Growth performance and linear body measurements of Hansli, CSML and Hansli×CSML cross under intensive system of rearing

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Abstract

A study was conducted to evaluate one improved (CSML - coloured synthetic male line), one native (Hansli) and their cross (Hansli × CSML) chicken up to 8 weeks of age under intensive system of rearing. Ninety (90) day-old chicks, each from CSML, Hansli and Hansli × CSML cross from a single hatch were collected randomly. Chicks of each genotype were divided into three replicates of 30 each. Body weights (BW) of all birds were recorded at day-one and at weekly interval up to 8 weeks. The feed consumption was recorded replicate wise on weekly basis. Mortality was recorded daily replicate wise. Linear body measurements were recorded at 6th and 8th week of age. The 8th week body weight of CSML, Hansli and Hansli × CSML were 1993.55, 740.33 and 1159.45g respectively. The rate of BW gain in CSML and Hansli × CSML were similar for 6th, 7th and 8th week.The rate of BW gain in CSML increased up to 7th week and declined thereafter where as the rate of gain in Hansli and Hansli × CSMLwas on the rise till 8th week of age. The 8th week feed conversion ratio was recorded as 2.17, 2.58 and 2.26 for CSML, Hansli and Hansli × CSMLrespectively and values did not differ significantly (P>0.05). Highest mortality was recorded in CSML (8.88%) followed by Hansli × CSML(7.77%) and Hansli (6.66%). All recorded body measurement parameters (breast angle, body length, body girth, shank length, shank width, keel bone length and height of the bird) of the three genotypes at 6th and 8th week of age revealed a distinct trend showing the value of most of the body measurement parameters of Hansli × CSML cross in between the Hansli and CSML. Most of the characteristics of Hansli × CSMLF1cross coincide with the average of two parents (Hansli and CSML). So, these characters are governed by additive gene action and we suspect there is absence of dominance, over dominance and epistasis and so absence of heterosis.

Key words: growth performance; linear body measurements; Hansli× CSML; poultry

Introduction

Genetic progress can be attained either by selection or crossbreeding (Adebambo et al., 2011). Crossbreeding of the indigenous stock with exotic commercial birds will take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. Crossbreeding programmes including upgrading local chickens with suitable exotic stocks could lead to production of birds that will be better in growth rate, efficiency of feed conversion and reproductive traits without sacrificing adaptation to the local environment, thereby resulting in reduced cost of production. The outcome of crossbreeding is due to the phenomenon of heterosis, which is expressed in the performance of the hybrids. Since, heterosis is almost exclusively the aggregate of all single locus dominance effects, and as these are usually positive or beneficial, heterosis can be expected to be usually in the favourable direction. Growth and production traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment (Ahmad and Singh, 2007). The information on the growth, linear body measurement traits is scanty which are also influenced by breed, strain, system of rearing and climatic conditions. Considering the necessity to identify potential poultry crossbreds, suitable for backyard farming as well as commercial farming in different regions of India which are easily adaptable to high rainfall, high humidity and high environmental temperature, the proposed study was aimed at evaluatingthe growth performance and linear body measurements of one improved (CSML - coloured synthetic male line), one native (Hansli) and their cross (Hansli × CSML) chicken maintained up to 8 weeks of age.

Materials and methods

Experimental birds and protocol design

Ninety (90) day-old straight run healthy chicks from the three genotypes (CSML, Hansli and Hansli × CSML cross) were randomly selected, wing banded and kept for 8 weeks in deep litter system of management. The birds were given floor space according to their age and kept in three different pens during the entire period of study. Routine medication procedures were followed for all the experimental chicks. All the chicks were immunized against Marek's disease on 1st day, Ranikhet disease (RD) on 5th and 28th day using LaSota strain, infectious bursal disease (IBD) on 14th and 35th day, fowl pox on 42nd day and RD using R_2B strain at 8th week. An experimental chick diet was prepared and fed to the chicks *ad libitum*. Clean and fresh water was made available at all times. The experimental diets were analyzed for proximate composition according to AOAC (2000). Calcium was determined according to the modified method of Talapatra et al. (1940) and available phosphorus was determined spectrophotometrically adopting the metavanadate method. The gross and proximate compositions of the experimental diets are presented in Table 1.

