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WITHIN POPULATION VARIATION IN PERFORMANCE TRAITS IN THE NIGERIAN INDIGENOUS CHICKEN (NIC)

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ABSTRACT
The within population variation in growth performance (body weight, BW and body weight gain, BWG), fed intake (FI) and feed conversion ratio (FCR) in the NIC was investigated using body weight lines (high and low lines) created from purebred progenies of five (5) sire families established from a base population of unselected random breeding NIC. Results indicate that BW differed significantly ($P \leq 0.05$) between lines within sire groups with the high lines surpassing their low line counterparts across the entire age periods. FI, BWG and FCR did not differ much between lines within sires, but overall mean was significantly higher for the high line for these traits at most of the age periods. Across sire groups and age periods, individuals belonging to the same BW line were less varied in all the traits studied. The bivariate correlation matrix for pairs of traits within and between age periods showed that BW for various age periods were positively significantly ($P \leq 0.05$) correlated with each other (range; 0.50 to 0.94). BW and BWG were also mostly significantly ($P \leq 0.05$) positively corrected (range 0.06 to 0.98). FI and FCR were mostly significantly($P \leq 0.05$) positively correlated within age periods (range 0.14 to 0.50) but mostly negatively correlated between age periods (range; -0.01 to -0.24). BW was mostly significantly ($P \leq 0.05$) negatively correlated with FCR within and across age periods whereas BWG and FCR were mostly significantly ($P \leq 0.05$) negatively correlated. It is inferred that lines genetically different in growth potentials could be established from random populations of NIC and such variations are raw materials for the genetic improvement of the NIC. Again, the positive correlation between BW and BWG and BW and feed efficiency means that improvement in one trait will bring about correlated improvement in the others.

KEYWORDS: Body Weight, Body Weight Gain, Feed Intake, Feed Conversion Ratio

INTRODUCTION

Most experimental evaluation of NIC populations for performance traits (BW, BWG, FI and FCR etc) often do not highlight the wide variation (differences) among individuals in these traits. Unselected or unimproved populations of NIC are characterized by considerable genetic variation in productive (metric) traits owing to genetic and ecological diversity (Mathur and Horst, 1990; Ajayi and Agaviezo, 2009; Adebambo 2005) as well as the extensive husbandry and interregional marketing systems which bring ecotypes together (Ogbu, 2010). Experts unanimously agree that these variations are useful for the genetic improvement of NIC populations in these traits (Sonaiya *et al.*, 1998; Ajayi and Agaviezo, 2009; Ajayi, 2010; Ogbu and Nwosu, 2010,).

Flock rearing of chickens of the same age is meant to achieve a population uniform (similar) in body weight values or growth potentials for easy management and to minimize cannibalism. For the vastly improved (exotic) chickens, this is often achieved by housing birds of the same age and differences in growth performance among individuals of the same age are usually minimal. For the unimproved NIC, birds of the same age vary widely in growth potentials. This, in addition to the expression of social dominance lead to intense cannibalization through various forms of pecking and this often discourages the keeping of groups of indigenous chickens in confinement.

Separating NIC populations into subpopulations containing chicks of similar growth potentials will greatly enhance management, reduce cannibalism and the attendant losses, improve feed utilization efficiency, body weight gain and general well being of the birds. Progenies of unselected populations of NIC from any of the agro-ecological zones of Nigeria normally contain individuals that differ widely in growth potentials (Momoh and Nwosu, 2008; Olawumi et al., 2008; Ogbu and Omeje, 2010) and such populations can be separated into body weight lines by choosing an appropriate point of truncation. For effectiveness, such separation should be done within the accelerating phase of growth when the genetic potentials for growth have not been exhausted.

