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Genetic variation of guinea fowl alkaline phosphatase

S.K. PAL AND HARPREET SINGH

Central Avian Research Institute, Izatnagar - 243 122

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ABSTRACT

Genetic and non-genetic variations of guinea fowl alkaline phosphatase were investigated. Two distinct electrophoretic activity zones were identified; rare individual variation was also observed in both zones. Enzyme activity variations between varieties and sexes were significant ($P<0.05$). Inheritance studies suggested polygenic control besides major gene influences. Plasma alkaline phosphatase activity level showed positive correlation with body weights and egg production.

Key Words : Alkaline phosphatase, guinea fowl, genetic variation

Plasma alkaline phosphatase is an abundantly investigated poultry enzyme. Literature on inheritance of both qualitative as well as quantitative variations and their importance in poultry production has been reviewed by Grunder (1990) and Meret (1990). However, little information on these aspects is available for guinea fowl plasma alkaline phosphatase (Ukoha *et al* ., 1988). This article presents some preliminary observations on genetic determination of qualitative and quantitative variations of plasma alkaline phosphatase in guinea fowl..

MATERIALS AND METHODS

Investigations were conducted in four indigenous guinea fowl genetic groups : pedigreed 'Guncari' population comprising of White, Lavender and Pearl varieties and non descript stock being maintained at this institute. Plasma samples of keets, growers (10 wk) and adults (26 wk) were collected and stored at -20°C, until required for analysis. Samples (n = 170) were subjected to agarose-gel electrophoresis (Ogita, 1962). Quantitation of enzyme activity levels in 238 individuals belonging to 34 halfsib families was done by the method of Bessey *et al.* (1946).

Alkaline phosphatase data was corrected for hatch, variety and sex effects (Harvey, 1975) and heritability was estimated by half-sib correlation method. Linear statistical model was used to study the genetic and non-genetic factors affecting enzyme activity. Critical difference test and Duncan's multiple range test (Duncan, 1955) was used for pair wise comparisons of the group means. The genetic and phenotypic correlations were estimated from variance and covariance component analysis as suggested by Becker (1975).

RESULTS AND DISCUSSION

Activity variations : High plasma alkaline phosphatase activity levels observed at hatch revealed a declining trend among keets and growers; a

Table 1. Mean plasma alkaline phosphatase activity (IU/liter) in guinea fowl

Age	Varieties			Mean activity	Feathering type		Mean activity
	White	Lavender	Pearl		Slow	Fast	
10 wk	802.3±16.4 (89)	793.4±26.8 (112)	785.9±22.7 (178)	794.2±16.4 (379)	788.3±22.8 (145)	800.2±19.7 (235)	794.2±21.3 (614)
26 wk	232.9±11.6[a] (102)	194.9±19.3[b] (54)	146.5±10.2[c] (172)	191.4±7.4 (328)	800.2±19.7[a] (235)	203.8±8.2[b] (170)	502.0±7.3 (498)

Figures in parenthesis represent number of observations; and values with same superscripts do not differ significantly ($P < 0.05$).

Table 2. Percent distribution of alkaline phosphatase activity level (IU/litre) in guinea fowl varieties

Plumage colour	N	Alkaline phosphatase level (IU/litre)		
		High (> 1600)	Medium (1100-700)	Low (< 600)
10 weeks				
White	89	14.6	74.2	11.2
Lavender	112	8.3	76.7	15.1
Pearl	178	8.4	79.3	12.3
Overall	379	9.8	77.3	12.9
		(> 230)	(210-150)	(< 130)
26 weeks				
White	102	30.3	44.1	25.6
Lavender	54	29.6	37.0	33.4
Pearl	172	20.3	40.2	39.5
Overall	328	26.5	41.8	32.7

subsequent increase among females was seen with onset of sexual maturity (Fig. 1). Population distribution pattern of the enzyme activity revealed three peaks; incidence of individuals showing high enzyme activity level was significantly more among white variety (Table 2, Fig. 2). Enzyme activity differences due to sex, variety and age were significant ($P<0.05$). Similar observations were reported earlier also by Ukoha *et al.* (1988) and Savova and Kirev (1992). Feathering type also showed significant influence on 26 wk enzyme level. Genetic studies of enzyme activity revealed moderate heritability estimates (0.233±0.124 at 10 wk; 0.477±0.206 at 26 wk). Segregation studies among the limited progeny from matings between parents

Table 3. Mating results for alkaline phosphatase activity level (IU/litre) in guinea fowl

Sire	Dam	N	Offspring (%)			Overall mean activity
			High (> 800)	Medium (800-500)	Low (< 500)	
High (4)	High (4)	18	66.7	27.8	5.5	950.0
High (4)	Low (3)	13	23.2	61.5	15.3	760.0
Low (3)	Low (5)	16	6.2	31.3	62.5	430.0

with known high/medium/low enzyme activity phenotypes suggested existence of dominant gene(s) influences (Table 3).

