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Genetic Parameter Estimates of Body Weights of Naked Neck Broiler Chickens

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Abstract: The chicks used in this experiment were obtained from a population of naked neck broiler chickens that has been kept in NAPRI since 1998. Six Hundred chicks were obtained from four hatches, one week apart. At hatch, pedigreed chicks were wing-banded and housed on deep litter in an open house. Body weights were measured biweekly up to 8 weeks of age. Other measurements taken include Neck length, Back length, keel length and breast angle. The general least square means were 37.22 ± 0.32, 210.46 ± 1.97, 744.33 ± 4.31, 1351.3 ± 7.91 and 2428.1 ± 14.61g for wt at day old (WT0D), weight at 2 weeks (WT14D), weight at 4 weeks (WT28D), weight at 6 weeks (WT42D) and weight at 8 weeks (WT56D), respectively. While measurements taken included Neck length, Back length, keel length and breast which were 7.31±0.06, 15.99±0.05, 5.63±0.04, 10.44±0.04cm respectively. The heritability estimates ranged from low value of 3.013±0.08 for keel length to 0.315±0.22 for WT0D. There were negative genetic correlations between WT0D and other traits. This study showed that additive heritabilities are low for linear body measurement and moderate for body weight for naked neck chickens during rearing.

Key words: Poultry, heritability, genetic correlation, linear measurement

Introduction

One of the major causes of low production in the hot tropical environment is heat stress. In poultry production, broiler growth and meat yield has been known to be strongly and negatively affected by high ambient temperatures (Adams and Rogler, 1968; Chwalibog and Eggum, 1989; Howlider and Rose, 1989; Osman *et al.,* 1989; Cahaner and Leenstra, 1992; Leenstra and Cahaner, 1992). Moreso, broiler lines with a higher potential for growth rate have been found to be more sensitive to constant high ambient temperatures (Cahaner and Leenstra, 1992; Leenstra and Cahaner, 1992; Cahaner *et al.,* 1995). Natural heat stress, induced by the summer season in Izmir (Turkey), reduced 7-wk BW and 4- to 7-wk weight gain (BWG) of commercial broilers by about 23 and 33%, respectively, compared to their counterparts reared under the same management during the temperate fall season (Yalc'in *et al.,* 1997). It appears that broiler stocks bred for high growth rate and meat yield in optimal environments, are not able to fully express their genetic potential when reared in hot climates, unless their selection programs include breeding for heat tolerance. Whereas studies on alleviation of heat stress have focused on costly management adjustments, however, genetic improvement of heat tolerance may provide a low-cost solution, particularly attractive to developing countries with hot climates, chickens suffer under high ambient temperature because their feather coverage hinders internal teat dissipation, leading to elevated body temperature (BT) (Yahav *et al.,* 1996). To avoid a lethal increase in body temperature, chickens minimize endogenous heat production by reducing feed intake, resulting in decreased growth and meat yield in broilers (Yahav *et al.,* 1996). Reduced feather overage should improve and enhance heat dissipation and consequently alleviate the effects of heat on chickens reared in hot climates. In addition, reduced feathering saves on the amount of protein required to form feather. Such protein that would have been used to form feather would now be used for meat tissues (Cahaner *et al.,* 1987; Ajang *et al.,* 1993).

The naked neck *(Na)* gene reduces feather coverage in chickens by about 20 and 40% in the heterozygous (Na/na) and homozygous (Na/Na) states, respectively. The effects of this gene have been reviewed comprehensively, especially with regard to egg-type chickens (Merat 1986). In the early 1980s, Hanzl and Somes, (1983) studied the potential usefulness of naked neck broilers at high ambient temperature, but its importance became more apparent in the 1990s , Lou *et al.,* 1992; Cahaner *et al.,* 1993, 1994; Eberhart and Washburn 1993a,b). From these studies, the advantage of naked neck broilers over their normally feathered counterparts, when reared at constant high ambient temperatures (above 30^{o}C) was well demonstrated. It has been shown that the increase in body temperature in high ambient temperatures was higher in normally feathered than in naked neck broilers, due to the reduced feathering of the latter. Consequently, the naked neck broilers exhibited higher feed intake, growth rate, and meat yield than their normally feathered counterparts (Deeb and Cahaner, 1994). Most of the studies were conducted in artificially controlled climates, mostly with constant temperature. Natural hot climates are characterized by a diurnal cycle of ambient temperature, which varies among geographical locations and seasons. Broilers, whose appetite and growth are depressed by the higher mid-day temperatures, may exhibit compensatory feed intake and weight gain during the cooler night hours.

The objective of this study is to estimate genetic parameters (heritability, genetic and phenotypic correlations) among the traits of economic importance in the flock of naked neck chickens kept at the Institute. The values obtained will be used in further selection experiment.

Table 1: Least Square and means (with standard error) of various traits of naked neck chicken

Trait	Least Square Means	SE
WTOD	37.22	0.32
WT14D	210.46	1.97
WT28D	744.33	4.31
WT42D	1351.3	7.91
WT56D	2428.1	14.61
NL	7.31	0.06
BL	15.99	0.05
KL	5.63	0.04
BA	10.44	0.04

Materials and Methods

The chicks used in this experiment were obtained from a population of naked neck broiler chickens that has been kept in NAPRI since 1998. Chicks were obtained from four hatches, one week apart. At hatch, pedigreed chicks were wing-banded and housed on deep litter in an open house. The hatching chicks were placed in a confined area of artificial heat using 200watts bulbs and kerosene stoves for four weeks. Mixed chicks were fed *ad libitum* on a broiler starter diet (containing 21.0% CP and 3000 kcal ME/kg) from hatching to 4 weeks of age, followed by a finisher diet (18% CP and 2900 kcal ME/kg) to 8 weeks of age. Water and feed were available *ad libitum* to the birds. Chicks were vaccinated for Newcastle Disease and Mareks before they were transferred into the brooding house. During brooding, routine medication and vaccination against common poultry diseases were administered as at when due.

