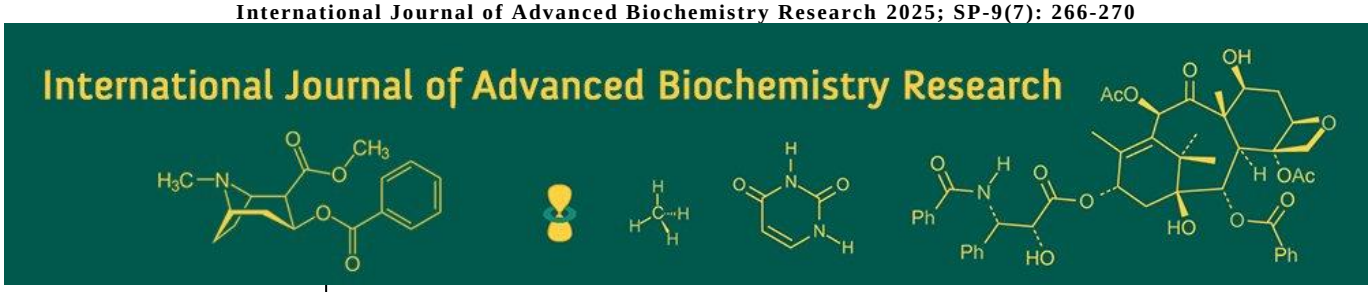

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2025; SP-9(7): 266-270
www.biochemjournal.com
Received: 19-04-2025
Accepted: 22-05-2025

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Characterisation and potential of the Khukhri poultry breed of Jharkhand in rural farming systems

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7Sd.4810

Abstract
The present study was conducted to characterize the Khukhri chicken reared under backyard system in three districts of Chotanagpur plateau of Jharkhand. Data on phenotypic and body measurements were recorded of 540 adult chickens; 180 male and 360 females drawn from 270 households. The overall flock size differed significantly ($p \leq 0.01$) in the study area. In males, mixed and red plumage were the dominant phenotypic traits. However, female chickens were characterized by brown plumage. The predominant shank colour was yellow. The colour of ear lobe and comb were red and skin was white in all the birds. The predominant comb type was single followed by pea and rose. The present study has developed the baseline data of indigenous chickens for recognition as a distinct breed in future. The overall value of age of first egg laying, clutch size, clutch interval, number of clutches per cycle, number of eggs per cycle, cycle per year, pause period and annual egg production was 216.51±0.9, 5.16±0.6, 1.311±0.001, 2.64±0.026, 13.16±0.107, 3.32±0.025, 107.6±0.423 and 43.39±0.395. The overall mean percent hatchability on total egg set basis recorded was 76.11±0.432. The overall average body weight of male and female chicken was 1552.18±27.46 and 1182.04±14.30 g, respectively in Chotanagpur plateau of Jharkhand. The body weight of males was observed to be significantly ($p<0.05$) heavier than females. The overall average shank length of adult male and female was found to be 9.85±0.08 and 8.73±0.05 cm respectively.

Keywords: Characterisation, Khukhri, poultry, rural farming systems

Introduction
The Khukhri, an indigenous poultry breed native to the Chota Nagpur Plateau region of Jharkhand, India, represents a vital genetic resource within rural and backyard poultry farming systems. It is famous for its hardiness and resilience, this breed has successfully adapted to the region's challenging environmental conditions—characterised by low temperatures, undulating terrain, and limited access to commercial poultry management practices. Despite its socio-economic importance and potential for sustainable poultry development, scientific data on the Khukhri's growth performance, production traits, and reproductive efficiency remain scarce. Indigenous breeds such as Khukhri typically offer several advantages over commercial strains, including superior adaptability to local environments, enhanced disease resistance, and lower input requirements—making them particularly valuable for smallholder and resource-poor farmers. However, the absence of systematic performance evaluation and targeted research has hindered the optimal utilisation and integration of this breed into structured breeding and conservation programmes. There is an urgent need to collect and analyse comprehensive data on the breed's morphological, productive, and reproductive parameters to support its sustainable management. The present study has been panned to characterise the morphological features, production attributes, and economic traits of the Khukhri breed. Understanding these traits is crucial for designing sound breeding strategies, improving productivity, and enhancing the economic viability of indigenous poultry farming in the region.

