Research paper

Genetic analysis of body conformation traits of indigenous Uttara chicken

MK Singh[1]*, S Kumar[2], RK Sharma[2], SK Singh[2], B Singh[2] and DV Singh[2]

[1]*DUVASU, Mathura-281 001 (UP), India*
[2]*G.B.P.U.A & T, Pantnagar-263145 (Uttarakhand), India*

ABSTRACT

This investigation aimed to evaluate genetics of body conformation characteristics in indigenous of Uttara chicken maintained at Govind Ballabh Pant University of Agriculture and Technology (India). Data was analysed using least-squares analysis of variance technique. Least squares means of shank length, keel length and breast angle were estimated at 8 and 20 weeks of age. Sires of the chicks significantly ($p<0.05$) influenced the estimates of all the traits throughout the ages. Male birds demonstrated better estimates than females at all stages. These results suggest that heritabilities are low for linear body measurements in the early period of growth in indigenous Uttara chickens. These research-outcomes may serve as base information to the breeders and academicians for chalking out breeding strategy in concerned aspect.

Keywords: Body conformation, heritability, Uttara chicken
***Corresponding author:** drmksingh_1@rediffmail.com
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INTRODUCTION

A native chicken population from Uttarakhand, named as "Uttara fowl" a distinctive bird with rich black plumage and feathered shank has recently been identified. This germ plasm has a number of desirable characters such as hardiness, adaptability to the wide agro-climatic variability ranging from tropical and subtropical to alpine zones of India, disease tolerance, and flavor of meat and eggs (Singh et.al. 2017). Body conformation, which constitutes body proportions as decided by bone size and degree of fleshing, is considered a better measure of body capacity of birds. External appearance which reflects physiological changes related to egg production may also have bearing on the genetic potential of pullets for egg laying. Shank and keel lengths are indicators of skeletal growth and may be associated with egg production in laying hens. The amount of meat derived from a chicken increases as it grows. Breeders are interested in increasing the meat yield of the chicken and in improving the appearance of the carcass. Many of the body measurements that have been studied are good indicators of skeletal size. These include keel and shank length, breast angle, leg circumference and body depth, *etc.* The present investigation is, therefore, aimed at determining conformation traits of Uttara fowl with a view to yielding a more appropriate selection criterion in future.

Uttara Chicken

MATERIALS AND METHODS

The present study was carried out on Uttara fowls (figure 1 and 2) maintained at the Instructional Poultry Farm (IPF), of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar,

U.S. Nagar from July 2014 to February 2016 using 3836 eggs. The place is located between 28° 53' 23" to 30° 27' 50" N and 77° 34' 27" to 81° 02' 22" E at 243.84 m MSL (mean sea level) in the Tarai region of Uttarakhand State (India). The climate is humid sub-tropical. Winters are very severe and summers are hot and humid. Temperatures may rise to a maximum of 43°C in the summer and fall to a minimum of 2°C in the winter. Relative humidity ranges between 15 to 95 % (Singh *et al.,* 2015).

The pedigreed population under present study descended from 25 sires and 200 dams which were raised under uniform farm conditions were utilized for present study. The details of birds are presented in Table 1 Body conformation traits measured at 8 and 20 weeks in morning before feeding as given below**:**

Shank length (cm): Shank length was measured by placing the jaw of the vernier caliper between the hock and tarsal-metatarsal joints.

Keel bone length (cm): The length of keel bone was measured between anterior and posterior ends of keel bone using Vernier caliper.

Breast angle (degree): Breastometer was placed at the point of 10-12 mm posterior to the anterior edge of the keel bone for measuring the breast angle.

The genetic and phenotypic parameters of various traits were estimated using following statistical model after taking care of hatch effect,

$$Y_{ijkl=}\mu + h_i + s_{ij} + d_k + e_{ijkl}$$

Whereas,

Y_{ijkl} = l^{th} observation on k^{th} sex of j^{th} sire in the i^{th} hatch,

μ = population mean,

h_i = fixed effect due to i^{th} hatch (i = 1, 2, ..H),

S_{ij} = random effect due to j^{th} sire within i^{th} hatch (j = 1, 2,....S),

d_k = effect due to k^{th} sex (k= 1,2),

e_{ijkl} = random error associated with each l^{th} observation with mean 0 and variance

The heritability of traits under study were estimated from sire component of variances and covariances using MMLSML computer programme of Harvey (1990). The data were analysed statistically by running ANOVAs using SPSS 16.0 software. Significant mean differences between the treatments were determined at a 5% probability level ($p<0.05$) using Duncan's Multiple Range Test (DMRT) as modified by Kramer (1957).

