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# Evaluation of production performance in Naked neck broiler breeders under tropical environment

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The naked neck gene received greater attention in recent past in broiler production because of its association with heat tolerance (Merat 1986, Lin *et al*. 2006, Rajkumar *et al*. 2010 a, b) which is considered to be the most important inhibiting factor for poultry production in hot tropical climate. The high ambient temperature causes heat stress because of the less heat dissipation due to complete feather coverage which hinders the internal heat dissipation, leading to increased body temperature. To reduce the body temperature, birds minimize endogenous heat production by reducing feed intake resulting decreased growth rates and meat yields in chicken (Yahav *et al*. 1998). Naked neck gene reduces relative feather mass by 40 and 20% in NaNa and Nana birds respectively, thus increasing the heat dissipation. (Merat 1986, Rajkumar *et al*. 2010a). Lot of work has been carried out on Naked neck birds with respect to heat tolerance, growth and carcass traits, however the information on production performance of Naked neck breeders is scanty. Therefore, the production performance of the three genotypes of Naked neck chicken was evaluated in the present study.

The base population of Naked neck line was developed after 4 successive generations of backcrossing and is maintained under mild selection pressure for 6 week body weight for the last 6 generations at Project Directorate on Poultry, Hyderabad, India. The data were collected from 231 hens (NaNa, 62; Nana, 135; nana, 34) selected from a flock produced from 40 sires and 120 dams in 2 hatches in sixth generation. The effect of the gene was estimated by mean deviations of the NaNa and Nana from the nana genotypes using the following formula for all the traits (Fathi *et al*. 2008).

Gene effect = (NaNa or Nana-nana/nana) × 100.

The birds were reared up to 40 weeks of age in individual cages with 1–1/2 feet floor space with automated drinkers. The birds were kept on restriction feeding schedule from seventh week onwards to maintain the target body weight during the laying cycle for better egg production. The birds were maintained on a broiler grower ration (2600: ME and 18: CP) upto 20 weeks of age and broiler breeder ration (2700: ME, 17 CP and calcium 3.5%) till the end of the production cycle. The birds were vaccinated against Marek's disease (day 1), Newcastle disease, Lasota (day 7 and 30), infectious bursal disease (day 14 and 26), fowl pox (sixth week), ND $R_2B$ (ninth week) and IB and ND inactivated (18th week). The ambient temperature ranged from 34 to 42°C during the rearing period.

The data were subjected to one-way analysis of variance using general linear model (GLM) procedure in SPSS 12.0 Package to assess the effect of genotype. The significance of differences of means among genotypes was tested with Duncan's multiple range tests (Duncan 1955). The pedigreed data were analyzed using Least squares technique (Harvey 1990) and the hatch corrected data were utilized for estimating the heritability estimates by variance component analysis (Kings and Henderson 1954). Genetic and phenotypic correlations were estimated from variance – covariance component analysis (Becker 1975).

*Production parameters*: Production parameters [ASM (age at sexual maturity), body weight, egg weight and egg production] of 3 Naked neck genotypes are summarized in Table 1. The body weight at 20 weeks of age was not significant in the 3 genotypes while it was significantly (higher in *nana* birds at 40 weeks of age (Table 1). The birds were on restriction feeding schedule to maintain the target body weight during laying period, therefore the variation in body weight among the genotypes may not be a true reflection of its genetic potential. The body weights observed was higher than that reported by Padhi *et al*. (2001) and Reddy *et al*. (2008) in naked neck chicken. Rahman (2000) reported significantly higher body weights in Naked neck genotypes

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Table 1. Production performance in three Naked neck genotypes

| Parameter | Genotype | | | Prob. | Gene effect | |
|---|---|---|---|---|---|---|
| | NaNa | Nana | nana | | NaNa | Nana |
| N | 62 | 135 | 34 | | | |
| Age at sexual maturity (days) | 157.53±1.29 | 157.66±1.06 | 152.30±1.58 | 0.415 | 3.43 | 3.52 |
| *Body weight (g)* | | | | | | |
| 20 week | 2596.59±32.03 | 2558.72±24.47 | 2609.90±41.02 | 0.708 | –0.51 | –1.96 |
| 40 week | 3275.78±47.22$^{ab}$ | 3132.03±32.37$^{b}$ | 3421.10±65.69$^{a}$ | 0.014 | –4.25 | 0.845 |
| *Egg weight (g)* | | | | | | |
| 28 week | 53.81±0.57$^{a}$ | 53.68±0.33$^{a}$ | 49.50±0.95$^{b}$ | 0.007 | 8.71 | 8.44 |
| 32 week | 56.31±0.65$^{a}$ | 56.45±0.32$^{a}$ | 54.10±0.73$^{b}$ | 0.042 | 4.02 | 4.34 |
| 36 week | 58.78±0.45$^{a}$ | 59.60±0.31$^{a}$ | 57.00±0.81$^{b}$ | 0.014 | 3.12 | 4.56 |
| 40 week | 60.93±0.55 | 61.07±0.33 | 60.80±0.75 | 0.707 | 0.02 | 0.39 |
| *Egg production (no.)* | | | | | | |
| 40 week | 64.65±2.41 | 64.57±1.58 | 61.25±4.04 | 0.560 | 5.55 | 5.42 |

