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Evaluating body conformation and feed efficiency characteristics in CARI-Sonali grower chicken

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ABSTRACT

The investigation was aimed to evaluate body conformation and feed efficiency characteristics in CARI-Sonali grower chicken developed and maintained by the institute. Single hatched out 112 chicks were investigated. The least squares means of body weight and weight gain, shank length, keel length, breast angle, feed intake and feed conversion ratio were estimated at various age groups. Sex of the chicks had significant effect on the body weight, weight gain and shank length at sixth week of age onwards, and keel length and breast angle at eighth week onwards; male birds having higher estimates than the females throughout the age. The FCR estimates were also affected by the sex at twelfth and sixteenth week of age, male birds having better FCR than the females throughout the age. The feed intake varied among the feeding groups almost throughout the age, body weight gain at earlier age and FCR at eighth week of age. The phenotypic correlations coefficients were positive in the range of 0.3647 to 0.9062 among the intra-week body weight, breast angle, and shank and keel lengths. These might serve as base information to the breeders for chalking out breeding strategy in concerned aspect.

Key words: Breast angle, CARI-Sonali chicken, Feed conversion ratio, Sex effect, Shank and keel lengths, Weight gain

The CARI-Sonali, a layer purpose chicken developed at CARI (mating males of IWH line of White Leghorn chicken with Rhode Island Red (RIR) female line maintained at this institute), is generally selected for high egg production, heavier egg, earlier sexual maturity, higher viability, strong eggshell and optimum body size. Most of these traits are related to the feed efficiency along with its genetic background and improvement in these traits would also be expected to improve feed efficiency (Niranjan and Kataria 2008). The CARI-Sonali chicken is suitable for rearing at rural backyard poultry production system with encouraging remuneration because of its better performance with early sexual maturity, heavy egg size and high egg production even better than the RIR chicken (Das *et al.* 2014a), but literature on its body conformation and feed efficiency is still lacking. Hence, the present investigation was carried out to evaluate body conformation and feed consumption efficiency characteristics in CARI-Sonali grower chicken.

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MATERIALS AND METHODS

Experimental birds and husbandry adopted: Single hatched out day-old chicks (112) of CARI-Sonali chicken maintained at the experimental layer farm of the Central Avian Research Institute (India) was investigated. The chicks were wing banded, dubbed and vaccinated with F strain at the hatchery and subjected to standard brooding. Standard floor space and brooding temperature were provided. After attaining the 4 weeks of age at the battery brooder shelves, the chicks were shifted into colony house for 16 weeks of age. The female birds were then shifted in to cages for laying. Freshwater and feed were provided *at lib.* twice daily with all possible measures adopted to reduce wastage of feed. The birds were fed on the institute-formulated chick mash with crude protein 20.65%, metabolic energy 2694.64 Kcal/kg, calcium 1.02%, available phosphorus 0.45%, lysine 1.05% and methionine 0.41% for 0–8 weeks of age, and grower mash with crude protein 16.78%, metabolic energy 2536.00 Kcal/kg, calcium 1.15%, available phosphorus 0.40%, lysine 0.76% and methionine 0.37% for 9–20 weeks of age. The birds were vaccinated following standard vaccination schedule being followed at the institute (Das *et al.* 2014b).

Feeding trials: The feeding trials (*ad lib.*) were conducted from day-1 to 16th week of age maintaining 2 feeding groups each of 56 chicks. The birds were provided with weighed quantity of standard ration. The feed residue

was weighed after each recording period, followed by notice of any mortality on specific date, if any, the dead bird's(s') wing band number(s) and weight were date-wise recorded and the amount of feed consumed by individual birds per day was calculated.