RESULTS AND DISCUSSION

Conformation traits at 8 weeks of age

It is evident from the Table 2 that the average 8 week shank lengths were 6.68 ± 0.06, 6.31 ± 0.05 and 6.55 ± 0.04 cm; keel lengths were 7.82 ± 0.08, 7.46 ± 0.07 and 7.70 ± 0.05 cm and breast angles were 52.79 ± 0.20, 50.76 ± 0.17 and 52.10 ± 0.09 (^{0}) in male, female and pooled sex, respectively. Sexual dimorphism for conformation traits accounted for 5.54, 4.60 and 3.85 % of the difference in SL, KL and BA between males and females at 8 week in Uttara fowl.

Higher shank length in males were reported by Sola-Ojo *et al.* (2011), Das *et al.* (2015), Padhi *et al.*, (2015) and Das *et al.* (2016) whereas Sola-Ojo *et al.* (2011) and Das *et al.* (2015) found comparable shank lengths in females. Padhi *et al.* (2015) and Das *et al.* (2016) observed lengthy shanks in females. The average shank length in the pooled sex was comparable with the report of Pushkar (2013) in Uttara fowl (comb and crown types) but was lower than that reported by Das *et al.* (2016).

Table 1: Experimental population at different weeks of age for body conformation traits under study*

Sire	Dam	Traits in week	Male	Female	Pooled
25	200	SL8	791	609	1400
		KL8	791	609	
		BA8	791	609	
		SL20	687	488	1175
		KL20	687	488	
		BA20	687	488	

* Some birds are culled during different ages.

Table 2: Least-squares means of conformation traits in Uttara fowl at 8 and 20 weeks of age

Body conformation traits	Male	Female	Pooled
8 week shank length (cm)	6.68 ± 0.06a	6.31 ± 0.05b	6.55 ± 0.04
8 week keel length (cm)	7.82 ± 0.08a	7.46 ± 0.07b	7.70 ± 0.05
8 week breast angle (0)	52.79 ± 0.20a	50.76 ± 0.17b	52.10 ± 0.09
20 week shank length (cm)	10.17 ± 0.10a	9.39 ± 0.09b	9.91 ± 0.06
20 week keel length (cm)	10.64 ± 0.13a	10.31 ± 0.12b	10.53 ± 0.09
20 week breast angle (0)	59.94 ± 0.39a	56.00 ± 0.31b	58.61 ± 0.25

Means within columns with different superscript differ significantly (P<0.05)

The average keel length in males were comparable with the reports of Sola-Ojo *et al.* (2011) in Fulani chicken and Das *et al.* (2015) and Das *et al.* 2016) in RIR and CARI Sonali respectively. Higher keel lengths were reported by Padhi *et al.* (2015) in RIR. The average keel length in female was comparable with the reports Das *et al.* (2015) and Das *et al.* (2016).Lower keel length than present study in female was reported by Sola-Ojo *et al.* (2011). However, Padhi *et al.* (2015) reported higher keel lengths in female. The average keel lengths in pooled sex were comparable with the reports of Pushkar (2013) and Das *et al.* (2016).

The average breast angles in male and female were comparable with the reports of Champat *et al.* (2013), Das *et al.* (2015) and Das *et al.* (2016). Pushkar (2013) and Dash *et al.* (2016) found comparable breast angles in pooled sex.

Differences in conformation traits might be due to strain, line or breed studied and differences in management as well as rearing system. These findings also indicated that the body conformation in poultry was sex dependent and sire-influenced. Male Uttara fowl were better than their female counterparts in all the conformation traits studied which is a clear instance of sex dimorphism. This possibly is an adaptive feature necessitates for the survival from predation and dominance in social order.

Conformation traits at 20 weeks of age

It is evident from the Table 2 that 20 week shank lengths were 10.17 ± 0.10, 9.39 ± 0.09 and 9.91 ± 0.06 cm; keel lengths were 10.64 ± 0.13, 10.39 ± 0.31 and 10.53 ± 0.09 cm and breast angles were 59.94 ± 0.39, 56.00 ± 0.31 and 58.61 ± 0.25 (^{0}) in male, female and pooled sex respectively. Sexual dimorphism accounted for 7.67, 3.10 and 6.57 % of the difference in SL, KL and BA between male and female at 20 week in Uttara fowl.