Table 1. Gross and chemical composition of experimental chick diet

Gross composition		**Chemical composition (% on DM basis)**	
Ingredient	**Quantity (%)**	**Nutrient**	**Conc. (%)**
Maize	60	Moisture	9.23
Soya bean meal	30	Crude protein	19.98
De-oiled rice bran	7	Ether extract	4.14
Mineral mixture	3	Crude fibre	4.22
Common salt	0.3	Total ash	9.43
Trace mineral	0.1	Acid insoluble ash	2.6
Vitamin premix	0.3	Nitrogen free extract	62.23
Choline chloride	0.05	Calcium	0.90
Anti-coccidial	0.05	Available phosphorus	0.45
Toxin binder	0.02	Metabolizable Energy*	2850 kcal/kg

*Calculated value

Body weight(BW) of all birds was recorded at day-one and at weekly interval up to 8 weeks. The BW gain for a particular week was calculated by subtracting the BW of previous week from the recorded BW of current week. Weekly cumulative BW was calculated by subtracting the day-old BW from the BW of the respective week. The feed intake was recorded replicate-wise on weekly basis by subtracting the left over feed at the end of the week from the total feed offered during the week. Cumulative feed consumption was calculated by adding the feed consumption from 1st week up to the desired week. From the weekly BW gain and feed consumption, weekly feed conversion ratio (FCR) was calculated. Cumulative FCR was calculated from cumulative BW gain and cumulative feed intake.Mortality of the chicks was recorded daily replicate-wise. Various linear body measurements such as beak length, head width, breast angle, shank length, shank width, body length, height, girth and keel length were measured in the three genotypes at 6th and 8th week of age with electronic digital callipers as described below.

Beak length: It was measured as the distance between the base and tip of the beak.
Head width: It was measured at the widest region of the head.
Breast angle: It was recorded with the help of a breast meter to the nearest of one degree accuracy. For measuring the breast angle, the apparatus was placed posterior to the anterior edge of keel bone.
Shank length: It was measured from top of the hock joint to toe.
Shank width: It was measured at the centre between the hock joint and carpal joint.
Body length: It was recorded from the tip of the beak to the tip of the tail with the help of a measuring tape to the nearest of 1 cm accuracy.
Height of the bird: It was recorded from the tip of the beak to the tip of the middle toe with the help of a measuring tape to the nearest of 1 cm accuracy.
Body girth: It was measured at the centre of the girth region with the help of measuring tape to the nearest of 1 cm accuracy.
Keel length: It was recorded as the distance between the anterior end of keel bone and the point of keel (posterior end of keel bone) with the help of measuring tape to the nearest of 1cm accuracy.

Data analysis

Data were subjected to analysis of variance and the treatment means were separated by Duncan's test using SPSS 17.0 (SPSS Inc., Chicago, IL, USA).Significance was declared at $P \leq 0.05$.

Results and discussion

Body weight

The mean weekly BW of the chicks of CSML, Hansli and Hansli × CSML from 0 to 8 weeks are presented in Table 2 and depicted in Figure 1. The BW of Hansli × CSML chicks were significantly ($P \leq 0.05$) higher than that of Hansli but lower than that of CSML chicks throughout the experimental period.

The mean day-old BW of Hansli chicks is 28.40 g. Similar day-old BW has been reported in Kadaknath breed (Haunshi et al., 2010). However, the day-old BW of Hansli is lower than Hazra (31.48g) as reported by Jha et al. (2013). The day-old BW of native chicks in Pakistan and Bangladesh has been reported as 25.91g (Khawaja et al., 2012) and 29.14g (Faruque et al.,2013), respectively. The 8th week BW (740.33g) of Hansli chicks on combined sex basis is much higher than Hazra, Assel and Kadaknath breeds whose 8th week BW are reported as 384, 273 and 238g, respectively under intensive system of management (Jha et al.,2013). The 8th week BW of Hansli is also higher than Tripura black (male-650g, female-505g), Dahlem Red (male-723g, female-590g) and native birds from Rajasthan (668.72g) which are under evaluation at concerned Rural Poultry Centres of AICRP on Poultry Breeding. The 8th week BW of Hansli chicks is also higher than the 8th week BW (514.40g) of RIR (Khawaja et al., 2012). From the present findings, it may be inferred that the BW of Hansli is higher than the BW of most of the indigenous/non-descript poultry breeds as well as some improved dual purpose breeds at similar age.