Body weights were recorded at day of hatching (day 0) and at 2, 4, 6 and 8 weeks of age. Other measurements taken at 8 weeks of age include shank length, keel length, breast length, Kleel length and back length. Birds were weighed individually on an electronic balance. Chicks were classified by sex (male, female), determined at week 10 by phenotypic appearance. The data was edited to include dams that did not lay or had no chicks at hatching and chicks that lost their wing-bands before sexing. After data editing, a total of 600 chicks belonging to 8 sires were available for analysis.

Statistical analysis: Variance components and genetic parameters were estimated for each body weight data set using Harvey (1966). The animal model for birth weight and 4 weeks body weight included the fixed effects of hatch number of the chicken and the random effects of animal, sire, and additive maternal and common environmental effect of each dam common to all their progeny, and residual environmental effect.

The animal model notation was:

$$Y_{ijk} = U + S_i + H_j + e_{ijk}$$

Where Y_{ijk} is the individual measurement on each chicks

U is the overall mean

S_i is effect of i^{th} sire on the progeny belonging to the j^{th} hatch.

H_j is the effect of the j^{th} hatch to which the i^{th} progeny belong

e_{ijk} is the random error

Table 2: Heritability estimates of naked neck broiler traits

Traits	h^2	Se
WTOD	0.32	0.218
WT14D	0.22	0.179
WT28D	0.31	0.215
WT42D	0.24	0.188
WT56D	0.20	0.170
NL	0.12	0.143
BL	0.08	0.112
KL	0.01	0.080
BA	0.03	0.089

Results and Discussion

The general least square means were 37.22 ± 0.32, 210.46 ± 1.97, 744.33 ± 4.31, 1351.3 ± 7.91 and 2428.1 ± 14.61g for wt at day old (WTOD), weight at 2 weeks (WT14D), weight at 4 weeks (WT28D), weight at 6 weeks (WT42D), weight at 8 weeks (WT56D) respectively (Table 1). Other traits estimated include Neck length, keel length and breast angle which were 7.31±0.06, 15.99±0.05, 5.63±0.04, 10.44±0.04cm respectively.

Table 2 shows the heritability estimates for the various traits in this study. The heritability estimates ranged from low value of 0.013±0.08 for keel length to 0.315±0.22 for WTOD. Heritability estimates for weights at various ages were moderate. This is expected as normally body weights are highly heritable. Heritability estimates for linear body measurements were very low compared to those of body weights. Low heritabilities means that dominance, epistatic and environmental effects are more important than genetic additive effects on linear body measurement of naked neck broiler chickens, at least under the present conditions of this study. Kinney (1969) reported, using data from the literature and estimates based on ANOVA Procedures, mean heritability values of 0.43 (range 0.19-0.66), 0.38 (range 0.01-0.88), 0.40 (range 0.38-0.73) for body weights of 4, 8 and 12 weeks old broiler chickens, respectively. The estimates obtained by Kinney were slightly higher than

Table 3: Genotypic correlation (above diagonal) and phenotypic correlation (below diagonal) of body weight and body linear measurement of Naked Neck chickens

Traits	WT0D	WT14D	WT28D	WT42D	WT56D	NL	BL	KL	BA
WTOD		-0.42	-0.32	-0.67	-0.62	-0.47	0.62	2.20	0.74
WT14D	0.19		1.08	1.13	1.13	1.39	1.20	1.64	1.11
WT28D	0.17	0.55		0.95	0.91	1.26	1.15	1.77	1.79
WT42D	0.05	0.39	0.75		1.05	1.12	0.92	1.26	1.17
WT56D	0.04	0.24	0.56	0.82		1.03	0.88	1.36	0.93
NL	-0.01	0.06	0.28	0.52	0.68		0.93	2.46	0.76
BL	0.13	0.17	0.31	0.36	0.57	0.53		3.57	1.93
KL	0.12	0.16	0.07	-0.19	-0.10	0.01	0.17		2.99
BA	0.04	0.00	0.06	0.16	0.34	0.32	0.40	0.06	

those obtained in this study for body weights. The observed differences in the estimates obtained may be due to data size.

In broilers, Tullett and Burton (1982) observed that 97% of the variation in chick weight at hatch can be explained by two factors: fresh egg weight and weight loss during incubation. Pinchasov (1991) observed that the initial high correlation between egg weight and hatch weight declined with age. North (1986) indicates that the weight of the chick represents approximately 70% of the egg weight. It is therefore desirable to separate common environmental effects such is nutrition housing etc. from heritability estimates, in order to better predict response to selection.

Chambers (1990) noticed that heritabilities for body weight of broilers tend to increase with age. However, in this study heritabilities for the early growth traits of the naked neck broiler chickens showed no increase, rather, a decrease in heritability estimates was observed. Differences in heritability estimates could be attributed to method of estimation, breed, environmental effects and sampling error due to small data set or sample size. Environmental (high temperature and humidity) and poor management conditions, are known to increase the residual variance and decrease the heritability estimates.

Table 3 shows the genetic (above diagonal) and phenotypic correlation (below diagonal). There was a negative genetic correlation between WT0D and other traits. This seems to be an absurdity. However the phenotypic correlations were positive for all traits except WT0D with NL, WT42D with KL and WT56D with KL.

In conclusion, this study showed that heritabilities are low for linear body measurement and moderate for body weight for naked neck chickens during rearing. High heritability of body weight at 56 days of age is an indication that selection for body weight at this age will improve body weight in subsequent generation.

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