



Evaluation of Growth Traits of Aseel, Kadaknath, Dahlem Red and their Crosses in the Agro Climatic Conditions of Bihar

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ABSTRACT

Background: The indigenous breeds of chicken remain as the preferred choice for the farmers because of their, attractive colour patterns, resilience, adaptability and meat quality. However, with the increasing trend of commercial farming exotic breeds and their crosses are also in demand for their higher production performances. Despite this, there is limited studies on the comparative assessment of their economic traits in various agroclimatic region of Bihar.

Methods: The present study was done at the Poultry Research and Training Centre of BASU Patna on 500 birds divided into five genetic groups namely Assel, Kadaknath, Dhalem Red, Aseel x Dhalem Red, and Kadaknath x Dhalem Red having 100 birds in each group. These groups were maintained under deep-litter system. Economic parameters like weekly body weight up to 20 weeks followed by monthly body weight up to 12 months along with the growth rate and feed consumption were recorded for data collection.

Result: On the basis of the present study, it was found that Aseel x Dahlem Red were heaviest among all the genetic groups in 20th weeks of age. The average body weight of Aseel x Red of male and female was found to be 1876 ± 16.5 and 1449 ± 14.9 gm, respectively. Dahlem Red was found to have significantly higher body weights at all age groups from 1st weeks to 20th weeks of age among the pure breeds. The average body weight of male and female at 20th weeks of age were recorded to be 1689 ± 14.50 , 1420 ± 12.00 respectively. Similar trends for body weight were maintained at 52nd weeks of age in which Aseel female having significantly heavier than all the genetic groups, however the difference was non-significant for its crosses with Dahlem Red (Aseel x Dahlem Red).

Key words: Agro climate, Aseel, Dahlem Red, Growth traits, Kadaknath.

INTRODUCTION

Indigenous breeds of chicken like Kadaknath and Aseel are the, most important indigenous breeds in our country. Kadaknath exhibit intense black colouration, which is due to the deposition of Melanin pigments in the connective tissue of organs and in the dermis (Rao and Thomas 1984). These birds are poor in egg production potential, but their black flesh is very delicious and popular among tribal people. Sometimes the flesh is being used for the treatment of many diseases by tribal, which needs proper scientific intervention (Thakur *et al.*, 2006).

The other poultry breed Aseel is a very old game birds from Indian subcontinent that has been bred for many centuries due to its aggressive behaviour. Aseel birds are also known for their intelligent defensive and tactical behaviour to keep power for long time in endurance fight. "Aseel" is an Arabic word meaning "pure" or "thoroughbred". The Aseel breed is available in coastal areas of Andhra Pradesh. These birds are also found with cock fighting lovers throughout the country. It is well known for its pugnacity, high stamina, majestic gait and fighting qualities. It is the biggest in size among all the Indian native chickens, which measure 28 inches from back to toe. These birds are also known for its plentiful, delicious and flavoured meat. For centuries, Adivasi communities living in East Godavari district have reared

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and selectively shaped this breed especially for its meat and fighting abilities. The most of Indian villages with small population of desi fowl are not in a position to sustain industrial approach to poultry production. Therefore, attention of scientists has been drawn to see these small populations should also give higher production on sound economics. Simultaneously, their market for consumption may also be facilitated. Essentially, the present

requirement is to find out a methodology by which eggs as well as chicken can be made readily available even to the rural people at cheaper prices. In this direction, the cheapest egg in the form of backyard farming, which is produced by backyard poultry that lives on scavenging, foraging and feeding on kitchen waste.

Similarly White leghorn and Dahlem Red produce more range of eggs. Due to presence of colour inhibiting genes the crossbreed chicken of White leghorn will be White in colour, whereas crossbreed chicken of Dahlem Red will have coloured plumage. Farmers in general, prefer chicks of colour plumage than the white plumage in the local desi birds. The production potentiality, adaptability and disease resistance of Aseel and Kadaknath have not yet been studied in agro climatic conditions of Bihar. Hence, Dahlem Red (German origin) may be used as an exotic genetic resource for crossing with Aseel and Kadaknath.

Information on the genetic parameters of the economic traits is the pre-requisite for formulating the breeding program. Therefore, it is essential to evaluate the growth performance of Aseel, Kadaknath, Dahlem Red and their crosses in agro climatic condition of Bihar to understand the genetic mechanism of their adaptability and their sustainable improvement of poultry production systems for meeting the needs of protein deficiency and promoting poultry production activity.

MATERIALS AND METHODS

The present study was conducted on a total of 500 birds (100 birds each from Aseel, Kadaknath, Dahlem Red, Aseel × Dahlem Red and Kadaknath × Dahlem Red) procured from CARI, Bareilly and maintained under deep litter system in the Poultry research and training center (PRandTC) of BASU, Patna.

The following traits were recorded for the evaluation of growth, production and reproduction performance of Aseel and Kadaknath birds. For the study of growth, Weekly body weight up to 20 weeks of age, Monthly body weights from 6 to 12 months of age, Growth rate up to 20 weeks of age and Bi-weekly feed consumption from 0 to 20 weeks were considered. Similarly for the evaluation of production trait, Egg production data from 20 weeks to 52 weeks of age, Percent egg production from 20 to 52 weeks of age and Part annual egg production were considered for the study. For study of reproductive traits, age at sexual maturity, hatchability and fertility percentage were considered for the study. But for this article only growth parameters have been considered.

RESULTS AND DISCUSSION

Body weight in purebreds

It was evident from Table 1 that among purebreds Aseel male recorded the highest body weight from 5th week onwards upto 20th weeks of age, but did not differ significantly ($P \leq 0.05$) from the Dahlem Red male upto 10th

week of age. Aseel males were significantly ($p \leq 0.05$) heavier than the Dahlem Red male by 96 g at 11th week onwards upto 20th week of age. Almost similar trends were also observed in case of females. Aseel females were lighter than the Dahlem Red female upto 3rd week of age. Thereafter, Aseel females recorded higher body weight than the Dahlem Red female from 4th week onwards, but did not differ significantly ($P \leq 0.05$) upto 10th week of age. Aseel females were significantly ($p \leq 0.05$) heavier than the Dahlem Red females at 11th week of age by 106 g. The lowest body weight was observed in both the sexes of Kadaknath (KN) than the counter parts of Aseel and Dahlem Red respectively at all ages of measurement. The average estimates of body weight of male of Aseel, Kadaknath and Dahlem Red at 12th week of age were 983.0 ± 7.01 , 582.0 ± 6.62 and 826.0 ± 6.39 g respectively. At 16th week of age the respective body weights of male were 1501.0 ± 11.41 , 979.0 ± 10.78 and 1283.0 ± 10.45 g respectively. Whereas, at 20th week of age the corresponding value were 1758.0 ± 15.90 , 1225.0 ± 15.0 and 1689.0 ± 14.50 g respectively. At 20th week of age Aseel male were heavier in body weight than 12th week of age. The corresponding value for Kadaknath and Dahlem Red were 643.0 g and 863.0 g respectively. The rate of growth of Aseel, Kadaknath and Dahlem Red male during the same period were 110.48, 78.84 and 104.48 per cent respectively. Aseel, Kadaknath and Dahlem Red females at 12th week of age weighted 859.0 ± 6.12 , 458.0 ± 5.91 and 701.0 ± 5.24 g respectively. The corresponding value at 16th week of age were 1280 ± 9.39 , 737.0 ± 9.06 and 1036.0 ± 8.08 g respectively and at 20th week of age were 1549.0 ± 13.8 , 1004.0 ± 13.4 and 1420.0 ± 12.0 g respectively.

