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Effect of Genotype and Age on Egg Quality Traits in Naked Neck Chicken under Tropical Climate from India

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Abstract: A comprehensive study was undertaken to evaluate the egg quality traits in three naked neck genotypes, NaNa (homozygous), Nana (heterozygous) and nana (normal) by utilizing 556 eggs collected at 28, 32, 36 and 40 weeks of age. The overall mean egg weight, shape index and Haugh unit values were 56.41 g, 75.79 and 75.98, respectively. The yolk index, yolk height and yolk colour varied significantly ($p \leq 0.01$) in three genotypes. All other external and internal egg quality traits were not differed significantly among the genotypes; however Naked neck had better egg quality in almost all the traits. Age had significant ($p \leq 0.01$) effect on all the traits studied in Naked neck chicken. Haugh unit score was better in 28 week age group. The egg, yolk, albumin and shell weights were positively correlated with the age. The average shell weight and thickness values were 5.07 g and 0.401 mm, respectively, which had no significant variation among the genotypes. The Na gene had marginal effect on all the egg quality traits studied. The better egg quality parameters in naked neck chicken are desirable which indicate the better keeping quality of the eggs and withstand the handling damages.

Key words: Naked neck, egg quality, haugh unit, shape index and yolk index

INTRODUCTION

The Naked neck condition is characterized by complete absence or reduced feathers in the neck region of chicken controlled by an autosomal dominant gene (Davenport, 1914). The heterozygotes have a tuft of feathers on the ventral side of the neck (Scott and Crawford, 1977) whereas homozygotes have no plumage (Somes, 1988). The naked neck gene plays an important role in broiler production in tropical areas because of its association with heat tolerance (Merat, 1986; Lin *et al*., 2006) which is considered to be the most important inhibiting factor for poultry production in hot tropical climate (Horst, 1987). The Naked neck chicken has the ability to adapt, survive, perform and reproduce under harsh, hot and humid climatic conditions better than the normal feathered birds (Yakubu *et al*., 2008). Evaluation of external and internal quality of the egg is essential as consumers prefer better quality eggs.

The Naked neck eggs have consumer preference because of its larger size, heavier weight and brown colouration. Stadelman (1977) described egg quality as the characteristics of an egg that affect its acceptability to the consumers. Many factors influence the egg quality i.e., breed/ strain/ variety, temperature, relative humidity, rearing practices and season (Sauter *et al*., 1954; Washburn, 1990). The success of poultry farming largely depends on the total number of good quality eggs produced especially in breeders. Though lot of work has been carried out on growth performance of naked neck chicken, the information on egg quality traits in naked neck birds are scanty. Islam and Nishibori (2009) reviewed the present status and prospects of naked neck chicken from Bangladesh and observed that the egg quality studies in naked neck chicken are limited. In the present study the effect of naked neck gene and age on different external and internal egg quality traits in three genotypes of Naked neck chicken were studied.

MATERIALS AND METHODS

The data on egg quality traits collected form three Naked neck genotypes maintained at Project Directorate on Poultry, Rajendranagar, Hyderabad, India, under selection for 6 week body weight for the last six generations were analyzed in the present study. The birds were identified phenotypically by the lack feathers (NaNa, homozygotes), tuft of feathers on the ventral side (Nana, heterozygotes) and full feathers (nana, normal) on the neck region. The birds were under restricted feeding schedule with a broiler breeder ration to maintain the desired body weight during growing and laying period.

A total of 556 eggs were collected from the three genotypes at different ages i.e. 28, 32, 36 and 40 weeks and various external and internal egg quality traits were estimated. The external characters like egg weight, length and width were measured. Thereafter the eggs were broken and the internal traits like yolk weight, colour, height, albumin weight were recorded using standard procedure. Egg weight, Haugh unit, albumin height and yolk colour were measured using egg quality tester (EMT 5200, Japan). All the parameters were estimated using standard methods.

The data were analyzed as per the standard methods (Snedecor and Cochran, 1994) using General Linear Model (GLM) procedure in SPSS 12.0 package. The effect of genotype and age on the different egg quality traits was assessed. The significance of differences of means among genotypes was tested with Duncan's multiple range test.

RESULTS AND DISCUSSION

The findings are presented and discussed according to the genotype wise (Table 1) and age wise (Table 2). The analysis of variance revealed that the naked neck gene had significant effect ($p \leq 0.01$) on yolk traits, while age had highly significant ($p \leq 0.01$) on all the egg quality traits studied.

