RESEARCH ARTICLE

Phenotypic and Performance Characterization of Aravali Breed of Chicken

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Abstract

The study was carried out to characterize native chickens of North Gujarat recently registered as "Aravali" breed of chicken for phenotypic and performance traits from field and farm levels. Observations were recorded as per the format of National Bureau of Animal Genetic Resources (NBAGR). Data collected at farm level and from field level, by survey work were analyzed. The proportion of black breasted silver-red plumage colour was highest for male and the buff-brown plumage colour in females at both field and farm level. Plumage pattern in males and females was birchen and shafty, respectively. Pre-dominantly red ear lobe was observed in males and white ear lobe in females. Body weight of adult male and female field birds was 1990.56 g and 1618.05 g, respectively while at the end of 40th week, male and female body weight was found to be 2001.80 g and 1593.57 g, respectively on farm. Age at first egg was found to be 6.25 and 5.67 months at field and farm level, respectively. Annual egg production recorded was 72.36 at field level and 95.04 at farm level upto 56 weeks of age. Clutch size and clutch intervals were 18.11 and 92.03 days, respectively, at field level. Egg weight and shell thickness were higher and intensity of the yolk colour was lower at farm level as compared to field level. Dressing percentage was higher in males as compared to the females. Fertility and hatchability were higher at field level as compared to farm level for Aravali breed of chicken.

Key words: Aravali breed of chicken, Carcass characteristics, Growth characteristics, Phenotypic traits, Plumage.

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Introduction

India possesses the rich sources of genetic diversity particularly for poultry, cattle, buffalo, sheep, goat etc. Chicken rearing plays an important socio-economic role for rural people. In India, chicken rearing is widespread in many rural families. They provide valuable sources of protein and income. Currently, the total chicken population in India is about 851.81 million. Out of which backyard or rural poultry has the population of 317.07 million which shares 37.22 % of total poultry production and increased by 45.8 % from previous census (Livestock Census, 2022). Due to low genetic potential, prevalence of diseases and predators, limited feed resources, socio-economic and infrastructure practices, the economic contribution of indigenous chicken is not proportional in comparison to commercial poultry farming. The increased global use of highly productive breeds has continuously replaced indigenous breeds which has led huge threat and pressure to the indigenous chicken populations. Consequently, the genetic merits of indigenous chicken populations have been diluted with exotic breeds (Tadele *et al.,* 2018). In the recent years, some studies have started to describe the phenotypic characters of native chickens based on quantitative (morphometric) and qualitative (discrete) characters. Local Indian chickens have specific phenotypic characteristics; therefore, specific phenotypic characterization is required to identify the genetic diversity of the local chicken population and for the development of a germplasm. Therefore, this study was undertaken for phenotypic characterization of native chicken (Aravali breed) of North Gujarat, India.

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Materials and Methods

Description of Study Location

The study was carried out in Banaskantha, Sabarkantha, Aravalli and Mahisagar districts of North Gujarat (India) for field level data of Aravali breed of chicken. Farm level data were collected from Poultry Research Station of Anand Agricultural University (now Kamdhenu University), Anand for comparison. Banaskantha is located in North latitude 24.1023°N and East longitude 72.2553°E, Sabarkantha in North latitude 23.03°N and East longitude 73.39°E, Aravalli in North latitude 24.0283°N and East longitude 73.0414°E while

Mahisagar in North latitude 23.1711°N and East longitude 73.5594°E. Gamar, Rohishah, Begadiya, Parmar, Khokhariya, Damor, Parghi, Kankodia, Muli, Solanki, Chauhan, Vanjara etc. communities are spread across North-Eastern region of Gujarat and are responsible for conserving this breed. Of these, most of them belong to tribal community and non-migratory with low to medium economic status. Their main source of income is from agriculture and subsidiary income is from livestock and poultry. Most of the women from the family are engaged with backyard poultry activities.

Sample and Flock Size of the Field Level Data

The survey of total 308 farmers was done and the data of 1052 number of male birds and 2442 number of females were collected at field level. Total chicken population was 5099 with average flock size of 16.56 birds per farmer at field level. Observations on phenotypic characteristics, growth and production performance, and carcass quality were recorded as per the NBAGR format. Data was analyzed using descriptive statistics and compared with those obtained from Poultry Research Station.