Aseel females were significantly ($p \leq 0.05$) heavier than the Kadaknath and Dahlem Red females by 545 g and 129 g respectively and the average body weight of Aseel female increased by 690.0 g than the Kadaknath body weight at 12th week of age. The corresponding values for Kadaknath and Dahlem Red were 546.0 g and 719.0 g respectively. The rate of growth from 12th to 20th week of age of Aseel, Kadaknath and Dahlem Red was 119.2, 102.57 and 80.33 percent respectively. The higher rate of growth of Aseel male and female may be indicated that Aseel may be sexually matured earlier than the Kadaknath and Dahlem red. The body weight of both sexes of Kadaknath recorded in the present study was lower than the average body weight of Aseel and Dahlem Red). Superiority of males and females of Aseel over Kadaknath observed in the present study was in agreement with finding of Jha and Prasad (2013), who reported the average body weight of Aseel higher at 20th week of age irrespective of sex as 2103.39 ± 7.39 g. The live body weight at 12 weeks of age in sample of birds varied significantly ($P \leq 0.05$) between the sexes Rajkumar *et al.* (2020).

Usman *et al.* (2014) reported higher body weight of Aseel at 12th week of age. They reported the average body

weight of Aseel at 12th week of age as 2195.50 ± 14.45 g that supports the findings of the present study. Raj Kumar *et al.* (2017) reported higher average body weight for Aseel male at 20th week of age than the finding of the present study. However, the body weight of females, obtained in the present study was higher.

Haunshi *et al.* (2011) who reported that body weight of Aseel and Kadaknath at 20th week of age was 1872 and 1440g for male and 1303 g and 123 g for female respectively. However, contrary to the finding of the present study Jha and Prasad (2013) reported lesser body weight for Aseel (1038 g) and Kadaknath (957 g) at the same age. The body weight of male and female of Kadaknath observed in the present experiment is in close agreement with the findings of Thomas and Rao (1988), reported 1205 g and 1090g body weight at 20th week of age for male and female of Kadaknath. Saini *et al.* (2011) reported body weight of Dahlem Red as 1300 g at 20th week of age, which was significantly ($P \leq 0.05$), lower than the findings of the present study.

In a previous study in two-way cross, higher body weights in males were reported while the body weights in hens were similar (Rajkumar *et al.*, 2019). Lower body weights were recorded in three-way cross developed for backyard poultry farming (Rajkumar *et al.*, 2018; Padhi *et al.*, 2016), in Nigerian chicken (Ndofor-Foleng *et al.*, 2015) and in White Leghorn layers (Chandan *et al.*, 2019).

Body weight of crossbreds

It was revealed from Table 1 that males and females crossbred of all genetic groups were found significantly ($P \leq 0.05$) heavier than the purebreds from which it has been produced. Presence of heterotic effect was observed in crossbreds. Many workers such as Aggarwal *et al.* also reported the superiority of crossbreds over purebreds like Singh *et al.* (2015), Ulangathan and Rahmnassapathy (1989), Padhi *et al.* (2012) and Lata *et al.* (2014). However, contrary report was presented by Kaur (2007) that has observed significantly ($P \leq 0.05$) lower body weight in the crossbred produced by crossing between Kadaknath $\times$ RIR and Aseel $\times$ RIR at 8th week of age than the findings of the present study. However, the same worker observed higher body weight of crossbreds produced by crosses between Aseel $\times$ Black Cornish and Kadaknath $\times$ Black Cornish (BL). Between the two crossbreds, male of Aseel $\times$ Dahlem Red (AP $\times$ DR) recorded the highest body weight from 9th week onwards, but difference was found significantly ($p \leq 0.05$) higher in 12th to 20th week of age. The average body weight of Aseel $\times$ Dahlem Red made at 12th week of age was recorded as 1101.0 ± 7.17 g, which was significantly ($p \leq 0.05$) than the KN $\times$ DR by 56g. Significant ($p \leq 0.05$) differences between two-crossbred males at 16th and 20th week of age were 129 g and 101 g respectively. The average body weight of AS $\times$ DR and KN $\times$ DR male at 20th week of age were 1776.0 ± 16.50 and 1675.0 ± 15.10 g respectively.

Among crossbreds the average body weight of the females of AS $\times$ DR were marginally superior than the females of KN $\times$ DR from 6th week of age, but did not differ significantly ($P \leq 0.05$) up to 11th week of age. At 12th week of age the AS $\times$ DR females were significantly ($p \leq 0.05$) heavier than KN $\times$ DR females by 56 g. The similar trends were maintained up to 20th week of age. The females of AS $\times$ DR were significantly ($p \leq 0.05$) heavier than the KN $\times$ DR females at 16th week and 20th week of age by 76g and 169 g respectively. The average body weight of AS $\times$ DR and KN $\times$ DR at 16th week of age weighted as 127.0 ± 10.10 and 1196.0 ± 9.06 g respectively and at the 20th week of age the corresponding values were 1559 ± 14.90 and 1390.0 ± 13.50 g respectively. The average body weight of crossbred male and female observed in the present study were higher than the body weights reported by Singh *et al.* (1999) for AS $\times$ CR and KN $\times$ CR. They found the average body weight of AS $\times$ CR and KN $\times$ CR male at 20th week of age as 1847 and 1490 respectively. For female, the corresponding value were 1353 g and 1104 g respectively. The better performance of crossbreds observed in the present study than the findings of Singh *et al.* (1999) might be due to improvement taken place in the germplasm of Aseel, Kadaknath and Dahlem Red through selection for several generations. The average body weights of crossbred male and female observed in the present study were higher than the finding of Singh *et al.* (1999), but the another has reported higher mean body weight for AS $\times$ CR male.

Irrespective of sex, the overall least squares means of body weight of Aseel (AS), Kadaknath (KN), Dahlem Red (DR) and their crosses (AS $\times$ DR and KN $\times$ DR) from 0 to 20th weeks of age have been depicted in Table 2.