Egg weight: The mean egg weight in NaNa, Nana and nana genotypes was 56.45, 56.72 and 56.11 g, respectively (Table 1). The Na gene had non significant effect on egg weight, though it was numerically better in Nana genotype. The gene had marginal positive effect on egg weight either in single or in double condition. The non significant effect of the gene may be because of the genetic similarity of the three genotypes which were produced from the same flock. The egg weight significantly ($p \leq 0.01$) varied between the age groups except between 36 and 40 weeks which showed no significant variation (Table 2). The mean egg weight recorded was 56.41 g in Naked neck chicken. Islam *et al*. (2001) observed significant difference in egg weights between desi naked neck and full feathered chicken from Bangladesh, however it was significantly lower (40.5 g) compared to the present findings. Yakubu *et al*. (2008) reported lower egg weight (43.04 g) in Naked neck (NaNa) chicken from Nigeria under free range conditions. Egg weight variations in different genetic groups were reported by many authors (Washburn, 1990; Padhi *et al*., 1998; Chatterjee *et al*., 2007). Lower egg weights than the present study were observed in Naked neck (54.39±0.87), White Nicobari fowl (52.45±1.72), Brown, Black Nicobari (Chatterjee *et al*., 2007). Niranjan *et al*. (2008) observed lower egg weights in rural varieties (Vanaraja and Gramapriya) developed for backyard poultry. Mathivanan and Selvaraj (2003) reported higher egg weight (60.23 g) in IWH as compared to the naked neck chicken studied. The egg weights gradually increased as age increases showing the positive correlation between egg weights and age. The variation in egg weight may be attributable to the feed composition, feeding schedule and local environmental conditions.

Shape index: Shape index is the ratio of the width to length of the egg. The average shape index was 75.79 in Naked neck chicken. The genotypes had no significant variation in the shape indices; naked neck gene had little positive effect (Table 1). The shape index was significantly ($p \leq 0.01$) higher at 36 weeks of age indicating the more uniform egg shape, whereas significantly lower at 40 weeks of age. The shape index at 28 and 32 weeks did not show any significant variation. Yakubu *et al*. (2008) reported lower shape index of 74.65 for NaNa birds from Nigeria. Chatterjee *et al*. (2006) observed higher shape index, 80.76±1.32 for IWK and lower indices for IWI (73.77±3.08) and IWH (72.67±7.56) strains of White Leghorn. Lower shape index was observed for Naked neck (74.54) and higher for some other indigenous poultry breed of Andaman i.e., black, white and brown Nicobari fowl (Chatterjee *et al*., 2007) than the present study. The higher shape indices observed in the study may be because of the more uniform shape and size of the eggs. The egg length and egg width also showed the similar trend as that of shape index.

Haugh unit: Haugh unit is the measure of albumin quality which determines the quality of the egg. The average Haugh unit values were 75.94 (NaNa), 76.36 (Nana) and 73.99 (nana) with a marginal positive effect of Na gene in either single or double condition. The genotype had no significant effect on the Haugh unit scores. Yakubu *et al*. (2008) observed comparable Haugh unit value (73.22) for NaNa genotype which differed significantly from normal feather counterparts in Nigerian local chicken. At 28 weeks of age Haugh unit scores were significantly ($p \leq 0.01$) higher than other age groups (Table 2) which may attributable to the better albumin quality. Lower Haugh unit values of 73.16 in Naked neck was recorded by Padhi *et al*. (1998). Parmar *et al*. (2006) observed wide range of Haugh unit value for Kadaknath birds starting form 62.58-90.00 from India. Chatterjee *et al*. (2006) also reported lower Haugh unit values, 59.62-71.62 for the White Leghorn strains. The higher Haugh unit score in the Naked neck chicken indicated the superior quality of the albumin. Haugh unit values ranging from 100.25-106.29 were reported in crosses of naked neck, frizzle and normal chicken from Nigeria which are higher than the present values (Nwachukwu *et al*., 2006).

