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Phenotypic Characterization of Indian Naked Neck Chicken Under Tropical Climatic Conditions

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ABSTRACT

The three naked neck broiler genotypes (*NaNa, Nana* and *nana*) were investigated for the effect of temperature on juvenile body weights, shank length, immune competence and carcass characteristics. Weekly body weights were recorded from day old to six weeks (n = 417). The body weights were significantly higher in naked neck genotypes (*NaNa* and *Nana*) at 4th, 5th and 6th week of age. Birds with *NaNa* and *Nana* genotype recorded significantly ($p \leq 0.05$) higher weight gains during 4th (211.17 g) and 5th (207.96 g) week, respectively than *nana* genotype. The body weight gains were numerically higher at all ages either in *NaNa* or *Nana* genotypes without any significant difference. The shank length did not show any significant variation among the genotypes, which ranged from 78.54 mm in full feathered (*nana*) birds to 79.67 mm in heterozygous (*Nana*) population with an overall mean of 79.13 mm. Mean anti SRBC titre, anti NDV titre and response to PHA-P ranged from 3.55-5.6, 2.75-5.10 and 1.35-1.47 mm, respectively in different genetic groups. The dressing percentage was significantly higher in *NaNa* genotypes (71.96) than their normal (*nana*) siblings (69.66), which can be attributed to higher body weight and less losses due to lack of feathers in naked neck chicken. The liver, heart and gizzard weights are numerically higher in *NaNa* and *Nana* genotypes. The present study invariably concluded that *Na* gene in homozygous and heterozygous condition is more beneficial to exploit for better performance of Naked neck in tropical conditions.

Key words: Naked neck, juvenile traits, immune competence, carcass traits

INTRODUCTION

Poultry production in India evolved from back yard venture to full-fledged poultry industry in last three decades. The contribution from high yielding germ plasm in the progress of poultry enterprise is very significant. Most of the high yielding exotic breeds have been originated or developed in temperate climatic conditions. India being a tropical country having vast hot and humid area around coastal regions is not suitable for full expression of its genetic potential. In the peak summer and humid months, high yielding stocks suffer from increased stress, decreased feed

consumption, reduced reproductive efficiency, low egg production, affects egg quality, reduced immune competence and reduction in the feed efficiency (Cahaner *et al*., 1995; Singh, 2003). It will be therefore desirable to breed birds suitable to the tropical environment. Heat tolerance can be improved through various means like more efficient thermoregulation, through enlarged naked body surface, lowering basal metabolism, reduced feathering intensity, creating specific colors by obtaining skin having melanin and non-pigmented feathers. Various authors studied the attributes of naked neck with respect to physiological immunity, production and carcass traits under different agroclimatic conditions (Nardone *et al*., 2010; Rajkumar *et al*., 2010b, 2010c, 2011; Azoulay *et al*., 2011; Hadad *et al*., 2014). The present investigation is designed to evaluate the effect of reduced feathering intensity in the naked neck birds.

MATERIALS AND METHODS

Experimental birds and protocol design: The present investigation was carried out by using Naked neck population which were maintained under mild selection pressure for sixth-week body weights for 10 successive generations by inbreeding at Directorate of Poultry Research, Hyderabad. Naked neck chicks (n = 417) produced from 40 sires and 120 dams in two hatches in 11th generation were utilized in the present study. The birds were divided into three genotypes homozygous dominant (*NaNa*), heterozygous (*Nana*) and full feathered homozygous recessive (*nana*) based on the feathering pattern of the genotype and respectively pictures are depicted in Fig. 1, 2 and 3, respectively. The investigation was carried out during the months of April-May. Pictures depicting various naked neck genotypes i.e., homozygous, heterozygous and recessive are presented in Fig. 1, 2 and 3, respectively. A total of 60 birds of which 20 from each genotype i.e., homozygous, heterozygous and recessive had been randomly selected and were utilized to evaluate various quantitative traits.

