Characterization of Local Chicken of Trans-boundary region of Jammu & Kashmir (India)

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Research Article

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Abstract

The study was conducted in the Poonch district of Union territory of Jammu & Kashmir, India with the goal of assessing the qualitative and quantitative traits of indigenous chicken reared under natural production environment. Adult indigenous chicken reared by 55 randomly selected rural households were used for measuring the various qualitative and quantitative traits (n=117). The result showed predominant black plumage (38.46%), solid plumage pattern (75.21%), yellow skin colour (84.62%), yellow shank colour (81.20%), red earlobe colour (94.87%), single comb type (90.60%) and red comb colour (100%) in overall indigenous chicken population in field condition. Overall mean for body weight, body length, shank length, chest circumference and wingspan were 1.84 ± 0.05 kg, 37.16± 0.32 cm, 9.33± 0.19 cm, 32.31± 0.30 cm and 35.64± 0.35 cm, respectively. The correlations of body weight (BW) with other linear body measurements (BL, SL, CC and WS) were positive and significant (P<0.01). The body length (BL) could be the best predictor of body weight of indigenous chicken in linear nature of responses due to the highest adjusted R$^2$ value (0.337). The rate of inbreeding was 0.50 % across the studied population. The distinctive variability in these traits is due to both genetic and environmental factors providing the foundation for further characterization of indigenous chicken population.

Introduction

In India, ICAR-National Bureau of Animal Genetic Resources has reported 19 registered indigenous chicken breeds. These indigenous populations are usually reared under traditional scavenging system by many villagers, in absence of high inputs for feeding, housing and health care (Maharani et al., 2019). Indigenous birds serve as a source of cheap and high quality protein, adaptability to adverse environments, disease resistance, broodiness, self-defense from predators, characteristic taste and flavour of the meat, brown shelled eggs and a better price for the indigenous poultry products are the unique attributes of indigenous chicken. However, the productive and reproductive potential of these birds is very low (Veeranna Gowda et al., 2020). Indigenous chicken breeds/populations display a wide distribution of phenotypic and morphological properties that are the outcome of natural and artificial selection (Wragg et al., 2012). This symbolizes underlying genetic diversity that requires intensive characterization for breeding and conservation aspects (Dessie et al., 2011) besides enhancement of the production potential of indigenous chicken resource (Hailu, 2012).

Poonchi chicken population is a trans-boundary chicken population. Poonch district of union territory of Jammu and Kashmir is bounded by the Line of Control (boundary between Indian and Pakistan administered Kashmir) on three sides (north, west and south). The indigenous chicken population of Poonch district of Jammu and Kashmir is reared on scavenging system by local people, Pahari and other nomadic communities like Gujjar and Bhakarwal. The local chicken population can survive and reproduce in high and low temperatures with poor quality and inadequate feed provision, specific diseases and parasitic infestation. They have been under immense pressure to develop adaptations to these stressors. They weigh approximately 2.0 kg. and 1.5 kg body weight per bird in males and females, respectively and laying 60–70 eggs per bird per annum besides exhibiting late sexual maturity, slow growth, smaller egg
and body size. A very scanty information regarding characteristics of this prized population is available. Therefore, the current research was undertaken for phenotypic characterization of indigenous scavenging chicken population reared under traditional management system with the aim of enhancing production prospects for effective breed improvement and conservation strategies.

**Material And Methods**

**Study site**

The study was carried out Poonch district of Union Territory of Jammu and Kashmir (India) falling between 33°-35° to 34°-01°, north latitude and 73°-58° to 74°-35°, east longitude. The district is bordered by Kulgam district, Shopian district and Budgam district in the east, Rajouri district to the south and Baramulla district and Haveli district, Pakistan administered Jammu and Kashmir to the north and Poonch district, Pakistan administered Jammu and Kashmir to the west. The average temperature ranges from −5.4°C (January) to 26.9°C (July). The annual rainfall ranges from 10 mm during October to 87 mm during February. The average wind ow in the studied district ranges from 3.7 km/hr in October to 6.4 Km/hr in January.

**Data collection**

Data for the study of phenotypic characterization of indigenous chicken of Poonch district were collected from four Tehsils namely Haveli (Magnar village), Mandi (Sathra, Sekaloo and Loran villages), Surankote (Sanai and Lassana villages) and Mendhar (Ari and Goldh villages).

