Gashua Journal of Irrigation and Desertification Studies
Available online at www.gjidsfugashua.org.ng
Maiden Edition: Vol 1, Nos. 1 & 2

GENETIC RELATIONSHIPS AMONG SERUM ALKALINE PHOSPHATASE, GROWTH AND CARCASS TRAITS IN MALE AND FEMALE BROILER LINES IN SHIKA, NIGERIA

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Abstract

This study was conducted to genetically evaluate the relationship between serum alkaline phosphatase (SAP) and carcass traits of male and female broiler lines at National Animal Production Research Institute (NAPRI),Shika, Nigeria. Data on body weight and linear body measurements, carcass traits, proximate analysis of meat samples and blood parameters were obtained from 350 progenies consisting of 100 birds each for sire and dam line and 75 birds each for sire control and dam control respectively. The carcass measurements made were breast muscle weight (Brwt), carcass weight (Carwt), thigh weight (Thwt) in gram using measuring scale and body length (Bl) using flexible tape in centimeter (cm). The blood traits measured were serum alkaline phosphatase (SAP), Total Protein (TP) and Acetylcholine esterase (Ach). There were significant ($P<0.05$) differences in body weight, linear body measurements and carcass traits of the birds which could be attributed to line effect. Serum alkaline phosphatase showed high and positive genetic correlations with body weight at 8 week (0.499) and carcass traits ranging from 0.447 – 0.925 for the dam lines and body weight at 8 week (0.412) and breast weight (0.698) for the sire lines. It was therefore concluded that line is an important source of variation in serum alkaline phosphatase, growth and carcass traits. Serum alkaline phosphatase should be used as a marker for improved growth traits and carcass traits in the development of NAPRI broilers.

Keywords: Broiler birds, carcass traits, serum alkaline phoshpatase (SAP)

INTRODUCTION

The major sources of poultry meat in Nigeria are broiler chicken, spent layers and cockerels. Broilers are specially reared for meat production because they have short turn-over rate, better feed conversion ratio, rapid growth rate and ability to utilize feedstuffs and bi-products regarded as wastes to man. Evaluation of the performance of farm animals is carried out using various indices, especially the growth and development traits as well as body linear measurements. Linear measurements of body parts have heritable basis and have been identified to play a major role in the subsequent carcass yield of an animal (Falconer, 1989). Body parts such as keel length and width, body length, shank length are dependent on one another but when observed separately tend to make some facts known and provide ability to select superior individuals (Falconer, 1989).

A significant difference in SAP and blood biochemical traits of birds could be of value to breeders for selection in early life. SAP is an important enzyme in chicken which is majorly found in bones, kidney, liver, plasma and intestinal mucosa. It helps in absorption of protein, carbohydrate and fat (Das and Deb 2008). These functions could pose significant effects on carcass traits. Therefore, this study was designed to determine the relationship between SAP, growth and carcass quality traits in male and female broiler lines at NAPRI, Shika, Zaria.

MATERIALS AND METHODS

The research was carried out at the Poultry Research Programme of National Animal Production Research Institute (NAPRI) Shika, Zaria, Kaduna State. Shika lies between latitude 11^0 12`N, longitude $7^0$ 33`E and at altitude of 640m above sea level. The area falls within the Northern Guinea Savannah having an average annual rainfall of 1100mm (Akpa and Jokthan,1996).

Experimental Birds and Management

The birds used for this study comprised of 4 groups each of sire line, dam line, sire control and dam control line from a collapsed groups of Hubbard and Anak broiler birds in National Animal production Research Institute (NAPRI). Broiler starter mash with crude protein of 24.96% and energy of 2767.62 Kcal/Kg was given to the chicks at the first four weeks while broiler finisher mash with crude protein of 23.23% and energy of 2839.64 Kcal/Kg was given at the last four weeks of age. The same type of feed was given to all the groups. Water and feed were provided *ad-libitum.* All rations were formulated and mixed at the feed mill of the Institute (NAPRI) with appropriate composition as shown in Table 1.

