Assessment of Egg quality and Economic Traits of Kadaknath Chicken under Deep Litter System

Asma Khan[1], Anmol Pareek[2], Biswajit Brahma[3] and Dipanjali Konwar[3]*
[1]Professor and Head, Division of LPM, SKUAST-Jammu (J&K), India.
[2]M.V.Sc Scholar, Division of LPM, SKUAST-Jammu (J&K), India.
[3]Professor, Division of LPM, SKUAST-Jammu (J&K), India.

(Corresponding author: Anmol Pareek)*

ABSTRACT: The present study was conducted to analyze internal and external egg quality traits as well as economic traits of Kadaknath chicken at Jammu. The birds were reared in a deep litter system upto 62 weeks of age. The body weight, shank length, middle toe length, and radius length were measured sex wise at different ages. The internal egg qualities were measured at 28, 32, 40, 52 and 62 week of age. Body weight at 52 weeks of age was 1.69±0.13 kg in male and 1.34±0.02 kg in female. The shank length, radius length and middle toe length in males and females were 95.40±0.24 mm, 91.19±0.23 mm, 54.84±0.13 and75.01±0.11mm, 69.16±0.08 mm, 46.50±0.06 mm respectively. The egg weight of Kadaknath at 28 week age was 39.43±0.46 gm and at 62 week age was 46.93±1.30 gm. The albumen index was maximum 0.11±0.004 at 32 week age while minimum 0.079±0.009 at 52 week age. The yolk index was minimum 0.39±0.005 at 52 week of age and maximum 0.41±0.005 at 28 week of age. The shell thickness of Kadaknath egg was ranging from 0.34±0.01 mm to 0.41±0.01 mm. The shell % was ranging from 11.60±1.08 to 13.29±0.43. The yolk to albumen ratio was minimum 0.49±0.03 at 28 week of age and maximum 0.75±0.04 at 62 week of age.

Keywords: Kadaknath, Internal Egg Quality, External Egg Quality, Economic trait.

INTRODUCTION

The Indian poultry sector has shifted from small backyard businesses to major commercial agricultural activity in the last forty years. According to the volume of operations and level of biosecurity, the FAO divided chicken production systems into four categories: village or backyard production, commercial production with low biosecurity, large-scale commercial with high biosecurity, and industrial and integrated production systems. Since the majority of commercial poultry production is still centered in urban and peri-urban regions, village or backyard poultry farming can be effectively encouraged in rural areas (Chatterjee and Rajkumar 2015). There are nineteen recognized breeds of poultry in India that are reared in backyard by farmers. Kadaknath is an indigenous fowl breed native of Dhar and Jhabua districts of Madhya Pradesh. Kadaknath is famous for its unique black colour of skin and muscles hence known as "Kalamasi". Tribals use kadaknath blood for the treatment of chronic diseases and its meat has aphrodisiac and medicinal properties (NBAGR, Pathak *et al*., 2015). Kadaknath meat is abundant in the bioactive dipeptide carnosine and a rich source of anserine and creatine. Meat of Kadaknath chicken can be used in diet to promote human growth and health (Sharma *et al*., 2022). Despite such unique characters of kadaknath, this breed is neglected due to its low production potential (Haunshi *et al.,* 2011). According to FAO (2015), the global demand for

livestock products is expected to double by 2050 due to the improved standard of living and the rising population. Egg is an important product obtained from poultry and contains any vital nutrients, hence popular over the globe. Consumer acceptability of a variety of parameters, such as cleanliness, freshness, surface area, mass, volume, packaging coefficient, egg weight, yolk index, shell quality, yolk, albumen index, Haugh unit, and chemical composition determines egg quality (Narushin, 1997). The profitability of backyard chicken raising depends on the quality of the eggs produced and monitoring egg quality standards, which is essential for maintaining high-quality egg production (Sreenivas *et al*., 2013). Egg quality is the price deciding factor for table as well hatching eggs. Therefore, the successful economics of laying flock depend on the production of quality eggs. The egg quality can be affected by the rearing method, temperature, season and relative humidity (Parmar *et al*., 2006). The current study was conducted to evaluate the egg quality and economic traits of kadaknath birds at different age under deep litter system in Jammu region.

