



Morphological Characterization in Native Birds of Gulbarga Division under Farm Conditions

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Abstract

This study was carried out to morphologically characterize the native birds of Gulbarga division under farm conditions. All the birds were normal feathered and the males were mostly multicoloured, whereas the females were black. The dominant primary plumage pattern observed was solid in males and dull in females. The color of the skin and shanks were yellow in majority of the birds. All the birds had red ear lobes and most of the birds were brown eyed. Majority of the birds had wattles and were single combed. The body weights of birds were recorded from day old to 20th weeks of age and it was observed that the birds of Koppala district had significantly higher body weights than the birds of Gulbarga and Bidar districts. The average shank length recorded was 59.19 ± 0.26 and 52.43 ± 0.21 mm, and the average breast angle was $80.41 \pm 0.14^\circ$ and $72.04 \pm 0.17^\circ$ in males and females, respectively at 8th week of age. This study revealed distinctive variations among the birds of three districts of Gulbarga division, providing the basis for further characterization of these native birds.

Key words : Native birds, plumage pattern, characterization, body weight, gulbarga, comb type, wattles.

Introduction

India is rich in poultry genetic resources having 19 indigenous recognized breeds and various subtypes among the 72 poultry breeds found in Asia. The native chicken is a store house of genetic diversity along with a number of genomes and major genes of tropical relevance. India is considered to be the native tract of Red Jungle Fowl (*Gallus gallus*) from which the present day domestic birds have been descended. The farmers having indigenous poultry are capable of contributing significantly to alleviate malnutrition, poverty and unemployment. There is significant diversity observed in phenotypic characteristics of the native birds, with respect to body weight, plumage pigmentation, plumage distribution, comb type, shank and skin color, which increases the adaptability of these breeds to climatic environments of our country. There is a need to study and characterize the native breeds as they are gold mines of genomes and major genes for improvement of high yielding germplasm for tropical adaptability and disease resistance. The backyard poultry production constitutes vital component of agricultural economy in India since many years. The conservation of these breeds will act as source of variation for development of backyard poultry strains in India. Systematic studies on phenotypic characteristics of native birds in Karnataka have been studied in Mysore and Bangalore divisions. Hence, this study was designed to morphologically characterize the native birds of Gulbarga division (Bidar, Gulbarga and Koppala district) as per the

NBAGR proforma and to compare the same with documented native chicken breeds.

Materials and Methods

This study was carried out to morphologically characterize the native birds of Gulbarga division under farm conditions. The fertile eggs were collected from twenty villages in each district (Bidar, Gulbarga and Koppala) for a period of seven days and were transported safely to Veterinary College, Bengaluru. The collected eggs were incubated in the standard forced draft incubators at department of poultry science. A total of 595 chicks were wing banded and housed in the brooder cum grower house under deep litter system. The standard rearing practices were followed. At 19th week, 296 females were shifted to breeder house. In each pen 16 females and 2 males were housed. The experiment was carried out up to 52nd week of age. The birds were fed starter ration from zero to eight weeks of age and grower diet from 9-20 weeks of age.

The morphological features were recorded as per NBAGR proforma. The body weights of birds were recorded weekly from day of hatching to 20th week of age. From 16th week onwards the body weights were recorded sex wise and the body weight at sexual maturity was recorded for females using digital balance. Shank length was taken as the distance between the hock joint and the tarso metatarsus using digital Vernier calipers and Breast angle was taken as the circumference of the breast

Table-1 : Morphological characteristics in native birds of Gulbarga division.

