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Original Article

Estimates of Crossbreeding Parameters for Growth Traits in Crosses between Nigerian Indigenous and Exotic Chickens

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ABSTRACT

The aim of this study was to estimate crossbreeding parameters namely direct additive, maternal additive and direct heterosis for bodyweight and weight gain of crosses between Nigerian indigenous (NIC) and two inbred lines of exotic chickens namely pure white (PW) and pure black (PBL). The NIC was divided into two replicate groups namely NIC_1 and NIC_2. The inbred lines were derived from the within strain mating of two commercial strains of egg type chickens namely H and N Brown Nick and Black Olympia. Estimates of direct additive and their percentages were high and highly significant (p<0.01) in PW, NIC_1 and their crosses at 4-20 weeks of age and at 4, 12-20 weeks of age in PBL, NIC_2 and their crosses. Similarly, estimates of direct additive for weight gain were significant (p<0.05) at 0-8 weeks of age for PW, NIC_1 and their crosses and at 0-4, 8-12 weeks of age in PBL, NIC_2 and their crosses. While estimates of maternal additive were positive and significant for bodyweight at 0-4 weeks and weight gain at 0-4 and 12-16 weeks of age in PBL, NIC_2 and their crosses, the estimates were not significant for bodyweight and weight gain in PW, NIC_1 and their crosses. The estimates of direct heterosis and its percentage for bodyweight and weight gain were significant in both crosses. The study concluded that significant improvement in the bodyweight and weight gain of the NIC could be obtained by crossing with the exotic lines.

Keywords: Crossbreeding, direct additive, direct heterosis, direct maternal, inbred lines.

INTRODUCTION

The NIC are known to be inferior to the exotic types in growth and egg production characteristics. However, it has some good genetic attributes. Some of the genetic attributes of the NIC includes resistance to some endemic diseases, early age at sexual maturity, low feed consumption, low pause and clutch numbers (Omeje, 1989). Improvement of the NIC involves two main strategies namely selection within breed and crossbreeding with improved exotic chickens. Selection within breed exploits additive genetic variation while crossbreeding takes advantage of non-additive genetic effects (Kinghorn, 1987). It is generally believed that crossbreeding gives a faster response to improvement compared to selection within breed. However, response from selection is permanent. Heterosis and breed complementarities are the primary benefits that producers realize from a properly designed crossbreeding program. Crossbreeding works involving NIC and exotic types have been reported by a number of authors (Omeje and Nwosu, 1988; Udeh and Omeje, 2002; 2005). Most of these studies reported positive improvement in the bodyweight and egg production of the NIC through crossbreeding. Estimates of crossbreeding parameters for growth traits such as direct additive and maternal additive have not been provided in the crosses between NIC and exotic chickens. Therefore, the objective of this study was to estimate direct additive, maternal additive and direct heterosis for bodyweight and weight gain of the crosses between NIC and exotic chickens.

MATERIALS AND METHODS

The study was conducted at the poultry unit of the teaching and research farm, Enugu State University of Technology, Enugu.

The Experimental Birds

This comprised two inbred lines of exotic chickens described by their plumage colour as pure white (PW) and pure black (PBL) and two replicate groups of Nigerian indigenous chickens (NIC_1 and NIC_2). The exotic inbred lines were produced from within strain mating of two commercial strains of egg type chickens namely H and N Brown Nick and Black Olympia while the inbred lines of the indigenous were produced through within breed mating of NIC. The inbred lines were hatched at the same time and brooded separately in floor pens.

Crossbreeding Procedure

Mating was done at 28 weeks of age when 4 cocks and 40 hens each of PW and PBL were reciprocally mated to 4 cocks and 40 hens each of the replicate groups (NIC_1 and NIC_2) of NIC to produce four F_1 crossbred groups with a total of 450 chicks. Mating was random in floor pens with a mating ratio of 1 cock to 10 hens (Udeh and Omeje, 2005).