MATERIAL AND METHODS

A. Experimental Location, Birds and Management
A total 134 female and 50 male kadaknath birds were reared in the deep litter system of intensive housing system at Experimental poultry shed, Division of Livestock Production Management, F.V.Sc & AH,

SKUAST-Jammu. The research was conducted according to guidelines declared by the Institutional animal care and use committee. The brooded chicks at the age of 30 days were procured from the hatchery. All the birds were kept under similar conditions during the growing phase. The average minimum and maximum temperature were 9.6°C and 42.3°C during experimental period and minimum and maximum RH% were 16.5 and 97.8. The meteorological data was obtained by a weather data logger (Testo sevris). 24 week old female birds were fed with 100 grams of layer ration formulated according to calculated basis (ME = 2600 Kcal/Kg and CP% = 16). The ration was formulated using maize, soyabean meal, meat blood meal, broken rice, limestone powder, methionine, lysine, vitamin supplements, trace minerals, salt and sodium bicarbonate. Sixteen hours of light was provided to female birds during laying phase. The diet for male birds was composed with same ingredients but level of calcium was maintained at 1%.

B. Egg Quality Traits
A total of 300 freshly laid eggs (60 eggs at a particular age) were used to determine external and internal quality at 28, 32, 40, 52 and 62 weeks of age. Shape index, egg weight was measured under external egg quality and albumen index, yolk index, albumen%, yolk%, shell%, yolk to albumen ratio and shell thickness were recorded under internal egg quality. The egg weight, shell weight and yolk weight were measured using a digital electronic weighing balance, length, width of albumen and yolk were measured using vernier caliper (least count = 0.1mm). Height of albumen and yolk were measured by spherometer (least count = 0.01 mm).The Shape Index was measured by determining the ratio of maximum width and maximum length and multiplied by 100. Shell weight was measured after removing internal shell membrane. Shell thickness was measured by screw gauge (least count = 0.01mm) after removing internal shell membrane, average thickness from the broad end, narrow end and middle portion was taken and average of three reading was considered as final thickness. Albumen index was calculated as ratio of average albumen height to average albumen length multiplied by 100. Yolk index was measured as the ratio of average height of the yolk to average length of the yolk multiplied to 100. Albumen % was determined as the ratio of albumen weight to weight of egg and multiply by 100. Yolk and shell % were determined by ratio of respective weight to egg weight multiply 100. Yolk to albumen ratio was determined as ratio of weight of yolk to weight of albumen. Egg weight, shell weight and yolk weight were determined individually and albumen weight was calculated by adding shell and yolk weights and subtracting from egg weight.

C. Economical Trait
The body weight of male and female individual birds was measured using an electronic weighing balance (accuracy 0.1 gm) at ages 24,28,40 and 52 weeks of age. Shank, radius and middle toe length were

separately measured in males and females at 40 weeks of age using a vernier caliper.

D. Economics and Cost benefit ratio
Economics of kadaknath rearing was estimated to find cost benefit ratio of layers and male as described by Belewu *et al*. (2018). Total 4 female birds died during the experimental period.