The effect of such management practices and the persistence of within population variation in growth performance, feed intake and feed conversion ratio were investigated using chicks generated from five (5) sire families created from an unselected and random breeding NIC population

MATERIALS AND METHODS

Adult, live, sex-independent, disease-free *P. lanceolatus* were collected from the local markets of South 24 Parganas and Two hundred and fifty (250) day – old chicks (G_1 generation) – purebred progenies of five (5) sire families established from a base population (G_0 generation) of unselected, random breeding NIC were the experimental materials. The birds were brooded according to sire groups from hatch to 4[th] week of age. The birds were then weighed to obtain their 4 weeks body weight and mean body weight value for each sire family. For each sire family, birds 20g above the mean body weight value were grouped together as high body weight line (HBWL) or high line (L_1) while those 20g below the

reference value were grouped together as low body weight line (LBWL) or low line (L_2). Birds that did not fall within these body weight categories were excluded from the study.

Birds belonging to each body weight line were reared separately from 4 weeks to 20 weeks of age and were evaluated for growth performance (BW, BWG), feed intake (FI) and feed conversion ratio (FCR). Males and females were reared together because of the inability to accurately sex the birds at this age. All birds were fed on the same standard ration of chicks mash (18% CP, 2800KcalME/kg) from hatch to 8 weeks, growers mash (15% CP, 2670 KcalME/kg) from 9 weeks to 20 weeks and layers mash (16.5% CP, 2650 KcalME/kg) from onset of egg production. All birds shared the same environment and as much as was possible, similar management attention were given to birds belonging to each body weight line.

Data Analysis:

Data on body weight (BW), feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) for body weight lines were subjected to analysis of variance (ANOVA) to test for line effect on the traits using the SPSS (13.0) statistical package (SPSS 2001). The statistical model is

$$Y_{ij} = \mu + L_i + e_{ij}$$

Where,

Y_{ij} = observation on an individual

μ = overall mean

L_i = line effect

e_{ij} = residual

Significant means were separated using the Duncan option of SPSS.

RESULTS AND DISCUSSION

Table 1 presents the mean body weight values for lines within sire families.

Table 1: Mean ± S.E for body weight (g) for G_1 lines at specific age periods (4 – 20 weeks)

	S_1		S_2		S_3		S_4		S_5	
Age (wk)	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
4	179.41 ± 1.90^{b}	156.57 ± 2.44^{e}	184.56 ± 2.00^{ab}	155.39 ± 4.12^{e}	169.55 ± 1.41^{cd}	151.63 ± 2.01^{e}	186.57 ± 1.59^{a}	165.28 ± 2.07^{d}	172.69 ± 1.42^{c}	142.14 ± 4.12^{f}
8	371.58 ± 6.40^{a}	312.76 ± 7.69^{c}	374.47 ± 7.22^{a}	317.63 ± 9.81^{c}	342.76 ± 8.78^{b}	312.29 ± 7.26^{c}	371.02 ± 7.43^{a}	312.55 ± 4.51^{c}	349.23 ± 6.21^{b}	303.82 ± 7.11^{c}
12	706.56 ± 10.51^{a}	658.24 ± 13.84^{bc}	689.33 ± 11.31^{ab}	609.21 ± 17.11^{def}	661.25 ± 8.98^{bc}	594.72 ± 11.63^{ef}	701.14 ± 10.93^{a}	628.35 ± 2.30^{cde}	640.00 ± 9.17^{cd}	585.33 ± 15.55^{f}
16	842.63 ± 9.20^{a}	767.94 ± 13.78^{b}	849.33 ± 10.23^{a}	768.33 ± 15.50^{b}	788.25 ± 10.81^{b}	728.41 ± 13.17^{cd}	849.77 ± 11.07^{a}	755.00 ± 12.75^{bc}	773.85 ± 9.34^{b}	694.93 ± 15.63^{d}
20	1000.56 ± 8.88^{a}	878.67 ± 14.88^{bc}	1004.67 ± 15.82^{a}	897.00 ± 12.36^{b}	896.75 ± 12.13^{b}	12.13 ± 13.26^{c}	1022.38 ± 12.74^{a}	898.74 ± 13.76^{b}	896.92 ± 10.40^{b}	807.67 ± 8.75^{d}

[abcdef]: Means on the same row with different superscripts are significantly different ($P \leq 0.05$) L_1 = high body weight line (HBWL); L_2 = low body weight line (LBWL); S_1; …; S_5 = sire families, 1, …, 5.

