

# Comparative Assessment of Live Weights, Weight Gains and Body Conformation Traits among Indigenous and Exotic Breeds of Chicken

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## Abstract

*The present study was conducted to assess and compare the growth performance and body conformation traits of two exotic chicken breeds viz. Australorp and Cornish with one of the indigenous Kadaknath chicken breeds. Body weights were measured from 3rd day following weekly basis up to 8th week and body conformation traits were measured at 3rd, 5th and 7th weeks of age under standard managemental conditions. The body weight increased linearly in all breeds. Among all the breeds, Cornish breed exhibited significantly higher ( $P < 0.05$ ) body weights and body weight gains up to 8th week whereas Kadaknath has the lowest body weight on all ages of measurements. The weights of chicks were increased 24 to 25 times for Australorp and Cornish breeds and 14th times for Kadaknath breed up to 8th week. The influence of breeds was observed highly significant on body weight, growth rate and body conformation traits i.e., shank length and keel bone length. The least squares mean (LSM) values for keel bone and shank length and their differences were highest in Cornish breed followed by Australorp and Kadaknath breed. Cornish breed had better production performance which can be more beneficial for commercial poultry farming and there is a need to pay attention towards improvement in Kadaknath breed for body weight gains.*

**Keywords:** Australorp, Body Conformation Traits, Body Weight, Cornish, Growth Rate, Kadaknath

## Introduction

Poultry has an essential role in India as it provides nutritious egg and meat for consumption which is rich sources of protein, vitamins and minerals and have major role in upliftment of the rural poor and marginalized section of India. The total poultry population in India is 729.21 million and there is increase of 16.81 % in total poultry (20<sup>th</sup> Livestock census, 2019). Chicken is India's most commonly accepted meat since there is no religious tabu, such as beef or pork. Poultry meat is more common on the consumer market because it is cheaper, easier to digest and offers a significant proportion of animal protein in the human diet over other livestock meat (Singh *et al.*, 2017).

In India, the share of chicken meat in total meat production is 50.06 % and is increasing every year (BAHS, 2019). It has been estimated that under moderate growth scenario of 6% per annum in country's gross domestic product (GDP), the demand for meat is likely to shoot up to 9 million metric tons by 2050 (CARI vision, 2050). Comparative analysis of body weight and body morphometric characteristics in chickens have been used to distinguish indigenous from exotic breeds (Mulyono *et al.*, 2009) and commercial breeds (Vitorović *et al.*, 2009). The heat tolerance and free-range characteristics of indigenous chicken breeds addresses the poultry rearing issues such as harsh climatic conditions, welfare and traditional rearing methods (Shanmathy *et al.*, 2018). The enhancement of body weight with simultaneous improvement in body conformation traits is important for qualitative and quantitative production of chicken. Improvement of growth performance and body composition characteristics are main criteria for the selection of chickens of the meat type (Reddy *et al.*, 2021). Incorporation of body conformation traits in a selection index along with body weights is expected to give better performance than selection based on body weight alone. In order to understand growth and development, knowledge on the structure of body conformation characteristics and their various parameters in chickens and other birds is important (Bell *et al.*, 2007). Pathak *et al.* (2017) evaluated layers of two indigenous chicken breeds, i.e., Aseel and Kadaknath and found differed in growth characteristics for body weights and growth rates for both breeds. Thus, keeping in view, the above facts, the present study was aimed to evaluate indigenous and exotic breeds of chicken with the objective to evaluate growth and body conformation traits of Indigenous and exotic breeds of chicken.

## Materials and Methods

### Experimental Birds, Feeding and Management

All the chicks were grown under similar and standard environmental (nutritional and managerial) conditions.