Fig. 1: Homozygous genotype (*NaNa*)

Fig. 2: Heterozygous genotype (*Nana*)

Fig. 3: Recessive genotype (*Nana*)

Quantitative traits: Various quantitative traits like body weights, shank length, immune and carcass traits were measured in the three genotypes of naked neck chicken.

Juvenile body weights: Weekly body weights were recorded on day-old, 1st, 2nd, 3rd, 4th, 5th and 6th weeks of age to the nearest one gram accuracy.

Shank length: Shank length was measured from top of the hock joint to toe at six weeks of age with vernier callipers to the nearest accuracy of millimeter.

Immuno-competence traits: Humoral immunity was measured as antibody response against Sheep Red Blood Cells (SRBC) at 6 weeks of age (Patra *et al*., 2004). Haemagglutination Activity

(HA) was done with sheep RBC from the serum collected at five days post injection of SRBC at 6 weeks of age as described by Siegel and Gross (1980). The reciprocal of highest dilution showing complete agglutination was expressed as titre (n). The titre was transformed into $\log_2$ values for further analysis. Similarly antibody titre against Newcastle Disease Virus (NDV) vaccination at 5th week of age was determined by Haemagglutination Inhibition (HI) activity with 4 HA units of virus. The highest dilution where complete inhibition of agglutination observed was read as titre (Thayer and Beard, 1998). Birds were vaccinated against NDV by ocular route at 7th and 28th day of age with Lasota strain.

In vivo cell mediated immune response (CMI) to mitogen, phytohaemagglutinin-P (PHA-P) as per Cheng and Lamont (1988) by using the wattle response to mitogen at the age of 6 weeks. Each bird received 0.1 mg of PHA-P intra-dermally and normal saline into the left and right wattle respectively. The thickness of injected wattle was measured using a thickness gauge (Mitutoyo) and the wattle swelling (cell mediated immune response) in millimeters was calculated as the difference in the increase in thickness of left wattle (injected with PHA-P) and the right wattle (injected with PBS). Response was estimated by assessing the difference between pre and post injections against control with normal saline:

Response = (Post injection-Pre injection)-(Post NS-pre NS)

Carcass characteristics: The slaughter parameters were recorded at 6th week of age. Carcass traits such as dressed weight, primal cuts (legs, wings, breast, neck and back), giblets (gizzard, liver, heart), head and blood are noted and expressed as percentage of live weight. The data were analyzed after *arc-sine* transformation of percentage values to observe the difference of means among the naked neck genotypes.

Heritability and correlation responses: Heritability and correlation estimates were measured for the data and were analyzed using Least squares technique as per, Harvey (1975) and the hatch corrected data were utilized for estimating the heritability estimates by variance component analysis (King and Henderson, 1954). Genetic and phenotypic correlations were estimated from variance covariance component analysis (Becker, 1975).

Statistical analysis: The data were subjected to a one way analysis of variance using General Linear Model (GLM) procedure in SPSS 16.0 package according to standard statistical procedures (Snedecor and Cochran, 1994). The significant differences of means among different genotypes were tested with Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Body weight, weight gain and shank length: The body weight (Fig. 4) and weight gain (Fig. 5) at 4th, 5th and 6th weeks of age were found to be significantly ($p \leq 0.05$) differed among the three genotypes under study as shown in the Fig. 4 and 5. *NaNa* genotype recorded significantly ($p \leq 0.05$) higher values while *nana* recorded lowest ($p < 0.05$). Results obtained in this study are in accordance with the findings of Rajkumar *et al*. (2010c, 2011) and Singh *et al*. (1998) but on lower side. Patra *et al*. (2002) identified higher body weight from 4th week onwards in *NaNa* genotype. Reddy *et al*. (2008) observed lower (877.60±0.10 g) 6th week body weights in naked neck gene line compared to the present findings and might be due to favourable effects of selection and feeding regimens followed and other managemental variations like environmental temperature and season