Albumin

Albumin weight: Albumin weight had no significant variation among the genotypes; however Naked neck genotypes had higher albumin weight (Table 1). The average albumin weight was 35.11 g in Naked neck chicken. Albumin weight was significantly ($p \leq 0.01$) higher in age group 36 weeks compared to other age groups. Islam *et al*. (2001) reported lower albumin weight (20.7 g) in Naked neck birds than the present study. Lower albumin weights (23.46-26.67 g) than the present study were recorded by Chatterjee *et al*. (2007) in indigenous fowls of Andaman. The albumin weight

Table 1: Egg quality traits in three genotypes of Naked neck chicken

Parameter	Genotypes			Gene effect		SEM	Prob
	NaNa	Nana	nana	NaNa	Nana		
n	152	281	123				
Egg weight, g	56.45	56.72	56.11	0.61	1.09	0.27	0.635
Egg length, mm	57.92	58.12	59.41	-2.51	-2.17	0.29	0.501
Egg width, mm	44.03	43.86	44.21	-0.41	-0.79	0.18	0.900
Shape index	76.36	75.77	74.81	2.07	1.28	0.35	0.668
Haugh unit	75.94	76.36	73.99	2.64	3.20	0.62	0.563
Shell weight, g	5.12	5.02	5.07	0.99	-0.99	0.04	0.869
Shell thickness, mm	0.40	0.41	0.39	2.56	5.13	0.03	0.826
Yolk colour	7.35^{b}	7.63^{b}	8.00^{a}	-8.13	-4.63	0.06	0.000
Yolk weight, g	17.09	17.05	17.78	-3.88	-4.11	0.15	0.375
Yolk height, mm	13.85^{b}	14.24^{b}	14.98^{a}	-7.54	-4.94	0.07	0.001
Yolk width, mm	38.83	38.91	39.39	-1.42	-1.22	0.17	0.313
Yolk index	35.82^{b}	36.79^{ab}	38.29^{a}	-6.45	-3.92	0.21	0.008
Albumin weight, g	34.24	34.65	33.26	2.94	4.18	0.28	0.456
Albumin height, mm	5.97	6.03	5.69	5.29	6.35	0.07	0.349
Albumin width, mm	75.88	74.74	76.07	-0.25	-1.75	0.47	0.792

Means with different superscripts within a row differ significantly ($p \leq 0.01$)

Table 2: Egg quality traits in Naked neck chicken at different ages

Parameter	Age in weeks					SEM	Prob
	28	32	36	40	Overall		
n	146	129	134	147	556		
Egg weight, g	53.67^{c}	56.29^{b}	59.23^{a}	59.96^{a}	56.41	0.27	0.000
Egg length, mm	54.68^{b}	55.83^{b}	60.56^{a}	61.71^{a}	58.23	0.29	0.000
Egg width, mm	41.72^{c}	42.35^{c}	47.67^{a}	44.10^{b}	43.91	0.29	0.000
Shape index	76.58^{b}	76.24^{b}	78.96^{a}	71.92^{c}	75.79	0.35	0.000
Haugh unit	81.59^{a}	75.12^{b}	74.41^{b}	72.40^{b}	75.98	0.62	0.000
Shell weight, g	4.76^{b}	4.54^{c}	5.42^{a}	5.52^{a}	5.07	0.03	0.000
Shell thickness, mm	0.455^{a}	0.388^{b}	0.389^{b}	0.372^{c}	0.401	0.003	0.000
Yolk colour	8.39^{a}	8.32^{a}	8.10^{a}	6.99^{b}	7.93	0.06	0.000
Yolk weight, g	14.18^{d}	16.07^{c}	18.51^{b}	19.72^{a}	17.12	0.15	0.000
Yolk height, mm	13.61^{b}	13.68^{b}	14.93^{a}	14.71^{a}	14.23	0.07	0.000
Yolk width, mm	36.16^{c}	37.97^{b}	40.85^{a}	40.83^{a}	38.93	0.17	0.000
Yolk index	37.74^{ab}	36.30^{c}	36.79^{bc}	36.07^{c}	36.74	0.21	0.015
Albumin weight, g	34.73^{bc}	35.68^{a}	35.3^{ab}	34.72^{c}	35.11	0.28	0.000
Albumin height, mm	6.65^{a}	5.77^{b}	5.81^{b}	5.60^{b}	5.97	0.07	0.000
Albumin width, mm	67.12^{c}	74.45^{b}	79.24^{a}	79.61^{a}	74.99	0.47	0.000

Means with different superscripts within a row differ significantly ($p \leq 0.01$)

ranged from 28.6-31.1 g in rural varieties developed for backyard poultry (Niranjan *et al*., 2008) which was lesser compared to the Naked neck genotypes. The higher proportion of albumin may be because of the larger size of eggs recorded in the present study.