Traits investigated: The traits of day-old chick weight (CW), live body weight (BW), shank length (SL), keel length (KL) and breast angle (BA) were investigated at 4, 6, 8, 12 and 16th week of age. Body weights were measured using digital weigh balance (capacity-0.5 g to 3 kg), shank and keel lengths using vernier calipers, and breast angle using goniometer. Feed consumption efficiency was expressed as feed intake (g), live body weight gain (g) and feed conversion ratio (FCR) (g feed intake / g weight gain) in different periods of age.

Statistical analysis: Data were analyzed by least squares analysis of variance (Harvey 1990) taking sex and feeding groups as fixed effects in the statistical model: $Y_{ijk} = \mu + S_i + H_j + e_{ijk;}$ where, Y, value of a trait measured on ijkth individual; μ, overall mean; S_i, fixed effect of ith sex; H_j, fixed effect of jth feeding group; and e_{ijk}, random error associated with mean zero and variance ó^2.

RESULTS AND DISCUSSION

Least squares means

Body conformation traits: The least squares means of day-old chick weight (CW), body weight (BW), shank length (SL), keel length (KL) and breast angle (BA) are presented in Table 1. The body weight and shank length at sixth week of age onwards and the other traits at eighth week onwards demonstrated significant (P<0.05) higher estimates for male birds than the females in accordance to the earlier reports (Das *et al.* 2014b, El-Safty 2012). The present chick weight was comparable to the reports for RIR chicken (Das *et al*. 2014a, Ashraf *et al.* 2003) and Fayoumi male × RIR female cross (El-Maghraby *et al.* 1975). The present flock demonstrated better chick weight as evident when compared to the reports for RIR control and white strains (Das *et al.* 2014a), and crosses of RIR with various genotypes (Das *et al.* 2014a, El-Maghraby *et al.* 1975, Mohammed *et al.* 2005). The present estimates of the body weights at 4 to 16th week of age were also better than the available reports for RIR-white strain (Das *et al.* 2014b), Fayoumi male × RIR female cross and its reciprocal (El-Maghraby *et al.* 1975), RIR × indigenous lines Bare-neck / Betwil / Large Beladi crosses (Mohammed *et al.* 2005), Kadaknath and Aseel chicken (Chatterjee *et al.* 2007). Difference might be due to strain, line or breed difference and different management as well as rearing system. The present estimates of shank and keel lengths and breast angle were comparable to the available reports for RIR-White strain (Das *et al*. 2014b), Libyan native chicken (El-Safty 2012), Ardennaise chicken (Lariviere *et al*. 2009), Kadaknath and Aseel (Chatterjee *et al.* 2007) and Giriraja and WLH chicken (Adebambo *et al.* 2006). The attributed difference was due to the different strain, line or breed studied different management and rearing system.

Table 1. The estimated least squares means of chick weight, body weights and various body conformation traits in CARI-Sonali grower chicken