Results and Discussion

Physical Characters

The factors affecting the variation in phenotypic characteristics are genes and environmental conditions (Fayeye *et al.,* 2006; Mahfudz *et al.,* 2011). One way to identify the various types of chicken is by observing quantitative physical characteristics like body weight, plumage color, comb colour and other properties that can be measured qualitatively (Nthimo *et al.,* 2004).

Plumage colour and pattern (Table 1): The proportion of black breasted silver-red plumage colour was highest followed by brown breasted golden red in males, while in females, the proportion of buff-brown plumage colour was highest followed by silver black both at field and farm level. Dominant colorations in hens could be due to varying levels of melanin pigments, *i.e.,* eumelanin and phaeomelanin, in the plumage which are responsible for black, gray, brown and other earth-tone colors in avian plumage (Paxton, 2009). Plumage coloration manifested highest total frequency in similar discrete phenotypic traits and this may indicate that plumage coloration, among others, is the best distinguishing character of sexual dimorphism among traditional chickens in all districts of Eastern Samar of Philippines (Picardel *et al.*, 2015). Faruque *et al.* (2010) observed black brownish plumage colour followed by white with black tips. Picardel *et al.* (2015) observed that red plumage consistently posted the highest frequency in all roosters across districts (18%), while brown plumage showed similar pattern among hens across the North district, Central district and South district in Eastern Samar of Philippines. Tadele *et al*. (2018) studied red pre-dominant colour of males and females characterized by reddish brown plumage. Rotimi *et al*. (2016) found the birds with only mixed plumage colour in their native chicken.

In Aravali breed under study, the proportion of birchen pattern was highest at field and farm level in males, while in females the shafty pattern was highest followed by laced pattern at field and farm level.

Skin, shank, ear lobe and eye colour (Table 2): In males of native chicken, major proportion of skin colour was white followed by yellow at field and farm level, while in females major proportion of skin colour was white at both field and farm level. Picardel *et al.* (2015) also consistently registered highest frequency of white skin colour with 92%. Rofii *et al.* (2018) reported black and pale white skin colour in various types of hens, *i.e.* Cemani, Black kedu, White kedu and Olagon in Indonesian native chickens.

Major proportion of shank was of yellow colour at field and farm level in males and females. This type of deviation from the black or gray-colored tarsus shank is an indication of gene introgression from domestic chickens (Condon, 2012). Tadele *et al*. (2018) found yellow as pre-dominant colour in males, while in females prominent white skin colour was observed. Major proportion of white shank colour followed

Table 1: Plumage colour and plumage pattern of Aravali chicken breed

Plumage colour in Males (In percent)			**Plumage colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Black Breasted Silver-Red	56.09	68.38	Buff Brown	48.56	46.05
Brown Breasted Golden-Red	41.82	29.41	Silver Black	25.14	29.21
Others	2.09	4.41	Brown	10.16	1.32
			Black	5.69	5.79
			Red	4.75	2.37
-	-	-	White	3.93	1.58
			Others	1.76	13.76
Plumage pattern in Males (In percent)			**Plumage pattern Females (In percent)**		
Pattern	**Field**	**Farm**	**Pattern**	**Field**	**Farm**
Birchen	67.11	53.67	Shafty	46.40	43.92
Speckled	18.35	14.71	Laced	32.06	34.66
Mottled	7.60	19.85	Speckled	8.35	8.20
Barred	3.80	11.76	Penciled	5.81	1.59
Others	3.14	0.00	Barred	4.05	1.85
-	-	-	Others	3.32	9.79

by yellow was also observed by Faruque *et al.* (2010). Mixed type of shank colour was observed by Picardel *et al.* (2015) in North, Central and South Districts in Eastern Samar of Philippines. Rofii *et al.* (2018) reported black, white and yellowish shank colour in various types of Indonesian native hens, *i.e.* Cemani, Black kedu. Tadele *et al.* (2018) found pre-dominantly yellow colour in males with 69.30%, 55.00% and 52.50% in Decha, Chena and Gimbo districts, while in female white shank colour was found to be dominant with the proportion of 33.20% and 40.60%, in Decha and Chena districts of Euthopia.