Means with different superscript within the row differ significantly (P≤0.05).

compared to their normal siblings contrary to the present estimates. The variation in body weights of Naked neck chicken might be attributable to the genotype environmental interactions prevailing in the area of study. The age at sexual maturity (ASM) was not significantly varied among the three genotypes, however normal birds matured early. Rahman (2000) observed earlier maturity in Nana/NaNa than nana birds contrary to the present findings. Padhi *et al*. (2001) observed, 189±3.01 days for ASM in Naked neck chicken from Andaman & Nicobar Islands which was significantly higher than present estimates. Reddy *et al*. (2008) also reported higher ASM (175.8±0.09) for Naked neck genotypes.

Egg weights in NaNa/Nana birds were significantly (P≤0.05) higher at 28, 32 and 36 weeks of age, while not varied significantly at 40 weeks of age (Table 1). Average egg weights for Nana birds were significantly higher than nana (Galal *et al*. 2000) which were similar to the present findings. *Na* gene increased egg weight significantly by 4% and 5.7% in Nana and NaNa genotypes (Rahman 2000) which were comparable to the present results. Reddy *et al*. (2008) and Galal *et al*. (2007) also reported comparable estimates for egg weights in Naked neck chicken, whereas Bhuiyan *et al*. (2005) reported lower egg weights.

Part period egg production up to 40 weeks was not significantly varied among the genotypes, though numerically higher in NaNa/Nana genotypes by 3 eggs (Table 1). Rahman (2000) observed significant increase in egg production by 14 and 16% in NaNa and Nana genotypes, respectively; however the increase was of less magnitude (6 and 5%) in the present study (Table 1).

*Genetic parameters*: Heritability estimates of the traits indicate the proportion of additive genetic variance that can be transmitted to the offsprings. The $h^2$ estimates of body weights at 20 and 40 weeks was moderate to high in Naked neck chicken. Reddy *et al*. (2008) observed higher heritability estimates for 20 and 40 week body weights in Naked neck chicken. The differences in the heritability estimates might be attributed to breed, environmental effects and sampling errors. Environment and poor management might increase the residual variance and decrease the $h^2$ estimates (Adeyinka *et al*. 2006). The $h^2$ estimate of ASM from various components was moderate to high in Naked neck chicken. The $h^2$ from dam component was high indicating the profound maternal effects for ASM in Naked neck chicken. Reddy *et al*. (2008) reported higher estimates of $h^2$ for ASM in Naked neck. The $h^2$ estimates of egg weights were low to moderately heritable (Table 2). The $h^2$ from dam components was higher for egg weights, indicating the maternal effects as it is a sex limited trait. Reddy *et al*. (2008) observed comparable estimates for egg weights in Naked neck birds. Similar estimates were observed by Jilani *et al*. (2007) in RIR for 35 week egg weight and Ahmed and Singh (2007) in WLH for 32 week egg weight.

The 40 week egg production was a lowly heritable trait with $h^2$ estimate (0.08±0.17) in Naked neck birds. Varied $h^2$ estimates were documented for egg production in the literature. Reddy *et al*. (2008) observed higher $h^2$ estimates for 40 week egg production in Naked neck birds. Jilani *et al*. (2007) observed very high estimates (<0.7) for 40 week egg production. However the present estimates are fairly reasonable keeping in view the low heritable nature of the trait.