### Experimental Birds

More than three hundred chicks with surplus of two exotic chicken breeds viz. Australorp and Cornish with one of the indigenous Kadaknath chicken breeds for research work were received from RAJUVAS, Bikaner and maintained at the Poultry Farm of Livestock Farm Complex unit of PGIVER, Jaipur. We received surplus chicks and discarded data belongs to died birds and we kept measured 100 birds for analysis for each breed at every age. We did not include died birds in our study and only alive chicks throughout the ages were utilized for further analysis. The farm is located at the geographical region of Jaipur in the grid position of 26°91'N and 75°78'E.

### General Brooding Management

The Chicks were transferred immediately after arrival to the brooder house and brooding was done up to 4 weeks of age with adequate ventilation and continuous light. The temperature of the brooder house in first week was maintained as 95°F and it was decreased by 5°F every week till it reached 70°F. Floor space of 700-950 sq cm per bird was provided for optimum growth. Wing bands were used for identification of the chicks of each breed.

### Litter Management

Dry saw dust and paper were used as bedding material which was spread over the floor about two inches in thickness to raise the chicks and feed was spread over the paper to facilitate the chicks to feed for first few days.

### ***Feeding and Watering Management***

The chicks were provided ad libitum feed and drinking water with 5 % glucose immediately after arrival. Chicks were fed standard balanced feed as per National Research Council (1994) recommendation. Feed was spread on flat tray and paper up to 3 weeks of age and thereafter the chicks were fed and watered in shallow feeding and watering troughs up to eight weeks. The chicks were Ad lib feed throughout the rearing period. Chick starter ration (2,800 Kcal/kg ME and 20% CP on calculated basis) was provided up to 3-4 weeks of age, thereafter chick grower ration was provided up to 8 weeks of age.

### ***Medication***

Vimeral @ 5ml per 100 chicks and vitamin B-complex @ 20 ml per 100 chicks daily in drinking water was provided to all the chicks and vaccination was done as per schedule for Marek's, Ranikhet, Gumboro diseases.

### **Studied Traits**

#### ***Body Weight and Growth Rates***

For comparison of growth in all breeds, the body weight of each individual bird was recorded at 3<sup>rd</sup> day, 1<sup>st</sup> week and then on weekly basis up to 8<sup>th</sup> week of age using digital weighing balance. Body weight gain was calculated as:  
- body weight gain = final weight - initial weight

#### ***Measurement of Body Conformation Traits***

Body confirmation is the form or outline of the body. Length of the keel bone and shank of the chickens were measured as body conformation traits at 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> weeks of age. The difference of shank length and keel length at 3 to 5 week, 5 to 7 week and 3 to 7 week were also calculated. Keel bone length was taken as a length of the sternum of bird. For measurement of keel bone length, flexible measuring tape was used. Shank length was taken by exposing the shank and measuring from the inner bend of the tibio-tarsal articulation to the base of the toes of the bird with the help of Vernier caliper.

### **Statistical Analysis**

Measured traits were subjected to analysis of variance (ANOVA) by generalized linear model using IBM Statistical package SPSS version 25.0. The model employed to examine the effect of breeds of chicken on various growth and body conformation traits was as follows:

$$Y_{ij} = \mu + A_i + e_{ij}$$

Where,

$Y_{ij}$  = Recorded body weights, weight gains and measured body conformation traits  $j$ th bird at different ages of  $i$ th breed ( $n= 100$  at every age point).

$\mu$  = Overall population mean

$A_i$  = Fixed effect of chicken breed ( $i$  = Cornish, Australorp and Kadaknath)

$e_{ij}$  = Random error NID ( $0, \sigma^2$ ) of associated  $Y_{ij}$

The differences between the least squares mean for subclasses under a particular effect were tested by Duncan's multiple range test (DMRT) as described by Kramer (1957).