Six (6) birds at 9 week of age were sampled out each from the four lines making a total of 24 birds for carcass analysis. The carcass measurements made were breast muscle weight (Brwt), carcass weight (Carwt), thigh weight (Thwt) in gram using measuring scale and body length (Bl) using flexible tape in centimeter (cm). Blood samples were taken from the wing veins of the 6 birds sample from each group and stored into non anticoagulated tube for serum analysis of SAP and other blood chemistry which include TP and Ach. Methods described by Bassey *et al.* (1946), George *et al.* (1961) and Abd El Azim (2012) were adopted for the analysis of SAP, Ach and TP respectively. Data on blood growth and carcass traits were analyzed using General Linear Model procedures of SAS (2002). Significant differences among means were separated using Duncan's Multiple Range Test (Duncan, 1955). The statistical model used for growth and linear body measurements was:

$$Y_{ij} = \mu + A_i + L_j + + e_{ij}$$

Where; Y_{ijk} = Records of the given measurable traits; μ = Common means; A_i = Effects of lines; L_j= Effects of growth traits and carcass traits; e_{ij} = Random error

The genetic correlations between two traits were obtained by analysis of covariance (ANCOVA) procedure of statistical analysis system (SAS, 2002). The general formula for estimating correlation is as described by Falconer (1989).

$$r = \frac{COVxy}{\sqrt{\sigma_X^2 \sigma_Y^2}}$$

RESULTS AND DISCUSSION

The least squares means for the biochemical traits for sire line, dam line, sire control and dam control is presented in

Table 2. The values of the serum alkaline phosphatase (SAP) obtained in this study was 64.67µ/l for sire line, 63.33µ/l for dam line, 69.00µ/l for sire control and 63.17µ/l for dam control. The values for Acetylcholine esterase (Ach) ranged from 19.17 to 21.50mg/dl for all the lines. The values for total protein (TP) also ranged from 6.83 to 7.08mg/dl for all the lines. There was no significant (P>0.05) difference in all the biochemical traits observed except in the SAP. The significant difference obtained in SAP showed that there is line effect of SAP and this could pose advantage of better performance in terms of body weight. The similarities obtained in the other traits for all the lines are indications that line had no effect on these traits. The values of TP ranged from 6.83 to 7.08mg/dl and SAP ranged from 63.17 to 64.67µ/l and these disagreed with the value obtained by Abd El Azim (2012) for TP (4.60) and SAP (143), respectively. The differences could be due to breed and environmental effects.

The least squares means (±SE) of carcass traits for sire line, dam line, dam control and sire control lines are outlined in Table 3. The values obtained for carcass traits ranged from 3008.8 to 3343.2g for live weight, 77.16 to 90.33g for shank weight, 8.18 to 9.25cm for shank length and 461.33 to 516.67g for breast weight. No significant (P>0.05) differences were observed in the shank length, body length and breast weight of all the groups. Dam control showed highest and significant (P<0.05) weight of thigh (168.33g), live weight (3342g) and shank weight (90.33). The sire control showed lower weight of thigh (138.83g) than sire and dam lines which had medium weight of thigh value ranging from 153.00 to 154.50g. Dam control also showed significantly (P<0.05) highest value in thigh length (11.5cm) and thigh weight (168.33g). Both the dam line and sire control showed medium values of thigh length compared to others. The sire line showed lowest and significant (P<0.05) value of thigh length (8.75cm). The body length values for dam line (32.42cm), sire control (32.63cm), and dam control were significantly (P<0.05) higher than that of sire line (27.00cm) but were not significantly different from each other.

The non-significant (P>0.05) differences observed in the shank length, body length and breast weight of all the groups were indication that lines have no effects on these traits. Differences observed in the other traits were influenced by genetic.

Bihan-Duval *et al.*(1999) reported lower values of breast weight for selected birds (274.1g) and control birds (213.0g) than the values obtained in this study for all the lines ranging from (461.33 to 516.67g). The differences could be attributed to breed/line differences. The thigh weights obtained in this study were also considerably higher than those obtained by Elie *et al.*, (2010).There were significant differences (P<0.05) observed in some traits estimated like body length, weight of thigh, and thigh length in the lines considered in this study. This means that these traits are genetically controlled.

Table 4 showed the genetic correlations among serum alkaline phosphatase, carcass weight, 8 weeks body weight and linear body measurements of sire line and dam line. For sire line, the serum alkaline phosphatase showed a high and positive correlation with body weight at 8 weeks (0.412) and breast weight (0.698), moderate and positive with carcass weight (0.261) and low and negative with body length at 8 week (-0.140). It was also observed low and negative with thigh weight (-0.030) but high and negative (-0.515) with carcass body length. Correlations among body linear measurements and carcass traits were negative and ranged from moderate to high except for body length and body weight at 8 week (0.77), carcass weight with thigh weight (0.920), weight at 8 week with body length at carcass (0.133), carcass weight with breast weight (0.856), and thigh weight with breast weight (0.696) were positive correlations were obtained and ranged from low to high.