Sl. No.	Phenotypic characters	Types	Percent-age in Males	Percent-age in Females
1.	Feather morphology	Normal	100.00	100.00
		Frizzled	0.00	0.00
2.	Feather distribution	Normal	100.00	100.00
		Naked neck	0.00	0.00
3.	Plumage color	White	-	1.01
		Blue	0.88	1.35
		Black	11.45	31.08
		Red	21.14	11.48
		Brown	3.96	32.09
		Gold	19.82	3.71
		Multicolor	42.73	19.25
		Solid	51.10	31.75
4.	Primary plumage pattern	Dull	25.55	46.62
		Patchy	10.57	1.35
		Spotted	1.32	2.36
		Barred	3.52	8.10
		Mottled	7.48	9.79
		Self White	-	0.33
5.	Secondary plumage pattern	Self Blue	-	0.33
		Self Black	6.16	19.25
		Self Red	26.87	24.66
		Barred	5.28	32.43
		Mottled	25.55	7.43
		Lacing	36.12	15.54
		Yellow	73.56	72.97
6.	Skin color	White	26.43	27.02
		Yellow	87.22	85.81
		White	0.00	1.01
		Black	9.25	10.47
7.	Shank color	Green	3.52	2.70
		Red	100.00	100.00
		White	0.00	0.00
		Brown	62.55	56.41
8.	Ear Lobe color	Black	7.40	7.70
		Grey	29.95	35.81
		Present	92.95	83.11
9.	Eye color	Absent	7.04	16.89
		Single	93.82	93.23
		Pea	5.28	5.06
10.	Wattles	Rose	0.88	1.67
		Present	92.95	83.11
		Absent	7.04	16.89
11.	Comb type	Single	93.82	93.23
		Pea	5.28	5.06
		Rose	0.88	1.67

around the deepest region of the breast. Data collected were subjected to simple descriptive analysis using SPSS statistical package.

Results and Discussion

Morphological Characteristics : The percentages of various morphological characteristics in native birds of Gulbarga division are presented in Table-1. The plumage color and pattern are influenced by sex in poultry (sexual dimorphism). Therefore, these characters are studied separately for sexes. In the present study, a total of 227 males and 296 females were evaluated for morphological characters as per NBAGR proforma. The highest per cent of plumage color recorded in male indigenous birds was multi-color (42.73) followed by red (21.14), gold (19.82), black (11.45), brown (3.96) and blue (0.88). The highest per cent of plumage color recorded in female indigenous birds was brown (32.09) followed by black (31.08), multicolor (19.25), red (11.48), gold (3.71), blue (1.35) and white (1.01). The present study revealed that cocks were generally multicolor, gold and red plumage, whereas the hens were generally brown and black colored. It has been reported by many earlier workers that the plumage colors are nonspecific to indigenous chicken populations of India and other countries, but consisted of several colors (1,2). The predominant plumage color reported was multicolor in indigenous birds of Mysore division (3), brown in birds of Bangalore division (4) and in birds of Belagaum division (5).

The predominant primary plumage pattern observed in the present study was solid in males and dull in female birds. Similar plumage pattern were reported in indigenous birds of Mysore division (3), birds of Bangalore division (4) and birds of Belagaum division (5). The predominant secondary plumage pattern observed in this study was lacing in males and barred in female birds. Similar plumage pattern were reported in indigenous birds of Mysore division (3) and of Bangalore division (4). (5) reported secondary plumage pattern as self red in birds of Belagaum division. Few researchers also reported no breed specific secondary plumage pattern in indigenous populations of India (6,7). The secondary plumage pattern is mainly due to the interaction of the genes Pg (pattern gene), *Ml* (melanotic), *Db* (dark brown), *mo* (moultling), *B* (barring), *C0* (columbian) and *Er* (Erminette) along with *E* allele (8).

The predominant skin and shank color observed was yellow in the present study. Similar plumage pattern were reported in indigenous birds of Mysore division (3), birds of Bangalore division (4) and birds of Belagaum division (5). The major determiners of carotenoid deposition in the skin are the autosomal white (W) and yellow (w) alleles, whereas the white skin gene acts to prevent the transfer

Table-2 : Average body weight (g) from day old to 12th week of age in native birds of Gulbarga division.

Districts	Day old ^{NS}	1 st week	2 nd week ^{NS}	3 rd week	4 th week
Bidar	27.04 ± 0.25	38.85 ± 0.46 ^b	62.71 ± 0.98	96.32 ± 1.68 ^b	129.86 ± 2.17 ^b
Gulbarga	27.47 ± 0.21	41.22 ± 0.46 ^a	63.27 ± 1.01	94.09 ± 1.59 ^b	125.70 ± 2.28 ^b
Koppala	27.37 ± 0.30	42.05 ± 0.56 ^a	65.63 ± 1.14	101.73 ± 1.83 ^a	139.07 ± 2.66 ^a
Overall mean	27.29 ± 0.14	40.60 ± 0.28	63.73 ± 0.60	96.98 ± 0.98	130.86 ± 1.37

Table-2 : Contd...