The high lines (L_1) significantly ($P \leq 0.05$) surpassed the low lines in BW across the entire age periods indicating that the separation into BW lines at 4 weeks of age was effective in separating birds of different genetic potentials for growth.

Table 2 presents the feed intake (FI) values for the body weight lines.

Table 2: Mean ± S.E for feed intake (g/bird/day) for G_1 lines at different age periods (4 – 20 weeks)

	S_1		S_2		S_3		S_4		S_5	
Age (wk)	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
4	19.63 ± 0.52^{b}	16.99 ± 0.60^{c}	21.84 ± 0.50^{a}	19.94 ± 0.53^{ab}	21.07 ± 0.68^{ab}	19.99 ± 0.56^{ab}	20.53 ± 0.83^{ab}	19.43 ± 0.52^{b}	20.81 ± 0.83^{ab}	19.21 ± 0.51^{b}
8	38.07 ± 1.11^{b}	36.46 ± 0.76^{b}	41.11 ± 1.42^{a}	33.29 ± 0.79^{c}	41.50 ± 1.03^{a}	37.54 ± 0.78^{b}	37.23 ± 0.93^{b}	36.83 ± 0.78^{b}	39.22 ± 1.19^{ab}	36.14 ± 0.44^{b}
12	63.01 ± 1.19^{abcd}	64.06 ± 1.62^{abc}	66.62 ± 0.94^{a}	60.38 ± 1.28^{cd}	65.87 ± 0.83^{ab}	61.32 ± 1.70^{cd}	66.30 ± 1.30^{ab}	62.03 ± 1.78^{bcd}	64.85 ± 1.30^{abc}	59.28 ± 1.87^{d}
16	74.91 ± 1.29^{bc}	74.67 ± 0.92^{bc}	78.08 ± 0.83^{ab}	72.33 ± 1.12^{c}	77.55 ± 0.89^{ab}	75.15 ± 1.08^{bc}	78.02 ± 1.58^{ab}	75.81 ± 1.32^{bc}	79.89 ± 1.30^{a}	73.27 ± 1.58^{c}
20	85.67 ± 1.28^{bc}	83.98 ± 0.78^{c}	88.19 ± 1.26^{b}	83.31 ± 0.01^{c}	89.73 ± 1.25^{ab}	86.12 ± 1.11^{bc}	98.75 ± 1.58^{ab}	93.61 ± 1.68^{a}	89.14 ± 1.95^{b}	87.44 ± 1.09^{bc}

[abcd]: Means on the same row with different superscripts are significantly different ($P \leq 0.05$) L_1 = high body weight line (HBWL); L_2 = low body weight line (LBWL); S_1; …; S_5 = sire families, 1, …, 5.

FI did not differ significantly between lines within sire groups and among lines across sire groups except in very few cases. The high lines, however, numerically consumed more feed than the low lines within and across sire groups resulting in overall significantly ($P \leq 0.05$) higher mean FI for high line at most of the age period (8 – 20 weeks, Table 5). Reports of studies evaluating feed intake in subpopulations of the NIC are scarce in literature. Momoh and Nwosu (2008) found non significant differences in FI between heavy and light ecotype NIC. Elsewhere, Hassen *et al*, (2006) and Reta (2009) found non-significant differences in feed intake at various age periods among Ethiopian native chicken ecotypes even though they were significantly different in body weight values. Haque *et al.*, (2004) also evaluated 5 commercial male layer strains for growth performance and found uniformity in their daily feed intake despite the highly significant body weight differences. The lack of significant differences in feed intake between lines genetically different in growth potentials suggests that FI have low genetic component in the NIC. FI intake values reported for the NIC in the present study, however, agree with the range reported for NIC ecotypes. For instance, Momoh (2005) reported daily FI values of 18.70 ± 0.63g for 0 – 4 weeks in a population of heavy ecotype local chickens of Nigeria. The values for 4 – 8 and 8 – 12 weeks of age were 26.77 ± 1.22g and 66.61 ± 2.03g, respectively, which are in high accord with the mean values of 19.94 ± 0.22g (range, 16.99 ± 0.60g to

