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RESEARCH ARTICLE
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Evaluation of egg quality traits of endangered Nicobari fowl and its crosses under intensive and backyard system of Andaman and Nicobar Islands, India

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Abstract

Aim: In the present study, egg quality traits of endangered Nicobari fowl and its crosses (Nicorock and Nishibari) were evaluated under intensive (deep litter) as well as backyard system, in the regions of Andaman and Nicobar Islands, India.

Materials and Methods: Fresh eggs (15) of all the three genetic groups of birds were collected randomly from institute farm (intensive system) and from farmers' field. The eggs were collected from adult birds (50 weeks of age) 3 times with 5 in number in each time. All the genetic groups of birds were subjected to same husbandry practices. The eggs were subjected to external and internal quality parameters study.

Results: The effect of genetic groups on egg weight was significant ($p<0.05$) for all the groups. Nicorock had significantly higher egg weight (g) (56.79±0.77) in comparison to Nicobari (53.20±0.34) and Nishibari (48.98±0.22) under intensive system of management. Under backyard condition, the egg weight (g) of Nicorock (48.60±1.04) was significantly higher than Nicobari but not with Nishibari. In general, the egg weight was found less under backyard system than intensive system that might be due to scavenging nature of birds. Egg length, egg width and shape index differed significantly ($p<0.05$) among the genetic groups. Yolk index of Nicorock was significantly ($p<0.05$) higher than Nishibari under intensive as well as backyard condition. The shell thickness varied significantly ($p<0.05$) among different genetic groups. Haugh unit of Nicorock was significantly ($p<0.05$) lower in comparison to Nicobari and Nishibari under intensive system, but did not vary significantly among genetic groups under backyard condition.

Conclusions: The study revealed that there was a significant effect of genetic groups on different egg quality traits; both in intensive system and backyard condition.

Keywords: egg quality parameters, nicobari fowl, nishibari, nicorock, Andaman and Nicobar Islands.

Introduction

Backyard poultry farming is gaining wider importance and acceptance among the rural people of tropical countries as a source of income generation and supplementary livelihood activity [1]. Total poultry population of Andaman and Nicobar Islands, India is 10.8 lakhs according to 2012 census (AH & VS, Andaman and Nicobar Administration, personal communication) and consists mostly of indigenous varieties [2]. Though very large population of birds is available, there is an acute shortage of egg and chicken in these Islands as the demand of animal protein is increasing day by day due to heavy inflow of tourists and a high percentage of non-vegetarian population [2]. The quality of the egg is one of the important considerations for the consumers and eggs of indigenous birds generally fetch higher price than eggs from commercial layer birds in the local market of Andaman and Nicobar islands. Therefore, it is utmost important to evaluate the egg quality parameters of the indigenous birds of Andaman and Nicobar islands.

Andaman and Nicobar islands are the habitat of many indigenous poultry varieties. Among them, Nicobari fowl draws most attention due to its several valuable characteristics i.e., it is highest egg producer among all Indian indigenous chicken breeds, resistant to some of the deadliest diseases of poultry, is very much adaptable to the local conditions of these Islands and can fly well to avoid predators [3]. They lay 128-142 eggs/annum under free range condition and attain a body weight of 1392 g in 184 days [3]. Nicorock and Nishibari were developed by the institute through cross breeding of Black Rock with Black Nicobari and Brown Nicobari with White leghorn respectively. Nishibari produces 160-170 eggs/year under backyard, and Nicorock produces 130-140 eggs/year with an average of 1 kg body weight at 12 weeks of age under backyard system [2]. They are easily adaptable to the local environment.

The information on the structure of the egg and its various quality parameters are essential for better

understanding of fertility, embryo development and diseases of the poultry. Many factors influence the egg quality, i.e., breed/strain/variety, temperature, relative humidity, rearing practices and season [4]. Differences in egg quality traits have been reported by various workers [5-7]. Though lot of work has been carried out on egg quality traits, the information on egg quality traits of Nicobari and its crosses under deep litter and backyard farming are limited.

The present study was aimed to assess the egg quality traits of Nicobari and its crosses (Nicorock and Nishibari) under deep litter and backyard farming system, in the regions of Andaman and Nicobar Islands, India.