E. Statistical Analysis
Statistical analysis was done using SPSS software.

RESULTS AND DISCUSSION

Egg Quality Traits. The mean egg weight, external egg quality and internal egg quality traits are given in Table 1.
Egg weight. The mean egg weight was 39.43±0.46 gram at 28 week of age, 41.68±0.24 gram at 32 week age and 42.79±0.32 gram at 40 week age which were higher than reported by Haunshi *et al*. (2011) and lower than reported by Bhagora *et al*. (2022), the egg weight at 40 week age lies in the range described by Haunshi *et al*. (2021) who reported 41.39 to 43.2 gram egg weight at 40 week of age. Haunshi *et al*. (2013) reported 44.06 gram egg at 56 week of age. Higher egg weight *viz.*, 43.87 and 44.20 gm at 40 week age in kadaknath birds was reported respectively by Dinesh *et al*. (2024); Mishra *et al*. (2024). Average egg weight of 45.55 gm was reported by Sangilimadan *et al*. (2024) at age of 46 weeks.
Shape Index. The shape index at 28, 32 and 40 week age was 76.41±0.67, 76.60±0.70 and 75.89±0.9 respectively, the lower shape index was reported by Bhagora *et al*. (2022) (67.44) at 40 week of age and higher shape index was reported by Haunshi *et al*. (2011) (76.39). Similar shape index was reported by Dinesh *et al*. (2024) in kadaknath birds at the age of 40 weeks and Sangilimadan *et al*. (2024) (76.04) at 46 week age. The shape index reported by Haunshi *et al*. (2013) at 56 week age is 75.26 which was similar to 52 week shape index in present study. Parmar *et al*. (2006) discovered shape index of kadaknath egg as 73.95% while Jaishankar *et al*. (2020) observed the shape index in Kadaknath breed was 73.64%, the similar shape index was found in current study at 62 week age.
Albumen Index. The albumen index at 28 week age was 0.94±0.006 and at 32 week age was 0.11±0.004. At 40 week age albumen index was 0.082±0.008 which was similar to findings of Kumar *et al*. (2022) (0.085), higher than reported by Haunshi *et al*. (2011) (0.072) and lower than findings of Bhagora *et al*. (2022) (0.12); Dinesh *et al*. (2024) (0.10). The results of study conducted by Sangilimadan *et al*. (2024) reported albumen index as 0.128 at 46 weeks of age in kadaknath birds which was higher than the findings of present study.
Yolk Index. The yolk index was least at 52 week age that was 0.38±0.009 and highest at 28 week that was 0.41±0.005, Kumar *et al*. (2022) reported lower yolk index (0.36) in kadaknath reared in backyard system while Haunshi *et al*. (2011); Bhagora *et al*. (2022) reported higher yolk index at 40 week age that was 0.44 and 0.54 respectively. Higher yolk index (0.42) was

reported by Dinesh *et al.* (2024) at 40 week of age in kadaknath birds. Sangilimadan *et al.* (2024) reported higher yolk index (0.51) at 46 week of age in kadaknath birds. Haunshi *et al.* (2013) reported yolk index as 0.44 at 56 week of age and similar results were given by Jaishankar *et al.* (2020).

Albumen %. The albumen % was maximum at 28 week age (58.23±1.43) and minimum at 62 week age (49.43±1.68). In present study the Albumen % decreased according to age while yolk % increased according to age. The albumen % was 55.94 at 40 week age reported by Haunshi *et al.* (2011) while Jaishankar *et al.* (2020) reported albumen % was 52.37. Sangilimadan *et al.* (2024) reported lower albumen % (54.59) at 46 week of age in kadaknath birds.

Yolk %. The yolk % was minimum at 28 week of age that was 28.57±0.95 and maximum at 62 week of age that was 37.21±1.57. Similar yolk % (30.22) at 40 week age was reported by Haunshi *et al.* (2011) while Jaishankar *et al.* (2020) reported yolk % was 33.80. Higher yolk % was observed by Sangilimadan *et al.* (2024) at 46 week of age in kadaknath birds

Shell %. The shell % was ranging from 11.60±1.08 to 13.29±0.43 which was lower than reported by Jaishankar *et al.* (2020) (13.83). Kumar *et al.* (2022) reported shell % of 10.61 under field conditions while the shell thickness reported by Haunshi *et al.* (2011) was 10.47 at 40 week of age which was lower than present finding (11.60). Sangilimadan *et al.* (2024) reported shell % as 12.40 at 46 week of age in kadaknath egg.

Shell thickness. The shell thickness was ranging from 0.34±0.01mm to 0.41±0.01mm. The maximum shell thickness was at 28 week age (0.41) and minimum shell thickness was at 52 week age (0.34). The shell thickness of Kadaknath egg was reported as 0.34 mm (Kumar *et al.*, 2022), 0.36 mm (Bhagora *et al.*, 2022; Jaishankar *et al.*, 2020) and 0.31 mm (Biswas *et al.*,

2010). Similar shell thickness of kadaknath egg was reported by Dinesh *et al.* (2024) at 40 week of age and Sangilimadan *et al.* (2024) at 46 week of age.