Body weight from 20 to 52 weeks of age

The least squares means along with standard error (SE) of body weight (g) of female from 20 to 52 weeks of age have been presented in Table 3 which reveals that body weight of all genetic groups increased gradually with decreasing rate.

At 20th weeks of age the average body weight of Aseel, Kadaknath and Dahlem Red were observed as 1549.0 ± 13.80 , 1004.0 ± 13.40 and 1420.0 ± 12.0 g respectively. The corresponding value at 40 weeks of age were 1717.0 ± 3.12 , 1252.0 ± 3.01 and 1645.0 ± 2.64 g respectively. Hence, the respective body weights of AS, KN and DR at 40th weeks of age were found to be increased by 168, 248 and 225g over 20th week of age. The rates of increment in body weight of AS, KN and DR over 20th week of age recorded as 10.85, 24.70 and 15.85% respectively. The rates of increment in body weight of Aseel, Kadaknath and Dahlem Red at 52nd weeks of age over 40th weeks of age were 3.72, 7.03 and 6.56 percent respectively indicating slower growth rate observed in all the genetic groups. Aseel was the heaviest at 40th week of age among the purebred. It was significantly ($p \leq 0.05$) heavier than KN and DR by 465 g and 72g respectively, but did not differ significantly ($P \leq 0.05$) from DR at 52nd week of age.

Table 1: Least squares means $\pm$ standard error (SE) of body weight (gm) of Male of different genetic groups of chicken from 0-20 weeks of age.

Age (week)	Male					Female				
	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)
HW	32.70 $\pm$ 0.16	29.2 $\pm$ 0.18	36.9 $\pm$ 0.14	45.0 $\pm$ 0.16	35.3 $\pm$ 0.16	32.70 $\pm$ 0.16	29.2 $\pm$ 0.18	36.9 $\pm$ 0.14	45.0 $\pm$ 0.16	35.3 $\pm$ 0.16
1 st week	40.2 $\pm$ 0.19	40.5 $\pm$ 0.19	58.2 $\pm$ 0.17	63.7 $\pm$ 0.21	56.7 $\pm$ 0.19	39.3 $\pm$ 0.17	39.7 $\pm$ 0.17	57.4 $\pm$ 0.15	62.9 $\pm$ 0.19	55.8 $\pm$ 0.17
2 nd week	72.3 $\pm$ 1.08	54.2 $\pm$ 1.07	109.1 $\pm$ 0.96	103.2 $\pm$ 1.17	56.28 $\pm$ 0.16	64.3 $\pm$ 0.97	46.2 $\pm$ 0.97	91.0 $\pm$ 0.84	95.2 $\pm$ 1.08	93.0 $\pm$ 1.06
3 rd week	110 $\pm$ 3.21	79.8 $\pm$ 1.49	169.0 $\pm$ 2.76	159.5 $\pm$ 1.64	178.3 $\pm$ 1.47	97.5 $\pm$ 1.35	70.8 $\pm$ 1.24	137.2 $\pm$ 1.35	150 $\pm$ 1.51	168.8 $\pm$ 1.36
4 th week	194.1 $\pm$ 3.21	121 $\pm$ 3.03	203 $\pm$ 3.75	256 $\pm$ 3.34	255 $\pm$ 2.99	180 $\pm$ 2.85	91 $\pm$ 2.74	174 $\pm$ 2.38	256 $\pm$ 3.05	225 $\pm$ 2.76
5 th week	292 $\pm$ 3.40	139 $\pm$ 3.18	261 $\pm$ 3.95	350 $\pm$ 3.49	351 $\pm$ 3.14	266 $\pm$ 2.99	113 $\pm$ 2.84	234 $\pm$ 2.49	324 $\pm$ 3.17	325 $\pm$ 2.87
6 th week	378 $\pm$ 7.70	244 $\pm$ 2.73	318 $\pm$ 6.68	475 $\pm$ 7.91	444 $\pm$ 7.12	313 $\pm$ 6.78	180 $\pm$ 6.45	324 $\pm$ 5.63	411 $\pm$ 7.18	402 $\pm$ 6.51
7 th week	465 $\pm$ 8.22	280 $\pm$ 7.69	450 $\pm$ 7.20	560 $\pm$ 8.38	508 $\pm$ 7.59	404 $\pm$ 7.19	219 $\pm$ 6.84	389 $\pm$ 6.06	508 $\pm$ 7.60	477 $\pm$ 6.90
8 th week	546 $\pm$ 4.78	316 $\pm$ 5.08	545 $\pm$ 4.75	673 $\pm$ 5.53	674 $\pm$ 5.01	485 $\pm$ 4.78	236 $\pm$ 4.51	484 $\pm$ 4.00	593 $\pm$ 5.01	563 $\pm$ 4.55
9 th week	660 $\pm$ 5.79	349 $\pm$ 5.40	649 $\pm$ 5.20	768 $\pm$ 5.92	721 $\pm$ 5.36	574 $\pm$ 5.08	273 $\pm$ 4.80	573 $\pm$ 4.29	692 $\pm$ 5.32	645 $\pm$ 4.86
10 th week	768 $\pm$ 7.92	445 $\pm$ 7.40	719 $\pm$ 7.11	906 $\pm$ 8.09	862 $\pm$ 7.38	659 $\pm$ 6.94	336 $\pm$ 6.60	609 $\pm$ 5.77	796 $\pm$ 7.27	753 $\pm$ 6.66
11 th week	849 $\pm$ 8.27	489 $\pm$ 7.82	753 $\pm$ 7.55	1003 $\pm$ 8.45	978 $\pm$ 7.82	746 $\pm$ 7.23	386 $\pm$ 6.98	650 $\pm$ 6.19	900 $\pm$ 97.58	874 $\pm$ 6.98
12 th week	983 $\pm$ 7.01	582 $\pm$ 6.62	826 $\pm$ 6.39	1101 $\pm$ 7.17	1045 $\pm$ 6.62	859 $\pm$ 6.12	458 $\pm$ 5.91	701 $\pm$ 5.24	977 $\pm$ 6.46	921 $\pm$ 5.91
13 th week	1081 $\pm$ 7.27	634 $\pm$ 6.87	895.0 $\pm$ 6.65	1204 $\pm$ 7.56	1067 $\pm$ 6.87	962 $\pm$ 6.35	515 $\pm$ 6.13	760 $\pm$ 5.46	1084 $\pm$ 6.83	947 $\pm$ 6.87
14 th week	1193 $\pm$ 7.60	780 $\pm$ 7.18	1018 $\pm$ 6.95	1284 $\pm$ 7.90	1164 $\pm$ 7.18	1070 $\pm$ 6.64	656 $\pm$ 6.41	895 $\pm$ 5.71	1161 $\pm$ 7.14	1070 $\pm$ 6.64
15 th week	1300 $\pm$ 7.57	835 $\pm$ 7.15	1112.0 $\pm$ 6.92	1349 $\pm$ 7.87	1265 $\pm$ 7.15	1171 $\pm$ 6.16	705 $\pm$ 6.38	947 $\pm$ 5.69	1219 $\pm$ 7.11	1136 $\pm$ 6.38
16 th week	1465 $\pm$ 10.76	922 $\pm$ 10.16	1222 $\pm$ 9.83	1458 $\pm$ 11.18	1329 $\pm$ 10.16	1280 $\pm$ 9.39	737 $\pm$ 9.06	1036 $\pm$ 8.08	1272 $\pm$ 10.10	1144 $\pm$ 9.06
17 th week	1501.8 $\pm$ 11.41	979 $\pm$ 10.78	1283 $\pm$ 10.45	1526 $\pm$ 1.87	1355 $\pm$ 10.78	1366 $\pm$ 9.97	984 $\pm$ 9.62	1088 $\pm$ 8.61	1331 $\pm$ 10.72	1160 $\pm$ 9.62
18 th week	1556.0 $\pm$ 12.39	1102 $\pm$ 11.71	1464 $\pm$ 11.34	1603 $\pm$ 12.88	1465 $\pm$ 11.71	1447 $\pm$ 10.82	875.5 $\pm$ 10.44	1197 $\pm$ 9.35	1136 $\pm$ 11.64	1198 $\pm$ 10.44
19 th week	1608 $\pm$ 12.95	1177.0 $\pm$ 12.24	1595 $\pm$ 11.86	1627 $\pm$ 13.47	1565 $\pm$ 12.24	1511 $\pm$ 11.31	959 $\pm$ 10.92	1255 $\pm$ 9.77	1352 $\pm$ 12.16	1290 $\pm$ 10.92
20 th week	1758.0 $\pm$ 15.90	1225.0 $\pm$ 15.0	1689 $\pm$ 14.5	1876 $\pm$ 16.5	1695 $\pm$ 15.1	1549 $\pm$ 13.8	1004 $\pm$ 13.4	1420 $\pm$ 12.0	1449 $\pm$ 14.9	1288 $\pm$ 13.5