Major proportion of ear lobe colour was pre-dominantly red in males and white in females at both field and farm level. Similar types of results were observed by Picardel *et al.* (2015), who recorded most dominant ear lobe colorations of mixed red and white in Eastern Samar of Philippines. Faruque *et al.* (2010) noticed higher proportion of white ear lobe colour followed by admixture of red and white. Tadele *et al.* (2018) noticed red ear lobe colour. Rotimi *et al.* (2016) found majority of white ear lobe colour (79.37 %) followed by red ear lobe (20.63 %), while Dahloum *et al.* (2016) observed white ear lobe colour in native birds of northwest of Algeria.

Major proportion of eye colour was of yellow at field and farm level in both males and females. Dahloum *et al.* (2016) observed major proportion of orange eye colour in males and females, while Rofii *et al.* (2018) reported pre-dominantly black dominant, wide black/orange, small black/orange eye colour in various types of Indonesian native hens.

Comb colour, type and size (Table 3): Major proportion of comb was red colour at field and farm level in males and females. Similar results were observed by Faruque *et al.* (2010) and Dahloum *et al.* (2016) with major proportion of red comb

Table 2: Skin, shank, ear lobe and eye colour of Aravali chicken breed

Skin colour in Males (In percent)			**Skin colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Yellow	43.25	**38.97**	Yellow	20.80	22.63
White	56.75	**61.03**	White	79.20	77.11
Shank colour in Males (In percent)			**Shank colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Yellow	51.05	75.74	Yellow	49.67	79.74
Slate	25.76	13.24	Slate	34.03	13.95
White	23.19	11.03	White	16.30	5.79
Ear-lobe colour in Males (In percent)			**Ear-lobe colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Pre-dominantly white	1.33	8.09	Pre-dominantly white	56.31	60.53
White	3.42	3.68	White	6.18	7.37
Pre-dominantly red	82.41	55.10	Pre-dominantly red	3.32	27.89
Red	12.83	33.09	Red	34.19	3.68
Eye colour in Males (In percent)			**Eye colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Yellow	97.24	94.85	Yellow	97.91	94.21
Red	2.76	5.15	Red	2.09	5.23
Others	2.00	4.42	Others	0.98	1.05

Table 3: Comb colour, type and size of Aravali chicken breed

Comb colour in Males (In percent)			**Comb colour in Females (In percent)**		
Colour	**Field**	**Farm**	**Colour**	**Field**	**Farm**
Red	96.58	89.71	Red	98.53	95.52
Pale pink	3.42	10.29	Pale pink	1.47	4.48
Comb type in Males (In percent)			**Comb type in Females (In percent)**		
Type	**Field**	**Farm**	**Type**	**Field**	**Farm**
Single	90.30	78.67	Single	95.37	91.05
Strawberry	1.52	3.68	Strawberry	0.45	3.68
Rose	1.81	2.21	Rose	1.47	1.05
Pea	4.37	11.03	Pea	1.72	2.63
Others	2.00	4.42	Others	0.98	1.05
Comb size in Males (In cm)			**Comb size in Females**		
Field	**Farm**	**Field**	**Farm**	**Field**	**Farm**	**Field**	**Farm**
Average Length		**Average Height**		**Average Length**		**Average Height**	
12.52	12.89	6.82	6.86	4.28	4.43	2.06	2.32

colour, while Rofii *et al.* (2018) reported pre-dominantly black and red comb colour in various types of Indonesian native hens, *i.e.* Cemani, Black kedu, White kedu and Olagon.

Major proportion of comb type in Aravali birds was single comb at field and farm level in both males and females, which concurred with similar observations of Faruque *et al.* (2010), Rotimi *et al.* (2016) and Tadele *et al.* (2018). Picardel *et al.* (2015) also recorded highest single comb pattern. Dahloum *et al.* (2016) observed other major types of comb than rose or pea in native birds of northwest of Algeria.