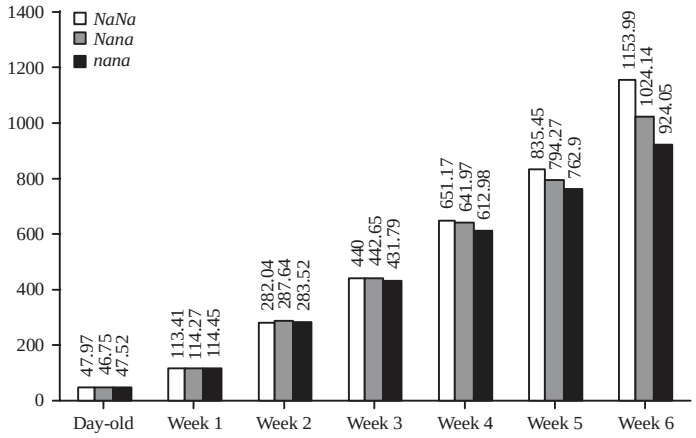

Fig. 4: Means of body weights (g) recorded during the first six weeks of age for the three genotypes

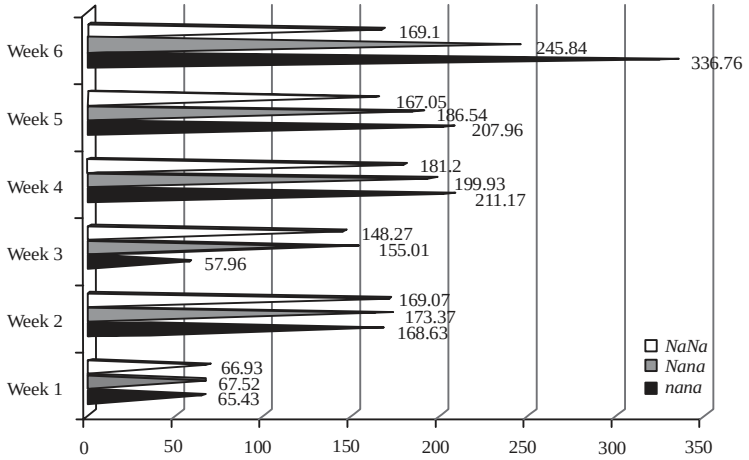

Fig. 5: Means of body weight gains (g) recorded during the first six weeks of age for the three genotypes

of the hatching during the trial. On contrary, De Almeida and Zuber (2010) and Magothe *et al*. (2010) reported lower body weights for naked neck genotypes than their normal counter parts from Kenya under free range conditions and temperate conditions, respectively. The higher body weight obtained in the present study indicates a more pronounced effect of *Na* gene in response to tropical climatic conditions. Shank length was observed to have no significant difference between genotypes but revealed higher values than Padhi *et al*. (2012). It is predicted that longer shank lengths are directly correlated with body weights, which may be used as the indirect selection criterion in birds. Longer and stronger shanks make the birds more fit for the forage conditions.

Immuno-competence traits: Significant differences in anti SRBC and titres were observed between *Nana* and *nana* genotypes (Fig. 6). The mean anti SRBC titres was found to be higher in 5.60 heterozygous populations rather than dominant and recessive populations. But HI titres to ND vaccination shows higher level for *NaNa* (5.10) followed by *Nana* and *nana* genotypes. Various reports (Patra *et al*., 2004; El-Safty *et al*., 2006; Fathi *et al*., 2005; Chatterjee *et al*., 2007;

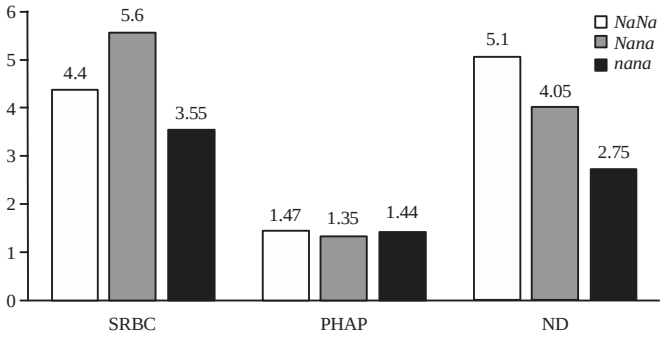

Fig. 6: Immunological parameters among the three genotypes

Table 1: Carcass characteristics as a percentage of live weight at the end of 6 weeks for all the genotypes