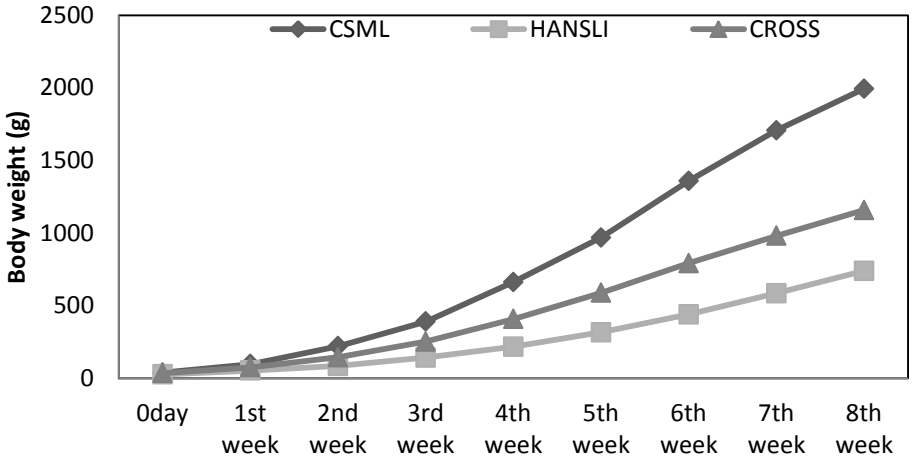
Table 2. Weekly body weight in different experimental groups

Age	Body weight (g)			P value
	CSML	Hansli	Hansli × CSML	
Day old	40.17^{a}±0.58	28.40^{b}±1.70	36.60^{a}±2.23	0.006
1st week	98.39^{a}±11.65	54.19^{b}±1.81	76.41^{ab}±3.72	0.014
2nd week	221.44^{a}±24.18	85.84^{c}±5.31	145.54^{b}±9.85	0.002
3rd week	391.06^{a}±24.45	143.19^{c}±6.86	253.67^{b}±15.92	0.000
4th week	663.42^{a}±36.50	219.03^{c}±9.48	408.83^{b}±19.58	0.000
5th week	970.02^{a}±32.87	317.77^{c}±11.09	589.30^{b}±23.38	0.000
6th week	1359.89^{a}±84.19	440.94^{c}±10.21	793.83^{b}±31.25	0.000
7th week	1707.61^{a}±71.43	586.62^{c}±6.68	981.42^{b}±42.43	0.000
8th week	1993.55^{a}±35.72	740.33^{c}±13.81	1159.45^{b}±49.09	0.000

^{abc}Mean with different superscripts in a row differ significantly ($P<0.05$)

The mean day-old BW of Hansli × CSML (36.60 g) is higher than BN cross (31.50g) and BND cross (33.52g) as reported by Guwahati Rural Poultry Centre as well as BN cross (30.37g) and DBN cross (32.36g) as reported by Ranchi Rural Poultry Centre. The day-old BW of Hansli × CSML is also higher than Dahlem Red (33.24g), Dahlem red × Desi (32.67g) as reported by Jha et al. (2013) and PD1 × PD4 (32.11 g) as reported by Padhi et al. (2014). The 6th week BW of Hansli × CSML (793.83 g) is also higher than PD1 × PD4 (380.63 g) as reported by Padhi et al. (2014). The 8th week BW of Hansli × CSML (1159.45 g) is much higher than Dahlem Red (495.46 g) and Dahlem Red × Desi (428.23 g) as reported by Jha et al. (2013). The 8th week BW of Hansli × CSML (981.32g) is much higher than Dahlem Red (495.46g), Dahlem Red × Desi (428.23g) and PD1 × PD4(380.63g) as reported by Jha et al.(2013) and Padhi et al. (2014). The 8th week BW of Hansli × CSML is also higher than 8th week BW of Australop× Tswana (male-727.61g, female- 634.30g)

