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Evaluation of Native and Kadaknath chicken for production performance, egg quality traits and farmers acceptability in Western Himalayan region of Himachal Pradesh, India

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ABSTRACT

The present study evaluated production performance and egg quality traits of native and Kadaknath chicken of Himachal Pradesh under sub-temperate western Himalayan region of India. External egg quality traits like egg weight, egg length, egg width, shell thickness and internal traits like length, height, width of albumen, yolk height, and yolk width were measured. Body weight of native and Kadaknath birds differed significantly at different age of measurements and body weight of native birds was significantly higher than Kadaknath. Age at sexual maturity was found less in native birds in comparison to Kadaknath. HHEP and HDEP was observed higher in native birds than Kadaknath. Mean value estimated for egg weight, egg length, egg width, shape index and shell thickness were 45.33 g, 54.99 mm, 41.27 mm, 75.02% and 0.36 mm, respectively in native eggs while corresponding values were 43.87 g, 53.61 mm, 40.80 mm, 76.20% and 0.34 mm, respectively in Kadaknath eggs. Albumen length, albumen width, yolk height and yolk index is observed significantly higher in native birds than Kadaknath. Appraisal of farm practices through field survey suggests that Kadaknath birds witnessed rising popularity in recent times. However, native birds of the region are better producers in comparison to Kadaknath. This suggests that native birds may be preferred over Kadaknath birds in similar regions where premium pricing of Kadaknath is unavailable. Occasionally peri-urban market offered opportunity of premium pricing based income through sale of Kadaknath birds. Thus, rearing of Kadaknath along with native birds is advised in such regions.

Keywords: Egg quality, Field survey, Kadaknath, Native, Production performance

Poultry is one of the leading component in agricultural sector in India having the highest growth rate. The introduction of high yielding chicken varieties, which resemble the native chicken, transformed the backyard poultry farming into a highly remunerative farming activity (Rajkumar *et al.* 2021). Native chicken are valuable genetic resources due to their adaptability to harsh climatic conditions and resilience to local diseases (Gheyas *et al*. 2021). Native birds are slow growers and produce lower eggs. However, they have attractive plumage colour, produce consumer- appealing brown shelled eggs, escape easily from predators, forage well on wastes and have high disease resistance (Dinesh *et al.* 2018).

The Kadaknath breed originated from Jhabua and Dhar districts of western Madhya Pradesh and adjoining areas of Gujarat and Rajasthan states of India. In recent times, Kadaknath birds have spread across the country due to the high demand for its meat and eggs (Haunshi and Prince 2021). The state government also initiated the distribution of free Kadaknath birds to some of the farmers in Himachal Pradesh. Studying the adaptability and production performance of these birds outside their breeding tract requires attention. No study was found on the adaptability of Kadaknath in the temperate regions of India.

Under rural poultry farming system the quality of egg and meat is an important criteria for consumer preferences, thus evaluation of external and internal egg quality traits needs to be evaluated for different breeds/stocks. Egg quality is the characteristics of eggs that affect its acceptability to consumers (Stadelman 1977). Internal quality factor for hatching and consumer preference include albumen thickness, albumen length, yolk index, haugh unit score, etc. (Sekeroglu and Altuntas 2008). Evaluation of external and internal quality of egg plays an important role in hatching of eggs and also in consumer preference for better quality eggs. Since little information exists on production characteristics of native and Kadaknath chicken, hence the present study has been carried out to evaluate and compare the growth, production performance, egg quality traits and acceptability of native and Kadaknath birds maintained under intensive system in Himachal Pradesh.

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MATERIALS AND METHODS

The study was carried out on native and Kadaknath birds maintained at CSKHPKV, Poultry Farm, Palampur, Himachal Pradesh, India. Himachal Pradesh is a western Himalayan state in northern India located between 30°22 N and 33°12N latitude and 75°47 E and 79°04 E longitude. Native chicks were obtained from parental stock of native birds kept under All India Coordinated Research Project on Poultry Breeding while Kadaknath chicks purchased from an entrepreneur who established his hatchery after taking parent stock from Jabalpur. A total number of 310 birds of native and 120 birds of Kadaknath were reared under deep litter system with standard managemental practices. Data for growth and production traits were collected from the performance records of native and Kadaknath birds kept at University Poultry Farm, Palampur. All chicks were brooded up to six weeks of age and afterward kept under deep litter system up to 72 weeks. Birds were offered starter feed up to 6 week, grower feed 7-18 week and layer feed 18 week onward as per specification given in Table 1. Growth and production traits evaluated were body weight, viz. (day old chick weight, body weight at 4 week, 8 week, 12 week, 20 week and 40 week), age at sexual maturity (ASM), hen housed egg production (HHEP) and hen day egg production (HDEP) at 40 and 52 weeks of age.

