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Comparative production performance traits of Kadaknath, Giriraja and black australorp breeds of poultry under intensive system of management in Maharashtra State of India

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Abstract
The present study was conducted in three breeds of poultry Kadaknath, Giriraja and Black Austrlorp in Kolhapur, Solapur, Sangali and Satara districts of Maharashtra, India over the period of 15 months (April 2019 to July 2020). The data from 61 Poultry farms over 16 weeks period was studied and analysed for the study. The experimental parameters studied were final Body weight, cumulative feed consumption, FCR, mortality percentage, carcass characteristics and economics of intensive rearing systems. All the birds from three breeds showed highly significant (p<0.01) differences in studied parameters except mortality. The performance of Giriraja bird was superior than Kadaknath and Black Australorp seems to be most economical under Intensive system of housing.

Keywords: Black Australorp, Carcass traits, feed consumption, FCR, Giriraja, Intensive system Kadaknath, mortality

Introduction
The Kadaknath or Kali Masi is an important indigenous breed of poultry. This breed is poor in egg production potential, but their black flesh is very delicious and popular. Its flesh is of higher value and is being used for the treatment of many diseases in human beings by tribals or adivasies living in Jhabua District of Madhya Pradesh (Dolberg, 2004) [7]. Likewise, The Giriraja**,** is a synthetic strain of chicken developed by KVAFSU at Banglore, India. The name "Giriraja" symbolically expressed as "king of the jungle fowl". It has gained popularity as a major scavenging bird and the prime choice under adverse environmental conditions (Reddy and Rajendiran, 2002) [24]. Also, the Black Australorp is a dual purpose chicken breed of Australian origin which was developed with the intension of increased eggs production. The breed achieved world-wide popularity in the 1920s after the breed broke numerous world records for number of eggs laid and has been a popular breed in the western world [34]. The importance of intensive and backyard poultry farming is well recognized by Government of Maharashtra and special programs are formulated for its promotion. Hence, efforts have been diverted into producing dual purpose native hybrids with improved production profiles [35]. The present research work was designed considering the importance and performance of above said three breed of poultry with the aim of studying comparative production performances under the intensive system of housing/Rearing.

Materials and method
The present study was conducted in twenty four villages of four districts Kolhapur, Solapur, Sangali and Satara of Maharashtra state, India in three types of poultry birds the Kadaknath, Giriraja and Black Australorp under intensive system of rearing. Sixty one farms among the villages were selected on the basis of interview schedule. Parameters like growth performance, feed intake, Feed Consumption, feed conversion ratio(FCR), carcass traits, mortality percentage and economics were studied during the experiment.

All the birds of these breeds were maintained under common feeding and water regime. The data of the birds was collected and recorded from 0 day to 16th week of age at biweekly interval and results were expressed as Mean ± S.E. The statistically analysis of the data was done using Complete randomized design as per method described by Panse and Sukhatme, (1967) [19] using Statistical Package for Social Science (SPSS, version-26, IBM Corporation Armonk, NY, USA)

Results and discussion

The parameters under study Growth performances, Cumulative feed consumption, Cumulative feed conversion ratio (FCR), Carcass traits, Mortality Percentage and economics of the Intensive system of housing is presented below

Growth performances

The data of comparative growth performances is presented in Table 1. At 16th week the biweekly body weight of Giriraja, Black Australorp and Kadaknath were 1864.89, 1693.32 and 1014.53g, respectively. It was observed that the Giriraja birds showed highly significant (p<0.01) biweekly body weight gain upto the 16th weeks of age, followed by Black Astrolorp birds and lowest in Kadaknath birds. At the end of the experiment it was statistically observed that Giriraja and Black Astrolorp both showed better feed efficiency.

Table 1: Comparative biweekly body weight (g) of Kadaknath(KD), Giriraja (GR) and Black Australorp (BA).

Breeds	Age (in weeks)								
	Day old	2nd	4th	6th	8th	10th	12th	14th	16th
KD	$28.64^{b} \pm 0.18$	$84.41^{c} \pm 1.80$	$186.27^{b} \pm 3.59$	$316.56^{c} \pm 2.79$	$458.21^{c} \pm 3.61$	$582.45^{c} \pm 3.94$	$717.98^{c} \pm 4.95$	$851.96^{c} \pm 4.90$	$1014.53^{c} \pm 5.45$
GR	$36.19^{a} \pm 0.18$	$156.81^{a} \pm 3.07$	$374.61^{a} \pm 6.14$	$610.79^{a} \pm 7.43$	$879.47^{a} \pm 9.00$	$1124.42^{a} \pm 11.84$	$1355.58^{a} \pm 14.81$	$1611.00^{a} \pm 17.32$	$1864.89^{a} \pm 20.24$
BA	$36.66^{a} \pm 0.30$	$126.73^{b} \pm 1.95$	$356.81^{a} \pm 8.24$	$572.99^{b} \pm 8.78$	$799.17^{b} \pm 9.94$	$1056.97^{b} \pm 9.77$	$1288.69^{b} \pm 9.94$	$1469.73^{b} \pm 9.21$	$1693.32^{b} \pm 8.68$
'F' Cal.Value	369.63**	208.76**	251.84**	484.78**	687.74**	852.64**	845.10**	914.21**	880.57**