Parameters	Slaughter weight (%)	Dressing (%)	Breast	Thighs	Wings	Back	Neck	Heart	Liver	Gizzard	Head	Blood
NaNa	94.83^{ab}	71.96^{a}	16.20	20.06^{a}	8.63	15.02	4.75	0.59	3.24	2.55	3.32	5.40
Nana	95.17^{a}	70.99^{ab}	16.77	19.45^{b}	8.63	14.92	5.09	0.53	3.03	2.52	3.00	4.83
nana	94.60^{b}	69.66^{b}	16.13	18.54^{c}	8.97	14.31	5.25	0.54	3.13	2.49	2.89	5.17
Overall	94.87	70.87	16.40	19.35	8.75	14.75	5.03	0.56	3.13	2.52	3.07	5.13
SEM	0.23	0.36	0.32	0.16	0.15	0.21	0.13	0.01	0.07	0.04	0.08	0.23
n	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
p	0.037	0.03	0.064	0.036	0.418	0.077	0.201	0.186	0.497	0.06	0.074	0.33

Means with the same superscripts in a column did not differ significantly ($p<0.05$)

Galal, 2008; Rajkumar *et al*., 2010c, 2012b) on naked neck suggested higher humoral and CMI response in *NaNa* genotypes than *Nana* and *nana* ones.

The Cell Mediated Immune (CMI) response to PHA-P doesn't vary significantly among the three populations (Table 1). The CMI values in the present study were in the line of the findings of Cheng and Lamont (1988) but lower than that of Santosh (1999) and Rajkumar *et al*. (2011). RajKumar *et al*. (2012a) observed significantly higher CMI response for PHA-P and anti SRBC titre in homozygous naked neck populations. Though SRBC and NDV responses are humoral in nature, the higher antibody titres to SRBC might be because of CMI dependent response, therefore the variation among the genotypes.

Carcass characteristics: Observations pertaining to carcass characteristics indicated a significant ($p<0.05$) variation in de-feathered weight, thigh proportion and carcass yield (Table 1) with the values showing significantly higher for *NaNa* genotype than their recessive and heterozygous counterparts except for thigh parts. The dressing percentage was significantly higher in naked neck genotypes than their normal siblings, which can be attributed to higher body weight and less losses due to lack of feathers in naked neck chicken. The higher meat yield due to the presence of *Na* gene is well established (El-Attar and Fathi, 1995; Deeb and Cahaner, 1999; Yalcin *et al*., 1999; Fathi and Galal, 2001; Fathi *et al*., 2008; Rajkumar *et al*., 2010b, 2011).

The dressing percentages were higher in *NaNa* and *Nana* genotypes than full feathered birds which was in accordance with the findings of Rajkumar *et al*. (2011), who reported that the naked neck chicken were significantly higher in live weight, dressing yield, thigh and giblet weight than their normal siblings. The increased proportion of muscle in pectoral and thigh region in *Na* genotypes might be due to the availability of higher levels of dietary protein for muscle development with less protein requirement for plumage feather development (Merat, 1990). El-Attar and Fathi (1995) observed significantly higher breast yields in naked neck genotypes

Table 2: Heritability estimates for juvenile traits in naked neck population

Trait	Sire (σ^2S)	Dam (σ^2D)	Sire+dam (σ^2S+D)
0 BW	0.22±0.15	0.61±0.41	0.44±0.29
2 BW	0.33±0.15	0.57±0.17	0.40±0.22
4 BW	0.23±0.12	0.39±0.14	0.28±0.20
6 BW	0.35±0.24	0.29±0.13	0.31±0.19
Shank length	0.24±0.18	0.14±0.11	0.18±0.15

