

Transferrin Genetic Types in Fulani and Yoruba Ecotype of Nigeria Indigenous Chickens

Research Article

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ABSTRACT

Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC) are the two major types of indigenous chickens in Nigeria. They subsist under traditional Animal husbandry and are thus liable to indiscriminate mating and consequently to loss of genetic diversity. Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC) were investigated to determine genetic variation at transferrin locus using cellulose acetate electrophoresis and to establish genetic relationship within and between the two ecotypes. Direct gene counting method was used to interpret the result after electrophoresis. Palentological statistics (PAST) was used to generate dendogram which was used to measure genetic similarity. Transferrin was interpreted into six phenotypes (AA, AB, BB, AC and BC) whose inheritance is genetically controlled by three codominant alleles (Tf^A, Tf^B and Tf^C). Gene frequencies of Tf^A, Tf^B and Tf^C were 0.35, 0.2 and 0.43 in Yoruba ecotype chickens (YEC) and 0.21, 0.32 and 0.44 in Fulani ecotype chickens (FEC). While Genotype frequencies were 12.5%, 10%, 75%, 35%, 17.5% and 15% for Yoruba ecotype chickens (YEC) and 11.19%, 2.5%, 16.6%, 22.2% and 27.7% for Fulani ecotype chickens (FEC). Main clusters observed from the dendogram indicated 72% genetic similarity within Fulani ecotype chickens (FEC), 58 % genetic similarity within Yoruba ecotype chickens (YEC) and 70 % genetic similarity between Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC). No genetic relationship existed between transferrin and phenotypic traits (sex, plumage colour and comb type). Conclusively, the two populations were closely related at transferrin locus. Further study should be extended to other protein markers and DNA level and conservation methods should be initiated to prevent further dilution of these chickens and for future development of Nigeria chicken line breed.

KEY WORDS Fulani, Nigerian chickens, transferring, Yoruba.

INTRODUCTION

The indigenous chicken breed is a general terminology given to animals kept in the extensive system, scavenging on free range, multipurpose and unimproved environment (Horst, 1989). The indigenous chickens are adapted to local environmental conditions and disease. Horst (1989) considered the indigenous chickens as gene reservoir, particularly, those genes that have adaptive values in the tropical and

subtropical area and they contribute greatly to human supply of egg and meat.

However, little information on their detailed characterization is available. Also no effort to initiate conservation of indigenous chickens' genetic resources is on going. One of the important reasons to conserve indigenous chicken genetic resources is to keep genetic variation within and between ecotypes. The present and future improvement and sustainability of indigenous chicken production systems are

dependent upon the availability of genetic variation (Banitez, 2002).

Biochemical characterization based on protein polymorphism has been reported to be useful in genetic characterization and diversity measures between and within livestock breeds (Lee *et al.* 2000; Yamamoto *et al.* 1996; Esmaeilkhani *et al.* 2000). Das and Deb (2008) described the importance of biochemical polymorphism in the improvement of chicken. It is also noted by Rendel (1967) that some polymorphic alleles may be correlated with economic traits due to linkage pleiotropy or general heterozygosity. Detection of biochemical polymorphism involves the use of electrophoresis which is the migration of ions in an electric field and widely used for analytical separation of biological molecules.

This study was therefore conducted to assess the genetic types of transferrin and establishes their gene and genotype frequencies in both Yoruba and Fulani ecotype indigenous chickens in the derived savannah zone of Nigeria.

MATERIALS AND METHODS

Blood samples were collected from one hundred chickens comprising 50 adult Yoruba ecotype chickens (YEC) and 50 adult Fulani ecotype chickens (FEC). In addition qualitative traits such as sex comb type and plumage colour were recorded individually for each chicken. Samples were prepared and subjected to cellulose acetate electrophoresis following the procedure of Riken (2006).