21.84±0.50g), 37.74 ± 0.35g (range, 33.29 ± 0.79g to 41.50 ± 1.03g) and 63.37 ± 0.48g (range, 60.38 ± 1.28g to 66.62 ± 0.94g), respectively, obtained for high and low lines for the same age periods. The present report also concur with reports on FI for other native tropical ecotypes (Furuta *et al.*, 1980; Mupeta *et al.*, 2002; Kingori *et al.*, 2003; Sarki and Noor, 2005; Hassen *et al.*, 2006).

Table 3 shows that body weight gain (BWG) was mostly significantly ($P \leq 0.05$) different between lines within sire groups 1, 2 and 5 (S_1, S_2 and S_5) but predominantly similar within sire families 3 and 4 (S_3 and S_4).

TABLE 3: Mean ± S.E for body weight gain (g/bird/day) for G_1 lines at different age periods (0 – 20 weeks)

	S_1		S_2		S_3		S_4		S_5	
Age (wk)	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
0-4	5.30 ± 0.06^{b}	4.68 ± 0.14^{de}	5.66 ± 0.09^{a}	4.54 ± 0.20^{e}	5.14 ± 0.06^{bc}	4.45 ± 0.11^{e}	5.72 ± 0.08^{a}	4.89 ± 0.09^{cd}	5.26 ± 0.07^{b}	4.11 ± 0.18^{f}
4-8	6.81 ± 0.25^{ab}	5.82 ± 0.34^{c}	6.73 ± 0.25^{abc}	6.15 ± 0.37^{bc}	6.31 ± 0.37^{abc}	6.36 ± 0.29^{abc}	7.11 ± 0.22^{a}	5.83 ± 0.20^{c}	6.66 ± 0.32^{abc}	6.10 ± 0.23^{bc}
8-12	12.45 ± 0.47^{a}	11.98 ± 0.63^{ab}	11.33 ± 0.48^{abcd}	10.98 ± 0.63^{abcd}	11.48 ± 0.34^{abc}	10.05 ± 0.43^{cd}	11.95 ± 0.44^{ab}	10.79 ± 0.59^{bcd}	10.53 ± 0.38^{bcd}	9.79 ± 0.56^{d}
12-16	4.82 ± 0.16^{b}	3.92 ± 0.14^{c}	5.61 ± 0.32^{a}	4.86 ± 0.18^{b}	5.03 ± 0.13^{b}	4.78 ± 0.19^{b}	5.37 ± 0.19^{ab}	4.82 ± 0.14^{b}	4.90 ± 0.17^{b}	4.02 ± 0.27^{c}
16-20	5.75 ± 0.17^{ab}	4.30 ± 0.31^{d}	5.86 ± 0.41^{a}	4.80 ± 0.38^{bcd}	4.11 ± 0.15^{d}	4.44 ± 0.47^{cd}	6.08 ± 0.32^{a}	5.46 ± 0.32^{abc}	4.72 ± 0.233^{bcd}	3.98 ± 0.47^{d}

[abcde]: Means on the same row with different superscripts are significantly different ($P \leq 0.05$) L_1 = high body weight line (HBWL); L_2 = low body weight line (LBWL); S_1; …; S_5 = sire families, 1, …, 5.