The lowest body weight was recorded in Kadaknath, which was significantly ($p \leq 0.05$) lower than Aseel and Dahlem Red by 441 and 413g respectively. The average body weights of Aseel, Kadaknath and Dahlem Red at 52nd week of age were recorded as 1781.0 $\pm$ 3.01, 1340.0 $\pm$ 2.90 g respectively. Similar trends were also found among the crossbreds: crossbreds sired by Aseel were heavier than the crossbred sired by Kadaknath. AS $\times$ DR was significantly ($p \leq 0.05$) heavier than the KN $\times$ DR at 40th week of age by 155g. Similar trend was also observed at 52nd week of age. The average body weight of AS $\times$ DR female at 52nd week of age was significantly ($p \leq 0.05$) heavier than the KN $\times$ DR female by 149 g. The average body weight of AS $\times$ DR and KN $\times$ DR at 40th week of age were recorded as

1777.0 $\pm$ 3.01 and 1622.0 $\pm$ 5.40 g respectively. The corresponding value at 52nd week of age were 1881.0 $\pm$ 2.90 and 1732.0 $\pm$ 2.95 g respectively. Lower body weight of Dahlem Red at 20th week of age were recorded by Jha and Prasad (2013), Dinesh *et al.* (2020) and Kalita and Talukder (2022) in comparison to the body weights recorded in the present study. However, all of them have obtained higher body weights at 52nd week of age than the finding of the present study. Lower body weight of Dahlem Red obtained in the present study in comparison to the body weight recorded by the aforesaid results may be due to inconvenient managemental practices, which was not in the hand of worker the farm was invaded by flood water for a couple of days during that period of time.

Table 2: Overall least squares means $\pm$ standard error (SE) of body weight (gm) of different genetic groups of chicken from 0-20 weeks of age.

Period	Sex	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)
HW		32.70 ^b $\pm$ 0.16	29.2 ^a $\pm$ 0.18	36.9 ^d $\pm$ 0.14	45.0 ^e $\pm$ 0.16	35.3 ^c $\pm$ 0.16
1 st week	Overall	39.76 ^a $\pm$ 0.17	40.09 ^a $\pm$ 0.18	57.81 ^a $\pm$ 0.14	63.31 ^a $\pm$ 0.18	56.28 ^b $\pm$ 0.17
2 nd week	Overall	68.3 ^b $\pm$ 0.94	50.2 ^a $\pm$ 0.93	90.1 ^d $\pm$ 0.88	99.2 ^e $\pm$ 1.04	94.50 ^e $\pm$ 0.98
3 rd week	Overall	102 $\pm$ 1.31	75 $\pm$ 1.29	132 $\pm$ 1.25	155 $\pm$ 1.46	174 $\pm$ 1.29
4 th week	Overall	195 ^b $\pm$ 2.79	106 ^a $\pm$ 2.62	188 ^b $\pm$ 2.28	241 ^c $\pm$ 2.96	240 ^c $\pm$ 2.61
5 th week	Overall	279 ^c $\pm$ 2.93	126 ^a $\pm$ 2.73	247 ^b $\pm$ 2.40	337 ^d $\pm$ 3.08	338 ^d $\pm$ 2.72
6 th week	Overall	346 ^b $\pm$ 6.64	212 ^a $\pm$ 6.19	356 ^b $\pm$ 5.45	443 ^d $\pm$ 6.97	412 ^c $\pm$ 6.16
7 th week	Overall	435 ^b $\pm$ 7.07	249 ^a $\pm$ 6.58	419 ^d $\pm$ 5.88	529 ^d $\pm$ 7.37	477 ^b $\pm$ 6.55
8 th week	Overall	505 ^b $\pm$ 4.69	276 ^a $\pm$ 4.34	534 ^c $\pm$ 3.88	633 ^d $\pm$ 4.86	601.3 ^a $\pm$ 4.32
9 th week	Overall	602 ^b $\pm$ 4.98	311 ^a $\pm$ 4.61	611 ^b $\pm$ 4.22	730 ^d $\pm$ 5.17	683 ^c $\pm$ 4.61
10 th week	Overall	714 ^c $\pm$ 6.80	390 ^a $\pm$ 6.32	664 ^b $\pm$ 5.77	851 ^e $\pm$ 7.07	808 ^d $\pm$ 6.34
11 th week	Overall	798 ^c $\pm$ 7.08	437 ^a $\pm$ 6.69	701.6 ^b $\pm$ 6.12	952 ^d $\pm$ 7.36	926 ^d $\pm$ 6.69
12 th week	Overall	921 ^c $\pm$ 6.00	520 ^a $\pm$ 5.66	763 ^b $\pm$ 5.18	1039 ^e $\pm$ 6.27	983 ^d $\pm$ 5.66
13 th week	Overall	1021 ^c $\pm$ 6.22	575 ^a $\pm$ 5.87	820 ^b $\pm$ 5.39	1144 ^e $\pm$ 6.63	1007 ^c $\pm$ 5.87
14 th week	Overall	1132 ^d $\pm$ 6.50	780 ^a $\pm$ 6.14	956 ^d $\pm$ 5.63	1222 ^e $\pm$ 6.93	1103 ^c $\pm$ 6.14
15 th week	Overall	1236 ^d $\pm$ 6.17	790 ^a $\pm$ 6.11	1011 ^b $\pm$ 5.61	1284 ^e $\pm$ 6.90	1200 ^c $\pm$ 6.11
16 th week	Overall	1373 ^d $\pm$ 9.20	829 ^a $\pm$ 9.85	1129 ^b $\pm$ 7.97	1305 ^d $\pm$ 9.81	1237 ^c $\pm$ 8.68
17 th week	Overall	1463 ^d $\pm$ 9.76	882 ^a $\pm$ 9.21	1136 ^b $\pm$ 8.49	1429 ^d $\pm$ 10.41	1258 ^c $\pm$ 9.21
18 th week	Overall	1580 ^d $\pm$ 10.60	988 ^a $\pm$ 10.00	1167 ^b $\pm$ 9.22	1469 ^c $\pm$ 11.30	1332 ^b $\pm$ 10.00
19 th week	Overall	1649 ^d $\pm$ 11.08	1060 ^a $\pm$ 11.86	1530 ^c $\pm$ 11.86	1540 ^c $\pm$ 11.81	1428 ^b $\pm$ 10.45
20 th week	Overall	1753 ^d $\pm$ 13.6	1208 ^a $\pm$ 12.8	1624 ^c $\pm$ 11.8	1622 ^c $\pm$ 14.4	1452 ^b $\pm$ 14.26