55 households rearing only indigenous chicken were surveyed on the basis of a well structured questionnaire designed in accordance with the guidelines of FAO (2011). The adult chicken were selected randomly from the unrelated households to avoid the risk of sampling chicken sharing the same cock. A total of 117 chicken (36 males and 81 females) were observed and recorded for the characterization study. Qualitative traits such as plumage colour, plumage pattern, skin colour, shank colour, ear lobe colour, comb type and comb colour were obtained by visual observation following FAO suggested descriptors for chicken genetic resources (FAO, 2011). The Quantitative traits were determined as follow:

Body weight (BW) cm –Live weight measured using weighing scale.

Body Length (BL) cm-Length between the tip of the rostrum maxilla are (beak) to the cauda (tail, exclusive of feathers) when fully stretched through its body length.

Shank Length (SL) cm-Length from the hock joint to the spur of either leg.

Chest circumference (CC) cm-Measured at the tip of the pectus (hind breast).

Wing Span (WS) cm- Length between tips of right and left wings after both are fully stretched.
Data analysis

Simple descriptive analyses of the data were performed using suitable statistical methods (Snedecor and Cochran, 1994). Coefficients of correlation for various quantitative traits were estimated. Linear regression of the linear body parameters on body weight was also performed using the following simple and multiple linear regression models:

\[ Y = B + \beta X \] \hspace{1cm} \text{Simple regression model}

\[ Y = B + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \] \hspace{1cm} \text{Multiple regression model}

Where \( Y \) = dependent variable (body weight), \( X_i \) = independent variables (BL; SL; CC; WS)

\( B \) = the intercept and \( \beta_i \) = the slopes

Further the rate of inbreeding was calculated in the population as

\[ \Delta F = 1 / (2N_e) \] \hspace{1cm} (Falconer and Mackay, 1996).

\[ N_e = 4 (N_m \times N_f) / (N_m + N_f) \]

Where, \( N_e \) = Effective population size; \( N_m \) = Number of breeding males; \( N_f \) = Number of breeding females.

Results

Qualitative traits

Analysis of qualitative traits of indigenous chicken in Poonch district of UT of Jammu and Kashmir has been presented in Table 1.

The commonest plumage colour was black (38.46%), followed by brown (33.33%) and others (28.21%) in overall population. The proportion of solid plumage pattern (75.21%) was dominant compared to barred (21.37%) and mottled (3.42%) plumage patterns in the studied population. In the current study, yellow skin colour (84.62%) was the most prevalent in the overall studied population. Most cocks (83.33%) and hens (80.25%) had yellow colour shanks.

The result pertaining to earlobe colour showed higher percentage of red colour earlobe (94.87%) in overall population. The proportion of single comb type chickens was dominant (90.60%), compared to the pea (5.98%) and rose (3.42%) in indigenous chicken overall population. The comb colour observed in the studied population was red (100%) in over population of indigenous chicken.
## Table 1
Analysis of qualitative traits of indigenous chicken

<table>
<thead>
<tr>
<th>Traits</th>
<th>Male % (N)</th>
<th>Female % (N)</th>
<th>Overall % (N)</th>
<th>$\chi^2$-test</th>
<th>Sex</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plumage colour</strong></td>
<td></td>
<td></td>
<td></td>
<td>1.71 NS</td>
<td>1.85 NS</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>41.67 (15)</td>
<td>37.04 (30)</td>
<td>38.46 (45)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>25.00 (9)</td>
<td>37.04 (30)</td>
<td>33.33 (39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>33.33 (12)</td>
<td>25.93 (21)</td>
<td>28.21 (33)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plumage pattern</strong></td>
<td></td>
<td></td>
<td></td>
<td>2.84 NS</td>
<td>98.00*</td>
<td></td>
</tr>
<tr>
<td>Solid</td>
<td>72.22 (26)</td>
<td>76.54 (62)</td>
<td>75.21 (88)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barred</td>
<td>27.78 (10)</td>
<td>18.52 (15)</td>
<td>21.37 (25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mottled</td>
<td>-</td>
<td>4.94 (4)</td>
<td>3.42 (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Skin colour</strong></td>
<td></td>
<td></td>
<td></td>
<td>1.99 NS</td>
<td>56.08**</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>8.33 (3)</td>
<td>18.52 (15)</td>
<td>15.38 (18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>91.67 (33)</td>
<td>81.48 (66)</td>
<td>84.62 (99)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Shank colour</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.16 NS</td>
<td>45.55**</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>83.33 (30)</td>
<td>80.25 (65)</td>
<td>81.20 (95)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>16.67 (6)</td>
<td>19.75 (16)</td>
<td>18.80 (22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Earlobe colour</strong></td>
<td></td>
<td></td>
<td></td>
<td>6.28 *</td>
<td>199.44**</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>5.56 (2)</td>
<td>-</td>
<td>1.71 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>94.44 (34)</td>
<td>95.06 (77)</td>
<td>94.87 (111)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red and white</td>
<td>-</td>
<td>4.94 (4)</td>
<td>3.42 (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comb type</strong></td>
<td></td>
<td></td>
<td></td>
<td>5.40 NS</td>
<td>172.77**</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>100 (36)</td>
<td>86.42 (70)</td>
<td>90.60 (106)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pea</td>
<td>-</td>
<td>8.64 (7)</td>
<td>5.98 (7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rose</td>
<td>-</td>
<td>4.94 (4)</td>
<td>3.42 (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comb colour</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>100 (36)</td>
<td>100 (81)</td>
<td>100 (117)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05  **P<0.01
Quantitative traits