Materials and Methods

Ethical approval

The present experiment complies with all relevant institutional and national animal welfare guidelines and policies and the experiment has been conducted as per the approval of the Institute Animal Ethics Committee, Central Island Agricultural Research Institute, Port Blair.

Birds

In the present experiment, three genetic strains of birds were utilized viz. Nicobari, Nishibari and Nicorock. Egg quality traits were evaluated under intensive and backyard system of management. Under intensive system (deep litter system), all the birds were wing banded and reared in equal numbers over different pens providing uniform management conditions. Feed and water were provided as per Bureau of Indian Standard specifications. Ambient temperature, lighting, ventilation and other environmental conditions were provided according to the recommended standards. Chick starter ration was provided to the chicks up to 8 weeks of age. Subsequently, the grower ration during growing and layer ration during laying period were provided. The composition of starter, grower and layer ration is given in Table-1. For backyard system, eggs were collected from farmers' field where birds were maintained under uniform management conditions.

Table-1: Ingredients and nutrient composition of the poultry feeds used in the study.

Ingredient	Starter (Kg)	Grower (Kg)	Layer (Kg)
Maize	59.15	58.95	60.55
DORB	0	5.99	4.97
Soyabean	31.89	20.80	18.01
Fish meal (43% protein)	0	0	8.0
Sunflower meal	5.20	11.08	6.17
CALCITE (Calcium D-pantothenate)	1.6	2	2
DCP	1.6	1.4	0.4
DLM	0.2	0.11	0.1
LY	0.06	0	0
Salt	0.4	0.4	0.1
ME (kcal/kg)	2781	2642	2560
Crude protein (%)	20.53	17.9	18
Calcium %	0.99	1.1	3.82
A. phosphorus%	0.46	0.42	0.42

DORB=Deoiled rice bran, DCP=Di-calcium phosphate, DLM=DL-methionine, LY=Lysine

Measurement of egg quality traits

Egg quality traits evaluated were egg weight (g), egg length (mm), egg width (mm), shape index, yolk diameter (mm), yolk height (mm), yolk weight (g), yolk percentage, yolk index, albumen height (mm), albumen weight (g), albumen percentage, shell weight (g), shell thickness (mm), shell percentage and Haugh unit. The traits were determined following standard procedure and formulae. The measurements were taken using digital venire calipers (least count 0.01 mm). Various indices of egg quality traits estimated are as follows:

A. Shape Index = Maximum width/Maximum length × 100
B. Albumen Index = Albumen height/Average Albumin width × 100
C. $$\text{Haugh unit} = 100\log\left[H - \frac{\sqrt{G(30W^{0.37} - 100)}}{100} + 1.9\right]$$

   H = Albumen height in millimeters
   G = 32.2 (gravitational constant)
   W = Weight of egg in gram
D. Yolk index = Height of yolk/diameter (mm).

Statistical analysis

All the collected data were analyzed with the SAS Software Release 8.2 (SAS Inst., Inc., Cray, NC) with the Proc GLM and Proc CORR procedures. The differences between treatments were analyzed using a one-way analysis of variance. Differences with a confidence level of 0.05 or less were considered to be significant.

Results

Egg quality traits of different genetic strains reared under intensive system of management are presented in Table-2. Under intensive system, egg weight of Nicorock (56.79±0.77 g) was found significantly ($p<0.05$) higher in comparison to Nicobari (53.20±0.34) and Nishibari (48.98±0.22). Yolk diameter, yolk height and yolk weight of Nicorock were also significantly higher in comparison to Nicobari and Nishibari; whereas, albumen height of Nicorock was significantly lower in comparison to other genetic strains. A significantly higher shell thickness was observed in Nicobari in comparison to the other strains though Nicorock and Nishibari did not differ in shell thickness significantly. No significant variations among three strains were found in respect to shape index. Yolk index of Nicorock was significantly higher than Nicobari, but did not vary significantly with Nishibari. Nicorock and Nishibari also did not differ significantly in respect to yolk index. Haugh unit of Nicorock was significantly lower in comparison to

Table-2: Egg quality traits of Nicobari and Cross Nicobari fowl under intensive system of management.