Means bearing different superscripts (^{a,b}) differ significantly (**p< 0.01) in a column

The findings of the study regarding the Kadaknath body weight gain is lesser is in agreement with earlier reports of Gurung and Singh (1999) [10], Thakur *et al*. (2006) [32], Thakur and Parmar (2012) [31] and Rahangdale *et al.* (2017) [21] which might be due to the smaller body size of the breed. Black Autralorp and Girirraja showed highest body weight gain throughout the study is might be due to heavy and larger breed size which is correlative with the findings of Neupane *et al*., (2014) [17], Somu, (2015) [28] and Jayanaik *et al*., (2021) [13], in Giriraja and Gondwe and Wollny, (2003) [8] and Kgwatalala and Segokgo, (2013) [14] in Black Australorp birds. The lower Average body weight gain in Kadaknath breed as compare to Giriraja and Black Australorp in the present study is may be due to the genetic makeup of the indigenous and cross-breeds (Singh and Singh, 2004) [27], management conditions (Gondwe and Wollny, 2003) [8], metabolic rate of breed (Shanmathy *et al*., 2018) [25]. Better growth potential might be due to the fact that this breed (Giriraja) had undergone series of improvement and selection for higher body weight and growth rate (Amusan *et al*., 2013) [3].

Cumulative feed consumption

The data of comparative cumulative feed consumption of the breeds at biweekly intervals is presented in Table 2. At the age of 16th week the biweekly cumulative feed consumption for KD, GR and BA birds were 3738.23, 4797.16 and 4898.47 g, respectively. It was observed that for most of the weeks, highest biweekly cumulative feed consumption was seen in Black Australorp and followed by Giriraja and lowest in Kadaknath birds, respectively.

Table 2: Comparative biweekly cumulative feed consumption (g) of Kadaknath(KD), Giriraja(GR) and Black Australorp(BA).

Breeds	Age (in weeks)							
	2nd	4th	6th	8th	10th	12th	14th	16th
KD	$137.67^{b} \pm 3.86$	$374.58^{c} \pm 4.72$	$726.59^{c} \pm 9.44$	$1231.41^{c} \pm 9.86$	$1738.76^{c} \pm 12.28$	$2317.87^{c} \pm 15.56$	$2976.43^{c} \pm 23.63$	$3738.23^{b} \pm 29.59$
GR	$218.38^{a} \pm 5.25$	$610.84^{b} \pm 10.50$	$1094.02^{b} \pm 17.30$	$1674.50^{b} \pm 20.30$	$2272.38^{b} \pm 27.50$	$2924.36^{b} \pm 31.07$	$3801.15^{b} \pm 39.83$	$4797.16^{a} \pm 42.77$
BA	$206.24^{a} \pm 6.70$	$714.47^{a} \pm 4.97$	$1233.40^{a} \pm 11.45$	$1799.55^{a} \pm 18.47$	$2538.05^{a} \pm 21.35$	$3301.27^{a} \pm 24.43$	$3973.48^{a} \pm 21.58$	$4898.47^{a} \pm 30.02$
'F'Cal. Value	60.76**	427.73**	310.64**	257.34**	286.75**	324.92**	255.27**	264.48**

Means bearing different superscripts ($^{a, b}$) differ significantly (**p< 0.01) in a column

The findings obtained during the study were in line with Tamang *et al.* (2015) [29] also observed that progenies of Giriraja crossed with Black Australorp will be the best compatible breeds for meat production on the basis of their feed consumption. The findings for feed intake in Giriraja is in agreement with the earlier findings of Neupane *et al*., (2014) [17] and Pakrawan *et al.* (2017) [18]. Also, Rathod *et al.*, (2018) [23] observed low feed consumption in Kadaknath birds. The Average feed consumption by the birds depends upon the metabolic rate (Shanmathy *et al*., 2018) [25] of the individual breeds, feed consumption depends on the bird age, diet and experimental conditions (Rajeswara and Naik, 2017) [22].