Materials and Methods
The study was conducted on 540 adult native chickens, including 180 male and 360 female were studied randomly from three districts of Chotanagpur plateau of Jharkhand. Total 270 households were randomly selected.

Male and female adult chicken were sampled in the ratio of 1:2 for the measurement of qualitative traits. Total 540 adult native chickens, including 180 male and 360 female were studied randomly from three districts of Chotanagpur plateau of Jharkhand.

Results and Discussion

General features of the Khukhri

The Khukhri is characterised by a number of distinct morphological and physiological features that contribute to its resilience and adaptability in harsh environmental conditions. These features are reflective of its natural selection for survival in agroclimatic conditions of Jharkhand.

Body Conformation

The Khukhri exhibits a medium body size with well-developed musculature, particularly in males, which are often larger than females. The birds typically have a broad chest, robust legs, and a well-balanced, upright posture. The body structure is suited for foraging and navigating rugged terrains, which is a common characteristic of indigenous poultry breeds. Population is unique with uniform appearance, production and reproduction parameters and exist in large number in field.

Feather Coloration

Plumage colour pattern was observed to be mostly mix in colour. The plumage provides effective insulation against the harsh climate, typical of the region, offering both thermal and cold protections.

Adaptation to Climate

One of the most notable characteristics of the Khukhri is its high degree of adaptability to extreme weather conditions. These birds are well suited for hot and harsh climates, where they can withstand high and low temperatures and fluctuating environmental conditions. This adaptation is supported by their dense feathers, which help conserve body heat (M. K. Singh *et al.* 2017) [20].

Hardiness and Disease Resistance

This breed is also known for its ability to forage for food, reducing its dependency on commercial feed (Patel *et al.* 2023) [16]. The Khukhri is known for its inherent hardiness and resistance to common poultry diseases. This trait is essential for survival in rural and backyard farming systems where veterinary care and vaccination programmes may be limited.

Reproductive Traits

The reproductive traits of the Khukhri include moderate fertility and hatchability rates. Males are generally active breeders, and females lay eggs with good hatchability under natural conditions. The birds are known to exhibit maternal instincts, with hens demonstrating effective broodiness and care for their young (M. K. Singh *et al.* 2018) [21].

Production Performance

The Khukhri is primarily raised for its meat and eggs. While it may not reach the rapid growth rates or high production levels of commercial poultry breeds, it is valued for its lean meat and flavourful eggs, which are often preferred in local markets due to their quality.

Behavioral Traits

The Khukhri exhibits behaviours that reflect its adaptability to free-range systems. They are known for their agility, foraging ability, and strong homing instincts. The breed is also typically more docile compared to other indigenous breeds, making it easier to manage in backyard farming systems.

These general features of the Khukhri contribute to its sustainability and economic importance in rural areas. Its resilience, adaptability, and low-input requirements make it an invaluable asset for smallholder farmers seeking to maintain a diverse and self-sustaining agricultural system.

Morphological features of the Khukhri

Plumage color

The overall value regarding predominant plumage colour of cocks were red (32.78%) followed by mix (27.22%) and black and white (12.78%) with lesser frequencies of brown (11.11%), white (9.44%) and black (6.67%). Among hens, the predominant plumage colour was brown (52.78%) followed by black (19.44%) and white (12.22%) with lesser frequencies of black and white (8.61%), red (3.89%) and mix (3.06%).Predominance of mixed colour over any plumage colour was in accordance to the findings of Tantia *et al.* (2005) [24] in Kashmir Faverolla birds, Iqbal and Pampori (2008) [8] in native chicken of Kashmir. The hens of Chotanagpur plateau of Jharkhand generally had brown or dark brown feathers on neck, wings and back and black feathers on tail. Similar to this Vij *et al.* (2008) [27] observed brown feathers on neck, breast and wings of Tellicherry birds. Negassa *et al.* (2014) also reported brown back feathers in native hens of three agro ecological zones of Southeastern Oromia Regional State of Ethiopia.