Parameters	Nicobari (15)	Nicorock (15)	Nishibari (15)
Egg weight (g)	53.20±0.34[b]	56.79±0.77[a]	48.98±0.22[c]
Egg length (mm)	55.71±0.08	56.94±0.79	56.94±0.79
Egg width (mm)	36.85±0.09[ab]	37.25±0.34[a]	29.28±6.18[c]
Shape index	66.15±0.17	65.50±1.48	66.45±1.46
Yolk diameter (mm)	38.71±0.14[b]	40.89±0.67[a]	36.65±0.02[c]
Yolk height (mm)	11.80±0.12[b]	13.80±0.73[a]	11.70±0.12[b]
Yolk weight (g)	14.93±0.11[b]	18.17±0.71[a]	14.93±0.11[b]
Yolk %	28.99±0.75[b]	32.41±1.49[a]	30.48±0.35[ab]
Yolk index	0.30±0.01[b]	0.33±0.03[a]	0.31±0.01[ab]
Albumen height (mm)	5.60±0.03[a]	5.26±0.09[b]	5.64±0.09[a]
Albumen weight (g)	31.41±0.23[a]	31.98±1.12[a]	27.65±0.53[b]
Albumen %	59.03±0.06[a]	56.88±1.41[b]	56.46±0.86[b]
Shell weight (g)	6.38±0.41	6.01±0.10	6.41±0.21
Shell thickness (mm)	0.39±0.04[a]	0.29±0.05[b]	0.30±0.03[b]
Shell %	11.96±0.69	10.70±0.14	13.08±0.48
Haugh unit	76.13±0.07[a]	71.96±0.83[b]	78.02±0.53[a]

Values are expressed as mean±standard error. [a,b,c]Values within the same column with different superscripts differ significantly ($p<0.05$)

Table-3: Egg quality traits of Nicobari and Cross Nicobari fowl under backyard system of management.

Parameters	Nicobari (15)	Nicorock (15)	Nishibari (15)
Egg weight (g)	43.01±1.16[b]	48.60±1.04[a]	43.48±1.38[ab]
Egg length (mm)	51.38±0.69[b]	54.59±0.48[a]	52.01±0.77[b]
Egg width (mm)	35.42±0.68	35.32±0.30	34.14±0.59
Shape index	69.03±1.51[a]	65.26±0.93[b]	65.68±1.04[b]
Yolk diameter (mm)	37.95±0.64	39.66±1.31	37.14±0.84
Yolk height (mm)	12.50±0.43[a]	10.88±0.17[b]	10.79±0.18[b]
Yolk weight (g)	15.46±0.74	16.23±0.78	15.51±1.22
Yolk %	35.07±0.95	34.64±1.59	37.41±2.55
Yolk index	0.33±0.02[a]	0.27±0.01[b]	0.29±0.01[b]
Albumen height (mm)	5.74±0.34	5.34±0.11	5.48±0.08
Albumen weight (g)	23.02±0.62[a]	25.00±1.03[a]	20.64±2.33[b]
Albumen %	52.49±1.64	53.00±1.68	49.85±3.98
Shell weight (g)	4.74±0.25	5.59±0.20	5.25±0.50
Shell thickness (mm)	0.39±0.08[a]	0.29±0.03[b]	0.28±0.04[b]
Shell %	11.35±0.51	11.93±0.60	12.73±1.54
Haugh unit	78.78±2.58	76.32±0.97	78.14±1.23

Values are expressed as mean±standard error. [a,b]Values within the same column with different superscripts differ significantly ($p<0.05$)

the other genetic strain of birds. Nishibari fowl had significantly higher Haugh unit than Nicorock but did not differ with Nicobari.

Egg quality traits of different genetic strains reared under backyard system of management are presented in Table-3. Egg weight of Nicorock was significantly higher than Nicobari, but not with Nishibari. Whereas, the yolk height of Nicobari was significantly higher in comparison to Nicorock and Nishibari, no significant variations in yolk diameter and yolk weight were found among the three groups. Albumen weight of Nishibari was significantly lower in comparison to the other groups. Shell thickness and shape index of Nicobari was significantly higher in comparison to other genetic groups. No significant variation in Haugh unit was found among the three groups.