Table 3: Least squares means $\pm$ standard error (SE) of monthly body weight (g) of female from 20th week to 52nd weeks of age under different genetic groups of chicken.

Period	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)
20 th week	1549 ^d $\pm$ 4.52	1004 ^a $\pm$ 4.36	1420 ^c $\pm$ 3.83	1449 ^d $\pm$ 14.90	1288 ^b $\pm$ 4.44
24 th week	1586 ^d $\pm$ 7.52	1131 ^a $\pm$ 7.24	1450 ^c $\pm$ 6.35	1605 ^{cd} $\pm$ 7.25	1460 ^b $\pm$ 7.37
28 th week	1617 ^d $\pm$ 3.30	1162 ^a $\pm$ 3.18	1501.0 ^c $\pm$ 2.79	1646 ^c $\pm$ 3.18	1486 ^b $\pm$ 3.23
32 th week	1655 ^e $\pm$ 3.05	1193 ^a $\pm$ 2.94	1560 ^c $\pm$ 2.58	1690 ^d $\pm$ 2.94	1512 ^b $\pm$ 2.99
36 th week	1688 ^d $\pm$ 2.81	1235 ^a $\pm$ 2.71	1596 ^c $\pm$ 2.38	1744 ^d $\pm$ 2.71	1568 ^b $\pm$ 2.79
40 th week	1717 ^d $\pm$ 3.12	1252 ^a $\pm$ 3.01	1645 ^c $\pm$ 2.64	1777 ^d $\pm$ 3.01	1622 ^b $\pm$ 3.06
44 th week	1738 ^d $\pm$ 5.51	1278 ^a $\pm$ 5.31	1680 $\pm$ 4.66	1815 ^d $\pm$ 5.31	1664 $\pm$ 5.40
48 th week	1768 ^d $\pm$ 3.44	1310 ^a $\pm$ 3.31	1709 ^c $\pm$ 2.91	1849 ^d $\pm$ 3.32	1697 ^b $\pm$ 3.37
52 nd week	1781 $\pm$ 3.01	1340 ^a $\pm$ 2.89	1753 ^c $\pm$ 2.56	1881 ^d $\pm$ 2.90	1732 ^b $\pm$ 2.95

Similarly, the lower average body weight of Aseel obtained in the present experiment at 52nd week of age in comparison to the finding of Raj Kumar *et al.* (2017), but body weight obtained at 20th and 40th week of age were comparative to their findings. The growth appears to slow in Kadaknath during the early period of life, but birds continued to grow upto 52nd week of age. The growth rate was faster after 40 weeks of age in comparison to Aseel and Dahlem Red. Singh *et al.* (1999) reported significantly ($p \leq 0.05$) higher body weight in both male and female of Aseel than Dahlem Red at 20th week of age, which corroborated the finding of the present study. The average body weight of Kadaknath female obtained in the present study at 20th, 40th and 52nd week of age were little higher than the findings of Preeti (2018), which substantiates the findings of worker.

Heterosis for body weight

Heterosis percentage for body weight of male and female crossbred estimated based on mid parent value have been presented in Table 4 from 1st to 20th week of ages. Present heterosis for body weight of crossbred female from 20th to 52nd weeks of age has been depicted in Table 5.

It was recorded from Table 5 that percent heterosis were higher in magnitude during early phase of growth from 1st to 15th week of age, there by started declining with the advancement of age in both the sexes and in all the genetic groups. However, present heterosis were found to be higher in KN $\times$ DR than Aseel $\times$ Dahlem Red chicken. Estimates of heterosis percentage were positive, which indicated that crossbreeding improves growth rate in the crossbred chicken. Improvement gradually decline since the bird's approaches sexual maturity. Laxmi *et al.* (2009) reported positive heterosis for body weight at 20th week of age and negative heterosis as 40th week of age. Reddy *et al.* (1999) reported heterosis in both desirable and undesirable directions. Positive heterosis for body weight have been reported by Padhi *et al.* (2012, 1998), Jaya laxmi *et al.* (2009). In contrary to the, negative heterosis percentages have been reported by Khalil *et al.* (1999) and Sharma *et al.* (2003) in chickens.

Body weight gain

The mean value along with their standard errors of body weight gain of male, female and sexes pooled at weekly

interval from 1st to 20th week of age under different genetic groups of chicken have been presented in Table 6 and 7 respectively. Analysis of variance for the effect of genetic groups and sex on body weight gain of male and female are presented in Table 6 and 7 that revealed significant ($p \leq 0.05$) effect of genetic groups and sex on body weight gain.

