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Effect of chick weight and morphometric traits on growth performance of coloured broiler chicken

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Abstract
The present study investigated the effect of day old chick weight, length, ratio of weight to length square (body mass index), ratio of weight to length and shank length on growth performance of coloured broiler chicken (n=76) at Junagadh Agricultural University, Junagadh (Gujarat) from June to August, 2017. Chicks were classified into 3 groups (low, medium and high) based on their initial value of the parameters studied. Chicks with high initial body weight gained significantly more weight (19.65g, P≤0.05) up to day 15 than those with low initial weight. However, body weight was similar on later age among the groups. Chicks with high initial body length gained significantly higher live weight up to market age (126.31-139.42g) as compared to low to medium length groups (P≤0.05). However, day old chicks with medium weight and length had higher live weight (9.74 and 8.39g) on day 8 than the low weight and length group, respectively (P≤0.05). Chicken growth was not affected by body mass index and shank length. Moreover, day old chicks having medium to higher ratio of weight to length had significantly more live weight on day 8 (7.7-8.0g, P≤0.05) than the low groups. Taken together, it may be concluded that day old chick length markedly affected growth performance in coloured broiler chicken.

Keywords: Coloured broiler, chick weight, morphometric traits, growth

1. Introduction
Chick weight and morphometric traits like chick length and shank length have great influence on growth performances of broiler as these parameters positively affect slaughter yield at market age [1-3]. Chicks' weight being an easily measureable trait as compared to other traits gets more importance by breeders to assess their growth performance [1]. Chicks with higher initial body weight have better subsequent growth up to market age [1-3]. However, other studies cited significant effect of initial chick weight on growth during early life, but later diminished [4, 5]. Chick weight as a predictor of growth performance is biased due to presence of unabsorbed residual yolk in the abdomen; hence chick length is gaining more importance to predict growth performances of broilers [6]. Several researchers reported positive effect of day old chick length on body weight and its direct influence on growth performance as well as carcass weight at market age [2, 3, 5, 7]. Shank length is also positively associated with chick weight and length, and markedly affects their growth performance [2, 3, 8]. In present scenario, lean growth in broiler is in great demand among the consumers due to more health consciousness, which is reflected by ratio of body weight to length square (body mass index) or length [2, 3, 6, 9]. Slow growing coloured broilers developed from indigenous breeds have great demand due to better meat quality in terms of appearance, less fat and taste as well as better performance in tropical climate than fast growing broilers [4]. Most of the studies on effect of hatchling weight and body measurements on growth have been conducted on broiler strains which are developed in temperate countries and very scanty informations are available on coloured broiler strains which are specially developed in India. Hence, there is need to study the early chick factors affecting growth performances in coloured broilers. Thus, keeping these in view, the present study was designed to assess the effect of chick weight and certain morphometric traits on growth performance in coloured broilers.

2. Material and Methods
The present study was conducted at poultry unit of Instructional Livestock farm Complex, Junagadh Agricultural University, Junagadh (Gujarat) on coloured broiler chicken (Caribro-Dhanraja) during rainy season (June to August, 2017).

Seventy eight physically healthy day old unsexed coloured broiler chicks (breeder patent age was about 58 weeks) were included for this study and numbered by wing band individually at the start of experiment. Experimental chicks were reared under similar managemental conditions as per the farm standard. Birds were provided feed and water *ad libitum* and maintained under deep litter system of housing with groundnut hulls as litter material. Continuous lighting facilities were provided to the birds during the study period for 24 hours. Birds were fed with broiler starter ration (23% CP and 2800 Kcal ME per kg) during first four weeks and later broiler finisher ration (20% CP and 2900 Kcal ME per kg) up to the market age. All the experimental birds were vaccinated for poultry diseases as per the guidelines for commercial broilers.

Body weight of chicken was measured on day one and then at weekly intervals for a period of 6 weeks. Body measurements like chick length (length from tip of beak to length of longest toe excluding its nail) and shank length (length from hock joint to bottom of foot pad) were measured on day one at the start of experiment. Body length was measured by keeping the chick on a platform on its ventral aspect in such a position by extending neck and toe to their maximum extent gently. Then body mass index i.e., ratio between weight (g) and chick length square (cm^2) was calculated [3, 6, 9]. Additionally, ratio between chick weight (g) to length (cm) was also calculated [2, 7].