Descriptive statistics for quantitative traits for indigenous chicken have been presented in Table 2. Average body weights of 2.25 ± 0.09 kg in cock and 1.66 ± 0.05 kg in hen were estimated. Mean body length values of 39.42 ± 0.59 cm, 36.20 ± 0.33 cm and 37.16 ± 0.32 cm were observed for male, female and overall population, respectively. In the present study, the mean values of shank length were estimated as 10.26 ± 0.39 cm and 8.93 ± 0.20 cm for male and female, respectively. In males and females, mean chest circumference values of 34.19 ± 0.54 cm and 31.48 ± 0.33 cm were observed. Overall wing span of 35.64 ± 0.35 cm was estimated.

<table>
<thead>
<tr>
<th>Traits</th>
<th>Male</th>
<th>Female</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>CV (%)</td>
</tr>
<tr>
<td>BW (kg)</td>
<td>2.25 (36)</td>
<td>0.09</td>
<td>23.08</td>
</tr>
<tr>
<td>BL (cm)</td>
<td>39.42 (36)</td>
<td>0.59</td>
<td>9.04</td>
</tr>
<tr>
<td>SL (cm)</td>
<td>10.26 (36)</td>
<td>0.39</td>
<td>22.59</td>
</tr>
<tr>
<td>CC (cm)</td>
<td>34.19 (36)</td>
<td>0.54</td>
<td>9.53</td>
</tr>
<tr>
<td>WS (cm)</td>
<td>36.94 (36)</td>
<td>0.67</td>
<td>10.94</td>
</tr>
</tbody>
</table>

Figures in parentheses are number of observations

BW- Body Weight (kg), BL- Body Length (cm), SL- Shank Length, CC- Chest Circumference, WS- Wing Span

Correlation coefficient between quantitative traits

Correlations between different traits considered in the present study have been presented in Table 3. The values ranged from 0.15 (WS and SL) to 0.59 (BW and BL, BL and SL and CC and SL). All the correlation values were positive and highly significant barring exception between SL and WS. The correlations of BW with BL, SL, CC and WS were 0.59, 0.28, 0.54 and 0.56, respectively.
Table 3
Coefficient of correlation for various quantitative traits for indigenous chicken

<table>
<thead>
<tr>
<th>Traits</th>
<th>BW</th>
<th>BL</th>
<th>SL</th>
<th>CC</th>
<th>WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW</td>
<td>-</td>
<td>0.59**</td>
<td>0.28**</td>
<td>0.54**</td>
<td>0.56**</td>
</tr>
<tr>
<td>BL</td>
<td>-</td>
<td>0.24*</td>
<td>0.49**</td>
<td>0.59**</td>
<td></td>
</tr>
<tr>
<td>SL</td>
<td>-</td>
<td>0.59**</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>-</td>
<td></td>
<td>0.41**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05  **P<0.01

Prediction of body weight using body linear parameters
Predictive equation relating to body weight of indigenous chickens to linear body measurements was shown in Table 4. Body weight and linear body measurements showed strong (P<0.01) associations.
Table 4
Predictive equations relating body weight to linear body measurements of indigenous chicken