	5 th week	6 th week	7 th week	8 th week	12 th week
Bidar	174.23 ± 2.88 ^b	234.54 ± 3.89 ^b	275.53 ± 4.56 ^b	326.37 ± 5.37 ^b	768.07 ± 12.30 ^a
Gulbarga	166.72 ± 3.02 ^b	221.47 ± 4.00 ^c	258.80 ± 4.71 ^c	311.47 ± 5.66 ^b	679.54 ± 13.81 ^c
Koppala	186.04 ± 3.72 ^a	248.69 ± 4.84 ^a	330.88 ± 5.67 ^a	394.66 ± 6.66 ^a	720.04 ± 15.77 ^b
Overall Mean	174.68 ± 1.85	233.52 ± 2.46	284.24 ± 3.09	339.37 ± 3.66	723.97 ± 8.12

Means with different superscripts (a,b,c,...) columnwise indicate significant difference (p=0.05).

Table-3 : Average body weight (g) in native birds of Gulbarga division at 16th week and 20th week.

	16 th week		20 th week	
	Males	Females	Males	Females
Bidar	1125.73 ± 21.38 ^{ab}	887.24 ± 12.65 ^b	1430.98 ± 33.48	1028.87 ± 15.59 ^b
Gulbarga	1081.21 ± 19.88 ^b	791.49 ± 14.69 ^c	1435.82 ± 28.69	955.95 ± 17.77 ^c
Koppala	1147.90 ± 20.23 ^a	960.13 ± 23.32 ^a	1472.15 ± 28.07	1165.13 ± 30.99 ^a
Overall	1117.04 ± 11.93	871.96 ± 10.02	1445.73 ± 17.39	1037.49 ± 12.61

Means with different superscripts (a,b,c,...) columnwise indicate significant difference (p=0.05).

Table-4 : Average shank length (mm) and breast angle at different weeks of age in native birds of Gulbarga division.

Age	Shank length		Breast angle	
	Males	Females	Males	Females
4 th wk	33.06 ± 0.12	31.10 ± 0.97	71.88 ± 0.16 ⁰	62.04 ± 0.40 ⁰
6 th wk	46.07 ± 0.22	41.21 ± 0.11	75.35 ± 0.13 ⁰	66.63 ± 0.19 ⁰
8 th wk	59.19 ± 0.26	52.43 ± 0.21	80.41 ± 0.14 ⁰	72.04 ± 0.17 ⁰
12 th wk	80.07 ± 0.18	69.63 ± 0.18	81.91 ± 0.13 ⁰	80.63 ± 0.17 ⁰
20 th wk	93.07 ± 0.21	73.59 ± 0.14	84.50 ± 0.58 ⁰	84.77 ± 0.25 ⁰

of carotenoids into the skin (8). All the indigenous birds of Gulbarga division had red ear lobes. The present findings are in comparison with reports of (8) in Danki, (6) in Miri, (10) in Kalasthi, (11) in Ghagus, (3) in birds of Mysore division, (4) in birds of Bangalore division and (5) in birds of Belagaum division. The present study evidenced the prevalence of three major eye colors namely; grey, brown and black. The predominant eye color was brown and similar observations were reported by (3) in birds of Mysore division, (4) in birds of Bangalore division and (5) in birds of Belagaum division.

The wattles were rudimentary or almost absent in the birds having pea comb while the birds with single comb had prominent wattles. These results are in conformity with breed descriptor of chicken (NBAGR-2011) where in the ghagus breed has smaller wattles and are red in color; genetically wattle color is inherited as a polygenic trait involving variation in pigmentation of carotenoid and melanin pigments. In the present study, three comb types were observed in birds of Gulbarga division viz., Single, Pea and Rose comb.

The predominant comb type was single and similar observations were reported by (3) in birds of Mysore division, (4) in birds of Bangalore division and (5) in birds of Belagaum division.