2.1 Statistical analysis

Birds were grouped into three groups like low, medium and high based on tertiles of the initial value of the each parameter studied in the present experiment [10]. Effect of initial chick weight, chick length, body mass index, ratio of weight to chick length and shank length of day old chicks on body weight at different intervals during the study period was analysed by one-way analysis of variance with general linear model. Duncan multiple range test was used as post hoc test to compare all pair wise mean differences and the difference was considered as significant if $P \leq 0.05$. Frequency distribution of male and female birds among the groups was compared by chi-square test. Statistical analysis was carried out using SPSS software package (Version 16.0, USA).

3. Results

Initial means of chick body weight, length, body mass index, ratio of weight to length and shank length at day 1 in low, medium and high groups are presented in Table 1. There was significant difference for all parameters among the groups of day old chicks ($P \leq 0.05$). Effect of chick body weight, length, body mass index, ratio of weight to length and shank length on subsequent growth are presented in table 2, 3, 4, 5 and 6, respectively. Body weight significantly increased by 7.14% (10.62g) and 5.52% (19.65g), respectively on day 8th and 15th in those chickens with high initial body weight as compared to low weight group ($P \leq 0.05$). However, on later age though the body weight of chicken remained numerically higher in high weight group but statistically did not differ (Table 2). Day old chicks with medium weight had 9.74g higher live weight on day 8 as compared to low weight group ($P \leq 0.05$). Initial chick length though significantly ($P \leq 0.05$) affected the body weight of chickens, the effect gradually diminished towards market age (Table 3). Chicks with high initial body length had significantly ($P \leq 0.05$) more live weight throughout the study period as compared to other two groups (small and medium groups), but chicks with medium length group had higher body weight on day 8 only as compared to those with low body length. Chicks with high initial body length gained 126.31-139.42g more live weight up to market age as compared to low to medium length groups ($P \leq 0.05$). Medium length group chicks had 8.39g higher live weight on day 8 than the low length group ($P \leq 0.05$). On the other hand, body mass index (Table 4) and shank length (Table 5) did not show any significant effect on body weight of chicken except on day one. Moreover, ratio of day old chick weight and length significantly affected the body weight on day 8, and chicks in medium to high group gained 7.7-8.0g (5.1-5.3%) more weight than the low groups (Table 6, $P \leq 0.05$).

4. Discussion

In commercial broilers, identification of non-invasive tools for prediction of growth performance at an early age is gaining more importance. There are several traits like day old chick weight, hatchling length and shank length that are commonly used for early prediction of growth in broilers, but hatchling length is considered better among these traits [6]. Additionally body mass index and ratio of chick weight to length reflects leanness in broilers, hence commonly used for evaluation of lean growth in broilers [2, 3]. Although, informations on association of day old chick weight and morphometric traits with growth performance of commercial broilers are available, such informations are scanty for coloured broilers, which are developed particularly for the tropical climate. In the present study, we investigated the effect of day old chick weight and morphometric traits on growth performance in coloured broilers up to market age.

In coloured broilers, the effect of initial chick weight on successive body weight was statistically significant up to 2nd week. Coloured broiler chicks with high initial weight had higher body weight on 1st, 8th and 15th day as compared to low weight group, but later the effect diminished gradually. In a similar line, Jiang and Yang [4] observed significantly higher body weight on 1st day in Lingnan yellow chick of high initial weight group than the low to moderate weight groups, but the effect was nullified from 2nd week up to market age. Similarly, in Ross broiler strain, Suk [11] did not observe any effect of chick weight on post-hatch growth (during 1st to 5th week) except on day one. Moreover, in Cobb strain the effect was similar to our study up to 15th day post-hatch but later it was contradictory [11]. Presence of unknown quantity of residual yolk (0.8-10.6g, 2; 2-8g) [6] in abdominal region of chick may mislead their actual weight, which might be the reason of non-significant effect of chick weight on growth beyond two weeks age. Further, the strain of experimental birds used in different study might be attributed to dissimilarity of result among different studies [11].

Coloured broiler chicks with high initial body length had comparatively more weight throughout the study period than the low to medium length groups which is in agreement with previous reports [6, 7]. In coloured broilers, about 113-214 g more live body weight per extra each centimeter of initial chick length was observed on 43rd day which is more or less comparable with other studies (20-134g/cm) [5,12]. In another study, about 18 gram more body weight for every extra centimeter of initial chick length has been reported on day 7 [6], which is comparatively higher than our study (7.5 to 10.5 g/cm on 8th day). The variation of results in different studies might be attributed to sample size or age or strains of broiler flock [5]. Gender of the birds (male and/or female broilers) used in different studies may be another reason for variation of results [5]. However, in our study, birds of both sexes were

observed to be distributed equally among the groups without any statistical difference (P>0.05).