Shank colour

The overall value of shank colour of native chickens of Chotanagpur plateau of Jharkhand showed predominant yellow in cocks (97.78%) and in hen (85.56%) followed by slaty-black in cocks (2.22%) and in hen (14.44%).

The predominant yellow colour corresponds with the native chicken of Kashmir (Iqbal and Pampori, 2008) [8], Tripura Brown (Malik *et al*, 2013) [13], Kaunayen birds (Vij *et al.*, 2016) [25]. The predominant yellow colour shank followed by slaty black was in agreement with Harikrishnan *et al.* (2019) [6] in native chicken of Kerala. The yellow coloration of shank is might be due to presence of carotenoid in scavenging feed materials.

Ear lobe and skin colour

All the birds of study area had red ear lobe and white skin in either sex. This result was in agreement with the findings of Gopinath (2013) [5]. Predominant red ear lobe was also observed by Churchil *et al.* (2019) [4] in Assel male, and Sethi (2016) [19] in Hazra chicken of Odissa. In contrast white ear lobe was reported by Banerjee (2012) [1] in native chickens of West Bengal and Sikkim and Harikrishnan *et al.* (2019) [6] in native chicken of Kerala.

Predominant white skin colour was also reported by Iqbal and Pampori (2008) [8] in native chicken of Kashmir, Banerjee *et al.* (2012) [1] in native chicken of West Bengal and Sikkim Vij *et al.* (2016) [25] in Kaunayen bird.

Comb colour and type

The colour of comb in both male and female were red (100%) in all the districts of study area. Similar finding was also reported by Gopinath (2013) [5], Malik *et al.* (2013) [13], Malik and Singh (2013) [13], Sethi (2016) [19] and Vij *et al.* (2016) [25]. Results showed that single comb was predominant followed by pea and rose in both the sexes. This pattern was in agreement with the observations of Lalhlimpunia *et al.* (2021a) [12]. The commonest comb type was single which was in accordance with the findings of Gopinath (2013) [5]. In contrast to the present findings predominant pea comb type was reported by Vij *et al.* (2008) [27], Laenoi *et al.* (2015) [11], Sethi (2016) [19] and Churchil *et al.* (2019) [4]. The variations in morphological character in different genotypes pertaining to different regions are supportive of natural adaptation to local environment. Phenotypic variation of indigenous chicken resource provides opportunity for selection and improvement of local chicken populations.

Body weight

The average body weight of adult males and females was 1552.18±27.46 and 1182.04±14.307 g, respectively, which was in accordance with the findings of Banja *et al.* (2017) [2]. However, higher body weight than the present study was observed by Nayak *et al.* (2020) [15] and Lalhlimpunia *et al.* (2021) [12]. Body weight of male chicken was observed to be significantly higher than females. This was in agreement with the reports of Mishra *et al.* (2019) [14] and Lalhlimpunia *et al.* (2021b) [12]. The study further revealed that the native chickens of Chotanagpur plateau of Jharkhand had not undergone appreciable gene mixing with the exotic breeds, otherwise their body weight could have been high. Sexual dimorphism with respect to body weight was also expected due to differential growth rates of the males and females.

Shank length

The overall average shank length of adult male and female was found to be 9.85±0.08 and 8.73±0.05 cm respectively, which was comparable to those reported in indigenous chicken of Mizoram (Haunshi and Doley, 2011) [7] and in indigenous chicken Zoar female of Mizoram (Lalhlimpunia *et al.*, 2021b) [12]. On the other hand, longer shank length was reported by Haunshi *et al.* (2011) [7] in Assel bird. The variation in present findings may be due to difference in genetic factors, type of birds and other environmental factors.

Correlation between body weight and shank length

In the present study, positive correlation (0.665) between body weight and shank length was observed which was higher than the findings of Tadele *et al.* (2018) [23]. High correlation between body weight and shank length was observed by Pragnya *et al.* (2021) [17]. So, the results suggested that the selection of birds on the basis of shank length will cause direct improvement in body weight.

Body size and structure

The mean value of body weight and shank length was recorded. Body weight and shank lengthof males were significantly (p<0.05) greater than females (Table 1). This was in agreement with the reports of Mishra *et al.* (2019) [14].