The magnitude and trend of phenotypic and genetic correlations between enzyme activity and quantitative traits e.g. body weight at 4 wk, 8 wk (r_P 0.39, 0.36; r_g 0.4±0.32, 0.86±0.23), age at first egg (r_P -0.23, r_g - 0.15±0.09), egg weight (r_p 0.10, 0.66± 0.54) and 90 day egg production (r_P 0.49, 0.44±0.06) showed good agreement with reports for chicken, quail and other poultry species (Gootwine and Brody, 1979; Singh *et al.*, 1985; Day *et al.*, 1996; Meret, 1990).

Electrophoretic variations : Two discrete heterogeneity zones were identified during alkaline phosphatase electrophoresis in agarose-gel (Fig. 3). Two different phenotypes were detected in zone-1 : the most predominant slow type (S-type) was characterized by presence of a slow moving major component, while existence of a minor faster band identified the rare fast type (F-type). The more annodal zone-II showed two discrete bands in three phenotypic combination viz. FF, FS and SS (Fig. 3). However, no variations were detected in starch-gel electrophoresis during present investigations and electrophoresis in polyacrylamide gel by Ukoha *et al.* (1988). The observed frequency of the rare Akp-I and Akp-II, variants was 0.01 and 0.08, respectively. Inheritance investigations for these rate phenotypes were not carried out. Possibly it is similar to that reported for other galliform species like domestic fowl and quail (Grunder, 1990). But present inferences required further detailed investigations.

Present findings suggest a two level genetic control for alkaline phosphatase activity variations viz., a set of polygenes and major gene(s) influences. In view of largely conflicting reports on alkaline phosphatase associations with economic traits in chicken present observations required further confirmation. With respect to alkaline phosphatase associations, Meret (1990) underlined the need for undertaking more detailed investigations on gene x genome and/or gene x environment interactions in different species.

REFERENCES

Becker, W.A. 1975. *Manual of procedures in quantitative genetics.* Washington State University; Pullman; Washington.

Bessey, O.A., Lowey, O.H. and Brock, M.J. 1946. A method of rapid determination of alkaline phosphatase with five cubic millilitres of serum. *J. Biol. Chem.* **164**: 321-29.

Dey, B.R., Kumar, J. and Singh, R.P. 1984. Genetic variation and covariation for some biochemical traits in egg type chicken. *Indian J. Poult. Sci.* **19**: 220-23.

Duncan, D.B. 1955. Multiple range and multiple 'F' - tests. *Biometerics* **11**: 1-42.

Gootwine, E. and Brody, T. 1979. The relationship between plasma alkaline phosphatase specific activity and productive traits in poultry. *Poult. Sci.* 58: 1640-43.

Grunder, A.A. 1990. *Genetics of biochemical variants in chicken.* In: Crawford, R.D. (Ed.), Poultry Breeding and Genetics, pp : 239-256, Elsevier, Amsterdam.

Harvey, W.R. 1975. *Least-square analysis of data with unequal subclass numbers.* Agricultural Research Services, USDA, Washington.

Meret, P. 1990. *Pleiotropic and associated effects of major genes.* In: Crawford, R.D. (Ed.), Poultry Breeding and Genetics, pp 429-68; Elsevier, Amsterdam.

Ogita, Z. 1962. Genetic - biochemical analysis of the enzyme activity in the house fly by agar gel electrophoresis. *Japanese J. Genet.* 37: 518-21.

Savova, M. and Kirév, T. 1992. Alkaline phosphatase activity in serum of guinea fowl bearing bone tumours induced by osteopetrosis virus strain PTS-56. *Avian Pathol.* 21: 667-73.

Singh, Harpreet, Garg, R.C. and Dimri, C.S. 1985. Genetic study of serum cholesterol and alkaline phosphatase and their association with growth traits in Japanese quails. *Indian J. Anim. Genet. Breed.* 7: 18-19.

Ukoha, A.I., Okoh, P.N., Icce, D. Dim, N.I. and Olonu, J.M 1988. Purification of some of the properties of alkaline phosphatase in guinea fowl (Numida meleagris galeate). *Brit. Poult. Sci.* 29: 27-33.