Table 1. Specifications/ nutrient composition of different types of poultry feed

Ingredient	Starter feed	Grower feed	Layer feed
Moisture (maximum)	11.0%	11.0%	11.0%
Crude protein (minimum)	20.0%	16.0%	18.0%
Crude fiber (maximum)	7.0%	9.0%	9.0%
Ether extract (minimum)	2.0%	2.0%	2.0%
Calcium (minimum)	1.0%	1.0 %	3.0%
Phosphorus (minimum)	0.7 %	0.65 %	0.65%
Metabolizable energy (kcal/kg)	2800	2500	2600

A total of 150 eggs, 75 each of native and Kadaknath were collected from birds at 40-42 weeks of age for evaluating the external and internal egg quality parameters of native and Kadaknath. The eggs were weighed to an accuracy of 0.01 g using electronic balance. The eggs length and width were recorded using digital vernier calipers. Shape index was calculated as the ratio of width of egg to its length times 100. Subsequently, the eggs were broken, and internal egg quality traits, viz. albumen length, albumen width, yolk length and yolk height were measured using the vernier caliper. Albumen height was recorded with the help of spherometer at 3 or 4 locations and averaged. Thickness of shell was recorded with the help of screw gauge from four places of shells, one each from the broad and narrow end and two from the body of the eggs and averaged. Haugh unit was calculated using the formula given below:

$$\text{Haugh unit (H.U.)} = 100 \log (H+7.57-1.7W^{37})$$

Where, H, albumen height in millimeters (mm) and W, egg weight in grams (g).

The data were analysed using SPSS 20.0 software. Significant differences between native and Kadaknath birds were studied by one way analysis of variance (ANOVA) (Snedecor and Cochran 1994).

An appraisal of farmer's comparative perspective on native and Kadaknath birds was assessed. This was studied through a field survey through pre-tested semi structured interview schedule. A total of 50 farmers were randomly selected in purposively selected village panchayats of Kunsal and Kudail in Baijnath block of Kangra district. These two panchayats were selected as it was found through veterinary institutions that farmers of these panchayats had been rearing Kadaknath birds for last three years. Afterwards individual farm and home visits were undertaken to randomly selected 50 farmers of these panchayats. Data was analysed on frequency and percentage basis.

RESULTS AND DISCUSSION

Mean along with standard error for body weight, viz. day old chick weight, body weight at 4, 8, 12, 20 week and 40 weeks, age at sexual maturity (ASM), hen housed egg production (HHEP) and hen day egg production (HDEP) for native and Kadaknath chicken are presented in Table 2.

Table 2. Growth and production performance of Native and Kadaknath chicken at different period of age

Parameter	Native	Kadaknath
Body weight (g)		
Day old	30.15±0.20^{a}	28.15±0.10^{b}
4 weeks	180.95±1.64^{a}	169.20±2.64^{b}
8 week	456.69±10.39^{a}	400.69±10.15^{b}
12 week	780.55±15.20^{a}	750.50±15.20^{a}
20 week	1409.42±20.05^{a}	1295.20±20.15^{b}
40 week	1595.20±24.00^{a}	1410.10±24.0^{b}
Age at sexual maturity (days)		
Age at first egg	141	168
Age at 50% HHEP	180	195
Egg Production up to 40 week		
HHEP	54.28	45.0
HDEP	60.31	48.41
Egg Production up to 52 week		
HHEP	74.55	66.31
HDEP	85.33	78.56

Means bearing same superscript with in rows did not differ significantly (P<0.05).