Management of the Stocks

The management of birds conformed to standard management procedures described by Oluyemi and Roberts (1979). The chicks from each group were brooded in separate brooding pens. They were fed *ad libitum* for 8 weeks with a chick starter diet that contains 20% CP and 2685 Kcal ME/Kg. From 8-18 weeks of age, the birds were provided with *ad libitum* growers mash containing 2642 Kcal ME/Kg and 16% CP. However, from 18 weeks to the end of egg production in the short term (40 weeks), they were provided *ad libitum* layers mash containing 2676 Kcal ME/Kg, 17% CP and about 3.00% calcium. Clean drinking water was also made available all the time. All necessary vaccinations were given to the birds at the appropriate ages. Occasionally, vitamin supplement was administered to enhance productivity.

Data Collection and Analysis

Bodyweight of each chick was recorded at hatch and subsequently at 4 weekly bases to 20 weeks of age. Weight gain of each chick was also recorded at 4 weekly bases from hatch to 20 weeks. The data collected for each age period were analysed using one way analysis of variance in a completely randomized design with breeding group as the main source of variation. Estimates of direct additive genetic, maternal additive and direct heterosis were calculated using the methods of Dickerson (1992) stated as follows:

Direct additive (G^I): {[PW×PW-NIC_1×NIC_1]-[NIC_1×PW-PW×NIC_1]},{[PBL×PBL-NIC_2×NIC_2]- [NIC_2×PBL-PBL×NIC_2]}

Maternal additive (G^M): {[NIC_1×PW]-[PW×NIC_1]}, {[NIC_2×PBL]-[PBL×NIC_2]}

Direct heterosis (H^I): $\{[PW \times NIC_1 + NIC_1 \times PW] - [PW \times PW + NIC_1 \times NIC_1]\}$, $\{[PBL \times NIC_2 + NIC_2 \times PBL] - [PBL \times PBL + NIC_2 \times NIC_2]\}$.

The significance of each effect was tested using student's t-test (Iraqi *et al*., 2002).

RESULTS

Means and standard errors for bodyweight and weight gain of the PW, NIC_1 and their crosses are shown in Table 1. Hatch weights of the crossbred groups were influenced by the hatch weight of purebred dams. The NIC_1 was consistently inferior to the PW and crossbred groups in bodyweight from 4 – 20 weeks of age. The bodyweight of PW was consistently similar to those of NIC_1×PW. This shows that the bodyweight of NIC_1×PW was consistently influenced by dominant genes from the PW. The bodyweight of the two reciprocal crossbred groups were statistically similar from 4-20 weeks of age.

Table 1: Mean and standard error for bodyweight and weight gain of pure white (PW), indigenou chicken (NIC_1) and their crosses (g)

Age (weeks)	PW	NIC_1	PW × NIC_1	NIC_1 × PW
Bodyweight				
Hatch	36.23 ± 0.49^b	24.38 ± 0.35^a	25.46 ± 0.34^a	33.32 ± 0.61^b
4	174.55 ± 4.27^c	97.03 ± 1.94^a	145.10 ± 4.60^b	160.40 ± 6.83^{bc}
8	331.18 ± 12.37^b	205.99 ± 2.01^a	329.45 ± 8.79^b	335.77 ± 15.97^b
12	643.13 ± 22.11^b	406.88 ± 7.30^a	657.00 ± 17.89^b	634.84 ± 18.90^b
16	925.00 ± 15.05^b	504.38 ± 11.99^a	887.50 ± 27.78^b	882.78 ± 29.72^b
20	1185.00 ± 39.72^c	732.50 ± 14.16^a	1098.90 ± 8.27^b	1170.85 ± 33.52^{bc}
Weight gain				
0 - 4	132.90 ± 4.61^b	73.03 ± 2.33^a	120.43 ± 4.99^b	126.06 ± 7.93^b
4 - 8	160.87 ± 13.71^b	108.67 ± 3.33^a	183.50 ± 9.77^b	177.68 ± 17.75^b
8 - 12	311.63 ± 32.58^b	201.89 ± 8.12^a	322.57 ± 18.85^b	299.33 ± 23.63^b
12 - 16	281.87 ± 24.67^b	97.50 ± 12.52^a	230.50 ± 29.02^b	248.38 ± 37.61^b
16 - 20	260.00 ± 42.09	231.12 ± 16.92	211.40 ± 25.60	288.07 ± 25.26

Mean values along the same row not superscripted with the same letters are significantly different (p<0.05).