Discussion

Effect of genotype on egg quality parameters were reported by various previous workers [5-9]. In general, the egg weight of indigenous birds was found to be low as compared to exotic layers or broilers; however, we observed higher egg weight of Nicobari crosses than the exotic varieties/strains in this study. This might be due to the utilization of exotic germplasm for the development of these cross varieties [10]. Islam *et al*. [11] reported significant differences in egg weight and quality traits of indigenous Naked Neck and indigenous full feathered birds which were consistent with the results of the present study. In the present study, average egg weights under backyard condition were 43.01±1.16 g for Nicobari, 48.60±1.04 g for Nicorock and 43.48±1.38 g for Nishibari (Table-2) which were higher than that of Kadaknath [12] but lower than reported in Indian White leghorn Izatnagar (IWH) [13] under field conditions in India. Kadaknath is a black meat chicken breed of India, commonly available in jet-black, penciled and golden color. The bird is very popular among the tribal people of India mainly due to its adaptability to the local environment, disease resistance property, tasty meat quality, texture and flavor. It is considered not only a delicacy of distinctive taste, but also of medicinal value. IWH [13] is a pure line of white Leghorn, maintained at Directorate of Poultry Research. This breed of poultry is also very adaptable to the field conditions of India. The higher egg weight of Nicorock and Nishibari might be due to the presence of exotic germplasm in these cross birds [10].

Shape index is the ratio of the width to length of the egg. In the present study, the average shape index values recorded ranged from 65.50±1.48 in Nicobari to 66.45±1.46 in Nishibari bird under intensive system (Table-1) and from 65.68±1.04 in Nicorock to 69.03±1.51 in Nicobari bird under backyard condition (Table-2). Higher shape index of 74.35 was reported by Parmar *et al*. [12] in Kadaknath. Chatterjee *et al*. [14] observed higher shape index, 80.76±1.32 for IWK (Indian White Legorn K strain) and lower indices for IWI (Indian White Leghorn I-strain) (73.77±3.08) and IWH (72.67±7.56) strains of White Leghorn.

Albumen weight of Nicobari and it crosses varied from 27.65±0.53 g to 31.98±1.12 g which agrees with the findings reported by Chatterjee *et al*. [15] in indigenous fowls of Andaman but higher than the values reported in Kadaknath (20.74g) [12]. The

Nicorock bird studied was the cross of exotic and improved chicken varieties with Nicobari fowl that might be the reason for its better albumen weight. The egg albumen height ranged from 5.34±0.11 mm in Nicorock to 5.74±0.34 mm in Nicobari in backyard system (Table-2) and 5.26±0.09 mm in Nicorock to 5.64±0.09 mm in Nishibari in intensive system (Table-1). Fayeye *et al*. [16] reported the albumen height of Fulani-ecotype chicken as 4.92±0.79 mm which was lower than the values of the present study.

Yolk weight in the Nicobari and its crosses varied from 13.36±0.23 g in Nicobari to 18.17±0.71 g in Nicorock that differed significantly. A lower estimate of yolk weight (15.18 g) was observed in Kadaknath [12]. Chatterjee *et al*. [15] reported higher yolk weights in Naked Neck, Barred Desi and Frizzle Fowl and lower yolk weights in Brown and Black Nicobari breeds of Andaman and Nicobar Islands. The egg yolk height ranged from 11.70±0.12 mm in Nishibari to 13.80±0.73 mm in Nicorock in intensive system (Table-1) and 10.79±0.18 mm in Nishibari to 12.50±0.43 mm in Nicobari in backyard system (Table-2). Fayeye *et al*. [16] reported the yolk height of Fulani-ecotype chicken as 14.27±1.45 mm which was higher than the results reported in the present study. The egg yolk diameter ranged from 37.14±0.84 mm in Nishibari to 37.95±0.64 mm in Nicobari in backyard system (Table-2) and 36.65±0.02 mm in Nishibari to 40.89±0.67 mm in Nicorock in intensive system (Table-1). Yolk index values were significantly ($p<0.05$) influenced by the genetic groups in the present study (Tables 1 and 2). The yolk indices ranged from 0.30±0.01 (Nicobari) to 0.33±0.03 (Nicorock) under intensive system (Table-1). Higher yolk indices of 0.41±0.01 to 0.45±0.01 in Nicobari varieties of Andaman were observed by Padhi *et al*. [17]. Parmar *et al*. (2006) also observed higher yolk index (0.37) in Kadaknath birds [12]. The difference in yolk ratio among genetic groups in the present study agrees with the reports of Pandey *et al*. [18] that strain differences existed in yolk of eggs. Cobb 500, RIR and Deshi eggs were healthier than Fayoumi and Sonali eggs that contained higher yolk ratio [19]. Taken together, the results of the present study indicate strain specific differences in the yolk characteristics.