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Equation</th>
<th>$R^2$ Adjusted</th>
<th>$R^2$</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>$Y = 1.702 + (0.0954 \times BL)$</td>
<td>0.337</td>
<td>0.343</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SL</td>
<td>$Y = 1.136 + (0.0757 \times SL)$</td>
<td>0.067</td>
<td>0.075</td>
<td>0.003</td>
</tr>
<tr>
<td>CC</td>
<td>$Y = -1.147 + (0.0925 \times CC)$</td>
<td>0.286</td>
<td>0.292</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>WS</td>
<td>$Y = -1.130 + (0.0834 \times WS)$</td>
<td>0.308</td>
<td>0.314</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + SL</td>
<td>$Y = -1.866 + (0.0898 \times BL) + (0.0397 \times SL)$</td>
<td>0.352</td>
<td>0.363</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + CC</td>
<td>$Y = -2.566 + (0.0688 \times BL) + (0.0573 \times CC)$</td>
<td>0.418</td>
<td>0.428</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + WS</td>
<td>$Y = -2.274 + (0.0637 \times BL) + (0.0491 \times WS)$</td>
<td>0.404</td>
<td>0.414</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CC + WS</td>
<td>$Y = -2.390 + (0.0641 \times CC) + (0.0607 \times WS)$</td>
<td>0.421</td>
<td>0.431</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SL + WS</td>
<td>$Y = -1.485 + (0.0544 \times SL) + (0.0791 \times WS)$</td>
<td>0.341</td>
<td>0.352</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SL + CC</td>
<td>$Y = -1.196 - (0.0191 \times SL) + (0.0996 \times CC)$</td>
<td>0.283</td>
<td>0.295</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + SL + CC</td>
<td>$Y = -2.583 + (0.0685 \times BL) - (0.00991 \times SL) + (0.0611 \times CC)$</td>
<td>0.414</td>
<td>0.429</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + SL + WS</td>
<td>$Y = -2.433 + (0.0584 \times BL) + (0.0391 \times SL) + (0.0489 \times WS)$</td>
<td>0.418</td>
<td>0.433</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SL + CC + WS</td>
<td>$Y = -2.393 - (0.00261 \times SL) + (0.0651 \times CC) + (0.0605 \times WS)$</td>
<td>0.416</td>
<td>0.431</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>BL + SL + CC + WS</td>
<td>$Y = -2.934 + (0.0458 \times BL) - (0.00179 \times SL) + (0.0505 \times CC) + (0.0410 \times WS)$</td>
<td>0.458</td>
<td>0.477</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

$Y =$ Dependent variable (BW), $X =$ Independent variable (BL, SL, CC and WS), $R^2 =$ Coefficient of Determination

*P<0.05, **P<0.01

Effective population size and rate of inbreeding

The overall effective population size (Ne) was found to be 99.69 while the respective rate of inbreeding was 0.50% across the study area.
Discussion

Qualitative and Quantitative traits

Plumage colour

The findings of Bhuiyan et al. (2005) in Desi chicken of Bangladesh, Daikwo et al. (2018) and Odah et al. (2019) in indigenous chicken of Nigeria and Alebachew et al. (2019) in local chicken of Ethiopia also revealed that black plumage colour was predominant followed by other plumage colours. This diversity in plumage colours may be due to the fact that indigenous chicken have not been artificially selected (Odah, 2019). Also the study revealed non-significant difference in plumage colour distribution in both sexes which is contrary to the report of Tadel et al. (2018) in the indigenous chicken population of Ethiopia.

Plumage pattern

Parmar et al. (2003) in Kadaknath breed of India had identified similar plumage pattern. On contrary Otecko et al. (2019) observed the least proportion of solid or plain plumage pattern in the indigenous chicken population of Kenya. Researcher in different parts of the world reported that no specific plumage pattern found for the majority of their sampled village chicken (Wani et al., 2014 and Liyanage et al., 2015). Moreover, non-significant effect of plumage pattern in both males and females and significant effect ($P < 0.05$) on overall population were observed.