In this study, coloured broiler chicks with high body mass index had more live weight on day 1, but on later stage there was no effect. In consonance with our result, non-significant effect of body mass index on post-hatch growth performance of Cobb broilers during 7th and 42nd day was observed by Willemsen *et al.* [3]. Moreover, contrary to our result, Willemsen *et al.* [3] reported significant association of body mass index with post hatch growth in Ross strain up to market age. The alteration of results in different studies might be attributed to growth potential of different strains. In our study, association of weight to length ratio showed better response as compared to body mass index. Day old coloured broiler chicks with moderate to high value of weight: length ratio gained about 5.1-5.3% higher body weight on day 8 as compared to those with low value of weight: length ratio. The overall value of chick weight to length ratio of coloured broilers is comparatively higher than Wolanski *et al.* [2] but lower than Petek *et al.* [7]. As the ratio is a function of weight and length; so, the value may be affected by alteration of either of the paramers. Time of measurement after hatch also affects chick length [3] and could ultimately affect the ratio.

In our study, the effect of shank length on live body weight was significant on day one only; chicks with high shank length group had more body weight which is in agreement with other studies [2, 11]. In a similar line, Willemsen *et al.* [3] also did not observe any effect of shank length on body weight of broiler chickens (Ross and Cobb strains) in later stage. In contrast to our result, Wolanski *et al.* [2] observed effect of shank length on live body weight at 2nd week. In another study, variation of effect of shank length on live body weight was observed in different strains, where it was significant up to 3 weeks in Ross strain, but it persisted up to 5th weeks in Cobb strain [11]. Thus disparity of results among different studies might be attributed to strains of birds used for the experiment.

Table 1: Weight and morphometric traits of day old coloured broiler chicken

Groups	Weight (g)	Length (cm)	Weight: Length^2	Weight: Length	Shank (cm)
Low	41.24^a±0.23	17.95^a±0.06	0.120^a±0.009	2.24^a±0.01	2.19^a±0.01
Medium	44.32^b±0.20	18.59^b±0.03	0.128^b±0.002	2.39^b±0.01	2.32^b±0.01
High	47.76^c±0.37	19.18^c±0.05	0.138^c±0.001	2.55^c±0.02	2.46^c±0.02
Overall	44.44±0.34	18.58±0.06	0.129±0.001	2.39±0.02	2.32±0.01

Means with different superscripts differed significantly (*'P'* ≤ 0.05) within a column

Table 2: Effect of day old chick weight on body weight in coloured broiler chicken

Days	Body weight (g)			'*F*' Value	'*P*' Value
	Low	Medium	High		
Day 1	41.24^a±0.23	44.32^b±0.20	47.76^c±0.37	136.843	0.000
Day 8	148.67^a±1.83	158.41^b±2.43	159.29^b±3.40	5.007	0.009
Day 15	359.92^a±5.30	375.88^{ab}±6.85	379.77^b±7.48	2.535	0.086
Day 22	680.27^a±11.67	700.73^a±12.10	712.00^a±16.38	1.408	0.251
Day 29	1011.31^a±20.80	1030.12^a±20.17	1043.81^a±25.70	0.533	0.589
Day 36	1370.92^a±34.28	1374.27^a±31.86	1414.73^a±36.87	0.502	0.607
Day 43	1691.65^a±47.78	1712.31^a±39.44	1758.69^a±49.52	0.562	0.572

Means with different superscripts differed significantly (*'P'* ≤ 0.05) within a row

Table 3: Effect of day old chick length on body weight in coloured broiler chicken

Days	Body weight (g)			'*F*' Value	'*P*' Value
	Low	Medium	High		
Day 1	43.08^a±0.53	44.32^a±0.55	45.92^b±0.58	6.624	0.002
Day 8	148.41^a±1.97	156.80^b±3.12	161.17^b±2.58	6.233	0.003
Day 15	356.38^a±4.95	370.35^a±7.54	388.85^b±6.11	6.709	0.002
Day 22	673.19^a±11.19	689.04^a±13.58	730.77^b±13.84	5.296	0.007
Day 29	997.15^a±18.73	1011.88^a±19.29	1076.19^b±25.63	3.841	0.026
Day 36	1345.58^a±28.13	1367.35^{ab}±34.06	1447.77^b±37.65	2.538	0.086
Day 43	1670.04^a±38.53	1683.15^a±43.23	1809.46^b±50.57	3.008	0.055