Body weight of indigenous chicken from 0th day to 12th week of age : Average body weight (gms) from day old to 12th week of age in native birds of Gulbarga division are presented in Table-2. The average body weight recorded in present study at day old were 27.04±0.25 gms in birds of Bidar, 27.47±0.21 gms in birds of Gulbarga and 27.37±0.30 gms in birds of Koppala district and no significant (p=0.438) difference was observed in day old body weight among birds of three districts. The present findings of day old body weight are comparable with Rajakumar (2013) in indigenous chicks of Bangalore division, (3) in indigenous chicks of Mysore division and (12) in indigenous birds of Belagaum division. The body weight recorded at 1st week of age was 38.85±0.46 gms in birds of Bidar, 41.22±0.4 gms in birds of Gulbarga and 42.05±0.56 gms in birds of Koppala district. The overall average 1st week body weight recorded was 40.60±0.28

gms from all three districts. The higher body weight than the present study was reported by (4) in indigenous birds of Bangalore division (45.71 ± 0.36 gms) and the lower body weight was reported than the present study by (3) in indigenous birds of Mysore division (35.28 ± 0.31 gms).

The average body weight at second week was 62.71 ± 0.98 gms in birds of Bidar, 63.27 ± 1.01 gms in birds of Gulbarga and 65.63 ± 63 gms in birds of Koppala district. There was no significant difference among the three districts of Gulbarga division. The values of second week body weights reported by (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division are similar to the present findings. Lower 2nd week body weight were reported than the present study by (3) in indigenous birds of Mysore division. The average body weight recorded at third week of age was 96.32 ± 1.68 , 94.09 ± 1.59 and 101.73 ± 1.83 gms in indigenous chicks belonging to Bidar, Gulbarga and Koppala districts, respectively. The chicks of Koppala district have significantly ($p=0.007$) higher body weight than birds of Bidar and Gulbarga districts.

In the present study, average body weights at fourth week of age were 129.86 ± 2.17 , 125.70 ± 2.28 and 139.07 ± 2.66 gms in chicks of Bidar, Gulbarga and Koppala districts, respectively. The same trend followed from third week to fourth week body weight as the chicks of Koppala have significantly ($p=0.007$) higher body weight compared to birds of Bidar and Gulbarga districts. The body weight at fourth week of age in present study was comparable with (3) in indigenous chicken of Mysore division. The higher 4th week body weight was reported by (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division. The higher body weights in the present study may be attributed to better management, nutrition and differences in the genetic makeup of the birds. The average body weight of chicks at fifth week was 174.23 ± 2.88 gms in birds of Bidar, 166.72 ± 3.02 in birds of Gulbarga and 186.04 ± 3.72 gms in birds of Koppala district. The overall average body weight recorded was 174.68 ± 1.85 gms from all the three districts of Gulbarga division. The body weight of Koppala chicks at fifth week of age was high and differed significantly ($p=0.00$) with birds of Gulbarga and Bidar districts. The findings of present study were comparable with (3) in indigenous birds of Mysore division. The higher body weight was recorded by (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division.

The average body weight recorded at sixth week of age in present study was 234.54 ± 3.89 , 221.47 ± 4.00 and 248.69 ± 4.84 gms in birds of Bidar, Gulbarga and Koppala

districts, respectively. The overall average body weight from all the three districts was 233.52 ± 2.46 gms. The birds of three districts showed significant ($p=0.00$) variation among them and the chicks of Koppala district recorded significantly higher body weight compared to birds of Bidar and Gulbarga districts. The higher body weight than the present finding have been reported by (3) in indigenous birds of Mysore division, (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division. The higher body weight in the present study may be attributed to the genetic makeup and environmental factors since body weight being a quantitative trait and it is more likely to be influenced by environment. The average body weight recorded at 7th week of age in present study was 275.53 ± 4.56 gms in birds of Bidar, 258.80 ± 4.71 gms in birds of Gulbarga and 330.88 ± 5.67 gms in birds of Koppala district. The overall average body weight in Gulbarga division was 284.24 ± 3.09 gms. Chicks of all the three districts showed significant ($p=0.00$) difference among them. Whereas, the chicks of Koppala districts recorded significantly higher body weight compared to chicks of Bidar and Gulbarga districts. The body weight obtained in the present study are lower than those reported by (3) in indigenous birds of Mysore division, (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division.

The average body weight of chicks at eighth weeks of age was 326.37 ± 5.37 gms in birds of Bidar, 311.47 ± 5.66 gms in birds of Gulbarga and 394.66 ± 6.66 gms in birds of Koppala district. The overall average body weight in Gulbarga division was 339.37 ± 3.66 gms. The chicks of Koppala district recorded significantly ($p=0.00$) higher body weight compared to birds of Bidar and Gulbarga districts. Higher body weight than the present study were reported by (3) in indigenous birds of Mysore division, (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division. The higher body weight in the present study may be attributed to the genetic makeup, breed type, system of rearing and environmental factors.