Body weight: Body weight in native birds were significantly (P<0.05) higher than Kadaknath at day old stage, 4 week, 8 week, 20 week and 40 weeks of age. However, there was no significant variation in body weight of native and Kadaknath at 12 weeks of age. Contrary to present finding, Alireza *et al.* (2015) observed higher body weight in native hen and rooster pullets at age of 8, 12 and 24 week as 671±109 g and 853±125 g, 929±177 g and 1199± 237 g, 1765±363 g and 2167±335 g, respectively at Isfahan Province. Likewise, Pathak *et al.* (2015) obtained higher body weight of 192.0±2.08 g in Kadaknath breed

at 4 week of age at GADVASU, Ludhiana. However, Sarma *et al.* (2018) revealed lower body weight for desi birds at 8 (368.12±2.74 g), 20 (789.14±5.03 g), 40 (1269.31±9.01g) and 52 (198.31±2.03 g) weeks of age under field condition. Similarly, lower body weight than the present study were reported by Bhagora *et al.* (2022) in Kadaknath chicken at day old (25.81±0.24 g), 4 week (157.86±3.26 g), 8 week (341.42±11.87 g), 12 week (558.82±21.62 g) and 20 week (1247.07±30.31 g) of age except at 40 week (1520.44±39.85 g) of age which is higher than the present study. In a similar study, Dinesh *et al.* (2021) observed higher body weight of 30.62 g, 185.33 g, 500.53 g, 834.15 g, 1420.30 g and 1515.20 g in native birds at day old, 4 week, 8 week, 12 week, 20 week and 40 weeks of age, respectively. Least-squares means of 343.63±5.67, 552.35±6.97, 719.04±9.02, 920.47±11.20 and 1581.13±13.37 g were reported by Dalal *et al.* (2022) for body weight at 8, 12,16, 20 and 40 weeks of age respectively in Kadaknath birds at LUVAS, Hisar.

Age at sexual maturity: Age at sexual maturity is comparatively lower in native birds (141 days) than Kadaknath (168 days). A lower age at sexual maturity in the layer is preferred since this may result in increased laying period and higher egg production. Similarly age at 50% HHEP is observed less in native birds than Kadaknath. In a similar study, Niranjan *et al.* (2008) estimated age at sexual maturity of 160.89 and 164.79 days in Gramapriya and Vanaraja birds respectively under backyard farming system. In contrast, higher age at first laying than the current study was revealed by Haunshi *et al.* (2009) in improved varieties of Gramapriya (179.50 days) and Vanaraja (197.70 days), which were developed for backyard farming. However, Giri and Sahoo (2012) reported lower age at first lay under intensive (138 days) and extensive system (142 days) of management in Gramapriya birds. In a comparative study, Jha *et al.* (2013) observed age at sexual maturity of 143.65 days in Dahlem Red, 171.38 days in Dahlem Red × Native cross and 212.43 days in Native birds. Contrary to present finding, Haunshi *et al.* (2013) obtained higher age at sexual maturity in Aseel (174±0.9 days) and Kadaknath (181±1.2 days) breed at PDP, Hyderabad. In a comparative study, Kalita *et al.* (2017) reported delayed age at sexual maturity of 172.36±5.26 days in PB-2×indigenous and 158.23±2.75 days in Dahlem Red bird in comparison to present study. In a similar study Dinesh *et al.* (2021) observed age at sexual maturity of 136 days in Dahlem Red, 154 days in native, 160 days in DN and 140 days in Himsamridhi. However, Bhagora *et al.* (2022) observed higher age at sexual maturity of 195.2 days in Kadaknath.

Egg production: Hen housed egg production and hen day egg production at 40 and 52 week of age was higher in native compared to Kadaknath. HHEP and HDEP at 52 weeks of age in native were 60.31 and 85.33, respectively. Whereas corresponding value in Kadaknath were 48.41 and 82.53, respectively. In contrast, Kalita *et al.* (2009) recorded lower egg production of 65.30±1.45 and 62.60±1.56 in indigenous chicken up to 72 weeks of age as in tribal and non-tribal communities of Assam, respectively. The result of present study are consistent with the report of Haunshi *et al.* (2011) who observed egg production of 49.40 in Kadaknath and 36.23 in Aseel at 40 weeks of age. In another study, Haunshi *et al.* (2013) estimated higher egg production (80.31) in Kadaknath at 44 week of age. Yadav *et al.* (2017) demonstrated average age at sexual maturity (181 days), 8 week body weight (542 g in male and 450 g in female), 12 week body weight (885 g in males and 772 g in females), annual egg production (81) and average egg weight (34.3 gram) in Ankaleshwar breed of poultry. The result of current study are in agreement with earlier findings of Dinesh *et al.* (2021) who observed HHEP and HDEP of 79.83 and 84.58 in native chicken at 52 weeks of age, respectively.