## **Results and Discussion**

### **Body Weight**

Body weights of chicken indicate its genetic makeup and adaptation with respect to their habitats. The most widely used predictor of growth traits is possibly body weight at a specific age (Chambers, 1990). The  $LSM \pm S.E$  for body weights for different breeds at different ages are presented in Table 1. The body weight of the birds of different

breeds was evaluated up to 8<sup>th</sup> weeks of age. Overall body weight in all breeds was increased up to 8<sup>th</sup> week of age. There were significant ( $P<0.05$ ) difference between body weights of different breeds at different ages. As the Australorp and Cornish are the exotic breeds, the body weights of birds were significantly ( $P<0.05$ ) higher than the birds of indigenous breed Kadaknath in all different ages. Between the two exotic breeds the body weights of Cornish were significantly ( $P<0.05$ ) higher than Australorp up to 8 weeks of age.

**Table 1:** Body weight (LSM±S.E) in exotic and indigenous breeds of chicken at different ages

Age	Exotic Breeds		Indigenous Breed
	Australorp	Cornish	Kadaknath
	LSM± S.E	LSM± S.E	LSM± S.E
3 Day	57.71 <sup>b</sup> ±1.83	65.44 <sup>a</sup> ±3.12	51.07 <sup>c</sup> ±.66
1 Week	117.52 <sup>b</sup> ±4.36	144.37 <sup>a</sup> ±6.73	87.31 <sup>c</sup> ±1.01
2 Week	206.41 <sup>b</sup> ±9.08	262.96 <sup>a</sup> ±11.07	140.56 <sup>c</sup> ±1.57
3 Week	305.77 <sup>b</sup> ±13.70	396.85 <sup>a</sup> ±15.00	206.12 <sup>c</sup> ±2.29
4 Week	435.32 <sup>b</sup> ±21.77	586.19 <sup>a</sup> ±20.12	276.16 <sup>c</sup> ±2.94
5 Week	592.43 <sup>b</sup> ±30.44	801.04 <sup>a</sup> ±25.96	371.29 <sup>c</sup> ±4.05
6 Week	776.92 <sup>b</sup> ±39.98	1034.52 <sup>a</sup> ±30.94	483.22 <sup>c</sup> ±5.13
7 Week	962.64 <sup>b</sup> ±50.11	1288.22 <sup>a</sup> ±38.36	604.47 <sup>c</sup> ±6.24
8 Week	1359.83 <sup>b</sup> ±60.24	1614.25 <sup>a</sup> ±43.42	710.60 <sup>c</sup> ±11.31

LSMs in the same row with different superscripts letters (a, b, c) were significantly different ( $P<0.05$ )

Body weights observed for Cornish in present study were higher than the results obtained by Bharadwaj *et al.* (2006) and Chhabra and Sapra *et al.* (1973). Singh *et al.* (1976) reported comparatively lower body weights in Black Australorp fowls at 1,2,3,4,5,6,7 and 8 weeks of age as 67.6, 109.4, 164.8, 222.6, 270.3, 324.3, 383.4, and 446.6 g respectively. Ramkrushna (2011) found Body weight (g) at day old, 4 and 8 weeks of age in black Australorp as 38.24±0.43, 355.42±9.30, 596.32±11.42 which were lower than the present findings. Findings of comparatively lower body weights in Australorp breed were reported by Gupta *et al.* (1974), Phiri (2004) and Waleed *et al.* (2011). Kadaknath showed comparatively higher body weight on different ages in present study as compared to the weight reported by Thakur *et al.* (2006), Chatterjee *et al.* (2007), Thakur and Parmar (2011), Pathak *et al.* (2017) and Shanmathy *et al.* (2018). However, the body weights of the native Kadaknath breed have been found to be lower than the exotic breeds in this study, but the rearing of the Kadaknath breed may be more economically viable for rearing as a backyard or rural poultry farming as it has a considerable potential to reduce susceptibility to infectious diseases (Sharma *et al.*, 2020). Apart from having unique characteristics such as survive in challenging environments (Crawford and Christman, 1992), Kadaknath breed is ignored due to its lower production potential (Haunshi *et al.*, 2011).