Sample preparation

Two ml of blood was collected from individual chickens through wing vein puncture and put into plastic tubes containing anticoagulant. The plasma fraction was separated from erythrocyte fraction of heparinized blood by centrifugation at 2500-3000 rpm for 10min at 10 °C. The supernatant was stored at 4 °C until the time of analysis.

Cellulose acetate electrophoresis protocol

The cellulose acetate membrane was soaked very slowly in the buffer solution (Trisglycine, pH 8.5) and the buffer was poured into the electrophoresis chamber. Wick was folded and moistened with the buffer and placed on each of the support arms of the electrophoresis chamber. The sample (supernatant) was poured into the slots of the applicator. The soaked cellulose acetate membrane plate was gently placed between the paper towels on each support arm of the electrophoresis chamber. The comb was stamped into the applicator and placed on the gel upside down on the paper rows inside the electrophoresis chamber. Coin was placed on the gel to keep the plate flat and ensured an even current through the plate. The electrophoresis was run at 150 vol and 4 °C for 50min and the migration was from cathode to

anode. After the electrophoresis, ponceaus was applied to stain the paper and destained with 5% acetic acid. The bands were clearly separated and direct gene counting was used for the interpretation of allele.

Statistical analysis

Gene and genotype frequency were calculated using the expression provided by Rogharden (1977) as follows:

P: gene frequency of allele x.

Q: gene frequency of allele y.

$$P = (2 \times (N_{xx}) + N_{xy}) / (2 \times N)$$

$$Q = (2 \times (N_{yy}) + N_{xy}) / (2 \times N)$$

Where:

N: the total number of individual sampled.

N_{xx} : observed genotype number for xx.

N_{xy} : observed genotype number for xy.

N_{yy} : observed genotype number for yy.

Genotype frequency was calculated as follows:

$$(\text{number of } xx / \text{total individual}) \times 100$$

$$(\text{number of } xy / \text{total individual}) \times 100$$

$$(\text{number of } yy / \text{total individual}) \times 100$$

Palentological statistical (PAST) package was used to generate a dendrogram that measures the genetic similarity between chicken types.

RESULTS AND DISCUSSION

Electrophoretic separation of transferrin is shown in plates 1 and 2 for Yoruba and Fulani Ecotype respectively. It was interpreted into six phenotypes (AA, AB, BB, AC, CC and BC) whose inheritance is genetically controlled by three co-dominant allele (Tf^A , Tf^B and Tf^C). The distribution gene and genotype frequencies by ecotype were presented on Table 1.

Gene frequencies were 0.35, 0.2 and 0.43 for Tf^A , Tf^B and Tf^C respectively. However, the phenotypes AA, AB, BB, AC, CC and BC genotype frequencies of 12.5%, 10%, 7.5%, 35%, 17.5% and 15% in Yoruba ecotype chickens (YEC), respectively, while they were 11.19%, 2.8%, 16.6%, 16.6%, 22.2% and 27.7% in Fulani ecotype chickens (FEC) respectively. All types of transferrin were found in both sexes (Tables 2 and 3) where gene frequencies were Tf^A (0.39), Tf^B (0.25), Tf^C (0.36) for male and Tf^A (0.37), Tf^B (0.17), Tf^C (0.46) for female in Yoruba ecotype chickens (YEC), while in Fulani ecotype chickens (FEC) gene frequencies were Tf^A (0.19), Tf^B (0.44) Tf^C (0.30) for male and Tf^A (0.04), Tf^B (0.38) Tf^C (0.50) for female.