Factors	Least squares means±standard errors																	
	CW (g)	BW4 (g)	SL4 (cm)	KL4 (cm)	BA4 (°)	BW6 (g)	SL6 (cm)	KL6 (cm)	BA6 (°)	BW8 (g)	SL8 (cm)	KL8 (cm)	BA8 (°)	BW12 (g)	SL12 (cm)	KL12 (cm)	BA12 (°)	BW16 (g)	SL16 (cm)	KL16 (cm)	BA16 (°)
Overall	37.46	211.21	4.55	4.86	40.07	356.21	6.16	6.35	45.27	558.22	7.18	7.44	51.06	937.55	8.70	8.82	56.49	1332.43	10.04	10.50	59.63
	±0.31	±4.14	±0.05	±0.04	±0.25	±4.79	±0.04	±0.04	±0.37	±8.68	±0.05	±0.04	±0.25	±15.84	±0.06	±0.07	±0.40	±16.93	±0.08	±0.08	±0.33
	(91)	(49)	(49)	(49)	(49)	(91)	(91)	(91)	(91)	(90)	(90)	(90)	(90)	(90)	(90)	(90)	(90)	(81)	(81)	(81)	(81)
Sex																					
Male	37.15	214.02	4.46	4.80	40.20	372.64	6.23	6.38	45.76	590.56	7.36	7.57	51.85	1010.76	9.03	9.05	57.74	1454.86	10.65	10.81	61.43
	±0.47	±6.15	±0.07	±0.06	±0.37	±7.25^a	±0.06^a	±0.05	±0.56	±12.81^a	±0.07^a	±0.07^a	±0.36^a	±23.38^a	±0.09^a	±0.01^a	±0.58^a	±25.24^a	±0.12^a	±0.11^a	±0.50^a
	(39)	(22)	(22)	(22)	(22)	(39)	(39)	(39)	(39)	(41)	(41)	(41)	(41)	(41)	(41)	(41)	(41)	(36)	(36)	(36)	(36)
Female	37.76	208.39	4.63	4.91	39.94	339.78	6.08	6.31	44.78	525.88	7.01	7.32	50.27	864.35	8.37	8.60	55.23	1210.00	9.44	10.19	57.83
	±0.40	±5.55	±0.06	±0.06	±0.33	±6.28^b	±0.05^b	±0.05	±0.49	±11.72^b	±0.06^b	±0.06^b	±0.33^b	±21.39^b	±0.09^b	±0.09^b	±0.53^b	±22.57^b	±0.11^b	±0.10^b	±0.45^b
	(52)	(27)	(27)	(27)	(27)	(52)	(52)	(52)	(52)	(49)	(49)	(49)	(49)	(49)	(49)	(49)	(49)	(45)	(45)	(45)	(45)

Figures within parenthesis denote number of observations; CW, day old chick weight in grams; BW, SL, KL and BA denote body weight in grams, shank length in centimeter, keel length in centimeter and breast angle in degree at different weeks of ages, respectively; Means within a factor having different superscripts differ significantly (P<0.05).

Table 2. The estimated least squares means of various feed consumption efficiency traits in CARI-Sonali grower chicken

Factors	Obs	Least squares means±standard errors														
		WG4 (g)	FC4 (g)	FCR4	WG6 (g)	FC6 (g)	FCR6	WG8 (g)	FC8 (g)	FCR8	WG12 (g)	FC12 (g)	FCR12 (g)	WG16 (g)	FC16 (g)	FCR16
Overall	99	176.66 ±2.63	695.92 ±2.69	4.04 ±0.07	143.81 ±3.39	611.46 ±3.09	4.53 ±0.13	204.65 ±5.03	1364.20 ±3.94	7.21 ±0.22	375.98 ±10.86	2046.27 ±3.77	6.10 ±0.23	405.79 ±11.63	2491.47 ±3.92	6.80 ±0.24
Sex																
Male	46	181.37 ±3.85	693.91 ±3.94	3.95 ±0.10	150.78 ±4.95^{a}	609.75 ±4.52	4.35 ±0.19	217.17 ±7.36^{a}	1363.37 ±5.76	6.88 ±0.32	419.15 ±15.90^{a}	2044.64 ±5.52	5.49 ±0.34^{a}	441.74 ±17.02^{a}	2489.34 ±5.74	6.38 ±0.35
Female	53	171.94 ±3.59	697.93 ±3.67	4.13 ±.09	136.83 ±4.62^{b}	613.18 ±4.21	4.71 ±0.18	192.13 ±6.86^{b}	1365.02 ±5.37	7.53 ±0.30	332.80 ±14.81^{b}	2047.90 ±5.15	6.72 ±0.32^{b}	369.83 ±15.86^{b}	2493.61 ±5.35	7.23 ±0.33
Feeding Group	1 50	182.68 ±3.70^{a}	701.54 ±3.78^{a}	3.94 ±0.09	145.28 ±4.76	618.91 ±4.34^{b}	4.54 ±0.18	215.62 ±7.07^{a}	1370.83 ±5.54	6.76 ±0.31^{a}	361.47 ±15.27	2054.02 ±5.31^{b}	6.38 ±0.33	412.54 ±16.35	2500.88 ±5.51^{b}	6.67 ±0.34
	2 49	170.64 ±3.74^{b}	690.30 ±3.82^{b}	4.14 ±0.10	142.34 ±4.80	604.01 ±4.38^{a}	4.52 ±0.19	193.68 ±7.14^{b}	1357.56 ±5.59	7.65 ±0.31^{b}	390.48 ±15.42	2038.52 ±5.36^{a}	5.82 ±0.33	399.04 ±16.51	2482.07 ±5.57^{a}	6.94 ±0.34