Body weight gain in purebred

Among purebred's male, Aseel (AS) gained significantly ($p \leq 0.05$) higher body weight followed by Dahlem Red (DR) and Kadaknath. The lowest gain in body weight was shown in both the sexes of Kadaknath.

Table 6 and 7 revealed that weight gain for male of Aseel (AS), Kadaknath (KN) and Dahlem Red (DR) was 1601.96, 1170.15 and 1412.03 g respectively in comparison

Table 4: Estimates of percent heterosis for body weights of various crossbred male and female chicken at different weeks of age.

Age (week)	Male		Female	
	AS $\times$ DR	KN $\times$ DR	AS $\times$ DR	KN $\times$ DR
1 st	29.47	14.89	30.09	56.9
2 nd	13.78	86.50	22.60	35.56
3 rd	14.29	43.79	22.82	60.30
4 th	28.90	57.48	44.63	69.81
5 th	26.58	75.55	29.6	87.31
6 th	36.49	58.00	29.08	59.52
7 th	22.53	39.17	28.12	56.90
8 th	23.39	56.17	22.39	28.611
9 th	17.34	44.48	20.66	52.48
10 th	21.87	48.10	25.55	59.36
11 th	24.44	57.48	28.93	68.72
12 th	21.72	48.43	25.25	58.93
13 th	20.85	39.56	25.90	48.54
14 th	16.15	22.80	18.22	37.97
15 th	11.85	29.94	15.10	37.53
16 th	8.52	23.97	9.84	34.91
17 th	9.62	19.80	8.47	20.65
18 th	6.15	14.18	8.62	25.28
19 th	3.03	12.91	8.89	21.04
20 th	3.04	14.96	5.01	14.68

Table 5: Per cent heterosis for body weight of female only from 20 to 52 weeks of age.

Week	AS+DR /2	KN+DR/2	AS $\times$ DR% Heterosis	KN $\times$ DR% Heterosis
20 th week	1484.5	1212.0	5.01	19.80
24 th week	1518.0	1290.5	5.73	13.13
28 th week	1559.0	1331.5	5.58	11.60
32 th week	1607.5	1376.5	5.16	9.84
36 th week	1642.0	1415.5	6.21	10.77
40 th week	1681.0	1448.05	5.71	11.98
44 th week	1709.0	1479.0	6.20	12.51
48 th week	1738.5	1509.5	6.36	12.42
52 nd week	1767.0	1546.5	6.56	11.99

Table 6: Least squares means $\pm$ standard error (SE) of body weight gain (g) of different genetic groups of chicken.