The NIC_1 was also inferior to the PW and the reciprocal crosses in weight gain from 0-16 weeks of age. The weight gain of the PW was consistently similar to those of the reciprocal crosses (PW×NIC_1 and NIC_1×PW) from 0-16 weeks of age. There was no significant (p>0.05) difference among PW, NIC_1 and their crossbred groups in weight gain at 16-20 weeks of age. Table 2 presents the means and standard errors for bodyweight of PBL, NIC_2 and their crossbred groups. Hatch weights of the crossbred groups were also influence by the hatch weight of the pure bred dams.

Table 2: Mean and standard error for bodyweight and weight gain of pure black (PBL), indigenous chicken (NIC_2) and their crosses (g)

Age (weeks)	PBL	NIC_2	PBL × NIC_2	NIC_2 × PBL
Bodyweight				
Hatch	37.17 ± 0.43^b	24.67 ± 0.25^a	25.90 ± 0.69^a	35.96 ± 0.57^b
4	193.47 ± 3.85^c	93.78 ± 1.86^a	143.13 ± 3.40^b	188.41 ± 5.87^c
8	302.94 ± 10.01^b	199.10 ± 3.29^a	300.17 ± 14.21^b	366.23 ± 16.03^c
12	737.73 ± 16.66^c	406.88 ± 7.30^a	753.00 ± 7.68^c	661.19 ± 17.36^b
16	1046.36 ± 17.61^d	470.63 ± 8.90^a	827.14 ± 9.95^b	883.75 ± 17.56^c
20	1370.00 ± 39.14^d	739.38 ± 11.23^a	1101.00 ± 23.30^b	1211.00 ± 28.32^c
Weight gain				
0 - 4	156.29 ± 4.13^c	69.09 ± 2.20^a	117.23 ± 3.95^b	152.93 ± 5.54^c
4 - 8	109.48 ± 10.77^a	105.34 ± 3.73^a	157.03 ± 15.25^b	194.96 ± 15.60^b
8 - 12	432.08 ± 17.41^c	205.90 ± 4.86^a	452.83 ± 15.76^c	361.44 ± 24.62^b
12 - 16	308.63 ± 28.24^c	66.63 ± 9.50^a	74.14 ± 10.16^a	217.74 ± 18.69^b
16 - 20	323.64 ± 33.76	268.75 ± 12.67	273.86 ± 23.32	302.04 ± 27.65

Mean values along the same row with differing superscript letters are significantly different (p<0.05).

The influence of the PBL dam on bodyweight of NIC_2×PBL was extended to 4 weeks of age. The NIC_2 was also consistently inferior to PBL and the crossbred groups in bodyweight from 4-20 weeks of age. The NIC_2×PBL recorded the highest bodyweight at 8 weeks while both PBL and PBL×NIC_2 recorded the highest bodyweight at 12 weeks of age. PBL recorded the highest bodyweight at 16 and 20 weeks of age followed by NIC_2×PBL, PBL×NIC_2 and NIC_2 in that order. Significant ($p<0.05$) differences were also observed among the weight gain of the pure and crossbred groups from 0-20 weeks of age.

The weight gain of NIC_2×PBL at 0-4 weeks was influenced by that of PBL. However, from 8-16 weeks, PBL exhibited higher weight gain than PBL×NIC_2 and NIC_2×PBL. NIC_2 was the most inferior in terms of weight gain at 0-4 weeks and 8-12 weeks of age compared to PBL, PBL×NIC_2 and NIC_2×PBL. Estimates of direct additive, maternal additive and direct heterosis and their percentages for bodyweight and weight gain of PW, NIC_1 and their crosses are given in Table 3.