Albumin height: Albumin height did not vary significantly among the three genotypes; however the naked neck genotypes had higher estimates compared to the normal birds. Na gene had positive effect on albumin height in both single and double condition. Albumin height was significantly ($p \leq 0.01$) higher (6.65 mm) in 28 week age group compared to other age groups. Yakubu *et al*. (2008) observed lower albumin height (4.65 mm) in Naked neck chicken from Nigeria than the present estimates. Similar estimates for albumin height were reported in rural crosses by Niranjan *et al*. (2008).

Yolk

Yolk index: Yolk index values were significantly lesser in Naked neck genotypes ($p \leq 0.01$), it was higher (38.29) in normal feathered birds (Table 1). The Na gene reduced the yolk index marginally. Higher yolk indices, 50.6 in NaNa birds (Yakubu *et al*., 2008); 41.0±0.01 to 45.0±0.01 in Nicobari varieties of Andaman (Padhi *et al*., 1998); 44-46 in rural varieties (Niranjan *et al*., 2008) were observed than the present findings. Chatterjee *et al*. (2007) reported lower yolk index in Naked neck chicken of Andamans. The yolk index significantly varied between the age groups with highest value of 37.74 in 28 week age group.

Yolk weight: Yolk weight in the three genotypes NaNa, Nana and nana were 17.09, 17.05 and 17.78 g, respectively, which did not realize any significant variation. The lower yolk weights in Naked neck birds

indicated that these eggs had lower fat percentage than the normal birds. Yolk weight at 36 and 40 weeks of age were significantly higher ($p \leq 0.01$) compared to other two age groups (Table 2). Chatterjee *et al.* (2007) reported higher yolk weights in Naked neck, Barred desi and Frizzle fowl and lower yolk weights in brown and black Nicobari breeds of Andaman than the present findings. The yolk weight (16.95 g) in NaNa birds reported by Yakubu *et al.* (2008) was comparable to the present estimate, while Islam *et al.* (2001) observed lower (13.1 g) yolk weight in Naked neck birds.

Yolk colour: Na gene significantly ($p<0.01$) reduced the yolk colouration. The yolk colour values were significantly higher in nana birds (Table 1). Yolk colour estimates were significantly ($p<0.01$) higher in 28, 32 and 36 weeks age groups. As age advances the yolk colour reduced gradually up to 40 weeks of age. Islam *et al.* (2001) reported lower estimates (4.5) for yolk colour in Naked neck chicken from Bangladesh.

Shell

Shell thickness: The average shell thickness was 0.401 mm in Naked neck chicken which had no significant variation among genotypes. The shell was significantly ($p \leq 0.01$) thicker in 28 week age group compared to others. As age advanced the shell thickness gradually reduced (Table 2) with a significant lower shell thickness at 40 weeks of age. The higher shell thickness helps in preventing the damage during handling and also improves the keeping quality of the eggs. The mean shell thickness of 0.34 mm in Naked neck (Islam *et al.*, 2001); 0.30-0.34 in crosses involving Naked neck, Frizzle and normal birds (Nwachukwu *et al.*, 2006); 0.31 in Kadaknath (Parmar *et al.*, 2006); 0.33 in Nicobari, 0.31 in Naked neck and White Leghorn (Padhi *et al.*, 1998) were lesser than the shell thickness observed in the present study. The shell thickness values reported by Niranjan *et al.* (2008) were comparable to the present findings. Yakubu *et al.* (2008) observed 0.38 mm thickness of the shell in Naked neck chicken from Nigeria which was marginally lower to the present values. The variations may be attributed to the feed composition utilized and the climatic conditions prevailing in the regions.

Shell weight: Shell weight did not vary significantly among the three Naked neck genotypes. The average shell weight was 5.07 g accounting for 9% of the total egg weight. The shell weight was significantly ($p \leq 0.01$) higher in 36 and 40 week age groups. The shell weight increased with egg weight showing the positive correlation between the traits. Non-significant differences were observed in Nicobari, Naked Neck and White Leghorn breeds for shell weight (Padhi *et al.*, 1998). Chatterjee *et al.* (2007) also reported the non significant breed difference in shell weight for six indigenous chicken breeds from Andamans. Yakubu *et al.* (2008) and Islam *et al.* (2001) observed lower shell weight in Naked neck chicken from Nigeria and Bangladesh, respectively.

Conclusion: Naked neck gene had a marginal effect on various egg quality traits studied. Significant effect of the gene was observed for yolk index, yolk height and yolk colour. Age had significant effect on all the egg quality traits studied. The egg quality traits were better in Naked neck (NaNa and Nana) genotypes though not significant compared to their normal counter parts.

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