Means with different superscripts differed significantly (*'P'* ≤ 0.05) within a row

Table 4: Effect of day old chick body mass index on body weight in coloured broiler chicken

Days	Body weight (g)			'*F*' Value	'*P*' Value
	Low	Medium	High		
Day 1	42.63^a±0.47	44.45^b±0.51	46.25^c±0.59	11.917	0.000
Day 8	153.95^a±2.47	157.55^a±2.62	154.87^a±3.22	0.450	0.640
Day 15	367.31^a±6.73	379.15^a±6.30	369.12^a±7.17	0.895	0.413
Day 22	689.31^a±13.02	715.27^a±14.24	688.42^a±13.45	1.261	0.289
Day 29	1014.58^a±22.44	1055.88^a±22.84	1014.77^a±21.23	1.151	0.322
Day 36	1352.92^a±37.08	1433.19^a±33.83	1373.81^a±30.65	1.504	0.229
Day 43	1677.77^a±49.41	1784.46^a±44.98	1700.42^a±40.84	1.546	0.220

Means with different superscripts differed significantly (*'P'* ≤ 0.05) within a row

Table 5: Effect of day old chick body weight to length ratio on body weight in coloured broiler chicken

Days	Body weight (g)			‘*F*’ Value	‘*P*’ Value
	Low	Medium	High		
Day 1	$41.43^{a}\pm0.27$	$44.46^{b}\pm0.30$	$47.43^{c}\pm0.45$	74.299	0.000
Day 8	$150.23^{a}\pm2.24$	$157.88^{b}\pm2.22$	$158.26^{b}\pm3.46$	2.799	0.067
Day 15	$361.65^{a}\pm6.16$	$380.88^{a}\pm6.25$	$373.04^{a}\pm7.44$	2.120	0.127
Day 22	$682.73^{a}\pm12.90$	$713.88^{a}\pm13.15$	$696.38^{a}\pm14.60$	1.325	0.272
Day 29	$1013.50^{a}\pm22.21$	$1056.38^{a}\pm23.55$	$1015.35^{a}\pm20.64$	1.196	0.308
Day 36	$1366.58^{a}\pm35.08$	$1417.88^{a}\pm37.59$	$1375.46^{a}\pm29.89$	0.638	0.531
Day 43	$1699.54^{a}\pm48.15$	$1750.38^{a}\pm49.04$	$1712.73^{a}\pm40.07$	0.330	0.720

Means with different superscripts differed significantly (*‘P’* ≤ 0.05) within a row

Table 6: Effect of day old chick shank length on body weight in coloured broiler chicken

Days	Body weight (g)			‘*F*’ Value	‘*P*’ Value
	Low	Medium	High		
Day 1	$43.65^{a}\pm0.62$	$44.20^{ab}\pm0.50$	$45.47^{b}\pm0.62$	2.563	0.084
Day 8	$153.18^{a}\pm3.16$	$155.79^{a}\pm2.31$	$157.40^{a}\pm2.81$	0.587	0.559
Day 15	$364.69^{a}\pm7.92$	$368.27^{a}\pm5.72$	$382.62^{a}\pm6.09$	2.036	0.138
Day 22	$687.04^{a}\pm13.33$	$688.00^{a}\pm13.22$	$717.96^{a}\pm13.96$	1.695	0.191
Day 29	$1026.27^{a}\pm22.75$	$1003.58^{a}\pm18.85$	$1055.38^{a}\pm24.38$	1.379	0.258
Day 36	$1389.31^{a}\pm37.14$	$1346.77^{a}\pm29.20$	$1423.85^{a}\pm35.30$	1.286	0.282
Day 43	$1730.23^{a}\pm49.56$	$1671.23^{a}\pm37.89$	$1761.19^{a}\pm48.23$	1.008	0.370

Means with different superscripts differed significantly (*‘P’* ≤ 0.05) within a row

5. Conclusion

Chick weight on day 1 had significant effect on live body weight of coloured broilers during early phase of growth i.e up to 2 weeks. However, initial chick length markedly affected body weight up to 6 weeks. On the other hand, chick body mass index (ratio of chick weight to length square) and shank length had no effect on post-hatch growth performance of coloured broilers. Moreover, ratio of day old chick weight and length affected growth performance till day 8, beyond which the effect was nullified. Taken together, it may be concluded that day old chick length could be used for predicting growth performance in coloured broiler chickens.

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