Table 3: Estimates of direct additive, maternal additive and direct heterosis with their percentages for bodyweight and weight gain of PW, NIC_1 and their crosses

Age (weeks)	Direct additive	%	Maternal additive	%	Direct heterosis	%
Bodyweight						
Hatch	1.96±1.08^{NS}	6.47	3.84±0.80**	12.67	-0.77±1.22^{NS}	-2.54
4	29.11±9.78**	21.44	6.66±9.74^{NS}	4.90	19.51±7.88*	14.37
8	62.44±26.50**	23.25	0.32±20.69^{NS}	0.12	66.00±24.78*	24.57
12	128.93±32.63**	24.56	-11.30±23.63^{NS}	-2.15	120.20±37.09**	22.89
16	212.67±46.50**	29.76	-2.36±40.98^{NS}	-0.33	170.45±44.98**	23.85
20	190.28±52.11**	19.85	35.98±34.90^{NS}	3.75	176.13±47.87**	18.37
Weight gain						
0 - 4	27.13±9.91*	26.35	2.81±9.94^{NS}	2.73	20.29±8.09*	19.71
4 - 8	30.67±13.17*	22.76	-2.72±11.63^{NS}	-2.02	44.81±11.54**	33.25
8 - 12	66.49±46.58^{NS}	25.90	-11.62±30.17^{NS}	-4.53	54.19±45.92^{NS}	21.11
12 - 16	83.25±49.92^{NS}	43.89	8.94±44.88^{NS}	4.71	49.76±58.16^{NS}	26.24
16 - 20	-23.70±57.24^{NS}	-9.73	38.34±31.90^{NS}	15.61	4.18±68.29^{NS}	1.70

*P<0.05 **P<0.01 NS=Not significant.

The estimates of direct additive for bodyweight were high and highly significant ($p<0.01$) from 4-20 weeks of age. The estimates increased from 0-16 weeks of age before declining to 20 weeks. Estimates of direct additive for weight gain of PW, NIC_1 and their crosses were significant during the period of 0-4 weeks and 4-8 weeks of age. The estimates also followed the same trend with bodyweight as it increases from 0-16 weeks before declining to 20 weeks. Estimates of maternal additive were not significant ($p>0.05$) for bodyweight (4-20 weeks) and weight gain (0-20 weeks). Estimates of direct heterosis and its percentages were positive and significant for bodyweight (4-20 weeks) and weight gain (0-8 weeks). The direct heterosis for bodyweight showed a steady increase from day old to 20 weeks of age.

Table 4: Estimates of direct additive, maternal additive and direct heterosis and their percentages for bodyweight and weight gain of PBL, NIC_2 and their crosses

Age (weeks)	Direct additive	%	Maternal additive	%	Direct heterosis	%
Bodyweight						
Hatch	1.46±1.38^{NS}	4.72	4.79±1.15**	15.49	-0.24±1.11NS	-0.78
4	27.21±8.53**	18.94	22.64±7.30**	15.76	22.15±7.43**	15.42
8	18.89±24.92^{NS}	7.53	33.03±23.45^{NS}	13.16	82.18±22.86**	32.74
12	212.27±30.75**	37.09	-45.91±28.37^{NS}	-8.02	135.73±28.71**	23.72
16	259.56±29.44**	34.22	28.30±21.31^{NS}	3.73	96.95±36.66**	12.78
20	260.31±45.07**	24.68	55.00±28.48^{NS}	5.21	101.31±63.97^{NS}	9.61
Weight gain						
0 - 4	25.75±8.57**	22.85	17.85±7.49*	15.84	22.39±7.28**	19.87
4 - 8	16.90±28.53^{NS}	15.73	18.96±26.33^{NS}	17.65	68.59±23.25**	63.86
8 - 12	159.42±32.94**	49.98	-45.68±30.46^{NS}	-14.32	88.48±29.42**	27.74
12 - 16	47.47±39.90^{NS}	25.42	73.53±28.37*	39.38	-38.60±36.22^{NS}	-20.67
16 - 20	13.25±61.10^{NS}	4.47	14.20±44.29^{NS}	4.79	-8.14±56.41^{NS}	-2.75

