels in serum showed positive correlation with response in MER antibody titre and negative correlation with response in MES antibody titre in the present study. Saxena (1993) reported high genetic correlation of haemolytic complement level with response to SRBC and IgG levels in guinea fowl. Kundu *et al.* (1999) reported similar correlation between complement level estimated as calcium dependent as well as calcium independent pathway and MER titres.

For the phenotypic correlation between various immunocompetence and economic traits, none of the estimate except that between cell mediated response to Con-A and egg production was significant statistically though it varied in the range of -0.239 to 0.219. The cell mediated response to Con-A showed negative, but significant correlation (-0.36) with EN. Similar relationship between these two traits was also reported by Kundu *et al.* (1999), Shukla *et al.* (1996) reported non-significant phenotypic correlation between antibody response to SRBC and body weight. Martin *et al.* (1990) reported small and non-significant correlation of response to SRBC with body weight, percentage egg production and age at sexual maturity, while the genetic correlation were moderate to high and negative with body weight and positive with percent hen day egg production. Parmentier *et al.* (1998) also reported negative correlation between body weight and response to SRBC.

In general, the various measures of general immuno competence level showed no correlation among themselves as well as with economic traits. This findings suggested the use of an index incorporating different measures of immuno-competence would be more advantageous for improving general disease resistance in chicken. Since most of the correlation between immuno-competence measures and econmic traits were non-significant, it seems that improvement in general immuno competence will not affect most of the economic traits adversely.

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