The average body weight at 12th weeks of age was 768.07 ± 12.30 gms in birds of Bidar, 679.54 ± 13.81 gms in birds of Gulbarga and 720.04 ± 15.77 gms in birds of Koppala district. The overall average body weight of Gulbarga division was 723.97 ± 8.12 gms. The birds of Bidar district had significantly higher body weight followed by Koppala and Gulbarga districts. The grower birds from Gulbarga district continued to have lower body weights. On perusal of literature, higher body weight was recorded than the present study by (4) in indigenous chicken of Bangalore division. The lower body weight was recorded than the present findings by (3) in indigenous birds of

Mysore division and (12) in indigenous birds of Belagaum division.

Body weight of indigenous chicken at 16th week and 20th week of age : Average body weight (gms) in native birds of Gulbarga division at 16th week and 20th week are presented in Table-3. The average body weight of indigenous chicken at 16th week of age was 990.30 ± 14.55 gms in birds of Bidar, 925.45 ± 16.79 gms in birds of Gulbarga and 1053.70 ± 17.53 gms in birds of Koppala district. The overall average body weight of all three districts recorded was 986.48 ± 9.58 gms. The significant difference ($p=0.00$) was noticed among all three districts of Gulbarga division, the grower birds of Koppala district had significantly higher body weight compared to birds of Bidar and Gulbarga districts. On perusal of literature, higher body weight was recorded than the present study by (4) in indigenous chicken of Bangalore division and (12) in indigenous birds of Belagaum division. However, lower body weight than the present finding has been reported by (3) in indigenous birds of Mysore division.

At 20th weeks of age, the average body weight recorded was 1204.48 ± 22.42 gms in birds of Bidar, 1179.83 ± 24.95 gms in birds of Gulbarga and 1319.37 ± 24.72 gms in birds of Koppala district. The overall average body weight recorded was 1229.04 ± 14.08 gms. The birds belonging to Koppala district had significantly higher body weight and also differed significantly ($p=0.00$) with birds of Bidar and Gulbarga districts. The result of present study was comparable with the reports of (4) in indigenous chicken of Bangalore division. The higher body weight than the present study was reported by (12) in indigenous birds of Belagaum division. However, lower body weight compared to present study was reported by (3) in indigenous birds of Mysore division.

Shank length and breast angle of indigenous chicken: Average shank length (mm) and breast angle at different weeks of age in native birds of Gulbarga division are presented in Table-4. The shank length (mm) and breast angle ($^{\circ}$) at 4, 6, 8, 12 and 20th weeks of age were measured as per NBAGR guidelines in indigenous birds of Gulbarga division. The information available in the literature about the body measurements in indigenous chicken are scanty therefore effective comparison cannot be made at different weeks of age as per NBAGR proforma. The overall mean shank length of male birds recorded at 4th, 6th, 8th, 12th and 20th weeks of age were 33.06 ± 0.12 , 46.07 ± 0.22 , 59.19 ± 0.26 , 80.07 ± 0.18 and 93.07 ± 0.21 mm, respectively. The shorter shank length at 20th weeks of age has been reported by (13) in indigenous birds of Mysore division and (4) in indigenous birds of Bangalore division than the present study. The overall

shank length of female birds in Gulbarga division at 4th week was 31.10 ± 0.97 , 6th week (41.21 ± 0.11), 8th week (52.43 ± 0.21), 12th week (69.63 ± 0.18) and 20th week (73.59 ± 0.14 mm). At every week of growing stage, mean shank length of male birds was higher than that of females. The males have highly set body with long legs.

The average breast angle recorded in male indigenous birds of Gulbarga division at 4th week ($71.88 \pm 0.16^{\circ}$), 6th week ($75.35 \pm 0.13^{\circ}$), 8th week ($80.41 \pm 0.14^{\circ}$), 12th week ($81.91 \pm 0.13^{\circ}$) and 20th week ($84.50 \pm 0.58^{\circ}$). The breast angle recorded in present study are comparable with the results of (13) who recorded 84.70 ± 0.36 in indigenous birds of Mysore division. However lower values were recorded than present findings by (4) ($79.83 \pm 0.59^{\circ}$) in indigenous birds of Bangalore division. The average breast angle recorded in female indigenous birds of Gulbarga division at 4th week ($62.04 \pm 0.40^{\circ}$), 6th week ($66.63 \pm 0.19^{\circ}$), 8th week ($72.04 \pm 0.17^{\circ}$), 12th week ($80.63 \pm 0.17^{\circ}$) and at 20th week ($84.77 \pm 0.25^{\circ}$). The breast angle recorded in the present study are comparable with (13) who recorded $82.15 \pm 0.28^{\circ}$ in indigenous birds of Mysore division and (4) who recorded $82.79 \pm 0.38^{\circ}$ in indigenous birds of Bangalore division.