Overall, BWG was not as strikingly different between BW lines as was observed for BW. The table shows that mean range for BWG was 5.14 ± 0.06g to 5.72 ± 0.08g and 4.11 ± 0.18g to 4.89 ± 0.09g for L_1 and L_2, respectively at 0 – 4 weeks. For 8 – 12 weeks, the mean values were 11.55 ± 0.20g for L_1 and 10.72 ± 0.26g for L_2 while for 16 – 20 weeks mean values of 5.39 ± 0.15g and 4.60 ± 0.18g were obtained for L_1 and L_2, respectively (Table 5). Overall mean for BWG for the two BW lines were significantly ($P \leq 0.05$) higher for the high line at the early age periods (4 to 12 weeks) (Table 5). Similar between population uniformity in daily BWG has been reported by other studies involving native chickens (Haque *et al.*, 2004; Reta, 2009). Reta (2009) evaluated 8 Ethiopian native chicken ecotypes for performance traits and reported non-significant differences in BWG over the age periods. The values obtained for BWG in the present study are inferior to those commonly reported for exotic chickens (Huque *et al.,* 2004; Ukachukwu and Akpan, 2007) but closely agree with those reported by other studies for indigenous chickens elsewhere in Africa (Haque, 1999, Mupeta *et al.*, 2002; Reta, 2009). The significant differences observed in BWG between L_1 and L_2 at juvenile age periods (0 – 4 weeks and 5 – 8 weeks) indicate that response to selection for BWG will be best between 4 – 8 weeks of age

Table 4 presents the mean values for feed conversion ratio for lines within G_1 generation from 0-20 weeks of age. The Table shows that FCR was predominantly similar between BW lines within sires across the age periods.

Table 4: Mean ± S.E for feed conversion ratio for G_1 lines at different age periods (0 – 20 weeks)

	S_1		S_2		S_3		S_4		S_5	
Age (wk)	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
0-4	3.71 ± 0.12^{a}	3.69 ± 0.2^{a}	3.86 ± 0.09^{a}	4.56 ± 0.34^{bc}	4.10 ± 0.13^{ab}	4.52 ± 0.15^{bc}	3.61 ± 0.17^{a}	3.98 ± 0.07^{ab}	3.97 ± 0.17^{ab}	4.82 ± 0.29^{c}
4-8	5.67 ± 0.23^{ab}	6.52 ± 0.36^{bc}	6.20 ± 0.37^{abc}	5.62 ± 0.32^{ab}	6.90 ± 0.49^{c}	6.07 ± 0.30^{abc}	5.30 ± 0.22^{a}	$6.420.26^{bc}$	6.07 ± 0.34^{abc}	6.03 ± 0.24^{abc}
8-12	5.15±0.20	5.55±0.33	6.02±0.27	5.75±0.36	5.80±0.17	6.28±0.36	5.67±0.29	6.010.43	6.27±0.27	6.31±0.40
12-16	15.78 ± 0.64^{a}	19.42 ± 0.79^{b}	14.54 ± 0.89^{a}	15.19 ± 0.64^{a}	15.58 ± 0.46^{a}	16.07 ± 0.72^{a}	14.66 ± 0.36^{a}	$15.920.58^{a}$	16.56 ± 0.64^{a}	19.45 ± 1.47^{b}
16-20	15.05 ± 0.47^{a}	20.76 ± 1.39^{ab}	16.07 ± 1.17^{a}	18.90 ± 1.55^{ab}	22.27 ± 0.94^{bc}	23.21 ± 2.92^{bc}	15.27 ± 0.82^{a}	$17.891.08^{ab}$	19.29 ± 0.74^{ab}	27.70 ± 4.42^{c}

[abc]: Means on the same row with different superscripts are significantly different ($P \leq 0.05$) L_1 = high body weight line (HBWL); L_2 = low body weight line (LBWL); S_1; …; S_5 = sire families, 1, …, 5.