Egg quality parameters

External egg quality traits: Means along with standard error for native and Kadaknath eggs are presented in Table 3.

Egg weight: Average weight of native and Kadaknath eggs were 45.33±0.43 g and 43.87±0.75 g, respectively at 40 weeks of age. The result of current study for egg weight in Kadaknath chicken was similar to Jaishankar *et al.* (2020) who observed egg weight of 43.75 g in Kadaknath. In a similar study Rajkumar *et al*. (2014) demonstrated egg weight of 37.08, 38.83 and 47.52 g in Aseel chicken at 32, 40 and 72 weeks of age respectively with overall mean of 41.81 g. However, higher egg weight in Kadaknath than the present study were revealed by Haunshi *et al.* (2011); Valavan *et al.* (2016); Bhagora *et al.* (2022) and Kumar *et al.* (2022). Similarly Ansari *et al.* (2021) observed higher egg weight of 52.80±0.51 g and 53.20±0.92 g in comb and crown ecotypes of Uttara fowl respectively at 40 week of age. Dinesh *et al.* (2021) reported egg weight of 44.95 g in native birds at 40 week of age which is in accordance to present study. In another study, Dinesh *et al.* (2022) estimated higher egg weight of 52.33±1.21 g in Dahlem

Table 3. External egg quality traits of Native and Kadaknath chicken at 40 weeks of age

	Native		Kadaknath	
Trait	Mean±SE	C.V. (%)	Mean±SE	C.V. (%)
Egg weight (g)	45.33±0.43[a]	5.27	43.87±0.75[a]	9.40
Egg length (mm)	54.99±0.45[a]	4.49	53.61±0.59[a]	6.28
Egg width (mm)	41.27±0.43[a]	5.77	40.80±0.47[a]	6.04
Shape index (%)	75.02±0.62[a]	4.50	76.20±0.58[a]	4.15
Shell thickness (mm)	0.36±0.00[a]	7.94	0.34±0.0[a]	7.54

Means bearing same superscript with in rows did not differ significantly (P<0.05).

Red at 40 weeks of age.

Egg length: Mean and standard error estimated for egg length in native and Kadaknath were 54.99±0.45 mm and 53.61±0.59 mm, respectively which is in accordance to earlier estimate (54.37±0.52 mm) of Dinesh *et al.* (2022) in Dahlem Red at 40 week of age. Likewise egg length observed by Rajaravindra *et al.* (2015) at 32, 36 and 40 week of age was 52.39 mm, 54.32 mm and 55.71 mm, respectively in PB-2, a synthetic colored broiler female line. In a similar study Sharma *et al.* (2021) estimated egg length of 53.88 mm and 56.42 mm in DND and Dahlem Red respectively.

Egg width: Average egg width in native and Kadaknath chicken were recorded as 41.27±0.43 mm and 40.80±0.47 mm, respectively. The findings of current study agree with the report of Rajaravindra *et al.* (2015) in PB 2 birds, Sharma *et al.* (2021) and Dinesh *et al.* (2022) in Dahlem Red. However lower egg width was observed by Rath *et al.* (2015) in White Leghorn and Kumar *et al.* (2022) in Kadaknath. Sapkota *et al.* (2020) observed egg width of 40.35±1.48 mm in Sakini chicken breed in Nepal which is comparable to present findings.