The shell weight ranged from 6.01±0.10 g in Nicorock to 6.41±0.21 g in Nishibari in intensive system (Table-1) and 4.74±0.25 g in Nicobari to 5.59±0.20 g in Nicorock in backyard system (Table-2), which was consistent with the reports in Naked Neck and White Leghorn [18]. Chatterjee *et al*. [15] reported the non-significant breed difference in shell weight for six indigenous chicken breeds from Andamans. The shell thickness varied significantly ($p<0.05$) among different genetic strains in the present study. Shell thickness was higher in case of Nicobari (0.39±0.04 mm) and lower in Nicorock (0.29±0.05 mm) under intensive system; whereas, higher in case of Nicobari (0.39±0.08 mm) and lower in Nishibari (0.28±0.04 mm) under backyard system. The mean shell thickness of 0.31 mm in Kadaknath [12] and 0.31 mm in Naked Neck [17] was reported. The shell thickness of Nicobari eggs in the present study was found to be higher than reported in other indigenous birds like Kadaknath and Naked Neck. The higher shell thickness in the birds developed for backyard poultry was an indicator for their better suitability for rural/backyard/free range farming. The cross birds used in the study had better egg production, but the shell thickness reduced from the parental stock. Wani *et al*. [20] reported lower shell thickness (0.32 mm) for Vanaraja birds than the values of the present study. Non-significant variation in shell thickness between reciprocal crosses of ILI 80 and Brown Nicobari was observed by Chatterjee *et al*. [21].

Haugh unit is a measure of albumen quality that determines the quality of the egg. In the present experiment, the average Haugh unit ranged from 71.96±0.83 (Nicorock) to 78.02±0.53 (Nishibari) among the genetic groups under intensive system (Table-1) and from 76.32±0.97 (Nicorock) to 78.78±2.58 (Nicobari) under backyard system (Table-2), which were significantly higher than that of White Leghorn strains (59.62-71.62) reported by Chatterjee *et al*. [14]. The genotypic differences in Haugh unit obtained in this study are consistent with the report of Zaman *et al*. [22] where different Haugh unit values were observed for various strains of birds. Differences in Haugh unit among different genetic groups were also reported in main and reciprocal crossbred Normal Local, Naked Neck and Frizzle Chicken X Exotic broiler in humid tropical climate of Nigeria [23]. Parmar *et al*. [12] reported wide range of Haugh unit values (62.58-90.00) for Kadaknath birds under field conditions in India, which was consistent with the results of the present study. The Haugh unit values obtained for the Nicobari and cross Nicobari (Nicorock and Nishibari) eggs were above 70. The presence of exotic inheritance in Nicobari crosses [10] might be the reason for higher Haugh unit score in the present study.

Conclusion

The present study revealed that egg quality traits differed significantly among various genetic strains of chicken, both in intensive system and backyard condition. It was found that husbandry practices affected egg weight of birds; the egg weights of all three genetic strains were found less under backyard system than intensive system. The results of the study will be helpful for determination of quality of eggs of different indigenous chicken varieties of Andaman and Nicobar Islands.

Authors' Contributions

NCC and GP were involved in the design of the experiment. The experiment was done by NCC and AKD. AKD, AK, MSK and NR revised the final draft

of the manuscript. All authors read and approved the final manuscript.

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Competing Interests

The authors declare that they have no competing interests.

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