Conclusions

This study reveals phenotypic variability among the birds of Gulbarga division which is affected by both genetic and environmental factors. Considering the hardy nature and growth rate of these birds, these have vast potential for development of improved backyard strains. The birds of Koppala district had comparatively better body weights as compared to the birds of Bidar and Gulbarga districts, hence can be utilized for the development of backyard strains in northern part of Karnataka.

References

1. Tantia M.S., Ganai N., Vij P.K., Vijh R.K. and Ahlawat S.P.S. (2005a). Chicken Breeds of India-Kashmir Favorolla. Leaflet 1, National Bureau of Animal Genetic Resources, Karnal.
2. Vij P.K., Tantia M.S. and Vijh R.K. (2006a). Characterization of Punjab Brown chicken, *Anim. Gen. Res. Inform.*, 39: 65-76.
3. Gopinath C.R., Murthy H.N.N., Nagaraja C.S. and Islor S. (2020). Phenotypic characterization of Indigenous chicken in Southern Karnataka, *Indian J. Poult. Sci. India*, 55(1): 17-22.
4. Rajakumar N. (2013). Characterization and performance evaluation of indigenous chicken in the Bangalore division of Karnataka State, *Ph.D. thesis submitted to Karnataka Veterinary Animal and Fisheries Sciences University*, Bidar.
5. Veerannagowda B.G., Jayanaik Nagaraja C.S., Veeregowda M., Krishnamurthy T.N., Jayashree R., Kotresh A.M.,

Mahadevappa D. Gouri and D.M. Basavarajaiah (2020a). Phenotypic characterization of indigenous chicken of belagaum division of Karnataka State, India. *Int. J. Curr. Microbiol. App. Sci.*, 9(4): 1304-1312.

6. Vij P.K., Tantia M.S., Vijh R.K. and Ahlawat S.P.S. (2005). Chicken Breeds of India Danki. *Leaflet 23, National Bureau of Animal Genetic Resources*, Karnal.
7. Tantia M.S., Khanna K., Vijh R.K., Vij P.K., Singh G. and Ahlawat S.P.S. (2006). Chicken Breeds of India-Ankleshwar. *Leaflet 37, National Bureau of Animal Genetic Resources*, Karnal.
8. Smyth J.R. (1990). Genetics of plumage, skin and eye pigmentation in chickens. In Crawford R.D. Edn. *Poultry breeding and Genetics*. Amsterdam, Elsevier Scince Publisher's, pp 109-168.
9. Vijh R.K., Roy T.C., Vij P.K., Tantia M.S. and Ahlawat S.P.S. (2005a). Chicken Breeds of India Miri. *Leaflet 2, National Bureau of Animal Genetic Resources*, Karnal.
10. Vijh R.K., Vij P.K., Tantia M.S. and Ahlawat S.P.S. (2005b). Chicken Breeds of India-Kalasthi. *Leaflet 21, National Bureau of Animal Genetic Resources*, Karnal.
11. Tantia M.S., Vijh R.K., Vij P.K. and Ahlawat S.P.S. (2005b). Chicken Breeds of India Ghagus. *Leaflet 22, National Bureau of Animal Genetic Resources*, Karnal.
12. Veerannagowda B.G., Jayanaik G.S. Naveen Kumar, Krishnamurthy T.N., Harish M. and Banuvali Nagappa (2020b). Performance Evaluation of Indigenous Chicken of Belagaum Division of Karnataka State, India. *Int. J. Curr. Microbiol. App. Sci.*, 9(4): 2382-2393.
13. Gopinath (2013). Characterization and performance evaluation of indigenous chicken in the Mysore division of Karnataka State, *Ph.D. thesis, submitted to Karnataka Veterinary Animal and Fisheries Sciences University*, Bidar.