Shape index: Shape index is the ratio of egg's width to its length, which is a better indicator of homogeneity in size of the eggs. The more uniform the eggs are, higher the shape index. Average shape index for native and Kadaknath were estimated as 75.02±0.62% and 76.20±0.58%, respectively. The result of present study are consistent with report of Haunshi *et al.* (2013) who observed almost similar value of shape index as 74.03±0.49% and 75.26±0.45% in Aseel and Kadaknath, respectively at 56 week of age. Likewise, Rajaravindra *et al.* (2015) estimated the shape index value as 0.77±0.004, 0.77±0.003 and 0.76±0.004 at 32, 36 and 40 weeks, respectively in PB-2, a synthetic colored broiler female line. In contrast, Dinesh *et al.* (2022) observed lower value of shape index as 74.82±0.64, 74.09±0.55, 73.59±0.69 and 73.0±0.71% at 28, 40, 52 and 64 weeks of age, respectively in Dahlem Red. Similarly lower value of shape index were reported by Jaishankar *et al.* (2020), Bhagora *et al.* (2022), Kumar *et al.* (2022) in Kadaknath. The higher shape index value indicates more homogeneity in the eggs which is necessary for optimum hatchability and healthy chick production. The shape index reported under the study falls within the normal range of 72-76.

Shell thickness: This is an important economic trait that controls the keeping quality of the egg and also its breaking strength. Mean value for shell thickness was recorded as 0.36 mm and 0.34 mm in native and Kadaknath chicken, respectively. Similar results for shell thickness were observed by Padhi *et al.* (2013) in Vanraja male line, Rajaravindra *et al.* (2015) in PB-2, a synthetic colored broiler female line and Dinesh *et al*. (2022) in Dahlem Red. Lower value for shell thickness were reported by Rath *et al.* (2015) in White Leghorn, Kalita *et al.* (2018) in PB-2 × Indigenous × Dahlem Red crossbred chicken and Kumar *et al.* (2020) in Dahlem Red.

Internal egg quality traits

Albumen quality: The internal quality of the egg is significantly influenced by albumen, which makes up about 54% of the total egg weight. (Rajaravindra *et al.* 2015). Different parameters of albumen like length, height, width and index are presented in Table 4.

Albumen length: Albumen length in native and Kadaknath chicken were estimated as 77.82±0.69 and 74.17±0.78 mm, respectively. Albumen length of native eggs was significantly higher (P<0.05) than Kadaknath eggs. Contrary to present study, Dinesh *et al.* (2022) observed lower value of albumen length as 72.50±0.74 mm in Dahlem Red chicken at 40 week of age. However, Kumar *et al.* (2022) observed higher value of albumen length as 83.73±0.71 mm and 82.27±0.62 mm in Aseel and Kadaknath, respectively. Similarly higher value of albumen length (92.97±0.26 mm) was observed by Rath *et al.* (2015) in White Leghorn.

Albumen width: Mean value for albumen width in the present study is significantly (P<0.05) higher in native eggs (65.68±0.64 mm) as compared to Kadaknath (62.16±1.02 mm). In contrast to present study, Dinesh *et al.* (2022) estimated lower value of albumen width (60.85±1.04 mm) in Dahlem red breed at 40 week of age. Kumar *et al.* (2022) observed albumen width as 65.40±0.54 mm and 64.80±0.39 mm in Aseel and Kadaknath birds, respectively which is comparable to present finding. Higher value for albumen width was reported by Rajaravindra *et al.* (2015) in PB-2, a synthetic colored broiler female line and Rath *et al.* (2015) in White Leghorn.

Table 4. Internal Egg quality traits of Native and Kadaknath Chicken at 40 weeks of age

Trait	Native		Kadaknath	
	Mean±SE	C.V. (%)	Mean±SE	C.V. (%)
Albumen length (mm)	77.82±0.69[a]	4.91	74.17±0.78[b]	5.74
Albumen width (mm)	65.68±0.64[a]	5.34	62.16±1.02[b]	9.01
Albumen height (mm)	6.65±0.14[a]	11.56	6.40±0.13[a]	11.01
Albumen index (%)	0.10±0.0[a]	13.77	0.10±0.0[a]	12.39
Yolk height (mm)	18.54±0.21[a]	6.16	17.08±0.21[b]	6.70
Yolk width	40.43±0.34[a]	4.65	40.66±0.34[a]	4.56
Yolk index	0.46±0.00[a]	5.39	0.42±0.0[b]	4.81
Haugh unit score	85.83±0.83[a]	5.34	84.91±0.73[a]	4.71

Means bearing same superscript with in rows did not differ significantly (P<0.05).