Fig. 1: Mean weekly body weight of different experimental groups



as reported by Kgwatalala and Segokgo (2013) and RIR ×Fayoumi (Khawaja et al., 2012). Hansli × CSML cross also exhibited higher BW at all ages as compared to other crosses. It could be due to the fact that Hansli is a native bird with high growth potential as compared to other native breeds and CSML is a broiler parent line selected for high growth rate. The high BW of the crosses of these two breeds as compared to other crosses as discussed earlier could be attributed to the high growth rate of the two parent lines used to develop this cross.

The BW of CSML at 8th week of age was 1993.55 g which is higher than the reported value of Vanaraja birds (1061g). The 5th week BW of CSML (970.02 g) as obtained in the present experiment is similar to the findings of AICRP Bhubaneswar and Jabalpur centres. However the 5th week BW of CSML in the present experiment was lower than that of the AICRP CARI centre (1187.61 g) (AICRP Annual Report, 2013-2014).

The BW gains of the chicks of CSML, Hansli and Hansli × CSML from 0 to 8 weeks are presented in Table 3. When compared between the groups, CSML had significantly (P<0.05) higher body weight gain than Hansli and Hansli × CSML for all the periods. During 6th, 7th and 8th week, Hansli and Hansli × CSML had similar body weight gain and for all other periods, Hansli × CSML had significantly (P<0.05) higher body weight gain than Hansli. The findings are as expected as CSML is a broiler parent line and Hansli is a non-descript population. An interesting finding with respect to body weight gain was that the rate of gain in CSML increased up to 7th week and declined thereafter where as the rate of gain in Hansli and Hansli × CSML was on the rise till 8th week of age. This may be due to genetic variation among the genotypes under study.

Table 3. Weekly body weight gain in different experimental groups

Age (week)	Body weight gain (g)			P value
	CSML	Hansli	Hansli × CSML	
1st	58.22^{aC}±12.07	25.37^{bC}±3.67	39.79^{abC}±5.66	0.071
2nd	122.90^{aC}±12.63	31.65^{cC}±3.77	68.55^{bC}±6.22	0.001
3rd	169.62^{aC}±10.23	56.67^{cB}±2.19	108.13^{bB}±10.08	0.000
4th	272.36^{aB}±18.54	75.84^{cB}±3.31	155.16^{bB}±6.60	0.000
5th	306.60^{aA}±8.75	98.74^{cA}±4.08	180.47^{bA}± 3.81	0.000
6th	382.43^{aA}±69.00	121.88^{b}±4.43	202.65^{b}±18.12	0.011
7th	347.73^{a}±24.81	145.67^{b}±4.69	187.60^{b}±20.54	0.001
8th	285.93^{a}±39.76	153.72^{b}±7.36	178.02^{b}±32.22	0.043

^{ab}Mean with different superscripts in a row differ significantly (P<0.05).
^{ABC}Mean with different superscripts in a column differ significantly (P<0.05).

Feed intake

The mean daily feed intake, recorded on a weekly basis, of the chicks of CSML, Hansli and Hansli × CSML from 0 to 8 weeks is presented in Table 4. The feed intakes of CSML, Hansli and Hansli × CSML chicks were similar (P≥0.05) during 1st week. For all other periods, the feed intake of Hansli was significantly (P<0.05) lower than the CSML. The feed intake of Hansli and Hansli × CSML were similar for all the periods.

The mean cumulative feed intake of the chicks from 0 to 8 weeks is presented in Table 5. During 1st week, the cumulative feed intakes were similar (P≥0.05) in all the chicks of CSML, Hansli and Hansli × CSML. For all other periods cumulative feed intakes of Hansli were significantly (P<0.05) lower than CSML.