Table 1 Genotypes and gene frequencies at transferrin locus based on Ecotype

Ecotype	No	Genotype frequency										Gene frequency				
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Yoruba	40	5	12.5	14	35	3	7.5	7	17.5	6	15	4	10	0.35	0.20	0.43
Fulani	36	4	11.1	6	16.66	6	16.66	8	22.2	10	27.77	1	2.77	0.21	0.32	0.44

Table 2 Distribution of transferrin genotype and gene frequencies based on sex in Yoruba ecotype chickens (YEC)

SEX	No	Genotype frequency										Gene frequency				
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Male	14	1	7.14	7	50.00	2	14.29	1	7.14	1	7.14	2	14.29	0.39	0.25	0.36
Female	26	7	15.37	9	34.62	2	7.69	6	23.08	3	11.54	2	7.69	0.37	0.17	0.46

Table 3 Distribution of genotype and gene frequencies at transferrin locus with respect to sex in Fulani ecotype chickens (FEC)

Sex	No	Genotype frequency										Gene Frequency				
		AA	%	AC	%	AB	%	BC	%	CC	%	BB	%	A	B	C
Male	18	2	11.11	3	16.67	0	0	4	22.2	2	11.11	6	16.67	0.19	0.44	0.31
Female	18	2	11.11	4	22.22	1	5.55	3	16.67	7	38.88	5	27.77	0.04	0.38	0.58

The trend of the distribution of transferrin was not consistent with respect to sex in both ecotypes. Similar irregular pattern of the distribution was observed with respect to qualitative traits (plumage colour and comb type).

However, eight different patterns of plumage colour (Tables 6 and 7) were observed (white, black, brown, ash, multicoloured, red, yellow and whitish brown) and three distinct types of comb (single, rose and pea) (Tables 4 and 5) were found as well in the two populations. In both Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC), three main clusters were observed with 72%, 79% and 80% levels of similarity in Fulani ecotype chickens (FEC) and 58%, 65% and 66% levels of similarity Yoruba ecotype chickens (YEC) (Figures 1, 2 and 3).

On the contrary, four main clusters with similarities levels of 70%, 74%, 77% and 80% were observed between Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC). However, the variation within and between the ecotypes were generally low. Transferrins are the most heterogeneous of the blood proteins in poultry studies and therefore are well adapted to biochemical studies (Montag, 1992). Six phenotypes of transferrin (AA, AB, BB, AC, CC and BC) were observed in both Yoruba and Fulani ecotype chicken population using the nomenclature described by Ashton *et al.* (1966). Frequency of Tf^c (0.43) was predominantly higher than frequencies of Tf^a (0.35) and Tf^b (0.2) in Yoruba ecotype chicken, similarly, in Fulani ecotype chicken the frequency of Tf^c (0.44) was higher than frequencies of Tf^a (0.21) and Tf^b (0.32). This observation agrees with the work of Esmailkanian *et al.* (2000) on Iranian native poultry breeds. They reported a higher frequency of Tf^c (0.531) than Tf^a (0.031) and Tf^b (0.43) in Dashtryary breed, a higher frequency of Tf^c (0.574) than Tf^b (0.407) and Tf^a (0.019) in Lary breed, a higher frequency of Tf^c (0.629) than Tf^b (0.355) and Tf^a (0.016) in Marandy breed, a higher frequency Tf^c (0.523) than Tf^b

(0.432) and Tf^a (0.045) in Naked Neck and higher Tf^c (0.522) than Tf^b (0.523) and Tf^a (0.075) in common breed. Similar observations are found by Montag (1992) in Pheasants where he scored high frequencies of transferrin C allele in all of the populations studied and he attributed it to the influence of environment which caused increased selection pressure toward birds with the Tf^c allele.

However, Tanabe *et al.* (1991) and Okada *et al.* (1980) reported that the most frequent allele in their study was Tf^b. Stratil (1968) and Ogen *et al.* (1962) also stated that the frequency of Tf^b allele is highest in strains such as Light Sussex, White Cornish, White Leghorn, Partridge Leghorn, White and Black Leghorn, Rhode Island Red and some of their crosses. Lee *et al.* (2000) similarly reported a high frequency of Tf^b in red (0.982) and black (0.989) coloured lines of Korean native chickens. In addition, they recorded the presence of complete gene fixation for yellow line and all the foreign breeds investigated. Nevertheless, the present findings are concordant with that of Yamamoto *et al.* (1996) who found high frequency of Tf^b.