Skin Colour

This concurred with the findings of Dana et al. (2010) in indigenous chicken of Ethiopia, Zidane et al. (2017) in local chicken of Algeria and Hirwa et al. (2019) in indigenous chicken of Rawanda. The white skin birds carry the dominant allele and yellow skin birds are homozygous for a recessive allele (Eriksson et al., 2007). Therefore, the low fraction of white skin colour in the research findings indicated the presence of least frequency for the dominant allele. There was a non-significant difference in skin color across both male and female chicken which is in disagreement with the findings of Tadel et al. (2018) in the Ethiopian indigenous chicken population. However, highly significant effect ($P < 0.01$) of skin colour on overall population under study was recorded.

Shank Colour

The present findings were in agreement with the observations of Lopez Jr. et al. (2013) in native roosters and hens of Philippine. Yellow shank colour was also common in overall population (80.31%) which concurred with the findings of Dana et al. (2010) in indigenous chicken of Ethiopia, Daikwo et al. (2011) in local chicken of Nigeria, Sarkar et al. (2012) in Aseel breed of Bangladesh, Guni and Katule (2013) in local chicken of Tanzania, Odah et al. (2019) in local chicken of Nigeria, Hirwa et al. (2019) in indigenous chicken of Rawanda and Maharani et al. (2019) in Indonesian native chicken. Pigmentation of non-feathered tissue (skin and shank) involves the carotenoids and melanin’s which are responsible for yellow and black colour respectively (Veeranna Gowda et al., 2020).
The observed shank color showed non-significant difference among the studied male and female chickens. However, Tadel et al. (2018) observed significant different ($P < 0.01$) among the males and females chicken of Ethiopian indigenous chicken population. Also highly significant ($P < 0.01$) effect of shank colour on overall population was observed.

**Earlobe Colour**

On contrary to the reports of Alebachew et al. (2019) in local chicken of Ethiopia and Hirwa et al. (2019) in indigenous chicken of Rawanda. Variation in chicken earlobe color may be caused by ancestral lineages and mutations (Cabarles Jr., 2012) as well as the adaptability to local conditions (Duguma, 2006). Also, the purine base deposition which is controlled by a number of genes is responsible for white colour earlobe (Tadele et al., 2018). There were significant ($P < 0.05$) differences in ear lobe color of both sexes chicken which agree with the findings of Tadele et al. (2018) in the indigenous chicken population of Ethiopia. Also the different shank colours have highly significant effect ($P < 0.01$) on the overall population.

**Comb Type**

The predominant single comb in this study area tallies with the findings of Parmar (2003) in Kadaknath breed of India, Guni and Katule (2013) in local chicken population of Tanzania, Wani et al. (2014) in indigenous chicken of Sudan, Zidane et al. (2017) in local poultry population of Algeria, Daikwo et al. (2018) in indigenous chicken of Nigeria, Alebachew et al. (2019) in local chicken of Ethiopia and Saravanan et al. (2020) in indigenous Chirunkothu chicken of Tamil Nadu (India). The occurrence of different comb types might be due to the interactions of different genes responsible for comb expression (Odah et al., 2019). Also the presence of single comb helps to reduce 40% of body heat, hence advantageous in tropical conditions (Duguma, 2006). The occurrence of comb type was non-significant for sexes indicates that between male and female chickens there was no variations for comb type which was contrary to the reports of Tadele et al. (2018) in the indigenous chicken population of Ethiopia. Highly significant effect ($P < 0.01$) of different comb type was reported on overall population under present study.

**Comb colour**

The result was in agreement with the findings of Saravanan et al. (2020) in indigenous Chirunkothu chicken of Tamil Nadu (India). The intensity of the red colouration is an indication of the quality of sperm in the case of male birds (Navara et al., 2012). Moreover, it is biologically important to study this phenotype because it is an indicator of chicken's health and egg laying status (Hume, 2011). Also, there were non-significant differences in ear lobe color of both sexes chicken and overall population.

**Body Weight**

Findings reported by Vij et al.(2006) in Punjab Brown breed of India and Perini et al. (2020) in Polverara Bianca breed of Italy for male and female were in conformity with the result of present study. Also overall mean body weight of $1.84 \pm 0.05$ kg was estimated which was in disagreement with the observations of
Singh et al. (2016) in native chicken population of Odisha (Gujuri and Jhinjiria). Variation in the weights of male and female birds in the studied area indicates that the live weight of an animal is sex dependent (Odah et al., 2019).