Table 4. Weekly feed consumption of chicks for 0-8 weeks of age

Age (week)	Feed intake (g/bird)			P value
	CSML	Hansli	Hansli × CSML	
1st	104.02±25.18	55.24±8.69	59.14±6.48	0.129
2nd	236.26^{a}±51.51	71.11^{b}±8.18	124.95^{b}±18.23	0.027
3rd	319.13^{a}±46.77	144.37^{b}±9.83	201.55^{b}±29.96	0.023
4th	535.08^{a}±115.35	193.78^{b}±14.16	331.86^{ab}±35.64	0.037
5th	666.74^{a}±179.30	243.42^{b}±7.50	416.05^{ab}±56.35	0.084
6th	748.80^{a}±127.29	308.63^{b}±14.77	423.83^{b}±24.00	0.015
7th	747.53^{a}±131.15	386.97^{b}±31.95	476.93^{ab}±46.20	0.049
8th	862.37^{a}±111.06	431.62^{b}±29.31	504.83^{b}±63.84	0.015

^{ab}Mean with different superscripts in a row differ significantly (P<0.05)

Table 5. Mean cumulative feed consumption of chicks for 0-8 weeks of age

Age (week)	Cumulative feed intake (g/bird)			P value
	CSML	Hansli	Hansli × CSML	
1st	104.02±25.18	55.24±8.69	59.14±6.48	0.129
2nd	340.29^{a}±75.66	126.35^{b}±15.15	184.09^{ab}±24.63	0.042
3rd	659.42^{a}±120.78	270.71^{b}±24.42	385.63^{b}±54.04	0.030
4th	1194.50^{a}±229.70	464.49^{b}±10.28	717.49^{ab}±73.02	0.026
5th	1861.24^{a}±398.85	707.91^{b}±3.79	1133.55^{ab}±48.47	0.033
6th	2610.03^{a}±524.38	1016.54^{b}±11.14	1557.38^{ab}±58.05	0.026
7th	3357.56^{a}±651.52	1403.51^{b}±43.09	2034.31^{b}±94.91	0.028
8th	4219.93^{a}±711.47	1835.13^{b}±71.28	2539.14^{b}±154.33	0.018

^{ab}Mean with different superscripts in a row differ significantly (P<0.05)

Table 6. Mean weekly FCR of chicks for 0-8 weeks of age

Age (week)	FCR			P value
	CSML	Hansli	Hansli × CSML	
1st	1.75^{b}±0.09	2.17^{a}±0.04	1.50^{c}±0.05	0.001
2nd	1.89±0.30	2.26±0.15	1.82±0.18	0.375
3rd	1.93±0.40	2.53±0.09	1.85±0.12	0.178
4th	1.93±0.29	2.57±0.25	2.13±0.14	0.220
5th	2.21±0.67	2.48±0.17	2.32±0.36	0.915
6th	2.20±0.73	2.54±0.12	2.13±0.27	0.801
7th	2.17±0.42	2.65±0.18	2.55±0.12	0.473
8th	3.22±0.80	2.84±0.33	3.03±0.72	0.919

^{abc}Mean with different superscripts in a row differ significantly (P<0.05)

Table 7. Mean cumulative FCR of chicks for 0-8 weeks of age

Age (week)	Cumulative FCR			P value
	CSML	Hansli	Hansli × CSML	
1st	1.75^{b}±0.09	2.13^{a}±0.08	1.50^{b}±0.05	0.003
2nd	1.83±0.23	2.20±0.09	1.69±0.11	0.125
3rd	1.87±0.30	2.36±0.09	1.76±0.10	0.141
4th	1.90±0.29	2.45±0.10	1.92±0.08	0.134
5th	1.99±0.40	2.46±0.10	2.05±0.08	0.401
6th	2.02±0.49	2.47±0.10	2.06±0.02	0.505
7th	2.05±0.47	2.52±0.12	2.15±0.02	0.502
8th	2.17±0.41	2.58±0.16	2.26±0.09	0.533

^{ab}Mean with different superscripts in a row differ significantly (P<0.05)

Feed conversion efficiency

During 1st week, the FCR of CSML, Hansli and Hansli × CSML chicks were 1.75, 2.17 and 1.50 respectively (Table 6). The feed utilization efficiency of Hansli × CSML chicks was superior to that of Hansli and CSML chicks during 1st week. However, from 2nd week onwards, the feed utilization efficiency remained similar (P≥0.05) among all the chicks of CSML, Hansli and Hansli × CSML.