The difference may be due to differences in genetic background of the breeds examined herein and their purity. Vohs and Carr (1969) hypothesized that transferrin was controlled by four codominant alleles at a single locus in Iowa Pheasants. Additionally they found that one bird out of 869 sampled have the Tf^d allele which was not found in this study. This may be due to variation in sample size as it is possible that if the two populations studied were sampled more extensively there is a possibility that Tf^d allele would also be found. Transferrin polymorphisms have been shown to correlate with some production traits. Interestingly Stratil (1979) observed the superiority of chicken with Tf^b over Tf^a in terms of egg production. Lush (1966) noted that the effect of heterozygous transferrin (Tf^b and Tf^c) appears to be significantly better in fertility, hatchability and egg production.

Table 4 Distribution of genotype and gene frequencies at transferrin locus with respect to comb type in Yoruba ecotype chickens (YEC)

Comb type	No	Genotype frequency									Gene frequency					
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Single	35	5	14.29	14	40.00	2	5.71	6	17.14	5	14.29	3	8.57	0.39	0.17	0.44
Rose	0	0	0.00	0	0.00	0	0.00	0	0.00	1	50.00	1	50.00	0.25	0.50	0.25
Pea	0	0	0.00	2	66.67	0	0.00	1	33.33	0	0.00	0	0.00	0.33	0.00	0.67

Table 5 Distribution of genotype and gene frequencies at transferrin locus with respect to comb type in Fulani ecotype chickens (FEC)

Comb type	No	Genotype frequency									Gene frequency					
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Single	31	5	16.12	4	12.90	4	12.90	8	25.80	8	25.80	1	3.22	0.24	0.27	0.45
Rose	3	0	0	2	66.66	1	33.33	0	0	0	0	0	0	0.33	0.33	0.33
Pea	2	0	0	0	0	0	0	0	0	2	100	0	0	0	0.5	0.5

Table 6 Distribution of genotype and gene frequency at transferrin locus based on Plumage colour in Fulani ecotype chickens (FEC)

Plumage colour	No	Genotype frequency									Gene frequency					
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Brown	3	0	0	0	0	0	0	1	33.33	2	66.66	0	0	0	0.33	0.66
Black	6	0	0	1	16.66	2	33.33	0	0	3	50	0	0	0.08	0.58	0.33
White	6	1	16.66	2	33.33	1	16.66	0	0	2	33.33	0	0	0.33	0.33	0.33
Yellow	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Black + brown	12	2	16.66	0	0	3	25	5	41.66	1	8.33	1	8.33	0.20	0.33	0.45
Brown + white	2	0	0	0	0	0	0	2	100	0	0	0	0	0	0	1
White + black	7	1	14.28	3	42.82	1	14.28	0	0	1	28.57	0	0	0.35	0.28	0.35

Table 7 Distribution of genotype and gene frequencies at transferrin locus with respect to plumage colour in Yoruba ecotype chickens (YEC)

Plumage colour	No	Genotype frequency									Gene frequency					
		AA	%	AC	%	BB	%	CC	%	BC	%	AB	%	A	B	C
Brown	12	1	8.33	7	58.33	0	0.00	2	16.67	1	8.33	1	8.33	0.42	0.08	0.50
Black	4	0	0.00	2	50.00	0	0.00	2	50.00	0	0.00	0	0.00	0.25	0.00	0.75
White	2	0	0.00	1	50.00	0	0.00	0	0.00	1	50.00	0	0.00	0.25	0.25	0.50
Yellow	1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0.50	0.50	0.00
Black + brown	8	2	25.00	1	12.50	1	12.50	1	12.50	2	25.00	1	12.50	0.38	0.31	0.31
Brown+ white	5	1	20.00	1	20.00	0	0.00	2	40.00	0	0.00	1	20.00	0.40	0.10	0.50
White + black	8	1	12.50	4	50.00	1	12.50	0	0.00	2	25.00	0	0.00	0.38	0.25	0.38

Accordingly he concluded that Chicken with Tf^A appeared to have delayed sexual maturity while the chicken with Tf^B reached their sexual maturity at earlier age.