Head and Beak

The head of the Khukhri is medium-sized, with a well-structured comb that is typically single and upright, although variations in comb size and shape may occur. The comb is a bright red, which enhances its visual appeal and is associated with reproductive health. The beak is medium-sized, slightly curved, and strong, capable of efficiently foraging for food in a range of habitats. The wattles are well developed and red, contributing to the bird's overall appearance.

Legs and feet

The legs of the Khukhri are robust and muscular, providing the bird with strength and agility to traverse rocky and uneven landscapes. The feet are relatively large, with four toes on each foot, adapted for foraging and scratching. The shanks are of high-length, covered with sparse feathers, and are usually of a yellow colour. The strong legs and feet allow the birds to perform well in free-range systems, where they forage for a variety of food sources (M. K. Singh *et al.* 2019b) [22].

Tail and wings

The Khukhri has a moderately long, slightly curved tail that is characteristic of indigenous breeds. The tail feathers are well formed, with males displaying more prominent and elongated tail feathers than females. The wings are of medium length, and the birds are capable of limited flight, a trait that helps them evade predators and navigate difficult terrain. The wing structure is also adapted to provide stability during foraging and movement over hilly areas.

Sexual dimorphism

Sexual dimorphism is evident in the Khukhri, with males generally being larger and more robust than females. Males possess more vibrant feather colours, with a glossy sheen on the feathers, particularly in the neck and tail regions. The comb and wattles of males are more prominent, and they also exhibit a slightly more aggressive and territorial behaviour, especially during the breeding season.

Body weight

The average values of body weight at 0-day, 8th, 12th, 20th and 40th week of age was found to be 23.56±0.15, 330.09±1.95, 629.36±1.59, 1234.82±2.77 and 1738.68±3.94 g, respectively in male and 21.59±0.14, 298.44±0.17, 521.95±2.18, 938.50±3.23 and 1437.19±5.41 g respectively in female. Analysis of variance revealed that, there was a significant effect of sex on body weight in whole period of experiment.

Shank length

The average values of shank length at 20th week and 40th weeks of age were observed to be 10.05±0.05 and 10.51±0.04 cm in male and 9.27±0.03 and 9.69±0.03 cm in female chicken respectively. The effect of sex on shank length of birds were found to be highly significant.

Production performance of indigenous chicken at village condition

Age at first egg laying

The overall value was 216.51±0.90 days which was comparable with observations of Mishra *et al.* (2019) [14] in native chicken of Banswara district, southern Rajasthan and

Lalhlimpunia *et al.* (2021) [12] in local chicken of Mizoram. In contrast, lower values were reported by Sarma *et al.* (2020) [18].

Clutch size

The overall average number of eggs laid/ clutch/ hen (clutch size) was observed to be 5.16±0.60 days in the study area. This value was comparable to 4-5 eggs in Punjab Brown (Vij *et al.*, 2006a) [26], 4-6 eggs in Telicherry breed (Vij *et al.*, 2008) [27] and within the range of (5-15 eggs) reported in Hazra chicken of Odisha (Sethi, 2016) [19].

Clutch interval

The overall mean value was 1.31±0.00 days. These results were in close conformity with the findings of Vij *et al.* (2008) [27] in Tellicherry breedand Kumar *et al.* (2016) [10] in native chicken of Kerala.

Number of clutches per cycle/cycle per year/pause period

The overall value was 3.32±0.02 cycles per year. which was in consistent with findings of Vij *et al.* (2016) [25] and Mishra *et al.* (2019) [14] but did not agree with the findings of Gopinath (2013) [5] who reported lower value than the present findings. However, higher value of cycles per year was reported by Kalita *et al.* (2011) [9] in indigenous chicken of Assam.

The pause period was found to be 107.60±0.42 days which agreed with the findings of Mishra *et al.* (2019) [14] in native chicken of Southern Rajasthan.

Number of eggs laying per cycle

The overall value was found to be 13.16±0.1073. This result was similar to the observations of Kumar *et al.* (2016) [10]. However, higher values than the present finding were reported by Gopinath (2013) [5].