### Body Weight Gain

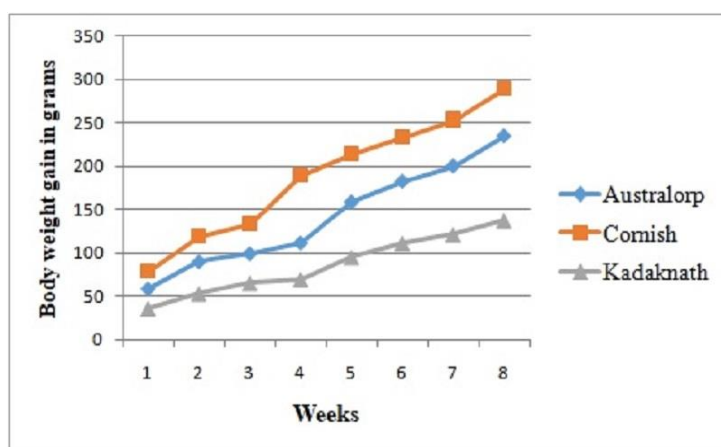
Body weight gains for all breeds are presented in Table 2. LSM±S.E value for weight gain was in ranged 58.73±2.74 g to 235.20±12.87 g for Australorp, 78.93±4.15 g to 283.37±10.14 g for Cornish and 36.24±0.62 g to 137.70±4.61g for Kadaknath. Among the exotic breeds of chicken, body weight gain of Cornish was significantly ( $P<0.05$ ) higher than Australorp between different age groups.

The body weight gain is significantly different between both exotic and indigenous breeds of chicken. Under the extensive management system obtained by Thakur *et al.* (2006), Chatterjee *et al.* (2007), Haunshi *et al.* (2010) and Sharma *et al.* (2004), Kadaknath's body weight gain was lower than in the present research. Cornish and Australorp's body weight gain were highest between 7<sup>th</sup> and 8<sup>th</sup> weeks of age. Ramkrushna, (2011) found lower values for Body weight gain in Australorp. Fayeye *et al.* (2005) reported that average weight of chicks was increased more than eleven times up to eight weeks of life. In the present study, the chick weight increased approximately 24 to 25 times in birds of exotic breed and 14 times in birds of indigenous breed. Backyard poultry farming in rural areas can occupies an important place in meeting the nutritional needs of increasing population of India; we should involve and pay attention to the native chicken breeds and their improved cross varieties under free range, semi-intensive or intensive conditions (Pal *et al.*, 2019).

**Table 2:** Body weight gain (LSM±SE) in exotic and indigenous breeds of chicken at different ages

Age	Exotic Breeds		Indigenous Breed
	Australorp	Cornish	Kadaknath
	LSM± S.E	LSM± S.E	LSM± S.E
3 Day - 1 Week	58.73 <sup>b</sup> ±2.74	78.93 <sup>a</sup> ±4.15	36.24 <sup>c</sup> ±.62
1 -2 Week	89.98 <sup>b</sup> ±4.93	118.59 <sup>a</sup> ±5.15	53.34 <sup>c</sup> ±.74
2-3 Week	99.36 <sup>b</sup> ±5.13	133.89 <sup>a</sup> ±5.56	65.56 <sup>c</sup> ±.93
3-4 Week	111.76 <sup>b</sup> ±6.44	189.33 <sup>a</sup> ±8.96	70.04 <sup>c</sup> ±1.12
4-5 Week	158.80 <sup>b</sup> ±10.06	214.85 <sup>a</sup> ±8.21	95.23 <sup>c</sup> ±1.54
5-6 Week	182.80 <sup>b</sup> ±10.34	233.48 <sup>a</sup> ±7.18	111.93 <sup>c</sup> ±1.57
6-7 Week	200.60 <sup>b</sup> ±10.94	253.70 <sup>a</sup> ±9.74	121.71 <sup>c</sup> ±1.79
7-8 Week	235.20 <sup>a</sup> ±12.87	289.80 <sup>b</sup> ±8.30	137.70 <sup>c</sup> ±4.61