The average comb length of Aravali male bird was 12.52 cm for field and 12.89 cm for farm birds while average comb height was 6.82 cm for field and 6.86 cm for farm birds. The average comb length of female was 4.28 cm for field and 4.43 cm for farm birds, while average comb height was 2.06 cm for field and 2.32 cm for farm birds. Faruque *et al.* (2010) measured average length 5.08 cm in females, which was lower as compared to the present finding.

Production Performance and Egg Quality Traits

Age at first egg was found to be 6.25 and 5.67 months at field and farm level, respectively (Table 4). Faruque *et al.* (2010) recorded age at first egg of 22.11 weeks. Annual egg production was 72.36 and 95.04 eggs at field and farm level upto 56 weeks of age, respectively. Tadele *et al.* (2018) recorded 44.00 eggs per year which was less than the present observation. Clutch size was 18.11 days and clutch interval 92.03 days at field level in Aravali breed.

Egg weight and shell thickness were higher at farm level (42.15 g and 0.38 mm) as compared to field level (39.09 g and 0.32 mm) (Table 5). Egg weight of 42.47 g was also recorded by Faruque *et al.* (2010). Intensity of the yolk colour and Haugh unit were lower at farm level (5.71 and 71.11) as compared to field level (10.92 and 78.66) in Aravali breed.

Reproductive Characteristics

Fertility of eggs was 86.59 % and 67.74 % for field and farm eggs. Hatchability on the basis of fertile egg set from farm eggs was 79.27%, while hatchability on the basis of total egg set was 86.59 % (field eggs) and 53.70 % (farm eggs) (Table 6). Faruque *et al.* (2010) observed fertility and hatchability of 88.72 % and 75.03 %, respectively, in Bangladesh native birds. Tadele *et al.* (2018) also observed 80.50 % hatchability in their study area.

Table 4: Egg production traits of Aravali chicken breed

Egg production characteristics		Source	Average	Range	N
a.	Age at first egg (months)	Field	6.25 ± 0.03	5 -7	308*
		Farm	5.67±0.02	4.50-8.68	902**
b.	Annual egg production (no.)	Field	72.36 ± 0.60	40 - 100	308*
		Farm	95.04±1.24***	11-178	576**
c.	Clutch size (days)	Field	18.11 ± 0.15	10-30	308*
d.	Clutch interval (days)	Field	92.03 ± 0.42	75 -120	308*
e.	Laying cycle (months)	Field	12.43 ± 0.11	9-18	308*

*No. of farmers, **No. of birds, ***up to 56 wks.

Table 5: Egg quality traits of Aravali chicken breed

Trait	Farm		Field	
	Average	Range	Average	Range
Egg weight (g)	42.15±0.36	34.40-1.70	39.09±0.52	27.90-46.40
Shell weight (g)	5.35±0.05	4.10-6.90	5.33±0.07	3.90-6.20
Albumen weight (g)	21.78±0.38	12.90-2.00	18.71±0.43	11.20-25.90
Yolk weight (g)	15.01±0.14	10.10-8.40	15.02±0.23	8.30-17.60
Shell thickness (mm)	0.39±0.00	0.28-0.48	0.32±0.00	0.28-0.39
Specific gravity	1.079±0.00	1.060-1.08	1.078±0.001	1.050-1.08
Albumen length (mm)	85.7±0.56	65.08-99.59	86.74±0.78	76.00-101.00
Albumen width (mm)	65.5±0.56	47.74-80.18	66.82±0.73	58.00-80.00
Albumen height (mm)	4.39±0.06	2.72-6.59	5.29±0.19	2.58-8.98
Albumen index	6.74±0.11	4.11-9.70	8.00±0.32	3.44-13.82
Yolk length (mm)	43.52±0.30	34.48-55.59	41.40±0.65	30.00-52.00
Yolk width (mm)	39.62±0.17	33.88-44.12	39.12±0.52	33.00-48.00
Yolk height (mm)	14.45±0.14	12.16-16.99	15.27±0.26	10.03-17.10
Yolk index	36.54±0.40	28.21-50.15	39.54±0.96	23.64-48.46
Haugh unit	71.11±0.53	52.86-86.02	78.66±1.37	49.39-99.75
Yolk colour	5.71±0.14	3.00-9.00	10.92±0.16	9.00-13.00

