



Genetic and phenotypic parameters evaluation for body weight, conformation and production traits of indigenous Uttara using MMLSML

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A native chicken population from Uttarakhand, named as Uttara, a distinctive bird with rich black plumage and feathered shank has been identified (Kumar *et al.* 2014). It has crest or crown type structure or bunch of feathers on head and is locally known as Dotiyal murgi or Bulbul murgi or Taj murgi (Singh 2016). This germplasm has a number of desirable characters such as hardiness, adaptability to the wide agro-climatic variability ranging from alpine zones to subtropical areas of Uttarakhand as well as India, disease tolerance, and flavour of meat and eggs (Singh *et al.* 2017). Uttara has its importance under various animal production systems because of its good conversion efficiency of converting agricultural by-products and wastes into high quality animal protein (Singh 2016). It may be used to produce organic meat and eggs under hilly backyard and inherent mixed farming system but giving significant contribution towards the farmer economy (Singh 2016). Therefore, efforts are being made to genetically improve native Uttara for growth performance and to develop improved chicken varieties for backyard poultry farming and make it more productive in the present scenario. However, the genetic and phenotypic parameters estimates of the indigenous Uttara chickens are very few (Singh 2016). So the present study was undertaken to estimate genetic and phenotypic parameters for body weight, conformation, and production traits in indigenous Uttara chickens. The reliable estimates of genetic and phenotypic correlations between various growth and conformation traits are prerequisite for devising suitable improvement programmes.

The birds used for the present study are presented in Table 1.

The chicks produced were raised under uniform farm conditions. During laying period the birds were reared in

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individual cages. Standard feeding and health care facility during brooding, growing and laying period were followed.

Traits measured: During brooding period, body weight were measured at 0 and 4 weeks of age in pooled sex. Conformation traits (shank length, keel length and breast angle) were recorded at 8 weeks of age in pooled sex. After selection during growing period, body weight were recorded at 8, 12, 16 and 20 weeks of age in pooled sex. Shank length, keel length and breast angle during growing period was recorded at 20 weeks of age in pooled sex. Production period data like age at sexual maturity (ASM) and weight at sexual maturity (WSM) were measured around 24 weeks; adult body weight were recorded at 24, 28, 32, 36 and 40 weeks of age; egg eight, egg production and egg mass up to 40 and 58 weeks of age were measured in female sex to find out any correlations between them.

The following two models were used in this study:

Sex-wise genetic and phenotypic parameters of traits were estimated after taking care of hatch effect in female

Table 1. Experimental population at different weeks of age for various traits under study*

Sire	Dam	Traits in week	Male	Female	Pooled sex
25	200	DW ₀	1049	858	1907
		BW ₄	995	814	1809
		BW ₈	972	795	1767
		SL ₈	791	609	1400
		KL ₈	791	609	
		BA ₈	791	609	
		BW ₁₂	951	778	1729
		BW ₁₆	940	768	1708
		BW ₂₀	932	761	1693
		SL ₂₀	687	488	1175
		KL ₂₀	687	488	
		BA ₂₀	687	488	
		BW ₂₄	—	470	—
		BW ₂₈	—	468	—
		BW ₃₂	—	463	—
		BW ₃₆	—	460	—
		BW ₄₀	—	457	—
		WK ₅₈	—	434	—

*Some birds were culled during different ages.

adult body weight, reproduction and production traits:

$$Y_{ijk} = \mu + h_i + s_j + e_{ijk}$$

where, Y_{ijk} , observation on k^{th} progeny of j^{th} sire in i^{th} hatch; μ , population mean; h_i , fixed effect due to i^{th} hatch ($i = 1, 2, \dots, H$); s_j , random effects due to j^{th} sire ($j = 1, 2, \dots, S$); e_{ijk} , random error associated with each k^{th} observation with mean 0 and variance σ_e^2 ;

The genetic and phenotypic parameters of traits of pooled over the sexes were estimated after taking care of hatch effect

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

where Y_{ijkl} , l^{th} observation on k^{th} sex of j^{th} sire in the i^{th} hatch; S_{ij} , random effect due to j^{th} sire within i^{th} hatch ($j = 1, 2, \dots, S$); 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.

Data were analysed using Mixed Model Least Squares and Maximum Likelihood (MMLSL) technique (Harvey 1990). Genetic and phenotypic correlations were estimated from variance-covariance component analysis (Becker 1967).