**Body Length**

This was in close association with the results of Perini et al. (2020) in Padovana Argenta and Polverara Nera breeds of Italy and Montes et al. (2019) in Creole backyard chicken of Colombia for cock and hen, respectively. On contrary, lower value for overall population was recorded by Hirwa et al. (2019) in indigenous chicken of Rwanda. Body length variation may be due to breed difference, age of the bird and management system employed (Alwell et al., 2018) as well as due to region (Apuno et al., 2011).

**Shank Length**

This was in agreement with the findings of Perini et al. (2020) in Millefiori di Lonigo, Polverara Bianca, Padovana Camosciata, Padovana Dorata and Polverara Nera breeds of Italy and Montes et al. (2019) in Creole backyard chicken of Colombia for cock and hen, respectively. Overall shank length of $9.33 \pm 0.19$ cm was found which was almost similar to the report of Singh et al. (2016) in native chicken population of Odisha (Gujuri). Long shank length observed results from breed difference, prevalence of major gene and extensive husbandry system which allows birds to scavenge long distance for their food (Odah et al., 2019).

**Chest circumference**

The results are in close association with the findings of Perini et al. (2020) in Padovana Argenta and Polverara Nera breeds of Italy. Overall chest circumference of $32.31 \pm 0.30$ cm was found in the present study. On contrary, Odah et al. (2019) found higher overall chest circumference value in local chicken of Nigeria. The variation in chest circumference might be attributed to genetic composition of birds and feed availability (Odah et al., 2019).

**Wing span**

The present find was lower than the finding of Hirwa et al. (2019) in indigenous chicken of Rwanda. Average wing span of $36.94 \pm 0.67$ cm in male and $35.05 \pm 0.40$ cm in female were observed in the indigenous chicken. However, Assefa et al. (2018) in local chicken of Ethiopia, Alwell et al. (2018) in local chicken population of Nigeria and Alebachew et al. (2019) in local chicken of Ethiopia reported lower values.

**Correlation coefficient between quantitative traits**

The positive and significant ($P < 0.01$) correlations between different traits indicate a strong relationship between body weight and other linear body parameters. This was in accordance with the findings of Mushi et al. (2020) in Tanzania free range local chicken ecotypes. Any improvement in body weight of indigenous chicken would lead to an improvement in linear body traits.
Prediction of body weight using body linear parameters

The body length (BL) showed the highest adjusted $R^2$ value (0.337) with linear nature of responses. This implies that body length (BL) could be the best predictor of body weight of indigenous chicken of Jammu & Kashmir. On contrary, Sadick et al. (2020) reported shank circumference as best predictor of body weight in the Cobb broiler chicken.

Based on the multiple regression equations for body weight on the studied body measurements (Table 4), adjusted $R^2$ values ranged from low (0.283) to relatively high (0.458) suggesting that the calculated equations could be employed to predict the body weight of chicken. This is particularly accurate in rural areas where weighing scales are not accessible as suggested by Alabi et al. (2012) and Liyanage et al. (2015). Also it is a challenging task to measure body weight in hilly areas of Poonch district due to the frequent mobility of birds in free range and wind flow. Therefore, it is advisable to select the birds for body weight with correlated traits like body length, chest circumference, etc.

Effective population size and rate of inbreeding

This present finding was contrary to the findings of Tadele et al. (2018) in indigenous chicken population of Ethiopia. Higher inbreeding rate in indigenous chicken population is due to smaller number of breeding individuals, thereby restricting mating in household only.

The present study reveals variations in phenotypic traits which serve as a prospect for genetic improvement through selection. The in-depth evaluation of the performance potential of the indigenous chicken in large population under enhanced management conditions should be undertaken in order to devise suitable intervention strategies for its better improvement, utilization and conservation. This would directly improve the rural socio-economic status and boost up the nation's wealth.

Declarations

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Data Availability

Data will be made available from the corresponding author on reasonable request.

Ethics approval

The manuscript does not contain clinical studies.
Statement of Animal Rights
Not applicable.

Consent for publication
All permissions are taken before submission

Conflict of Interest Statement
The authors declare no competing interests

Author Contributions
SS- Collected data from field condition and wrote the manuscript
RKT - conceived the idea for this work;
DC- conceived the idea for this work; analyzed the data and correction of manuscript
DK - Collected data from field condition
NK- correction of manuscript
MSA- Collected data from field condition

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