WG, FC and FCR denote live body weight gain in grams, feed consumed/ intake in grams and feed conversion ratio at different periods of ages in weeks, respectively; Means within a factor having different superscripts differ significantly (P<0.05).

Feed consumption efficiency: The least squares means of live body weight gain (WG), feed consumption / intake (FC) and feed conversion ratio (FCR) were presented in Table 2. The present FCR estimates were higher than the reports for Ardennaise chicken (Lariviere *et al.* 2009) indicating poor FCR in the present chicken flock. The present estimates of WG, FC and FCR might also be compared to the reports for RIR-White strain (Das *et al.* 2014b), and 4 genetic groups of feathered, frizzled, naked neck and naked neck-frizzled chicken (Mahrous *et al.* 2008). The present chicken flock gained more body weight throughout the age as evident when compared to the Kadaknath chicken, whereas less than the Aseel chicken at later age (Chatterjee *et al.* 2007). Mengesha (2012) reviewed corresponding eighth and twelfth week's average FCR as 7.0 and 4.2 in intensive rearing system, and 3.04 and 5.6 in semi-intensive rearing system in some indigenous chicken in the tropical countries of Africa. Whatsoever discrepancy might be attributed due to the strain, line or breed difference, and different facets of management practices as well as rearing system.

Genetic and non-genetic factors

Influence of sex: The least squares analysis of variance revealed that sex of the chicks had significant effect on the estimates of body weight and shank length at sixth week of age onwards and other body conformation traits at eighth week onwards; male birds being heavier than the females throughout the age. The sex also demonstrated its significant (P<0.05) effect on the estimates of body weight gain at sixth week of age onwards; male birds gained more than the females throughout the age. The FCR estimates were also affected by the sex at 12th (P<0.05) and 16th (P<0.08) week of age, the FCR for male birds being better than the females throughout the age.

Significant sex-differentiation in the body weights and the males being heavier than the females was reported for RIR-white strain chicken at eighth week onwards (Das *et al.* 2014a); Libyan native chicken at sixth week onwards (El-Safty 2012); and Giriraja, Indian WLH, and Nigerian improved indigenous chicken genotypes (F_1, F_2 and B-ß chickens) at 12 weeks onwards (Adebambo *et al.* 2006). Mohammed *et al.* (2005) also reported that the sex affected the estimates of body weight non-significantly at hatching in some crosses of RIR and indigenous lines of Bare-neck, Betwil and Large Beladi; whereas the differences were significant (P<0.05) at two weeks of age and highly significant (P<0.01) for the subsequent age.

Significant sex effect on the estimates of various feed efficiency traits was also reported for RIR-white strain from eighth week onwards except feed intake (Das *et al.* 2014a). The FCR estimates were also affected (P<0.05) by the sex at eighth and 16th week of age and the FCR for the male birds being better than the females throughout the age (Das *et al.* 2014b). El-Safty (2012) reported that the male birds had significantly greater values for keel and shank lengths of Libyan native chickens at different age when compared with the female counterparts. Lariviere *et al.* (2009) also reported that keel angle and keel length were all greater in the males and significantly different between the sexes (P<0.001) at 85 days in Ardennaise chicken. But Adebambo *et al.* (2006) reported that the body conformation traits viz. breast girth, shank length and keel length were significantly affected by the sex except shank length for 12th, 15th and 18th week of age in Giriraja, Indian WLH, and Nigerian improved indigenous chicken genotypes (F_1, F_2 and B-ß chickens). The higher estimates of shank and keel lengths, and breast angle at eight week of age in the male birds were also reported in CARI-Debendra chicken (Singh and Jilani 2005). These findings indicated that the body conformation and feed efficiency traits of poultry birds were not sex-independent.