The ecotypes studied herein therefore appear to be mixture of populations as they have the potential to be both egg and meat producer if selection is based on the result of biochemical traits studies.



Plate 1 Electrophoretic separation of transferrin in Yoruba ecotype chickens (YEC)

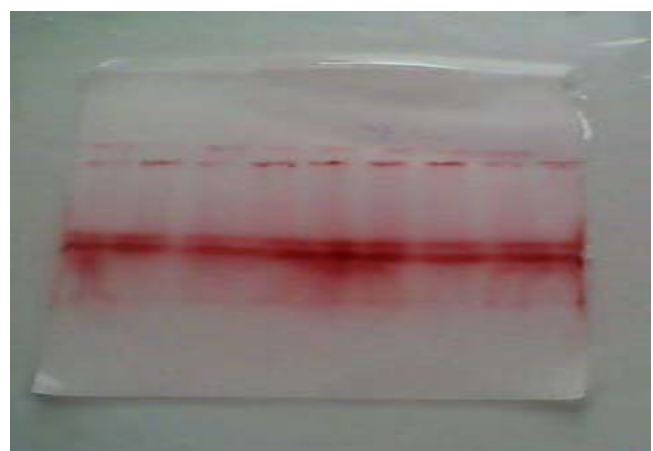


Plate 2 Electrophoretic separation of transferrin in Fulani ecotype chickens (FEC)

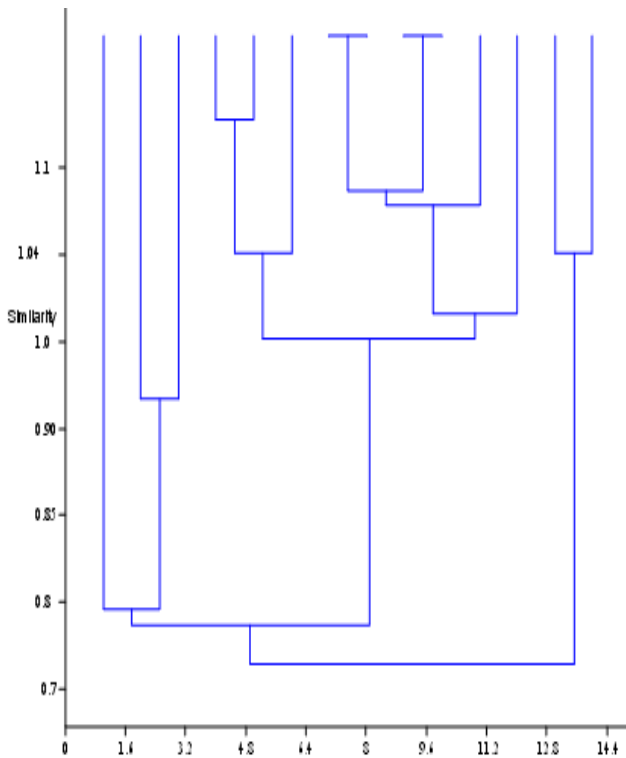


Figure 1 Dendrogram of genetic similarity of Fulani ecotype chickens (FEC) at transferrin locus