The low lines were significantly ($P \leq 0.05$) inferior to the high lines at few of the age periods but were mostly inferior numerically for most of the age periods. Consequently, the overall mean FCR for the two lines (Table 5) were significantly ($P \leq 0.05$) better (lower FCR values) for the high line, especially, at the mature age periods (12 – 16 and 16 – 20 weeks) probably as a result of greater limits of growth performance in the high lines (Mupeta *et al.,* 2002). The observed similarity in FCR between high and low lines within sire groups could be attributed to the presence in the low lines of the sex-linked dwarf gene (dw) which has been shown to reduce growth potentials while increasing feed efficiency in chickens (Nordskog, 1980; Missohou *et al.,* 2003). Our values for FCR in this study are, however, generally in high accord with those reported for indigenous chickens in Africa and elsewhere especially for the early growth phase (0 – 12 weeks). Specifically, Reta (2009) reported a range of 4.50 to 8.30 (mean, 5.90) for 0 – 6 weeks; 4.90 to 5.50 (mean, 5.40) for 8 – 12 weeks and 5.00 to 5.70 (mean, 5.60) for 0 – 12 weeks in indigenous chickens of Ethiopia. Sarkita and Noor (2005) reported mean range of 8.00 to 10.00 and 4.90 to 6.40 for FCR from 0 – 20 weeks, respectively, for semi intensively and intensively managed indigenous chickens of Indonesia. The very high values observed for FCR (poor feed efficiency) at weeks 12 – 16 and 16 – 20 could be attributed to greater differential resource allocation to the development of the reproductive system preparatory to reproductive activities. Again, beyond 12 weeks of age, the NIC enters into the auto-decelerating phase of growth within which body weight gain becomes very low in spite of increasing feed consumption (Ogbu and Omeje, 2010).

Table 5 presents the overall mean (irrespective of sire group) for high (L_1) and low (L_2) lines for the parameters evaluated.

Table 5**:** Within generation comparison for high and low body weight lines for performance traits (BW, BWG and FGR) at various age period (4-20 weeks**)**

Trait	Gen	Line	4	8	12	16	20
BW	G_1	L_1	178.53±0.95[a]	360.67±3.46[a]	677.01±5.19[a]	816.96±5.62[a]	958.05±7.75[a]
	G_1	L_2	154.36±1.50[b]	313.89±3.31[b]	615.92±6.76[b]	743.89±6.81[b]	869.33±6.77[b]
FI	G_1	L_1	20.78±0.31	39.43±0.54[a]	65.33±0.51[a]	77.69±0.56[a]	88.50±0.67[a]
	G_1	L_2	19.11±0.27	36.05±0.36[b]	61.41±0.75[b]	74.24±0.55[b]	86.89±0.67[b]
BWG	G_1	L_1	5.42±0.04[a]	6.72±0.13[a]	11.55±0.20[a]	5.15±0.10	5.30±0.15
	G_1	L_2	4.53±0.07[b]	6.05±0.13[b]	10.72±0.26[b]	4.48±0.10	4.60±0.18
FCR	G_1	L_1	3.85±0.06	6.03±0.16	5.78±0.12	15.42±0.29[a]	17.59±0.50[a]
	G_1	L_2	4.31±0.11	6.13±0.13	5.98±0.17	17.21±0.45[b]	21.69±1.20[b]

a,b: Means on the same column with different superscripts are significantly different; 0.05. BW = Body weight; BWG = Body weight gain

Heavier chickens generally consume more feed. The situation between FI and BWG was not as definite. Both traits were significantly ($P \leq 0.05$) positively correlated at some age periods (4th week, 4th and 8th week, 4th and 16th week, 8th and 16th week and 16th week) and non significantly correlated (positively and negatively) at other age periods. Surprisingly, FI was mostly non significantly correlated with BWG at the same age period (8th, 12th and 20th week). Feed intake (FI) and FCR were mostly significantly ($P \leq 0.05$) positively correlated (negatively correlated with feed efficiency) within the same age periods but mostly negatively correlated (positively correlated with feed efficiency) across age periods. Values for phenotypic correlation between pairs of productive traits vary with population and environment. The values and direction of phenotypic correlation coefficients obtained in the present study, however, considerably agree with those generally reported in literature for chickens and other species (Skinner – Noble and Teeter, 2004; Aggrey *et al.,* 2010).