Annual egg production

The overall mean number of eggs laid per hen per year was recorded to be 43.39±0.39 eggs. This result agreed with the findings of Choudhary *et al.* (2019) [3] and Lalhlimpunia *et al.* (2021) [12] but did not agree with the findings Nayak *et al.* (2020) [15], who reported higher annual egg production. The lower egg production of birds might be due to poor nutritional status under village condition.

The variations observed in production performances of indigenous birds compared to the values reported in the literature is expected due to variations in the genetic makeup of different indigenous breeds and environment in which they are reared.

Table 1: Phenotypic traits of indigenous chicken at Ranchi, Ramgarh and Bokaro districts of Chotanagpur plateau of Jharkhand.

Parameters	Male (n=180)	Female (n=360)
1. Plumage colour (%)		
White	9.44(17)	12.22(44)
Black	6.67(12)	19.44(70)
Brown	11.11(20)	52.78(190)
Black and white	12.78(23)	8.61(31)
Mix	27.22(49)	3.06(11)
Red	32.78(59)	3.89(14)
2. Shank colour (%)		
Yellow	97.78(176)	85.56(308)
Slaty black	2.22(4)	14.44(52)
3. Ear lobe colour (%)		
Red	100(180)	100(360)
4. Skin colour (%)		
White	100(180)	100(360)
5. Comb colour (%)		
Red	100(180)	100(360)
6. Comb type (%)		
Single	51.67(93)	54.44(196)
Pea	33.33(60)	34.17(123)
Rose	15(27)	11.39(41)

Table 2: Average body weight (g) of native chicken at various ages reared under farm management system (Mean ± S.E.).

Morphometric traits	Sex	Ranchi (n=180)	Ramgarh (n=180)	Bokaro (n=180)	Overall (n=540)
Body weight (g)	M	1738.58 ± 42.85^{Bb}	1491.68 ± 43.97^{Ba}	1426.32 ± 46.62^{Ba}	1552.18 ± 27.46^{B}**
	F	1302.24 ± 23.48^{Ab}	1098.83 ± 23.90^{Aa}	1145.04 ± 23.20^{Aa}	1182.04 ± 14.30^{A}**
Shank length (cm)	M	11.30 ± 0.03^{cB}	9.24 ± 0.07^{bB}	9.01 ± 0.05^{aB}	9.85 ± 0.08**^{B}
	F	9.88 ± 0.04^{bA}	8.11 ± 0.05^{aA}	8.19 ± 0.05^{aA}	8.73 ± 0.05**^{A}

Figure in parenthesis indicates number of observations; **p<0.01
Values bearing different superscript differ significantly (p<0.01)

Table 3: Shank length (cm) of native chicken at various ages reared under farm condition.

Age (Weeks)	Male (Mean ± S.E.)	Female (Mean ± S.E.)	p value	Pooled
20	10.05 ± 0.05^{b} (261)	9.27 ± 0.03^{a} (189)	2.515E-29**	9.73±0.03 (450)
40	10.51 ± 0.04^{b} (258)	9.69 ± 0.03^{a} (185)	5.758E-36**	10.17±0.03 (443)

Figure in parenthesis indicates number of observations; **p<0.01

Table 4: Correlation between body weight and shank length of native chicken at various ages reared under farm condition.

Body weight (g) at different age of chicken	Shank length		
	Male	Female	Pooled
20 weeks	0.516 (261)	0.934 (189)	0.631 (450)
40 weeks	0.340 (258)	0.726 (185)	0.654 (443)

Table 5: Production and reproduction performance of Khukhri chicken populations at Chotanagpur plateau of Jharkhand under village condition

Parameters	Overall mean ± S.E.	p-value
Age at first egg laying (days)	216.51±0.90	0.0081**
Clutch size(days)	5.16±0.60	0.0047**
Clutch interval (days)	1.31±0.00	0.7553
Number of clutches per cycle	2.64±0.02	0.066
Number of eggs per cycle	13.16±0.11	0.2153
Cycles per year	3.32±0.02	0.0200*
Pause period (days)	107.60±0.42	0.6215
Annual egg production	43.39±0.39	0.024*
Hatchability (%) (TES)	76.11±0.43	0.6863

n= number of observations.*p<0.05; **p<0.01; SE, standard error of the mean.
Values bearing different superscript within row differ significantly

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