The mean cumulative FCR of the chicks of CSML, Hansli and Hansli × CSML from 0 to 8 weeks is presented in Table 7. The cumulative FCR of Hansli chicks were significantly (P≤0.05) higher than that of CSML and Hansli × CSML chicks during 1st week. However, from 2nd week onwards, the cumulative FCR was

also without any significant variation among all the chicks of CSML, Hansli and Hansli × CSML. At 8th week, the cumulative FCR of CSML, Hansli and Hansli × CSML chicks were 2.17, 2.58 and 2.26 respectively.

The mean cumulative 8th week FCR (Table 7) was lowest in CSML followed by Hansli × CSML and Hansli. The 8th week FCR of Hansli was recorded as 2.58 in the present investigation. Khandoker (1993) reported FCR of 6.36 in indigenous chicken. Faruque et al. (2013) in three indigenous breeds recorded FCR of 3.58, 3.45 and 3.34 up to 8 weeks of age. Ogbu et al. (2015) reported FCR in two light and heavy indigenous chicken breeds as 8.11 and 5.11 respectively up to 8 weeks of age. The 5th week FCR of native birds from Assam and Himanchal Pradesh were reported as 3.39 and 3.24 (AICRP Annual Report, 2013-2014) which is also much higher than the FCR of Hansli (2.46) for the corresponding period as found in this investigation. The 8th as well as 5th week FCR of Hansli birds is lower than the FCR of most indigenous breeds for the corresponding periods which indicates better feed conversion efficiency of Hansli birds than other indigenous breeds. The 5th and 8th week FCR of Hansli × CSML was found to be 2.05 and 2.26 respectively. The 5th week FCR of BN crosses and BDN crosses of Guwahati centre were reported as 3.28 and 2.86 respectively and that of ND × D crosses was reported as 2.68 (AICRP Annual Report, 2013-2014) which were higher than the 5th week FCR of Hansli × CSML crosses. The 8th week FCR of Hansli × CSML crosses is at par with the 8th week FCR of Red Cornish (2.08), Vanaraja (2.16), Black Rock (2.22) and Kuroiler (2.19) (Debata et al., 2012). The present findings with respect to FCR indicate that the feed conversion efficiency of Hansli × CSML crosses is much better than different crosses and is at par with some of the popular breeds like Black Rock, Red Cornish and Vanaraja.The 5th and 8th week FCR of CSML were found to be 1.99 and 2.17 respectively in the present investigation. The 5th week FCR of PB1 and PB2 (broiler parent lines) were reported as 2.4 and 2.1 respectively. The 5th week FCR of CSML at AICRP Izatnagar centre and OUAT centre were reported as 2.0 and 1.93 respectively. The 5th week FCR of PB2 at Guwahati AICRP centre was reported as 2.76 (AICRP Annual Report, 2013-2014). The present finding with respect to FCR of CSML is in agreement with the previous findings. CSML being a broiler parent line is expected to have better feed conversion efficiency as compared to native and native × broiler crosses as evidenced from the findings of the present investigation.