Cumulative feed conversion ratio (FCR)

The data of comparative cumulative feed conversion ratio (FCR) of the breeds is presented in Table 3. At the age of 16th week the biweekly FCR for Kadaknath, Giriraja and Black Australorp birds were 3.68, 2.57 and 2.94 gm, respectively. On perusal of results the birds showed highly significant (p<0.01) differences within the breeds and Giriraja showed lowest FCR throughout the experimental period followed by Black Australorp and Kadaknath birds under intensive system of management up to 16th weeks of the age.

Table 3: Comparative biweekly cumulative FCR (g) of Kadaknath(KD), Giriraja(GR) and Black Australorp (BA) in Intensive system of housing.

Breeds	Age (in weeks)							
	2nd	4th	6th	8th	10th	12th	14th	16th
KD	2.49^{a} ± 0.04	2.42^{a} ±0.05	2.51^{a} ± 0.02	2.79^{a} ± 0.02	3.04^{a} ± 0.02	3.25^{a} ± 0.02	3.49^{a} ± 0.03	3.68^{a} ± 0.03
GR	1.82^{b} ± 0.02	1.81^{c} ± 0.01	1.89^{c} ± 0.01	1.96^{c} ± 0.01	2.06^{c} ± 0.01	2.19^{c} ± 0.01	2.36^{c} ± 0.02	2.57^{c} ± 0.02
BA	2.31^{a} ± 0.10	2.28^{b} ± 0.05	2.31^{b} ± 0.06	2.36^{b} ± 0.04	2.47^{b} ± 0.03	2.61^{b} ± 0.03	2.77^{b} ± 0.02	2.94^{b} ± 0.02
'F' Cal. Value	34.70**	56.93**	118.75**	296.17**	484.76**	639.40**	713.09**	573.37**

Means bearing different superscripts ($^{a, b}$) differ significantly(**p< 0.01) in a column

The findings were in accordance with Neupane *et al*., (2014) [17] and Pakrawan *et al.* (2017) [18] observed better FCR Giriraja. Shanmathy *et al.* (2018) [25] observed FCR ranged between 2.26 to 10.51 for the Kadaknath birds during the experimental period of 12 weeks. Mandal *et al.* (2013) [15] observed feed intake and feed conversion efficiency did not differ statistically in kadaknath breed. However, Chandra *et al.* (2015) [5] observed better feed conversion ratio and significantly lower in Kadaknath birds. Tamang *et al*., (2015) [29] observed progenies of Black Australorp crossed with Giriraja was observed the best compatible one on the basis of feed conversion ratio (2.63) at the end of 8th week of age.

The better feed Conversion in the breeds depends upon management of the poultry keepers might affect the feed intake and the affected feed intake might also affect FCR and thus weight gain. FCR increases with age and explained by slowing of growth rate with age (Das *et al*., 2016) [6].

Carcass traits

The mean of carcass traits are summarized in Table 4. The live weight of the birds, dressed weight, neck weight, brest weight, back weight, wing weight, thigh weight, drum stick weight and giblet weight showed highly significant (p<0.01) difference within the groups of the birds.

Table 4: Comparative biweekly Carcass traits (g) of Kadaknath (KD), Giriraja(GR) and Black Australorp(BA).

Parameters	Kadaknath	Giriraja	Black Australorp	'F' Cal. value
Live weight	1023.92^{c} ± 12.06	1947.17^{a} ± 31.32	1728.50^{b} ± 19.47	463.87 **
Dressed weight	655.75^{c} ± 7.85	1315.22^{a} ± 20.32	1214.25^{b} ± 15.69	525.16 **
Neck weight	31.35^{c} ± 1.16	82.55^{a} ± 2.10	71.60^{b} ± 2.99	300.52 **
Brest weight	123.65^{c} ± 2.42	278.95^{a} ± 5.31	236.92^{b} ± 3.40	424.75 **
Back weight	104.25^{c} ± 1.45	256.75^{a} ± 4.52	214.86^{b} ± 3.76	507.57 **
Wing weight	85.40^{c} ± 1.90	155.67^{a} ± 2.68	123.12^{b} ± 2.24	235.02 **
Thigh weight	107.92^{c} ± 0.90	267.87^{a} ± 6.60	216.70^{b} ± 2.96	3.77.08 **
Drum stick weight	110.05^{c} ± 2.61	247.80^{a} ± 4.29	216.75^{b} ± 4.62	336.40 **
Giblet weight	55.77^{c} ± 1.61	100.60^{a} ± 2.19	86.93^{b} ± 1.98	139.93 **

Means bearing different superscripts ($^{a, b}$) in a column differ significantly (**p< 0.01)