*P<0.05 **P<0.01 NS=Not significant

Table 4 presents the estimates of direct additive, maternal additive and direct heterosis and their percentages for bodyweight and weight gain of PBL, NIC_2 and their crosses. The estimates of direct additive for bodyweights were positive and showed a steady increase from hatch to 20 weeks of age. The estimates were highly significant ($p<0.01$) at 4 weeks and from 12-20 weeks for bodyweight and at 0-4 and 8-12 weeks for weight gain. The estimates of maternal additive were highly significant ($p<0.01$) for bodyweight at hatch and at 4 weeks of age and significant ($p<0.05$) for weight gain at 0-4 and 12-16 weeks of age. The estimates of direct heterosis were significant ($p<0.05$, 0.01) for bodyweight from 4-16 weeks and weight gain from 0-12 weeks of age.

DISCUSSION

The hatch weights of the crossbred groups were influenced by the hatch weight of pure bred dams in both crosses. Prodfoot and Hulan (1981), Tullet and Burtan (1982) and Ayorinde *et al*., (1994) reported that hatch weight and bodyweight at 4 and 8 weeks were influenced by dam's eggsize. Similar observation was reported by Abiola *et al*., (2008) and Alabi *et al*., (2012). The NIC_1 and NIC_2 were consistently inferior to the exotic (PW and PBL) and the crossbred groups in bodyweight at 4-20 weeks and weight gain at 0-16 weeks. Previous research efforts identified the local chicken inferior in growth characteristics compared with the exotic strains (Obioha, 1982; Nwosu and Omeje, 1984; Nwosu, 1987). The highly significant estimates of direct additive observed for bodyweight and weight gain in both crosses imply that PW and PBL sires transmitted favourable genes to the inheritance of bodyweight and weight gain in the crossbred groups. This suggests that the exotic sires (PW and PBL) could be effectively used for the improvement of body size in the local chicken. Lalev *et al.,* (2014) reported positive and highly significant ($p<0.01$) estimates of direct additive effects in crosses between two White Plymouth Rock lines (L and K) that ranged from 4.89 to 15.23%. Similarly, Iraqi *et al*., (2002) reported high direct additive effect of genes on growth traits of crosses between Mandarah (MN) and Matrouh (MA) strains of Egyptian local chickens that ranged from 2.17 to 10.63%. The authors suggested that MN strain could be used as a sire breed to get chicks with heavier bodyweight. While estimates of maternal additive were positive and highly significant ($p<0.01$) for bodyweight at hatch and at 4 weeks and weight gain at 0-4 and 12-16 weeks in PBL, NIC_2 and their crosses, it was not significant ($p>0.05$) for bodyweight and weight gain in PW, NIC_1 and their crossbred groups. This implies that using NIC_2 as a dam in crosses with PBL was advantageous in the improvement of growth traits in the local chicken while it was not so in using NIC_1 as a dam line in crosses with PW. Iraqi *et al*., (2002) reported negative and highly significant ($p<0.01$) maternal additive effects for growth traits which was in favour of Matrouh dam. Similarly, Bothaina *et al*., (2014) reported positive and highly significant ($p<0.01$) maternal additive effect of daily gain of crosses between Rhode Island Red (RIR) and Gimmizah (GIM). Estimates of direct heterosis and its percentages were significant ($p<0.05$, 0.01) for bodyweight and weight gain in both crosses. This implies that positive improvement in bodyweight of the local chicken could be obtained by crossing with the exotic lines (PW and PBL). Similar observation was reported by Omeje and Nwosu (1986) and Udeh and Omeje (2002).

CONCLUSION AND RECOMMENDATION

The most important conclusion drawn from this study were as follows:

1: Estimates of direct additive for bodyweight and weight gain were significant in both crosses implying that the exotic sires could be used for the improvement of growth traits in NIC.

2: Estimates of maternal additive were significant for bodyweight and weight gain only in PBL, NIC_2 and their crosses.

3: Estimates of direct heterosis for bodyweight and weight gain were significant in both crosses thus implying that improvement of bodyweight and weight gain of the NIC could be obtained by crossbreeding with exotic lines. Therefore, it is recommended that crossbreeding is a very effective tool for the improvement of growth traits in NIC.