Mortality

The mortality up to 8 weeks of age in CSML, Hansli and Hansli × CSML were 8.88%, 6.66% and 7.77% respectively. Maximum mortality in all the treatment groups was recorded during the 1st week of rearing and thereafter the mortality was reduced. Among the genotypes under study, Hansli (indigenous) chicks had lowest mortality which could be due to better adaptability to local climatic conditions. The mortality in CSML was highest and that of crosses was in between CSML and Hansli. Similar mortality values have been reported for Native, CSML and Native × CSML cross (AICRP Annual Report, 2013-2014). Gonmei (2012) reported mortality ranging 5-10% in indigenous chicken and 5.6% in Vanaraja chicks from 0-5 weeks of age. Khawaja et al.(2012) reported mortality of 12, 9 and 7.3% in RIR, Fayaumi and R_1F_1 chicks up to 8 weeks of age. Daida et al. (2012) reported that the mortality in CSML × RIR, CSML × B77 and B77 × CSML were 17.06, 9.96 and 12.80 respectively up to 8 weeks of age. From the findings of previous works, it is found that the mortality in different genotypes as recorded in the present investigation were lower than or similar to earlier reported values for native, improved and their crosses. The mortality in chicks is influenced by several factors including the management practices. Therefore a wide variation in mortality for the same genotype has been reported by different workers. As the mortality of the three genotypes under study were less than 9% and most mortality occurred during the first week of rearing, it may be considered to be within the normal range.

Linear body measurements

The mean linear body measurements of the chicks of CSML, Hansli and Hansli × CSML at 6 weeks of age are presented in Table 8. The breast angle (degree) of Hansli × CSML chicks (58.88) were significantly ($P \leq 0.05$) higher than that of Hansli chicks (53.52) but lower than that of CSML chicks (67.04). The length of the beak was significantly ($P \leq 0.05$) higher in CSML genotype than that of Hansli and Hansli × CSML genotypes. The highest value of head width was observed in CSML followed by Hansli and Hansli × CSMLgenotypes. The longest length of the body was observed in CSML chicks (34.64 cm) followed by Hansli × CSML (31.48cm) and Hansli (27.08 cm) chicks. The body girth measurement also followed the similar trend to that of body length; the corresponding values of body girth (cm) were 29.08, 19.37 and 25.05 for CSML, Hansli and Hansli × CSML chicks, respectively. The measurements of shank length, shank width, keel bone length and height of the chicks also followed the similar trend to that of body length and girth measurements. The length of the shank was 7.58, 5.63and 6.93cm for CSML, Hansli and Hansli × CSML chicks, respectively. The width of the shank (cm) was 1.88, 1.21and 1.59for CSML, Hansli and Hansli × CSML chicks, respectively. The keel bone length (cm) was 9.82, 6.90and 7.98 for CSML, Hansli and Hansli × CSML chicks, respectively. Maximum height was observed in CSML chicks (35.92 cm) followed by Hansli × CSML (31.53 cm) and Hansli (27.80 cm) chicks.

Table 8. Mean linear body measurements of chicks at 6th and 8thweeks of age

Traits	Age (week)	CSML	Hansli	Hansli × CSML	P Value
Breast angle (degrees)	6th	67.03^{a}±0.43	53.52^{c}±0.87	58.88^{b}±0.33	0
	8th	78.35^{a}±0.47	63.71^{c}±0.39	71.20^{b}±0.34	0
Beak length (cm)	6th	3.74 ^{a}±0.05	3.12^{b}±0.02	3.11^{b}±0.03	0
	8th	4.30^{a}±0.03	3.34^{c}±0.02	3.51^{b}±0.02	0
Head width (cm)	6th	3.63^{a}±0.02	3.24^{b}±0.03	3.10^{c}±0.03	0
	8th	4.19^{a}±0.03	3.47^{b}±0.03	3.49^{b}±0.03	0
Body length (cm)	6th	34.64^{a}±0.36	27.07^{c}±0.41	31.47^{b}±0.18	0
	8th	38.82^{a}±0.26	32.12^{c}±0.19	35.46^{b}±0.13	0
Body girth (cm)	6th	29.07 ^{a}±0.15	19.37^{c}±0.11	25.05^{b}±0.08	0
	8th	33.60^{a}±0.18	24.11^{c}±0.22	28.47^{b}±0.06	0
Shank length (cm)	6th	7.58^{a}±0.08	5.62^{c}±0.05	6.92^{b}±0.03	0
	8th	8.47^{a}± 0.04	6.87^{b}± 0.05	8.26^{a}± 0.05	0
Shank width (cm)	6th	1.87^{a}±0.03	1.20^{c}±0.02	1.58^{b}±0.02	0
	8th	2.18^{a}±0.03	1.60^{c}±0.02	1.87^{b}±0.01	0
Keel length (cm)	6th	9.82^{a} ±0.09	6.90^{c}±0.04	7.98^{b}±0.03	0
	8th	12.18^{a}±0.10	8.40^{b}±0.09	9.80^{b}±0.50	0
Height (cm)	6th	35.92^{a}±0.59	27.79^{c}±0.23	31.52^{b}±0.22	0
	8th	41.90^{a}±0.56	31.27^{c}±0.33	35.74^{b}±0.21	0