CONCLUSION

The two body weight lines (high and low lines) created from the NIC population are genetically different in growth potential. The persistent highly significant body weight differences between the two body weight lines throughout the experimental period (4 – 20 weeks) as well as the significant differences for BWG and FCR at some important age periods (4 – 12wks) and (12 – 20wks), respectively, means that lines genetically different in these traits could be established from NIC populations hence we conclude that selection to improve these traits could be carried out between 4 to 20 weeks for BW, 4 to 12 weeks for BWG, 12 – 20 weeks for FCR and 4 – 20 weeks for BW, BWG and FCR combined.

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Table 6: Correlation matrix for pairs of traits within and across age periods in the NIC at various age periods (4-20 weeks)

		Week 4				Week 8				Week 12				Week 16				Week 20			
Age	Trait	BW	FI	BWG	FCR	BW	FI	BWG	FCR	BW	FI	BWG	FCR	BW	FI	BWG	FCR	BW	FI	BWG	FCR
4	BW	-	0.22*	0.98**	-0.68**	0.59**	0.29**	0.14	0.04	0.52**	0.24**	0.18**	-0.08	0.61**	0.33**	0.39**	-0.27**	0.61**	0.12	0.36**	-0.33**
	FI	-	*	0.21*	0.50**	0.19*	-0.10	0.09	-0.08	0.18*	0.00	0.07	-0.10	0.25**	0.44	0.28**	-0.24**	0.20*	0.19*	0.04	-0.03
	BWG	-	-	-	-0.70**	0.58**	0.30**	0.14	0.05	0.51**	0.26**	0.17*	-0.06	0.59**	0.33**	0.37**	-0.26**	0.60**	0.13	0.35**	-0.33**
	FCR	-	-	-	-	-0.31**	-0.27**	0.02	-0.16	-0.25**	-0.19*	-0.07	-	-0.28**	-0.26**	-0.11	0.03	-0.33**	0.00	-0.24**	0.23**
			-										.03								
8	BW	-	-	-	-	-	0.27**	0.88**	-0.63**	0.50**	0.28**	-0.13	0.22**	0.55**	0.22**	0.26**	-0.19*	0.51**	0.11	0.18**	-0.17*
	FI	-	-	-	-	-	-	0.16	0.42**	0.27**	0.30**	0.12	-0.01	0.30**	0.26**	0.17*	-0.07	0.32**	0.15	0.03	-0.05
	BWG	-	-	-	-	-	-	-	-0.80**	0.30**	0.20**	-0.27**	0.32**	0.31**	0.08	0.08	-0.07	0.26**	0.06	0.01	-0.01
	FCR	-	-	-	-	-	-	-	-	-0.11	-0.03	0.32**	-0.30**	-0.09	0.08	0.02	0.01	-0.08	-0.00	-0.02	-0.01
12	BW	-	-	-	-	-	-	-	-	-	0.23**	0.80**	-0.64**	0.94**	0.11	0.08	-0.08	0.69**	0.01	0.06	-0.07
	FI	-	-	-	-	-	-	-	-	-	-	0.07	0.36**	0.26**	0.17*	0.11	-0.04	0.23**	0.20*	-0.06	0.04
	BWG	-	-	-	-	-	-	-	-	-	-	-	-0.89**	0.69**	-0.03	-0.09	0.04	0.44**	-0.07	-0.06	0.04
	FCR	-	-	-	-	-	-	-	-	-	-	-	-	-0.54**	0.10	0.11	-0.04	-0.32**	0.14	0.04	-0.04
16	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17*	0.42**	-0.38**	0.76*	0.08	0.09	-0.10
	FI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.18*	0.15	0.27**	0.17*	0.13	-0.13
	BWG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.90**	0.40**	0.20*	0.10	-0.11
	FCR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.31**	-0.13	-0.08	0.09
20	BW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	0.44**	-0.42**
	FI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-0.14
	BWG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.84**
	FCR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-