Albumen height: Average albumen height in native and Kadaknath was observed as 6.65±0.14 mm and 6.40±0.13 mm, respectively. The result of present study are consistent with report of Sharma *et al.* (2021) who observed albumen height as 6.81±0.23 mm and 6.45±0.17 mm in DND and Dahlem Red, respectively. In contrast, Rajaravindra *et al.* (2015) obtained lower value of albumen height as 5.97±0.12 mm in PB2, a coloured broiler female line at 40 weeks of age. Likewise, Singh *et al.* (2009) observed lower value of albumen height in hill fowl (5.34 mm), Hanusova *et al.* (2015) in Oravka and Rhode Island Red chicken (5.47 and 5.67 mm) and Kumar *et al.* (2022) in Aseel and Kadaknath (6.02±0.16 mm and 5.52±0.18 mm), respectively. However higher value of albumen height (8.41±0.04 mm) than the present study was observed by Rath *et al.* (2015) in White leghorn. Similarly Dinesh *et al.* (2022) observed higher value of albumen height (7.22±0.06 mm) in Dahlem Red at 40 week of age.

Albumen index: The egg white's firmness and viscosity is indicated by albumen index, which is considered as important aspect for determining quality of eggs (Rajaravindra *et al.* 2015). Mean value of albumen index was estimated as 0.10 in native as well as in Kadaknath. Contrary to present finding, higher value of albumen index was observed by Jaishankar *et al.* (2020) and Bhagora *et al.* (2022) in Kadaknath and Dinesh *et al.* (2022) in Dahlem Red. However, lower value of albumen height was obtained by Rajkumar *et al.* (2014) and Kumar *et al.* (2022) in Aseel and Kadaknath, respectively.

Yolk height: Mean value for yolk height in native and Kadaknath eggs differ significantly ($P<0.05$) and averages 18.54±0.21 mm and 17.08±0.21 mm in native and Kadaknath, respectively (Table 4). In contrast to present study, Rajkumar *et al.* (2014) observed lower yolk height in Aseel chicken (14.57 mm) at different ages. Similarly lower value for yolk height were observed by Sapkota *et al.* (2020) in Sakini chicken and Kumar *et al.* (2022) in Aseel and Kadaknath. The result of present study are in agreement with report of Dinesh *et al.* (2022) who observed yolk height as 18.97±0.19 mm in Dahlem Red at 40 weeks of age.

Yolk width: Average value for yolk width in native and Kadaknath chicken was observed as 40.43±0.34 mm and 40.66±0.34 mm, respectively (Table 4). The result of current study were similar to those of Rajkumar *et al.* (2014) in Aseel chicken and Dinesh *et al.* (2022) in Dahlem Red. In contrast, Kumar *et al.* (2022) revealed lower value of yolk width (40.66±0.34 mm) in Kadaknath eggs.

Yolk index: There is significant variation ($P<0.05$) in yolk index in native and Kadaknath eggs and averages 0.46 and 0.42 in native and Kadaknath, respectively (Table 4). Yolk index value of 0.41, 0.37, 0.43, 0.39 and 0.35 was observed by Padhi *et al.* (2013) at 28, 40, 52, 64 and 72 weeks of age, respectively in Vanraja male line (PD 1). In a similar study, Rajkumar *et al.* (2014) in Aseel, Rajaravindra *et al.* (2015) in PB2, a coloured broiler female line and Kumar *et al.* (2022) in Aseel and Kadaknath reported lower value of yolk index. However higher value of yolk height was observed by Jaishankar *et al.* (2020) in Kadaknath and Dinesh *et al.* (2022) in Dahlem Red.