LSMs in the same row with different superscripts letters (a, b, c) were significantly different ( $P<0.05$ )

**Figure 1:** Body weight gain of exotic and indigenous breeds of chicken up to 8 weeks of age

Body weight and body weight gain increased linearly in all the breeds (Fig. 1). The difference in growth rate pattern between the exotic breeds was not distinct until 2 weeks of age. From 3rd week onwards Cornish showed linear increase in body weights up to 8<sup>th</sup> week. The rate of increase in body weight from 5 to 8 weeks in Kadaknath was lower as compared to both the exotic breeds. Trend of continuous gain in weight were showed by black Australorp under intensive management system from 9-29 weeks of age in the experiment conducted by Gondwe and Wolny (2003). Pathak *et al.* (2017), Chatterjee *et al.* (2007) and Sharma *et al.* (2004) found that the gain in body weight of Kadaknath birds increased with age although the LSM±S.E values were found lower than present findings. Difference in the values of body weight and body weight gain was due to breed difference. Significant effects of genetic groups and sex on growth have been reported by Folasade and Obinna (2009).

### Body Conformation Traits

Body conformation traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment. The conformation traits like shank length and keel length are indicator of skeletal growth. These traits are useful in computing size and shape of animals (McCracken *et al.*, 2000). Poultry farmers should monitor the growth performance of birds regularly to know the achievement of the desired market weight, to determine response to any feeding programme and body weight losses in times of high parasitic load and disease challenges. In situations where body weight recording can't be done at field level, the linear body measurements can be used to predict body weight in chickens. The least square analysis for shank length and keel bone length in exotic and indigenous breeds of chicken showed that there was significant ( $P<0.05$ ) influence of breeds on shank length and keel bone length. The difference of shank length and keel length at 3 to 5 week, 5 to 7 week and 3 to 7 week was also significant ( $P<0.05$ ) in different breeds.

## Keel Bone Length

The overall LSM±S.E values for keel bone length are presented in Table 3. The LSM values for keel bone length were higher in exotic breeds as compared to indigenous breed. Results showed that the difference between 3-5- and 5-7-week keel bone length was found to be significantly ( $P<0.05$ ) different between indigenous and exotic breeds. The difference between keel bone length during 5-7 week were found to be non-significant between both exotic and indigenous breeds of chicken. There are breed differences for conformation traits with higher values in Cornish followed by Australorp and Kadaknath. Bharadwaj *et al.* (2006) reported a relatively lower value for keel length as  $7.18\pm0.05$  cm in Kadaknath than present findings. Keel length in Brown Cornish was also found to be lower  $7.06\pm0.06$  cm at 10 weeks of age. Chatterjee *et al.* (2007) reported a keel length of  $6.89\pm1.12$  cm in Kadaknath for combined sex at 15 weeks of age.

**Table 3:** LSM±SE for keel length (cm) at different ages of development

Age	Exotic Breeds		Indigenous Breed
	Australorp	Cornish	Kadaknath
	LSM± S.E	LSM± S.E	LSM± S.E
3 weeks	6.62 <sup>b</sup> ±0.10	7.05 <sup>a</sup> ±0.16	6.10 <sup>c</sup> ±0.03
5 weeks	8.48 <sup>b</sup> ±0.14	10.44 <sup>a</sup> ±0.14	7.48 <sup>c</sup> ±0.04
7 weeks	10.91 <sup>b</sup> ±0.18	12.96 <sup>a</sup> ±0.20	9.77 <sup>c</sup> ±0.04
Difference of Keel Length			
3-5 week	1.86 <sup>b</sup> ±0.09	3.39 <sup>a</sup> ±0.16	1.37 <sup>c</sup> ±0.05
5-7 week	2.43 <sup>a</sup> ±0.08	2.51 <sup>a</sup> ±0.16	2.28 <sup>a</sup> ±0.05
3-7 week	4.29 <sup>a</sup> ±0.12	5.91 <sup>b</sup> ±0.15	3.66 <sup>c</sup> ±0.04