Table 3: Overall Genetic (above the diagonal) and Phenotypic (below the diagonal) correlations of body weights in naked neck chickens

Age/trait	Day-old	2 week	4 week	6 week	Shank length
Day-old	-	0.29	0.26	0.34	0.29
2 week	0.06	-	0.92**	0.86**	0.59
4 week	0.05	0.64*	-	0.84**	0.77**
6 week	0.15	0.45*	0.66*	-	0.88
Shank length	0.13	0.32	0.51*	0.64*	-

*Significant at $p \leq 0.05$, **Significant at $p \leq 0.01$

under high ambient temperatures. Similarly, better meat yield in naked neck genotypes was also reported by Yalcin *et al*. (1997). The higher meat yield was attributable to high protein availability of naked neck birds which led to high muscle formation (Merat, 1990).

Heritability estimates: Heritability values for day-old, 2, 4 and 6 week body weight and shank length were estimated through sire, dam and sire + dam components of variance (Table 2). The h^2 estimates for 4th week body weight were higher for dam component than that of sire, while for 6th week it is vice-versa indicating the substantial additive genetic variance that can be transmitted to the next generation. The results were in accordance with the reports of Reddy *et al*. (2008) and Rajkumar *et al*. (2010a) in naked neck broilers. Further, these are found to be at higher end than indicated by Adeyinka *et al*. (2006) in Nigerian naked neck broilers. The low heritability of shank length (Table 2), in the present study may be attributable to non-additive effects like dominance, epistasis and environmental variation (Adeyinka *et al*., 2006; Rajkumar *et al*., 2010c).

Correlation responses: Weekly body weights were highly correlated with each other both on genotypic and phenotypic scale (Table 3) except for DOH which relevantly showed lower correlation coefficient. The DOH is found to be more dependent on egg weight and incubation losses. Correlation coefficients between 2, 4 and 6 week body weight and shank length were found to be positive and highly significant ($p \leq 0.01$) on phenotypic and genetic scale suggesting that these two traits were governed by same set of genes. The findings also suggests that selection criterion can be preponed to 4th week body weights instead of traditional 6 week body weights in naked neck broiler (Rajkumar *et al*., 2010c), thus reducing the cost of feed maintained etc. Further, the breeder to cull the unwanted birds at early age and improves the economics of broiler farming.

The positive correlation between body weight and shank length indicated that any improvement in one of the traits will bring about concomitant improvement in the other trait as a correlated response to selection. Similar correlation response was observed (Rao *et al*., 2004; Reddy *et al*., 2008; Rajkumar *et al*., 2010c) in different chicken varieties. The positive correlation of shank length with juvenile body weights indicated that higher body weights at these ages might lead to longer shank length, which is desired to selection for better production.

CONCLUSION

- As the age increases, the magnitude of relative superiority of *NaNa* and *Nana* genotypes realized over *nana* genotypes for growth in the present study

- The significantly higher hemolytic level in the sera for SRBC and ND virus in dominant and heterozygous birds suggests a positive effect of the naked neck gene. The assays used in this study revealed that the *Na* gene do not have a negative impact on the immune competence measures
- The h^2 estimates for the body weight were moderate to high indicating the substantial additive genetic variance and scope for further improvement in the population. The heritability estimates for shank length were low to moderate, but the sire component heritability were more than the dam component indicating further scope for improvement
- The 4 and 6 week body weights are highly and positively correlated, suggesting that selection criterion can be preponed to 4th week body weights instead of traditional 6 week body weight in naked neck broilers. The genetic and phenotypic correlation coefficient between body weights (4 and 6 weeks) and shank length were significant ($p<0.05$) and positively correlated
- The '*Na'* genotype had higher slaughter, dressing percentages and thigh yield indicating effects of '*Na'* gene on body weights. This may be associated to minimizing the negative effect of hot climate and less losses due to lack of feathers

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