All the genetic and phenotypic correlations among body weights and conformation traits at different ages were positive (Table 2) except negative genetic association between shank length and breast angle at 8 and 20 weeks of age. This was in agreement with the report of Lwelamira *et al.* (2009), Dana *et al.* (2011) and Padhi *et al.* (2015). Moderate to low correlations between body weight and keel length was reported by Ajayi *et al.* (2012). Body weight with breast angle at different ages shows wide variation. High correlation between body weight and breast girth was reported by Ajayi *et al.* (2012). Correlations between shank length, keel length, breast angle at different ages during growing period were high. High correlation of shank length at different ages was reported by Padhi and Chatterjee (2012). Moderate to high correlations were obtained between shank and keel lengths, shank length and breast angle, and keel length and breast angle measured at different ages. Similar observation was reported by Ajayi *et al.* (2012) in conformation traits. The present study results indicated that 4–12 week body weights can be taken as criteria to improve market weight in Uttara. The genetic and phenotypic correlations of body weight at 8 week with body weight at 20 week were positive which was observed by Jilani *et al.* (2007). The results of the present study indicate that the same set of genes govern growth and conformation traits at various ages, and conformation traits can be utilized to improve growth rate in Uttara. It was also revealed that Uttara can be selected for higher market weight at juvenile stage.

The correlation among 24, 28, 32, 36 and 40 week body weight were positive (Table 3) at genetic and phenotypic levels. The 24 week body weight was low to moderately negatively correlated with ASM, EN40 and EN58, respectively, at genetic level. The corresponding

Table 2. Genetic (above diagonal) and phenotypic (below diagonal) correlations of juvenile body weight and conformation traits in Uttara

	DW	BW4	BW8	SL8	KL8	BA8	BW12	BW16	BW20	SL20	KL20	BA20
DW		0.38±0.05	0.12±0.01	0.11±0.02	0.13±0.03	0.09±0.04	0.07±0.01	0.03±0.01	0.47±0.17	0.26±0.22	0.43±0.19	0.19±0.24
BW4	0.01±0.02		0.72±0.25	0.36±0.16	0.67±0.24	0.09±0.36	0.39±0.03	0.31±0.01	0.49±0.12	0.72±0.16	0.57±0.57	0.43±0.23
BW8	0.05±0.02	0.63±0.17		0.72±0.18	0.65±0.11	0.82±0.78	0.88±0.11	0.47±0.20	0.74±0.11	0.51±0.21	0.41±0.65	0.65±0.17
SL8	0.36±0.03	0.85±0.14	0.72±0.16		0.78±0.18	-0.16±0.11	0.90±0.78	0.56±0.11	0.76±0.20	0.78±0.11	0.37±0.21	0.68±0.17
KL8	0.02±0.02	0.82±0.12	0.71±0.21	0.93±0.31		0.67±0.05	0.62±0.23	0.54±0.25	0.62±0.22	0.42±0.11	0.30±0.02	0.56±0.07
BA8	0.01±0.00	0.81±0.13	0.69±0.13	0.92±0.21	0.84±0.27		0.54±0.21	0.48±0.22	0.87±0.45	0.52±0.18	0.42±0.17	0.01±0.23
BW12	0.04±0.01	0.82±0.11	0.71±0.17	0.92±0.07	0.88±0.21	0.88±0.29		0.79±0.03	0.49±0.13	0.70±0.16	0.48±0.26	0.69±0.10
BW16	0.02±0.03	0.80±0.09	0.69±0.09	0.85±0.01	0.86±0.20	0.86±0.23	0.88±0.24		0.57±0.38	0.71±0.15	0.46±0.23	0.47±0.20
BW20	0.05±0.02	0.77±0.08	0.64±0.07	0.86±0.03	0.81±0.17	0.83±0.20	0.82±0.04	0.87±0.03		0.93±0.51	0.73±0.50	0.23±0.47
SL20	0.11±0.02	0.71±0.05	0.65±0.11	0.83±0.05	0.77±0.13	0.83±0.18	0.81±0.06	0.77±0.10	0.71±0.13		0.88±0.05	-0.54±0.23
KL20	0.11±0.01	0.58±0.27	0.52±0.10	0.70±0.22	0.60±0.01	0.72±0.15	0.65±0.02	0.65±0.21	0.63±0.08	0.83±0.21		0.24±21
BA20	0.03±0.12	0.82±0.20	0.71±0.15	0.93±0.16	0.92±0.06	0.86±0.21	0.89±0.23	0.87±0.15	0.83±0.03	0.83±0.05	0.69±0.07	

BW, SL, KL, ad BA indicate body weight, shank length, keel length and breast angle, respectively, and the number indicate age in weeks.