LSMs in the same row with different superscripts letters (a, b, c) were significantly different ( $P<0.05$ )

## Shank Length

The overall LSM±S.E values for shank length are presented in Table 4. Difference between Australorp and Kadaknath for shank length at 3-5 weeks of age and, the difference between Cornish and Kadaknath breeds for shank length at 5-7 weeks of age was found to be non-significant. The difference of 3–7-week shank length showed similar values for Australorp and Cornish. There is a significant ( $P<0.05$ ) difference between exotic and indigenous breed. Among the birds of exotic breeds, Cornish have attained maximum value for shank length at all ages.

**Table 4:** LSM±SE for shank length (cm) at different ages of development

Age	Exotic Breeds		Indigenous Breed
	Australorp	Cornish	Kadaknath
	LSM± S.E	LSM± S.E	LSM± S.E
3 weeks	3.52 <sup>b</sup> ±0.06	4.10 <sup>a</sup> ±0.10	3.34 <sup>b</sup> ±0.03
5 weeks	3.88 <sup>b</sup> ±0.07	5.30 <sup>a</sup> ±0.08	3.73 <sup>c</sup> ±0.03
7 weeks	5.94 <sup>b</sup> ±0.11	6.49 <sup>a</sup> ±0.11	4.97 <sup>c</sup> ±0.04
Difference of shank length			
3-5 week	0.35 <sup>b</sup> ±0.04	1.20 <sup>a</sup> ±0.10	0.38 <sup>b</sup> ±0.03
5-7 week	2.06 <sup>a</sup> ±0.08	1.19 <sup>b</sup> ±0.10	1.24 <sup>b</sup> ±0.05
3-7 week	2.41 <sup>a</sup> ±0.07	2.39 <sup>a</sup> ±0.10	1.63 <sup>b</sup> ±0.05

LSMs in the same row with different superscripts letters (a, b, c) were significantly different ( $P<0.05$ )

Indirabai and Nair (1983) reported that the shank length of White Plymouth Rock males was found to be greater than the White Cornish and White Plymouth Rock females. However, the differences were non-significant. Bharadwaj *et al.* (2006) studied the body conformation traits in indigenous (Aseel and Kadaknath) and exotic (RIR and Brown Cornish) breeds and their crosses. They also reported significant difference in conformation traits due

to breeds and genetic groups. Bharadwaj *et al.* (2006) reported a relatively lower value for shank length as  $6.13 \pm 0.07$  cm in Kadaknath than present findings. Chatterjee *et al.*, (2007) reported a shank length of  $7.75 \pm 1.20$  in Kadaknath for combined sex at 15 weeks of age. Shank length in Brown Cornish was also found to be relatively lower as  $6.64 \pm 0.06$  cm at 10 weeks of age. Haunshi *et al.* (2011) reported the shank length values in case of Kadaknath breed was  $51.46 \pm 0.18$  mm at 6 weeks of age and it increased with age. The LSM values of conformation traits at present study showed increasing trend as the age advanced from 3 to 7 weeks of age indicating normal development of physical conformation of birds.

## Conclusion

The body weight and body conformation traits increased linearly at all ages in all breeds. Breed had significant ( $P < 0.05$ ) effect on body weight at all ages and body conformation traits. Cornish breed excelled over Australorp and Kadaknath for body weight, body weight gain and body conformation traits. Kadaknath breed is comparable with Australorp breed in differences in body conformation traits, however, growth rate of Kadaknath is lower than exotic breeds. There is need to pay attention towards improvement in body weights of Kadaknath breed to enhance the livelihood of marginal farmers.

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## Ethical Approval

Permission from Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) was taken before slaughtering of the birds and collection of blood samples under sterile condition to carry out the current research work.

## Conflict of Interests

There is no conflict of interest.

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