Haugh unit index: It is one of the important criterion for determining the internal quality of the egg. The most commonly used indicator of albumen quality is the Haugh unit, which describes the relationship between the height of the thick white and the weight of the egg. Thus, better the internal egg quality, better the albumen quality and better the Haugh unit. The average Haugh unit score in native and Kadaknath chicken was 85.83±0.83 and 82.03±2.90, respectively and indicates better internal egg quality (Table 4). The result obtained in current study for Haugh unit agree with Sharma *et al.* (2021) who observed Haugh unit of 84.08±1.53 in DND chicken. However, lower value of Haugh unit were reported by Yakubu *et al.* (2008) in naked neck and normal feathered Nigerian indigenous chicken; Hanusova *et al.* (2015) in Oravka and Rhode Island Red; Kalita *et al.* (2018) in PB-2×Indigenous×Dahlem Red crossbred chicken; Ansari *et al.* (2021) in comb and crown ecotype of Uttara fowl; Jayanaik *et al.* (2021) in indigenous chicken and Kumar *et al.* (2022) in Aseel and Kadaknath. In contrast, higher value of Haugh unit was observed by Padhi *et al.* (2014) in 3 way cross chicken and Dinesh *et al.* (2022) in Dahlem Red. The variable HU scores may be due to different albumen quality in various chicken breeds/ stocks.

Farmers' appraisal for rearing native and Kadaknath birds: Field survey suggested that relatives and friends formed important source of information for both native and Kadaknath chicken (Table 5). These two sources also formed major source of procurement for both types of birds. Focused group discussions revealed availability of Kadaknath birds was a major constraint faced by farmers. The cost of procurement of Kadaknath chicks from private dealer was at exorbitant price of ₹90-100. Though few farmers reported procurement of chicks from relatives and friends at lower prices (₹40-50). However, the supply from these informal sources was very limited. On the other hand availability of native bird was easier and at lesser price.

At the time of data collection, almost all the farmers had average flock size of less than 15 and Kadaknath rearing was adopted as backyard poultry farming. Socio psychological factors had played predominant role in diffusion of this technology (Kadaknath birds) in the social system of the region as majority of farmers reared the birds either as hobby or for personal consumption and social prestige. Similar factors were observed for rearing of native birds.

Data on selling prices revealed that the average selling price for both eggs and birds of Kadaknath were comparable to native birds in rural areas and no major difference was observed. On the other side the prices fetched from eggs and birds of Kadaknath were higher than native in urban areas. This points out the fact that owing to rural nature of rearing and selling farmers did not find rearing Kadaknath lucrative so the activity was restricted to minimal birds(<15).

Table 5. Farmers perspective towards rearing of Native and Kadaknath chicken (N=50)

Parameter	Native	Kadaknath
Source of information		
Relatives	24(48.0%)	27 (54.0%)
Friends	18 (36.0%)	19 (38.0%)
YouTube	0	1 (2.0%)
Institutional source	8 (16.0%)	3 (6.0)
Source of procurement		
Friends/relatives	50 (100.0%)	44 (88.0%)
Private input dealer	0	4 (8.0%)
Department of animal husbandry	0	2 (4.0%)
Reasons for purchase		
For hobby and personal consumption	35(70.0%)	21 (42.0%)
Popularity	2 (4.0%)	12 (24.0%)
Profit earning	10 (20.0%)	9 (18.0%)
Social prestige	3(6.0%)	8 (16.0%)
Procurement price		
Chicks	20	95-100
Adult bird	500	600
Average selling price (rural areas)		
Eggs	12	15
Live birds	650	700
Average selling price (urban areas)		
Eggs	15	25
Live birds	700	900

Based on comparative performance, it can be concluded that native birds had better performance than Kadaknath. Body weight of native and Kadaknath birds differ significantly at different age of measurements. Age at sexual maturity was found less in native birds in comparison to Kadaknath. HHEP and HDEP at different periods was observed higher in native birds than Kadaknath. External egg quality traits did not differ significantly in native and Kadaknath eggs. However, internal egg quality traits indicates that albumen length, albumen width, yolk height and yolk index is significantly higher in native birds than Kadaknath birds. As per the findings in the present investigation the performance of Kadaknath birds is not better than native birds under sub-temperate conditions. Appraisal of field survey is suggestive that rural rearing and marketing practices has led to sub-optimal commercial gain from rearing Kadaknath birds. High cost of initial procurement of chicks offsets the higher price associated with Kadaknath meat under field situations of the region. Lower benefit realization has restricted Kadaknath rearing to few birds (10-15 birds). Most of the farmers which have Kadaknath hens do have desi birds which shares major farm income. This activity serves mainly socio-psychological needs where birds have been reared for social prestige, pastime and personal consumption.

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