Table 3. Genetic (above diagonal) and phenotypic (below diagonal) correlations of adult body weights and production traits in Uttara

	BW24	BW28	BW32	BW36	BW40	ASM	WSM	EW40	EW58	EN40	EN58	EM40	EM58
BW24													
BW28	0.19±0.05												
BW32	0.18±0.09	0.97±0.21											
BW36	0.19±0.10	0.96±0.12	0.99±0.00										
BW40	0.18±0.03	0.96±0.23	0.99±0.00	0.70±0.11									
ASM	-0.10±0.02	-0.03±0.00	-0.00±0.03	-0.01±0.00	-0.00±0.00								
WSM	0.79±0.21	0.14±0.01	0.13±0.02	0.14±0.00	0.14±0.01	0.34±0.04							
EW40	0.01±0.03	0.01±0.00	0.01±0.00	0.01±0.00	0.02±0.03	-0.03±0.01	-0.03±0.00						
EW58	0.04±0.03	0.02±0.01	0.02±0.01	0.02±0.01	0.02±0.01	-0.00±0.10	-0.03±0.01	0.40±0.13					
EN40	-0.07±0.01	-0.05±0.02	-0.66±0.25	-0.07±0.02	-0.07±0.02	-0.07±0.02	0.04±0.02	-0.25±0.10	0.08±0.01				
EN58	-0.07±0.02	-0.04±0.02	-0.04±0.00	-0.03±0.00	-0.03±0.02	-0.00±0.07	0.04±0.03	-0.11±0.06	0.23±0.20	0.14±0.02			
EM40	0.07±0.01	0.05±0.01	0.07±0.01	0.06±0.01	0.06±0.01	-0.07±0.01	0.04±0.01	0.22±0.03	0.06±0.01	0.99±0.00	0.33±0.01		
EM58	0.06±0.14	0.04±0.17	0.04±0.02	0.03±0.07	0.03±0.10	-0.01±0.01	0.04±0.03	-0.16±0.04	0.37±0.05	0.15±0.12	0.99±0.23	0.24±0.04	

BW, ASM, WSM, and EM indicate body weight, age and weight at sexual maturity, egg weight, egg number and egg mass respectively, and the number indicate age in weeks.

correlations at phenotypic level were negative or very low in magnitude. The negative genetic and phenotypic correlations of age at sexual maturity with other production traits signify early sexual maturity which resulted in higher egg production and egg mass. Similarly, the correlation of body weight at 28, 32, 36 and 40 weeks of age with age at sexual maturity, egg number at 40 and 58 weeks very low negatively at genetic and phenotypic level. The results were in agreement with those reported by Kumar *et al.* (2002). Negligible association among these traits obtained in this study, is uncommon in literature on egg type chicken. The body weights were positively correlated with egg weight and egg mass (EM) at genetic and phenotypic level. The genetic correlation of egg production with egg weight was negative as expected. Most of the correlations between production traits were as per expectation. The egg number (EN) was negatively correlated with the egg weight at genetic and phenotypic level at 40 week of age. The egg number and egg weight at 58 week of age positively correlated with egg weight and egg mass at genetic and phenotypic level. EN was highly positively correlated with EM both at genetic and phenotypic levels. High positive correlation between EN and EM suggested that selection for EM may bring about concomitant increase in both EN and EW unlike selection for EN alone causing a decrease in EW as a correlated response. Positive high genetic and phenotypic correlation between EW, EM were observed among these traits. Chatterjee *et al.* (2008) reported high positive genetic correlations of EW with EM.

It can be concluded that there is a scope for improvement of Uttara as a dual purpose bird for low input free range system of rearing as evidenced by its size and egg production. Information on various production traits of Uttara could be useful in documentation of its actual genetic worth under intensive system of rearing and deciding improvement criterion. The present study is suggestive of the fact that Uttara have all the attributes of commercial bird for rural poultry production. Furthermore, this germplasm may be utilized for development of new crosses/strains of dual type coloured chicken for backyard/niche markets.

SUMMARY

The present study was undertaken to investigate correlations between body weight, conformation and production performance of indigenous Uttara chickens. The data collected for different periods from the birds were produced using 25 sires and 200 dams through pedigreed mating. The birds were maintained on a sire family basis, consisting of 25 sire families with a male to female ratio of 1:8. Genetic and phenotypic correlation were estimated between different traits at different period and showed varying levels of correlation estimates. The results indicated that indigenous Uttara chickens have all the attributes of commercial bird for rural poultry production and to be used as a dual purpose bird for low input free range system of rearing as evidenced by its size and egg production.

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