Age (week)	Male					Female				
	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)
1 st week	15.87 ^a $\pm$ 0.12	10.73 ^a $\pm$ 0.12	15.87 ^a $\pm$ 0.12	18.11 ^a $\pm$ 0.13	20.81 ^a $\pm$ 0.12	14.29 ^b $\pm$ 0.11	11.14 ^b $\pm$ 0.11	21.12 ^b $\pm$ 0.09	18.52 ^b $\pm$ 0.12	21.22 ^b $\pm$ 0.11
2 nd week	31.99 ^a $\pm$ 0.99	13.62 ^b $\pm$ 0.98	31.99 ^a $\pm$ 0.99	39.42 ^a $\pm$ 1.07	31.75 ^b $\pm$ 0.96	25.00 ^a $\pm$ 0.88	16.63 ^a $\pm$ 0.89	44.13 ^a $\pm$ 0.77	32.43 ^a $\pm$ 0.98	34.76 ^a $\pm$ 0.89
3 rd week	54.6 ^a $\pm$ 1.12	25.4 ^a $\pm$ 1.10	54.6 ^a $\pm$ 1.12	55.4 ^a $\pm$ 1.21	39.7 ^a $\pm$ 1.09	53.2 ^a $\pm$ 1.00	24.1 ^a $\pm$ 1.00	27.5 ^a $\pm$ 0.87	54.0 ^a $\pm$ 1.11	38.3 ^a $\pm$ 1.01
4 th week	80.8 ^b $\pm$ 3.35	39.5 ^b $\pm$ 3.16	80.8 ^b $\pm$ 3.35	62.5 ^b $\pm$ 3.44	45.5 ^b $\pm$ 3.13	62.8 ^b $\pm$ 2.97	31.5 ^b $\pm$ 2.87	44.9 ^b $\pm$ 2.49	64.5 ^b $\pm$ 3.17	97.5 ^b $\pm$ 2.89
5 th week	74.1 ^a $\pm$ 2.23	53.4 ^a $\pm$ 1.97	74.1 ^a $\pm$ 2.23	70.0 ^a $\pm$ 2.34	54.3 ^a $\pm$ 2.14	68.2 ^a $\pm$ 1.97	99.5 ^b $\pm$ 1.69	53.7 ^b $\pm$ 1.95	66.0 ^b $\pm$ 2.15	60.3 ^b $\pm$ 1.96
6 th week	80.2 ^b $\pm$ 5.70	54.2 ^a $\pm$ 4.68	80.2 ^b $\pm$ 5.70	75.0 ^a $\pm$ 5.70	56.0 ^b $\pm$ 5.18	70.8 ^a $\pm$ 5.27	60.0 ^a $\pm$ 4.11	59.5 ^a $\pm$ 4.75	68.8 ^a $\pm$ 5.27	59.8 ^a $\pm$ 4.80
7 th week	73.0 ^a $\pm$ 2.81	54.6 ^a $\pm$ 2.45	73.0 ^a $\pm$ 2.81	85.1 ^a $\pm$ 2.93	57.3 ^a $\pm$ 2.68	60.2 ^a $\pm$ 2.50	64.3 ^b $\pm$ 2.15	61.0 ^b $\pm$ 2.45	74.8 ^b $\pm$ 2.71	67.0 ^b $\pm$ 2.47
8 th week	65.8 ^a $\pm$ 6.48	55.2 ^a $\pm$ 5.55	65.8 ^a $\pm$ 6.48	86.1 ^a $\pm$ 6.75	62.5 ^a $\pm$ 6.13	61.2 ^a $\pm$ 5.80	70.0 ^a $\pm$ 4.87	60.4 ^a $\pm$ 5.63	79.9 ^a $\pm$ 6.23	94.9 ^a $\pm$ 5.68
9 th week	79.3 ^a $\pm$ 3.01	61.7 ^a $\pm$ 2.65	79.3 ^a $\pm$ 3.01	84.9 ^a $\pm$ 3.16	81.9 ^a $\pm$ 2.87	70.8 ^a $\pm$ 2.69	73.3 ^b $\pm$ 2.29	60.7 ^b $\pm$ 2.62	82.4 ^b $\pm$ 2.90	73.4 ^b $\pm$ 2.65
10 th week	94.7 ^b $\pm$ 6.43	67.6 ^b $\pm$ 5.53	94.7 ^b $\pm$ 6.43	81.6 ^b $\pm$ 6.73	81.1 ^b $\pm$ 6.15	78.4 ^a $\pm$ 5.71	81.3 ^a $\pm$ 4.86	65.0 ^a $\pm$ 5.64	90.3 ^a $\pm$ 6.21	80.9 ^a $\pm$ 5.67
11 th week	94.8 ^b $\pm$ 3.23	66.4 ^a $\pm$ 2.82	94.8 ^b $\pm$ 3.23	81.6 ^b $\pm$ 3.38	87.6 ^b $\pm$ 3.11	77.7 ^b $\pm$ 2.87	78.3 ^b $\pm$ 2.47	67.4 ^b $\pm$ 2.86	92.5 ^b $\pm$ 3.12	80.5 ^b $\pm$ 2.86
12 th week	96.4 ^b $\pm$ 6.12	68.0 ^a $\pm$ 5.26	96.4 ^b $\pm$ 6.12	86.1 ^b $\pm$ 6.42	92.1 ^a $\pm$ 5.81	74.8 ^a $\pm$ 5.44	76.4 ^a $\pm$ 4.62	73.2 ^a $\pm$ 5.34	93.5 ^a $\pm$ 5.95	81.6 ^a $\pm$ 5.38
13 th week	98.2 ^b $\pm$ 3.70	69.5 ^a $\pm$ 3.19	98.2 ^b $\pm$ 3.70	87.4 ^b $\pm$ 3.94	91.8 ^a $\pm$ 3.52	81.7 ^b $\pm$ 3.29	76.0 ^b $\pm$ 2.81	75.6 ^b $\pm$ 3.23	94.9 ^b $\pm$ 3.66	82.7 ^b $\pm$ 3.26
14 th week	99.6 ^b $\pm$ 7.75	66.6 ^b $\pm$ 6.67	99.6 ^b $\pm$ 7.75	98.4 ^b $\pm$ 8.13	90.8 ^a $\pm$ 7.36	84.5 ^b $\pm$ 6.89	80.5 ^b $\pm$ 5.85	77.4 ^b $\pm$ 6.76	96.3 ^b $\pm$ 7.54	84.8 ^b $\pm$ 6.82
15 th week	99.9 ^b $\pm$ 3.51	73.6 ^b $\pm$ 3.02	99.9 ^b $\pm$ 3.51	99.41 ^a $\pm$ 3.67	93.8 ^a $\pm$ 3.34	89.4 ^b $\pm$ 3.12	84.1 ^a $\pm$ 2.65	76.8 ^b $\pm$ 3.06	97.3 ^b $\pm$ 3.39	85.3 ^b $\pm$ 3.09
16 th week	112.6 ^b $\pm$ 8.16	89.4 ^b $\pm$ 2.40	112.6 ^b $\pm$ 8.16	104.8 ^b $\pm$ 8.54	94.0 ^b $\pm$ 7.76	92.5 ^b $\pm$ 7.25	85.0 ^b $\pm$ 6.16	81.4 ^b $\pm$ 7.12	99.6 ^b $\pm$ 7.88	89.3 ^b $\pm$ 7.18
17 th week	95.5 ^b $\pm$ 4.28	76.5 ^b $\pm$ 3.69	95.5 ^b $\pm$ 4.28	106.1 ^a $\pm$ 4.48	97.3 ^a $\pm$ 4.07	75.0 ^b $\pm$ 3.81	74.1 ^a $\pm$ 3.25	86.7 ^a $\pm$ 3.74	87.8 ^a $\pm$ 4.14	94.0 ^a $\pm$ 3.77
18 th week	90.2 ^b $\pm$ 4.93	78.4 ^b $\pm$ 2.69	90.2 ^b $\pm$ 4.93	96.2 ^b $\pm$ 9.34	103.8 ^b $\pm$ 8.49	74.8 ^b $\pm$ 7.93	72.2 ^a $\pm$ 6.77	89.3 ^b $\pm$ 7.79	80.9 ^b $\pm$ 8.63	89.6 ^b $\pm$ 7.86
19 th week	85.3 ^b $\pm$ 3.52	75.5 ^b $\pm$ 3.03	85.3 ^b $\pm$ 3.52	88.6 ^b $\pm$ 3.68	88.1 ^a $\pm$ 3.35	63.9 ^b $\pm$ 3.13	69.1 ^a $\pm$ 2.67	75.1 ^a $\pm$ 3.07	79.2 ^b $\pm$ 3.40	88.7 ^a $\pm$ 3.10
20 th week	79.2 ^b $\pm$ 1.97	70.3 ^b $\pm$ 4.14	79.2 ^b $\pm$ 1.97	86.4 ^b $\pm$ 11.48	82.3 ^b $\pm$ 1.52	61.6 ^b $\pm$ 9.75	62.7 ^b $\pm$ 8.28	58.3 ^b $\pm$ 9.62	76.8 ^b $\pm$ 10.60	85.0 ^b $\pm$ 4.13
Total	1601.96	1622.73	1601.96	1170.15	1472.46	1356.48	1481.25	1259.15	1099.67	1312.58

Table 7: Overall least squares means $\pm$ standard error (SE) of body weight gain (g) of different genetic groups of chicken under each sex.