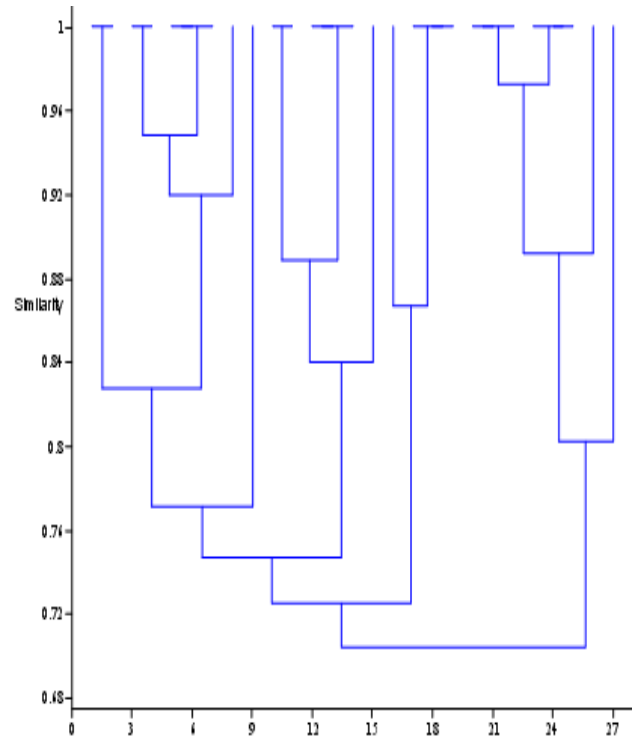


Figure 3 Dendrogram of genetic similarity between Yoruba and Fulani ecotype chickens (YEC and FEC) at transferrin locus

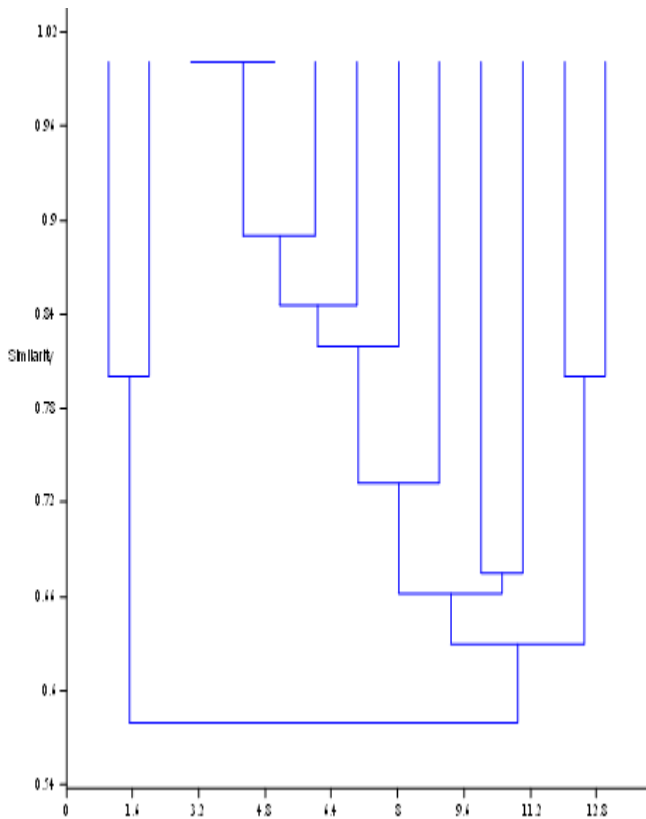


Figure 2 Dendrogram of genetic similarity of Yoruba ecotype chickens (YEC) at transferrin locus

Salako and Ige (2006) found similar observation that in the strict sense of genetic homozygosity, indigenous chickens are heterogenous at the haemoglobin locus. In this present study, low genetic variation observed between the two ecotypes as shown by the dendrogram indicated that the two ecotypes are genetically similar at transferrin locus and they are not genetically isolated from each other.