At the end of the experiment the findings are in tune with work of Adebambo *et al*. (2010) [1] observed that important carcass traits like Live weight (g), Carcass yield, Breast yield, Thigh yield, Drumstick yield, Wing yield, Giblet yield (Empty gizzard yield, Heart yield and Liver yield) showed genotype based (Sire and Dam) significantly (p<0.05) difference. Arora *et al.* (2011) [4] observed non-significant differences for both growth and carcass quality traits in Kadaknath chickens reared till 10 weeks of age. Haunshi *et al.* (2013) [11] observed significantly higher results in carcass traits in Aseel as compared to Kadaknath at 10 weeks of age. Tamang *et al.* (2015) [29] observed meat quality of the Black Australorp progenies of Giriraja crossed with Black Australorp will be the best compatible breeds for meat production. Pathak *et al.* (2015) [20] studied on Aseel and Kadaknath for their growth and carcass traits under deep litter system and observed that all the carcass traits except liver, gizzard and intestines were significantly (p<0.05) higher in Aseel than Kadaknath. Differences in carcass traits between indigenous Thai and crossbred chickens (Jaturasitha *et al*., 2008) [12]. The yield of carcass traits depends on the phenotypic breed characteristic, body conformation and could be attributed to the genetic basis, differences in activity level (Ahmad *et al*., 2019) [2], enhanced the activity of the birds and improved comfort and welfare (Martínez-Pérez *et al.*, 2017) [16]. Variation in carcass traits is due to higher breast and leg yields of slow-growing genotypes, which might be attributed to a large size of muscle fiber if achieved by muscle fiber hypertrophy (Jaturasitha *et al*., 2008; Tang *et al*., 2009) [12, 30] supporting the finding of our study.

Mortality Percentage

The mortality observed in the present experiment were expressed as percentage and no statistical analysis has been carried out. The mortality percentages were within the limits during the experimental period in all the three breeds.

Table 5: Comparative Mortality Percentage of Kadaknath (KD), Giriraja(GR) and Black Australorp (BA).

Breed	Mortality percentage (%)
Kadaknath	4.71 ± 0.66
Giriraja	4.96 ± 0.43
Black Australorp	5.69 ± 0.31

These findings were in agreement with Timothy *et al*., (2003) [33] observed mortality was 4.7 per cent in BA kept in intensive. However, Neupane *et al*., (2014) [17] found mortality percent as 6.21 and 12.25 percent in New Hampshire and Giriraja respectively. Sharma *et al.* (2012) [26] observed mortality in kadaknath breeds is may be due to the severe cold in the month of December and January. The lower mortality in the present study is may due to proper health care and management particularly in the early stage of growth (Neupane *et al*., 2014) [17].

Economics of Intensive system of housing in Kadaknath, Giriraja, and Black Australorp

Table 6: Comparative Economics of Kadaknath(KD), Giriraja(GR) and Black Australorp(BA)

Sr. No.	Particulars	Kadaknath	Giriraja	Black Australorp
1	Cost of day old chick (Rs)	40	20	20
2	Cost of feed (Rs)	27.5	27.5	27.5
3	Total feed consumption (g)	3738.23	4797.16	4898.47
4	Cost of feed consumed per bird (Rs)	102.80	131.92	134.70
5	Average body weight (g)	1014.53	1864.89	1693.32
6	Miscellaneous cost* (Rs)	20	20	20
7	Total cost of production (1+4+6) (Rs.)	162.80	171.92	174.70
8	Average price realized / bird, Kadaknath @ 250 RS/kg live weight, Giriraja and Black Australorp @ 150 RS/kg live weight	253.63	279.73	253.99
9	Net profit/ bird (Rs) (8-7)	90.83	107.81	79.29
10	Net profit/ kg live weight (Rs)	89.52	57.81	46.82

The total cost of production was Rs. 162.80, 171.92 and 174.70, average sell price per bird, Kadaknath @ 250 Rs /kg live weight, Giriraja and Black Australorp @ 150 Rs/kg live weight, the average price realized were Rs. 253.63, 279.73 and 253.99, Net profit per bird at 16th weeks of age for kadaknath Rs. 90.83, Giriraja Rs. 107.81 and Black Australorp Rs. 79.29. Net profit per Kg of live weight at 16th weeks of age for kadaknath Rs. 89.52, Giriraja Rs. 57.81 and Black Australorp Rs. 46.82.

The findings observed by Neupane *et al*., (2014) [17] observed higher saving per bird was observed in Giriraja (Rs132.39) than that of New Hampshire (Rs 67.09). Gupta *et al.* (2016) [9] observed in indigenous breed Kadaknath is well known for delicious black flesh, profitability was numerically higher in Kadaknath. Also, Rathod *et al.* (2018) [23] observed better growth performance and lowest cost of production in Kadaknath chicken from 7th to 14th week of age.

Conclusion

Observations of the study is conclusive that the performance Giriraja and Black Australorp was superior than Kadaknath breed under Intensive system of housing management which seems to be most economical in terms of nutritional, social and economic benefits to the poultry farmers.

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