Period	Sex	AS (gm)	KN (gm)	DR (gm)	AS $\times$ DR (gm)	KN $\times$ DR (gm)
1 st Week	Overall	14.08 ^a $\pm$ 0.10	10.93 ^b $\pm$ 0.10	20.92 ^d $\pm$ 0.09	18.32 ^c $\pm$ 0.11	21.01 ^d $\pm$ 0.10
2 nd Week	Overall	28.5 ^b $\pm$ 0.85	10.1 ^a $\pm$ 0.85	27.6 ^d $\pm$ 0.73	35.9 ^c $\pm$ 0.95	38.3 ^c $\pm$ 0.84
3 rd Week	Overall	53.9 ^c $\pm$ 0.97	24.8 ^a $\pm$ 0.96	28.2 ^a $\pm$ 0.82	54.7 ^c $\pm$ 1.07	39.0 ^b $\pm$ 0.95
4 th Week	Overall	71.8 ^c $\pm$ 2.90	30.5 ^a $\pm$ 2.74	53.8 ^b $\pm$ 2.35	63.5 ^d $\pm$ 3.06	66.5 ^c $\pm$ 2.73
5 th Week	Overall	77.1 ^c $\pm$ 1.92	46.5 ^b $\pm$ 1.62	56.5 ^b $\pm$ 1.87	63.0 ^d $\pm$ 2.08	67.3 ^b $\pm$ 1.86
6 th Week	Overall	59.1 ^a $\pm$ 4.63	49.1 ^b $\pm$ 3.89	72.6 ^a $\pm$ 4.55	71.9 ^b $\pm$ 5.08	72.9 ^a $\pm$ 4.54
7 th Week	Overall	77.9 ^c $\pm$ 2.43	59.5 ^b $\pm$ 2.03	76.1 ^a $\pm$ 2.35	80.0 ^c $\pm$ 2.61	82.1 ^b $\pm$ 2.34
8 th Week	Overall	63.5 ^a $\pm$ 5.64	58.9 ^b $\pm$ 4.60	82.7 ^a $\pm$ 5.38	84.2 ^b $\pm$ 6.01	90.2 ^c $\pm$ 5.37
9 th Week	Overall	85.0 ^d $\pm$ 2.61	67.5 ^c $\pm$ 2.19	34.9 ^a $\pm$ 2.50	90.6 ^d $\pm$ 2.80	97.6 ^b $\pm$ 2.51
10 th Week	Overall	96.6 ^b $\pm$ 5.56	59.5 ^a $\pm$ 4.59	83.1 ^a $\pm$ 5.39	92.5 ^{bc} $\pm$ 5.99	103.0 ^a $\pm$ 5.38
11 th Week	Overall	71.2 ^c $\pm$ 2.79	61.9 ^a $\pm$ 2.34	85.0 ^b $\pm$ 2.73	93.1 ^d $\pm$ 3.00	110.0 ^e $\pm$ 2.71
12 th Week	Overall	88.1 ^d $\pm$ 5.29	59.7 ^a $\pm$ 4.36	86.5 ^{bc} $\pm$ 5.11	97.8 ^{cd} $\pm$ 5.73	112.8 ^{ab} $\pm$ 5.09
13 th Week	Overall	84.4 ^c $\pm$ 3.20	58.8 ^b $\pm$ 2.65	88.3 ^b $\pm$ 3.09	99.7 ^c $\pm$ 3.53	114.0 ^a $\pm$ 3.08
14 th Week	Overall	90.1 ^{ab} $\pm$ 6.70	53.1 ^b $\pm$ 5.53	82.6 ^e $\pm$ 6.47	92.8 ^a $\pm$ 7.26	115.3 ^a $\pm$ 6.45
15 th Week	Overall	90.1 ^c $\pm$ 3.04	63.8 ^a $\pm$ 2.50	86.5 ^a $\pm$ 2.93	97.3 ^a $\pm$ 3.27	120.1 ^b $\pm$ 2.92
16 th Week	Overall	110.3 ^b $\pm$ 7.06	79.3 ^b $\pm$ 5.82	85.7 ^a $\pm$ 6.81	107.4 ^a $\pm$ 7.60	101.6 ^a $\pm$ 6.79
17 th Week	Overall	84.4 ^c $\pm$ 3.70	83.4 ^b $\pm$ 3.06	97.9 ^b $\pm$ 3.57	93.9 ^b $\pm$ 3.99	96.2 ^a $\pm$ 3.56
18 th Week	Overall	102.1 ^b $\pm$ 7.72	76.3 ^b $\pm$ 6.39	107.4 ^b $\pm$ 7.45	93.0 ^a $\pm$ 8.32	97.7 ^a $\pm$ 7.43
19 th Week	Overall	96.1 ^b $\pm$ 3.05	72.3 ^b $\pm$ 2.52	77.3 ^c $\pm$ 2.94	71.4 ^a $\pm$ 3.28	90.9 ^c $\pm$ 2.93
20 th Week	Overall	94.7 ^a $\pm$ 9.49	69.8 ^b $\pm$ 7.82	70.4 ^a $\pm$ 9.20	69.6 ^a $\pm$ 10.22	80.1 ^a $\pm$ 9.22
Total		1538.88	1559.12	1451.92	1095.73	1716.61

to their female counter parts gain of body weight of 1356.48, 1099.67 and 125.15 g respectively from 1st to 20th week of age. Dahlem Red (DR) female recorded higher body weight gain (1259.15 g) as compared to KN female (1099.67g) during the same period. Average body weight gain of male of all genetic groups were significantly ($p \leq 0.05$) higher than their female counter parts at age of measurement, in general. Body weight gain followed the trend of body weight growth, which was expected. It was revealed that in general, the mean value of body weight gain in both male and female were fowl to be increased as age advances and maximum body weight gain attained between 16th to 18th week of age. There after the rate of gain started declining.

Body weight gain in crossbreds

It was observed from Table 6 and 7 crossbreds attained significantly ($p \leq 0.05$) higher body weight gain as compared to the purebred in both male and female. Aseel $\times$ DR had significantly ($p \leq 0.05$) higher weight gain KN $\times$ DR in the corresponding age groups in general. Among male, AS $\times$ DR had significantly ($p \leq 0.05$) higher body weight gain than the KN $\times$ DR by 150.27 g and among female, the AS $\times$ DR had significantly ($p \leq 0.05$) higher body weight gain than the KN $\times$ DR by 168.67 g. The trend of gain in body weight with the advancement of age as observed in purebreds has also been noticed in the crossbreds. The highest body weight gain was found between 15th to 17th weeks of age and thereafter it started declining. Similar trends in increase of body weight gain with the advancement of age in Kadaknath breed has also been reported by Preeti (2018)

as observed the highest body weight gain at 20th week of age, which is contrary to the findings at the present study. Contrary to the findings of the present study, Singh (2013) reported the body weight gain of Kadaknath was the highest between 8th-12th weeks of age, which indicated the gain in body weight of Aseel and Dahlem Red that was still better at older age. The highest gain in body weight at 15th week of age in both Kadaknath and Aseel was also reported. The differences in growth rate of different breed of chicken could be attributed to interplay of multiple genes, which could be improved through genetic selection (Chambers *et al.*, 1981). Body weight gain of Aseel in relation to Kadaknath was significantly ($p \leq 0.05$) higher as observed in the present experiment that was also reported by Pathak *et al.* (2015), Haunshi *et al.* (2011) and Shanmathy *et al.* (2018).

CONCLUSION

The crosses of pure breeds of Kadaknath and Aseel with exotic Dahlem Red may be recommended for more yield of meat, eggs, egg shell quality, egg contents, carcass quality and FCR apart from these it was economical in overall performances of chickens. Eggs produced by the cross breeds were also found significantly heavier than the eggs produced by indigenous breeds, but significantly ($P < 0.05$) lighter than the eggs produced by Dahlem Red.

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Disclaimers

The data supporting the findings of this study are available with "the corresponding author" upon reasonable request. Due to the "ethical restrictions", the raw data are not publicly available. However, summarized data can be provided to interested researchers for academic purposes upon request. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

The experiment was carried out at Bihar Animal Sciences University, Patna, India, with approval from the University Animal Ethics Committee.

Conflict of interest

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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