CONCLUSION

Although no obvious genetic relationship is previously established between transferrin and qualitative traits, the current study showed that their inheritance is genetically controlled and that neither plumage colour nor comb type can be used to predict the type of transferrin of individual chicken examined. Plumage colour varied widely as eight different types (Brown, Black, White, Yellow, Black and Brown, Brown and White and White and Black) existed was scored Fulani ecotype chickens (FEC) and Yoruba ecotype chickens (YEC). In addition, three type of comb (Single, Rose and Pea) were also found in the two populations. The present study demonstrates the usefulness of protein marker to characterize the two ecotypes of indigenous chicken. The information got may be useful as an initial guide in defining objectives for designing future investigations of genetic integrity and developing conservation strat-

egies for Nigeria indigenous chickens.

REFERENCES

- Ashton G.C., Culmor D.G., Kiddy C.A. and Kristjanssin F.K. (1966). Proposal in nomenclature of protein polymorphism in farm livestock. *Immunogenet. Lett.* **4**, 160-167.
- Banitez F. (2002). Reasons for the use and conservation of some local Genetic Resources in poultry. Pp. 19-23 in Proc. 7th world cong. Gen. Appl. Livest. Prod., Montpellier, France.
- Das A.K. and Deb R. (2008). Biochemical polymorphism and its relation with some traits of importance in poultry. *Vet. World.* **1(7)**, 220-222.
- Esmailkhanian S.A., Mirhady R. and Osfori P.H. (2000). Genetic polymorphism in Iranian native poultry breeds part III albumin and transferrin polymorphisms. *Act. Agra. Kapos.* **4**, 21-26.
- Horst P. (1989). Native fowls as reservoir for genomes and major gene with direct and indirect effects on adaptability and their potential for tropical oriented breeding plans. *Anim. Breed. Abst.* **53**, 13-23.
- Lee H.K., Chung C.H., Cho S.W., Na H.J., Jin H.S., Jang K.W., Lee J.Y., Han J. and Ohh B.K. (2000). Analysis of genetic characteristics of Korean native chicken using biochemical Genetic markers. *Genetics.* **115**, 78-92.
- Lush J.L. (1966). Animal Breeding Plans. Iowa State College Press, Ames, Iowa.
- Montag D.G. (1992). Use of electrophoresis to determine populations of pheasants in south Dakota. MS Thesis. South Dakota State Univ., USA.
- Ogden A.L., Morton Gilmour D.G. and Mc Dermid E.M. (1962). Inheritance variants in the transferrins and conalbumins of the chicken. *Nature.* **195**, 1026-1028.
- Okada I., Toyokawa K. and Takayasu I. (1980). Genetic relationships of some native chicken breeds in the northern Tohoku district of Japan (Japanese with English summary). *Japanese Poult. Sci.* **17**, 334-343.
- Rendel J. (1967). The blood group systems in chicken. *Anim. Breed. Abst.* **2**, 311-316.
- Riken B.R.C. (2006). Genetic Quality Monitoring by Biochemical Isozymes. Riken Bioresource Center.
- Roghgarden J.D. (1977). Patchiness in the spatial distribution of a population caused by stochastic fluctuations in resources. *Oikos.* **29**, 52-59.
- Salako A.E. and Ige A.O. (2006). Haemoglobin polymorphisms in the Nigerian Indigenous chickens. *J. Anim. Vet. Adv.* **5(11)**, 897-900.
- Stratil A. (1979). Transferin and albumun loci in chicknens, *Gallus gallus L.* *Comp. Biochem. Physiol.* **24**, 113-121.
- Tanabe S., Sugo T. and Matsuda M. (1991). Synthesis of protein C in human umbilical vein endothelia cells. *J. Biochem.* **109(6)**, 924-928.
- Vohs P.A.J. and Carr L.R. (1969). Genetic and population studies of transferrin polymorphism in Ring-necked pheasants. *Condor.* **71(4)**, 413-417.
- Yamamoto Y., Namikawa T., Okada I., Nishibori M., Mansjder S.S. and Martojo H. (1996). Genetical studies in native chickens in Indonesia. *Am. J. Appl. Sci.* **9(4)**, 405-410.