For dam line, serum alkaline phosphatase showed a very high and positive correlations with all the measured traits except with the body length at 8 week of age where high and negative (-0.589) were obtained. Correlations among body linear measurements and carcass traits were positive and ranged from low to very high (0.147 to 0.961) except for thigh weight with body length at 8 week (-0.301), carcass body length with weight at 8 week (-0.440), thigh weight with body length at 8 week (-0.301), carcass body length with carcass weight (-0.090) and carcass body length with breast weight (-0.349), which ranged from negatively low to negatively high.

The positive though high genetic and phenotypic correlations obtained between SAP and body growth and carcass traits in selected lines (sire and dam) implies that selection intensity contributed positively to the performance of these traits in the selected groups. These results disagreed with the results of Orunmuyi (2006) who reported that there was no consistency of genetic correlation between enzyme activities and body weight at both ages of 20 and 40 weeks in both generations. The non definite pattern of genetic and phenotypic correlations obtained between carcass traits and body linear measurements in all the groups indicated that body linear measurements could be used as predictor of carcass traits in some groups and may not be used as predictor of carcass traits in the other groups.

The high and positive correlation between alkaline phosphatase and body weight disagreed with the result of Strivastava *et al.* (2004) which showed moderate and significant correlation of alkaline phosphatase with body weight. The high and positive genetic correlations between serum alkaline phosphatase and body weight and breast weight in sire line indicates strong relationships among these traits and it means that selection using SAP could be used to improve on body weight and breast weight.

CONCLUSION

Broiler lines affected weight of thigh, thigh length, shank weight and body length. Dam control line had highest values for live weight (3343.20g), weight of thigh (168.33g), thigh length (11.50cm), and shank weight (90.33g).Serum alkaline phosphatase (SAP) had high and positive genetic correlations with thigh weight (0.925), with carcass body length (0.772), and carcass weight (585) in dam line; and SAP with breast weight (0.698) and body weight at 8 week (0.412) in sire line. Serum Alkaline Phosphatase (SAP) is therefore recommended as a marker for selection for improving growth traits and carcass traits.

Acknowledgement

The project was sponsored by National Animal Production Research Institute (NAPRI).

REFERENCES

Abd El Azim (2012). Improve Heat Tolerance of Broilers through heat treatment during the first two weeks. *Egyptian Poultry Science*. 32(3): 489-495.

Akpa, G.N., and Jokthan, G.E.,(1996). Effect of feeding and routine management in rabbit production in Zaria area of Kaduna State, Nigeria. *Agricultural System in Africa*. 6(1):60-64.

Bassey O.A., Lowry O.H., and Brock M.,(1946). A method for the rapid determination of alkaline phosphatase with five cubic millimetre of serum. *Journal of Biochemical Chemistry*, 614 : 321 – 329.

Das, A.Kr., and Deb, R., (2008). Biochemical Polymorphism and its relation with some traits of importance in poultry. *Veterinary World Journal*,1(7): 220-220.

Duncan, D.B. (1995). Multiple range and multiple F Tests. *Biometric*s 11:1-42.

Elie, K. B., Ihsan, T., Housam, S. and Ibrahim, M.(2010). Physiological and carcass traits in heat-stressed broilers differing in heat acclimatization, chemical of feed restriction treatments. *Agricultural and Biological Journal of Northern America* 1(2) : 65-74.

Falconer, D.S. (1989). *Introduction to Quantitative Genetics*, 3rd Edition. Longman Scientific and Technical London.

George, L.E.,Diane, K.C., Valentino, A. JR. and Robert, M.F. (1961). A new and rapid colorimetric determination of acetylcholinesterate activity. *Biochemical Pharmacology* 7:88-95.

Bihan-Duval L.E., Millet, N. and Remignon, H. (1999). Broiler Meat Quality: Effect of Selection for increased carcass quality and estimates of Genetic Parameters. *Poultry Science* 78:822-826.

Orunmuyi, M. (2006) Genetic evaluation of plasma alkaline phosphatase activity in two strains of rhode Island Chickens. Ph.D thesis. Department of Animal Science. Ahmadu Bello University. Pp 89-90.

SAS (2002). *Statistical analysis system multiple incorporation*. Users' Guide Statistical version Cary, NC. USA.

Strivastava, A.K., Masnide, G.,Yu, H., Baylink, A.J. and Mohan, B. (2004). Mapping quantitative traits loci that influence blood levels of alkaline phosphatase in MRL/MPJ and SJL/J mice. *Bone* 35 (5):1086-94.