Das *et al.* (2016) at 16 weeks found comparable shank lengths in males. Sola-Ojo *et al.* (2011) and Padhi *et al.* (2015) observed lengthy shanks in males. Sola-Ojo *et al.* (2011) and Das *et al.* (2016) in CARI Sonali at 16 weeks observed comparable shank lengths in females. The average shank length in pooled sex was comparable with the result of Das *et al.* (2016) in CARI Sonali at 16 weeks.

The average keel length in males was comparable with the result of Das *et al.* (2016). Higher keel lengths in males were reported by Sola-Ojo *et al.* (2011) and Padhi *et al.* (2015). The average keel lengths in females were comparable with the results of Sola-Ojo *et al.* (2011), Padhi *et al.* (2015) in PD1 × PD4, PD1 × PD3 and PD1 × IWI and Das *et al.* (2016) in CARI Sonali. The average keel length in pooled sex was comparable with the result of Das *et al.* (2016).

The attributed difference was due to the different strain, line or breed studied under different managemental and rearing system.

Heritability of conformation traits at 8 weeks of age

The estimates of heritability of shank length were 0.54 ± 0.23, 0.46 ± 0.25 and 0.50 ± 0.24; keel length were observed as 0.69 ± 0.27, 0.53 ± 0.26 and 0.61 ± 0.26 and breast angle were 0.59 ± 0.11, 0.42 ± 0.22 and 0.51 ± 0.17 in male, female and pooled sex respectively.

The higher heritability values of shank lengths were reported by Adeleke *et al.* (2011), Rajkumar *et al.* (2011) in Dwarf chicken at 6 weeks of age, Haunshi *et al.* (2012) in Kadaknath (h^2s) at 6 weeks of agewhereas Osei-Amponsah *et al.* (2013) found

Table 3: Heritability estimates of conformation traits in Uttara fowl

Body conformation traits	Male	Female	Pooled
8 week shank length	0.54 ± 0.23	0.46 ± 0.25	0.50 ± 0.24
8 week keel length	0.69 ± 0.27	0.53 ± 0.26	0.61 ± 0.26
8 week breast angle	0.59 ± 0.11	0.42 ± 0.22	0.51 ± 0.17
20 week shank length	0.38 ± 0.28	0.30 ± 0.25	0.34 ± 0.26
20 week keel length	0.50 ± 0.13	0.44 ± 0.28	0.47 ± 0.21
20 week breast angle	0.54 ± 0.29	0.39 ± 0.27	0.47 ± 0.28

comparable shank length's heritability. Rao *et al.* (2004) and Haunshi *et al.* (2012) reported lower heritability for shanks lengths. Higher keel lengths heritability was reported by Adeleke *et al.* (2011) and Das *et al.* (2015), whereas, Padhi *et al.* (2015) observed lower 8-week keel lengths heritability. Lower breast angle heritability was reported by Das *et al.* (2015) at 8-week.

Heritability of conformation traits at 20 weeks of age

The estimates of heritability of shank length were 0.38 ± 0.28, 0.30 ± 0.25 and 0.34 ± 0.26; keel length were 0.50 ± 0.13, 0.44 ± 0.28 and 0.47 ± 0.21 and breast angle was 0.54 ± 0.29, 0.39 ± 0.27 and 0.47 ± 0.28 in male, female and pooled sex respectively.

Higher heritability value of shank length was reported by Osei-Amponsah *et al.* (2013) and Padhi *et al.* (2015), whereas, Adeleke *et al.* (2011) observed lower 20-week shanks lengths heritability. Adeleke *et al.* (2011) and Padhi *et al.* (2015) observed lower 20-week keel lengths heritability. Lower heritability value of breast angle was reported by Padhi *et al.* (2015) at 20-week.

The high heritability values of conformation traits; shank length, keel length and breast angle, at 8 week of age in male, female and pooled basis suggested a major role of additive genetic variance in the phenotypic expression of these traits. The individual selection can be applied for genetic improvement of these traits. The moderate to high values of heritability estimates for shank length, keel length and breast angle at 20 weeks of age also revealed that there is a more possibility for genetic improvement of this trait by the individual selection.

CONCLUSION

The mean values of conformation traits revealed that male Uttara fowl were better than their female counterparts in all the conformation traits studied which is a clear instance of sex dimorphism. Changes in heritability estimates across different ages could indicate various expressions of different genes at different ages of the chickens' growth and the reduction of environmental effects. The individual selection can be applied for genetic improvement of these traits.

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