Influence of feeding groups: The least squares analysis of variance revealed that the feed intake significantly (P<0.05) varied among the feeding groups throughout the periods of age except the period of eighth week of age

Table 3. The estimated phenotypic correlations among various intra-week body conformation traits in CARI-Sonali grower chicken

Traits	BW4	SL4	KL4	Traits	BW6	SL6	KL6
SL4	0.3799 (49)			SL6	0.8008 (91)		
KL4	0.3908 (49)	0.8392 (49)		KL6	0.6787 (91)	0.8120 (91)	
BA4	0.9062 (49)	0.3647 (49)	0.3763 (49)	BA6	0.7108 (91)	0.5930 (91)	0.4756 (91)
Traits	BW8	SL8	KL8	Traits	BW12	SL12	KL12
SL8	0.7969 (90)			SL12	0.8475 (90)		
KL8	0.6775 (90)	0.8143 (90)		KL12	0.8154 (90)	0.8499 (90)	
BA8	0.8363 (90)	0.6855 (90)	0.6161 (90)	BA12	0.9131 (90)	0.7996 (90)	0.8107 (90)
Traits	BW16	SL16	KL16				
SL16	0.6033 (81)						
KL16	0.5845 (81)	0.7749 (81)					
BA16	0.8416 (81)	0.6137 (81)	0.6304 (81)				

Figures within parenthesis denote number of observations.

(P<0.09). Feeding groups also affected (P<0.05) the estimates of body weight gain at earlier age *i.e*. upto eighth week of age and the FCR at eighth week of age. These results were in accordance to the reports for RIR-white strain (Das *et al*. 2014b) where the feed intake, weight gain and FCR were significantly affected by the feeding groups but in different age groups. These findings indicated that the feed intake of the birds might be affected by feeding management. and the affected feed intake might also affect the feed efficiency and thus weight gain.

Phenotypic correlations

The phenotypic correlation coefficients among various intra-week body weight, shank length, keel length and breast angle are presented in Table 3. The coefficient estimates were positive in direction and in a range of moderate to high magnitude (0.3647 to 0.9062) in accordance to the available reports (Das *et al.* 2014b).

The present body weight remained invariably positively correlated with shank length, keel length and breast angle throughout the age and were in consistence with the reports (Das *et al.* 2014b). The positive phenotypic association of the body weight with breast angle was reported earlier in Vigova Super M broiler ducks at all studied age groups (Banerjee 2010), and with keel length and angle in Ardennaise chicken (Lariviere *et al.* 2009). The phenotypic correlations among the body measurement parameters were generally lower at older age (–0.018 to 0.711) than at younger age (–0.081 to 0.828) reported for Giriraja, White Leghorn and Nigerian improved indigenous chicken genotypes (Adebambo *et al.* 2006). It was suggested that the phenotypic correlations were influenced by the magnitude and signs of the genetic and environmental correlations, hence it was of interest to compare these values with each other and to make comparisons of each within and between subpopulations of breast angle and body weight when studied in White Plymouth Rock chickens at eight weeks of age (Siegel 1962).

It is concluded that the body weight and weight gain, shank and keel length, breast angle and feed conversion ratio were not sex independent traits. Male birds gained more weightage for all the conformation traits and better FCR than the females throughout the age. All the body conformation traits were highly correlated with phenotypic positive association and could therefore be used to predict its body conformation. The investigation generated some valuable information that might be useful to the breeders for desired improvement programme of the chicken flock.

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