Genetic and phenotypic correlations between the traits are presented in Table 3. The correlation coefficient between 20 and 40 week body weights was significantly (P≤ 0.05) and positively associated in Naked neck chicken. The heavier birds laid heavier eggs indicating the positive association between body weights and egg weights. 40 week body weight and egg weights at 32, 36 and 40 weeks had significant (P ≤ 0.05) positive correlations. The heavier birds matured early with positive correlation between body weights and

Table 2. Least square means and heritability estimates of production traits in Naked neck chicken

| Traits | Means | Heritability | | |
|---|---|---|---|---|
| | | $h^2_S$ | $h^2_D$ | $h^2_{(S+D)}$ |
| ASM (days) | 157.34±0.93 | 0.17±0.13 | 0.36±0.39 | 0.24±0.25 |
| *Body weight (g)* | | | | |
| 20 weeks | 2568.46±18.19 | 0.22±0.26 | 0.57±0.37 | 0.35±0.24 |
| 40 weeks | 3174.36±28.16 | 0.26±0.21 | 0.46±0.33 | 0.34±0.20 |
| *Egg weight (g)* | | | | |
| 28 weeks | 53.47±0.31 | 0.11±0.22 | 0.30±0.41 | 0.19±0.29 |
| 32 weeks | 56.34±0.29 | 0.20±0.28 | 0.28±0.37 | 0.23±0.17 |
| 36 weeks | 59.31±0.30 | 0.16±0.21 | 0.39±0.47 | 0.29±0.31 |
| 40 weeks | 61.02±0.29 | 0.19±0.35 | 0.38±0.28 | 0.32±0.38 |
| *Egg production (No).* | | | | |
| 40 weeks | 63.83±1.08 | 0.04±0.31 | 0.12±0.28 | 0.08±0.17 |

Table 3. Genetic (above the diagonal) and phenotypic (below the diagonal) correlations between the production traits in Naked neck chicken

| Parameter | 20BW | 40BW | ASM | 28EW | 32EW | 36EW | 40EW | 40EP |
|---|---|---|---|---|---|---|---|---|
| 20BW | ** | 0.64* | 0.41 | — | 0.25 | — | 0.06 | –0.19 |
| 40BW | 0.45 | ** | 0.12 | 0.29 | 0.67* | 0.56* | 0.64* | –0.35* |
| ASM | 0.17 | 0.02 | ** | 0.82* | 0.98* | 0.47 | –0.15 | –0.30 |
| 28EW | –0.03 | –0.01 | 0.11 | ** | 0.33 | 0.42 | 0.28 | 0.09 |
| 32EW | 0.06 | –0.03 | 0.13 | 0.21 | ** | 0.61* | 0.34 | –0.90* |
| 36EW | 0.07 | 0.10 | 0.02 | 0.02 | 0.30 | ** | 0.81* | –0.17 |
| 40EW | 0.03 | 0.04 | 0.01 | –0.06 | 0.29 | 0.34 | ** | –0.24 |
| 40EP | 0.02 | –0.15 | –0.26 | 0.01 | –0.03 | 0.09 | 0.06 | ** |

*Significant at P≤0.05; 20BW: 20 week body weight; 40BW: 40 week body weight; ASM: Age at sexual maturity; 28EW: 28 week egg weight, 32EW: 32week egg weight; 36EW: 36 week egg weight; 40EW: 40 week egg weight; 40EP: 40 week egg production.

ASM. The ASM and egg weights also had positive significant correlation; the birds matured late laid heavier eggs at all ages. All the egg weights at different ages are positively correlated.

The egg production at 40 weeks of age was negatively correlated with all the traits except at 28 week egg weight which was positively correlated with (0.09) lesser magnitude. The negative association between body weights and egg production is well established. The lower the ASM, higher the egg production which was also a proven fact in chicken. The association between egg production with all other traits was in agreement with the earlier studies in various chicken populations (Jilani *et al*. 2007, Reddy *et al*. 2008). The phenotypic correlations between the traits were of lower magnitude except between few traits 20 and 40 week body weight; 32, 36 and 40 week egg weights; 32 and 36 week egg weights. Similar trends of correlation estimates were reported by Reddy *et al*. (2008) and Jilani *et al*. (2007) in chickens. The significant negative association between the 40 week body weight and 40 week egg production should be considered while formulating the breeding programme as the primary trait of selection is body weight.

## SUMMARY

The production performance of 3 Naked neck (NaNa, Nana and nana) genotypes and the inheritance pattern of various economic traits was evaluated in the present study. The pedigreed data collected for various economic traits from 231 hens were analyzed for determination of growth, production and genetic parameters. The performance of Naked neck (NaNa/Nana) genotypes was superior in terms of egg production and egg weights than their normal (nana) siblings. The introgression of Na gene can fore-see a viable alternative for poultry production in tropical countries.

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