Table 1: Composition of the Experimental Diets

	PERCENTAGE	
Ingredients	Broiler Starter	Broiler Finisher
Maize	45.00	52.00
Groundnut cake	30.00	30.00
Soyabean meal	15.00	10.00
Maize offal	4.60	2.50
Lime stone	3.00	1.50
Bone meal	1.50	3.00
Salt	0.30	0.30
Lysine	0.15	0.20
Methionine	0.15	0.20
Premix*	0.25	0.30
Total	100	100
Calculated analysis		
ME(Kcal/Kg)	2767.62	2839.64
Crude Protein (%)	24.96	23.23
Crude Fibre (%)	3.82	3.45
Ether Extract (%)	5.16	5.22
Methionine	0.47	0.50
Methionine + Cysteine	0.85	0.86
Lysine	1.20	1.13
Calcium	1.75	1.74
Phosphorous available	0.90	0.89

*The premix used in this study supplied the following nutrients (Kg/diet): Vit A: 20,000,00, IU Vitamin E. 500 I, thiamin (B) 2,000mg, Riboflavin (B2) 3500mg, Vit (B3) 20000mg, Panthothenic acid (B5) 6,600ml, Pyridoxine (B6) 3600mg, Vitamin (B12) 20mg, folic acid 400mg, Vitamin 20000mg, Methionine 10,000mg, antioxidant 12.5g, Ca 18%, P.Mn 8.0g, Zn ug Iodine 0.12g.

Table 2: The least squares means (±SE) of the blood biochemical traits of sire line, dam line, sire control and dam control

Traits	Sire line	Dam line	Sire control	Dam control
SAP(mg/dl)	64.67±2.830^{b}	63.33±2.830^{b}	69.00±2.830^{a}	63.17±2.830^{b}
Ach(mg/dl)	21.50±1.600	20.83±1.610	21.33±1.600	19.17±1.610
TP(mg/dl)	7.05±0.880	6.83±0.880	7.08±0.880	6.92±0.880

^{a,b,c} = Means with the same superscript within the same row for a particular parameter are not significantly (P>0.05) different.

SAP=Serum Alkaline phosphatase, Ach=Acetylcholine esterase, TP=Total Protein,

Table 3: The least squares means (±SE) of the carcass traits for sire line, dam line, sire control and dam control

Carcass traits	Sire line	Dam line	Sire control	Dam control	SEM
Live weight (g)	3008^{b}	3322^{a}	3180.5^{ab}	3343.2^{a}	146.18
Carcass weight (g)	2089.5^{a}	2077.2^{a}	2218.2^{a}	2259.5^{a}	111.92
Weight of thigh (g)	154.5^{ab}	153.00^{ab}	138.83^{b}	168.33^{a}	8.50
Thigh length (cm)	8.75^{b}	10.917^{ab}	11.13^{ab}	11.50^{a}	0.82
Shank weight (g)	77.16^{b}	77.83^{b}	74.17^{b}	90.33^{a}	5.40
Shank length (cm)	8.18^{a}	8.92^{a}	9.25^{a}	9.25^{a}	1.33
Body length (cm)	27.00^{b}	32.417^{a}	32.633^{a}	34.58^{a}	3.41
Breast weight (g)	461.33^{a}	486.83^{a}	511.33^{a}	516.67^{a}	34.13

^{a,b,c} = Means with different superscript within the same row for a particular parameter are significantly (P<0.05) different.

SEM=Standard Error of Means

Table 4: Genetic correlations among serum alkaline phosphatase, carcass weight, 8 week body weight and body linear measurements of sire line (above diagonal) and dam line (below diagonal)

	SAP	Wt8wk	Bl8wk	Carwt	Thwt	Brwt	Bl
SAP		0.412	-0.140	-0.261	-0.030	0.698	-0.515
Wt8wk	0.499		0.770	-0.617	0.782	-0.313	0.133
Bl8wk	-0.589	0.400		-0.449	-0.544	-0.547	0.068
Carwt	0.585	0.915	0.147		0.920	0.856	-0.661
Thwt	0.925	0.500	-0.301	0.399		0.696	-0.322
Brwt	0.447	0.961	0.365	0.978	0.333		-0.640
Bl	0.772	-0.440	-	-0.090	0.424	-0.349	

SAP=Serum alkaline phosphatase, Wt8wk=body weight at 8 week, Bl8wk=Body length at 8 week, Carwt=Carcass weight, Thwt=Thigh weight, Brwt=Breast weight, Bl=Body length