Yolk to albumen ratio. The yolk to albumen ratio was increasing according to age because yolk % was increasing and albumen% was decreasing as the age was increasing. The reported Yolk to albumen ratio by Haunshi *et al.* (2011) was 0.51±007 at 40 week of age which is lower than current finding which is 0.55±0.02.

Albumen weight. The albumen weight at 28, 32 and 40 week age was 23±0.91 gram, 23.46±0.45 gram and 24.4±0.70 gram respectively. The similar albumen weight was observed by Bhagora *et al.* (2022) at 40 week of age (23.99 gm) and higher albumen weight was observed by Haunshi *et al.* (2011) (26.29 gm). The albumen weight at 52 week was 25.78±0.89 which is similar as reported by Haunshi *et al.* (2013) at 56 week age (25.84) and albumen weight at 62 week age was 23.8±1.09.

Yolk weight. The yolk weight at 40 week age was 13.67±0.45 gram which is similar to yolk weight reported by Bhagora *et al.* (2022) (13.2 gm) and higher than reported by Haunshi *et al.* (2011) (12.49 gm). The yolk weight was maximum at 62 week age (18±1.03 gram) and minimum at 28 week age (11.2±0.38 gram).

Shell weight. The shell weight at 28 week age was 5.13±0.29 gram, at 40 week shell weight was 5.47±0.36 gram similar compared to Bhagora *et al.* (2022) and higher than Haunshi *et al.* (2011). The shell weight was 4.8±0.26 gram at 32 week age and maximum at 62 week at age (6.4±0.27 gram). However, there is limited detail research data is available on egg quality traits of Kadaknath at different age, geographical areas and different production systems but through this research an attempt is made to evaluate egg quality trait of kadaknath breed throughout the laying cycle in Jammu region.

Table 1: Egg quality traits of kadaknath birds at 28, 32, 40, 52 and 62 week of age (Mean±SE).

	28 week	32 week	40 week	52 week	62 week
Average egg weight(gram)	39.43±0.46	41.68±0.24	42.79±0.32	45.82±0.63	46.93±1.3
Shape Index(%)	76.41±0.67	76.60±0.70	75.89±0.91	75.42±1.42	73.74±0.95
Albumen Index	0.094±0.006	0.11±0.004	0.082±0.008	0.079±0.009	0.081±0.003
Yolk Index	0.41±0.005	0.39±0.005	0.40±0.008	0.38±0.009	0.39±0.007
Albumen%	58.23±1.43	57.18±0.77	56.25±1.05	55.93±0.99	49.43±1.68
Yolk%	28.57±0.95	31.16±0.58	30.5±0.78	31.67±1.19	37.21±1.57
Shell%	12.71±0.76	11.72±0.57	11.60±1.08	12.94±1.24	13.29±0.43
Yolk to Albumen Ratio	0.49±0.03	0.54±0.01	0.55±0.02	0.56±0.02	0.75±0.04
Shell thickness(mm)	0.41±0.01	0.35±0.01	0.36±0.01	0.34±0.01	0.38±0.01
Albumen weight (gm)	23±0.91	23.46±0.45	24.4±0.70	25.78±0.89	23.8±1.09
Yolk weight (gm)	11.2±0.38	12.8±0.32	13.67±0.45	14.67±0.47	18±1.03
Shell weight (gm)	5.13±0.29	4.8±0.26	5.46±0.36	5.78±0.52	6.4±0.27

Economic Traits. The mean of sex wise body weight at different age and shank length, radius length and middle toe length at 40 week age are provided in Table 2. The mean body weight was higher at 24 week of age and lower at 40 week of age in present study when compared with Haunshi *et al.* (2011) who reported 1.23 ± 0.39 kg body weight in male and 0.93 ± 0.21 kg body weight in female at 24 week and 1.73 ± 0.30 kg in male

and 1.32 ± 0.18 kg in female at 40 week of age. Higher body weight 1.41 kg in kadaknath female birds was reported by Dinesh *et al.* (2024) in a study conducted at CSKHPKV, Poultry Farm, Palampur, Himachal Pradesh, India. Similar body weight in kadaknath females was observed by Mishra *et al.* (2024) (1.26 kg). The 28 week body weight in male was 1.50±0.02 kg and 1.21±0.01 kg in female while Bhagora *et al.* (2022)