^{abc}Mean with different superscripts in a row differ significantly (P<0.05)

The mean linear body measurements of the chicks of CSML, Hansli and Hansli × CSML at 8 weeks of age are presented in Table 8. The breast angle of CSML chicks were significantly (P≤0.05) higher than that of Hansli × CSML and Hansli chicks. The beak length of the chicks also followed the similar trend to that of breast angle. The head widthof CSML chicks was significantly (P≤0.05) higher than that of Hansli and Hansli × CSML chicks. Highest body length was observed in CSML chicks (38.82) followed by Hansli × CSML (35.46cm) and Hansli (32.12cm) chicks. The body girth measurement also followed the similar trend to that of body length; the corresponding values of body girth (cm) were 33.60, 24.11and 28.47for CSML, Hansli and Hansli × CSML chicks, respectively. The length of the shank was significantly (P≤0.05) lower in Hansli chicks (6.87cm) than that of CSML (8.47cm) and Hansli × CSML (8.26cm) chicks. The width of the shank (cm) was also lowest in Hansli (1.60) chicks followed by Hansli × CSML (1.87) and CSML (2.18) chicks. The keel bone length was significantly (P≤0.05) higher in CSML chicks (12.18 cm) than that of Hansli (8.40 cm) and Hansli × CSML (9.80 cm). Maximum height was measured in CSML chicks (41.90 cm) followed by Hansli × CSML (35.74 cm) and Hansli (31.27 cm) chicks.

The linear body measurements of the three genotypes at 6th and 8th week of age revealed a distinct trend showing the value of most of the body measurements parameters of crosses in between the CSML and Hansli. The body length of Hansli birds (32.12cm) at 8th week of age was much higher (male-18.20 cm, female-19.33 cm) than the Nigerian native chicken. Similar findings have been reported by Mohapatra et al. (2001) who observed that both the sexes of Hansli birds are fairly long. The head width, body girth, keel length, shank length and breast angles found in the present experiment were also similar to the previous reported value Mohapatra et al. (2001). The linear body measurement values obtained in the present experiment were almost similar to the values reported by Semakula et al. (2011). The breast angle (49.31^{0}), shank length (49.31cm) and keel length (50.45 cm) of native birds from Assam were lower than those of Hansli birds. The linear body measurement values for shank length, keel length and breast angle of Hansli × CSML crosses were higher than Native × PB2 and BND crosses indicating better broiler body traits as compared to other crosses. The linear body measurement traits as obtained in the present experiment were similar to those reported by AICRP Bhubaneswar centre for two generations (AICRP Annual Report, 2013-2014).

Conclusions

Most of the characteristics like growth, body weight gain, feed conversion efficiencyand linear body measurements of Hansli × CSML F_1cross coincide with the average of two parents (Hansli and CSML). So these characters are governed by additive gene action and we suspect there is absence of dominance, over dominance and epistasis and so absence of heterosis. Body weight of Hansli at different ages is higher than the body weight of most of the reputed indigenous/non-descript breeds as well as some improved dual purpose breeds. Hansli × CSML cross also exhibited higher body weight at all ages as compared to other crosses. Better feed conversion efficiency was observed in Hansli birds than other indigenous breeds. Feed conversion efficiency of Hansli × CSMLcross is much better than different crosses and is at par with some of the popular breeds like Black Rock, Red Cornish and Vanaraja.

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