REFERENCES

Abiola, S. S., Meshioye, B. O., Oyerinde, B. O., and Bamgbosa. M. A. (2008). Effects of egg size on hatchability of broiler chicks. *Arch. Zootec*., 57 (217): 83 – 86.

Alabi, O. J., Ng'ambi, J. W., Norris, D., and Madelebele, M. (2012). Effect of egg weights on hatchability and subsequent performance of Potchefstroom Koekoek chicks. *Asian J Anim. and Vet. Advances*, 7: 718 - 725.

Ayorinde, K. L., Atteh, J. O., and Joseph, K. J. (1994). Pre- and post-hatch growth of Nigerian indigenous guinea fowl as influenced by egg size and hatch weight. *Nig. J. Anim. Prod*., 21: 59 – 65.

Bothaina, Y., Mahmoud, F., and Ensaf El-Full, A. (2014). Crossbreeding components for daily gain and growth rate traits in crossing of Rhode Island Red with Gimmizah chickens. *Egypt. Poult. Sci*., 1 (34): 151 – 163.

Iraqi, M. M., Hanafi, M. S., Khalil, M. S., El-Labban, A. F. M., and Ell-Sisy, M. (2002). Genetic evaluation of growth traits in a crossbreeding experiment involving two local strains of chicken using multi-trait animal model. *Livestock Research for Rural Development*, 14 (5): 1 – 9. http://www.cipav.org.co/lrrd/lrrd14/5/iraq145tmp.htm.

Kinghorn, B. P. (1987). Crossbreeding in domestic animals. *Proceedings of the Australian association of Animal Breeding and Genetics*. 6: 112 – 123.

Lalev, M., Mincheva, N., Oblakova, M., Hristakieva, P., and Ivanova, I. (2014). Estimation of heterosis, direct and maternal additive effects from crossbreeding experiment involving two White Plymouth Rock lines of chickens. *Biotechnology in Animal Husbandry*, 30 (1): 103 – 114.

Nwosu, C. C. (1987). Is the local chicken essential or non-essential? Invited paper, poultry farmer's workshop. Agric. Ext. and Res. Liason Service, ABU Zaria. Dec. 8-9: 1987.

Nwosu, C. C., and Omeje, S. I. (1984). Improved annual egg production from Nigerian local chicken by Gold Link F1 cross progeny. *Xviii world's poultry congress*, Helsinki, pp: 8 – 12.

Obioha, F. C. (1982). A guide to poultry production in the tropics. ACENA Publishers.

Oluyemi, J. A., and Roberts, F. A. (1979). Poultry production in warm wet climates. Macmillan publishers Ltd. London and Basingtoke, UK.

Omeje, S. I. (1989). Development of the Nigerian chicken for improved production. A new approach. Invited paper. Agric. Symp. Professors World Peace Academy, Ibadan, Nigeria. 18th Dec. 1989.

Omeje, S. I., and Nwosu, C. C. (1986). Further explanation of the genetic basis of bodyweight heterosis in local by Gold link chicken crosses. In Animal Production in Nigeria. *Nigerian Society for Animal Prod. Zaria*. pp: 41 – 46.

Omeje, S.I., and Nwosu, C. C. (1988). Utilization of the Nigerian chicken in poultry breeding. Assessment of heterosis in growth and egg production. *J. Anim. Breed and Genetics*. 105: 417 – 425.

Prodfoot, F. G., and Hulam, H. W. (1981). The influence of hatching egg size on the subsequent performance of broiler chicken. *Poultry Sci*., 60: 2167 – 2170.

Tullet, S. G., and Burton, F. G. (1982). Factors affecting the weight and water status of the chick at hatch. *Brit. Poult. Sci*. 23 (4): 361 – 369.

Udeh, I., and Omeje, S. I. (2002). Heterosis for bodyweight in native and exotic inbred chicken crosses. *Trop. J. Anim. Sci*., 4 (1): 1 – 14.

Udeh, I., and Omeje, S. I. (2005). Heterosis for egg production in native by exotic inbred chicken crosses. *Nig. J. Anim. Prod*. 32 (1): 7 – 20.