reported higher body weight at 28 week (1.37 kg) and 40 week (1.52 kg) age in females. The body weight at 52 week age was 1.69±0.13 kg in male and 1.34±0.02 kg in female in current study while Mohan *et al*. (2008) reported 1.55 ± 0.21 kg at 52 week of age, however sex wise body weight was not specified. The shank length at 40 week age was 95.40±0.24 mm in male and 75.01±0.11mm in female, radius length was 91.19±0.23 mm in male and 69.16±0.08mm in female, and middle toe length was 54.84±0.13 mm in male and 46.50±0.06 mm in female. The more shank length at same age in both sexes and less radius and middle toe length in both sexes was reported by Haunshi *et al*. (2011). The possible cause of contrary data between present study and Haunshi *et al*. (2011) might be that birds were kept in individual cages after sexual maturity in later study while in present study birds are reared in deep litter system throughout the experiment.

Economics and Cost benefit ratio. In present study the cost benefit ratio is 0.21 which was similar as obtained by Okedere *et al*. (2020) in Isa Brown layers reared on three different management systems. Economics and cost benefit ratio is calculated in table 3. It is advisable to sell male birds between age of 24 to 28 weeks to gain optimum benefit. Mishra *et al*. (2024) stated that for kadaknath, the gross income, net income and benefit cost ratio were, respectively, Rs. 1888.80±1.49, Rs. 1619.34±1.48, and 7.00.It was also noted that Kadaknath outperformed the indigenous breed in terms of economic criteria Ranabijuli *et al*. (2020) ; Shinde *et al*. (2023).

Table 2: Measured economic traits of kadaknath birds (Mean±SE).

	Male	Female
24 week body weight(Kg)	1.47 ±0.02	1.17 ±0.01
28 week body weight(Kg)	1.50±0.02	1.21±0.01
40 week body weight(Kg)	1.65±0.02	1.22±0.01
52 week body weight(Kg)	1.69±0.13	1.34±0.02
40 week Shank length (right+left)/2 (mm)	95.40±0.24	75.01±0.11
40 week Radius length (right+left)/2 (mm)	91.19±0.23	69.16±0.08
40 week Middle toe length (right+left)/2 (mm)	54.84±0.13	46.50±0.06

Table 3: Economics of rearing Kadaknath birds under deep litter system.

Cost of 184 brooded Kadaknath chicks @ 100rs/chick	18400/-
Cost of rearing of birds from day 30 to 168 (24 weeks) Grower Ration (Day30 to day 126) 70 gm per bird @ Rs. 30/Kg Finisher Ration (Last 42 days) 100 gm per bird @ Rs. 32/Kg	37094/- 24730/-
Cost of rearing females from 24 to 62 weeks age 100 gm feed/bird/day @ 34 Rs/kg	1,20,280/-
Cost of medicine, feed supplements etc @ 50 Rs/bird	184 x 50 = 9200/-
Mortality	2.17%
A. Total expenses/Cost of production	**2, 09,704/-**
Income from sale of 6 month male birds weighing 1.5 Kg @ 500 Rs/bird	50 x 500= 25000/-
Number of egg produced during 24 – 62 week age	19082
Income from sale of eggs @ 12 Rs/egg	2,28,984/-
Income from sale of spent hen after 62 week age @100 Rs/hen	130 x 100= 13,000/-
B. Gross income	**2,67,384/-**
Net Income (B-A)	57,680/-
Profit/bird	313.47/-
Cost Benefit ratio	0.215

CONCLUSIONS

In conclusion it can be said that Kadaknath breed is suitable for rearing in Jammu region and can help to generate additional family income for poor and marginal farmers if reared in intensive system (deep litter system). Since there is very limited research carried out on Kadaknath, it leaves a vast scope to explore the production potential in different terrains and production systems.

FUTURE SCOPE

Kadaknath is an indigenous breed of poultry with several medicinal properties in its meat, blood and eggs. This breed is native to the Dhar and Jhabua districts of Madhya Pradesh. Rearing of kadaknath bird is growing day by day because of its quality. This breed should be reared in different terrains of India under different production systems and evaluated for its performance and quality so that it can serve mankind in India through its benefits.

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