Growth Performance, Mortality and Carcass Characteristics

Day old weight of males and females was 27.57 g & 25.32 g, respectively, at farm level, whereas day old body weight was 23.43 g of straight run birds at field level. Faruque *et al*. (2010) reported higher day old weight than the present finding. Body weights at 8, 12, 16, 20 and 40 weeks of age for males were significantly higher than respective weights of female birds, and it also increased significantly with advancing age in both the sexes (Table 7). Body weight of adults at field level for males and females was 1990.56 and 1618.05, respectively. Faruque *et al*. (2010) recorded 1.54 kg adult body weight in Bangladesh native birds. Picardel *et al.* (2015) recorded non-significant difference of 1.12 kg, 1.15 kg and 1.11 kg of body weight in birds of North, Central and South districts in Eastern Samar of Philippines, respectively. Rotimi *et al.* (2010) found 1.23 kg body weight of female and 1.38 kg of male. Above mentioned scientists found lower body weight than the present findings of Aravali breed.

Average farm mortality in S2, S3 and S4 generations was 15.75 %, 6.75 % and 5.26 % (Table 8). Tadele *et al.* (2018) reported less survivability than the present study, *i.e.* 49.20% mortality in the Decha, Chena and Gimbo districts of Ethiopia.

Average hot and cold dressing percentage for males from field were 82.42 and 81.54, while for females these were 78.54 and 77.43 percentage, respectively. On farm, the hot and cold dressing percentages for males were 85.27 and 75.18, while for females these were 75.66 and 67.32 percentage, respectively (Table 9).

Table 6: Reproduction characteristics of Aravali chicken breed

Trait	Source	Mean	Range	N
Broodiness (usual/sometimes/rare/other)	Field	Usual	-	-
Fertility of eggs	Field	86.59%	50-100	308
	Farm*	67.74%	53.69-80.25	6817
Hatchability on fertile egg basis	Field	-	-	-
	Farm*	79.27%	75.42-81.57	4618
Hatchability on total egg basis	Field	86.59%	50-100	308
	Farm*	53.70%	43.43-65.45	6817

*Pooled over 3 generations

Table 7: Growth characteristics of Aravali chicken breed

Body weight trait	Male			Female		
	Average	Range	N	Average	Range	N
Hatching (g) Farm*	27.57±0.30	20-34	100	25.32±0.21	20-31	100
Hatching (g) Field	23.43±0.28#	17-40	361	-	-	-
8 week (g) Farm*	473.18±10.54	246-710	100	419.98±8.65	174-600	100
12 week (g) Farm*	751.76±8.04	538-968	100	741.76±8.04	528-958	100
16 week (g) Farm*	1167.56±29.17	690-1672	100	1045.92±4.73	890-1329	400
20 week (g) Farm*	1735.78±10.16	1540-1979	100	1445.97±4.74	1290-1729	300
40 week (g) Farm*	2001.80±48.86	1456-2652	50	1593.57±11.85	1038-2692	383
Adult (g) Field	1990.56±35.79	1440-2624	100	1618.05±24.66	1062-2290	100

*S5 Generation, # Straight run

Table 8: Mortality in Aravali chicken breed

Mortality (%) - Farm (Pooled over 3 generations - S2 to S4)						
Age groups	**S2**	**S3**	**S4**	**Pooled mean (%)**	**Range (%)**	**N**
0-8 weeks	7.98	18.40	20.87	15.75	7.98-20.87	3550
9-16 weeks	4.68	6.12	9.45	6.75	4.68-9.45	3005
17-40 weeks	2.74	1.49	11.55	5.26	1.49-11.55	2859

Table 9: Carcass characteristics of Aravali chicken breed (Mean ± SE, n=8 each)

Trait	Male				Female			
	Hot		Cold		Hot		Cold	
	FD	FR	FD	FR	FD	FR	FD	FR
Carcass weight (g)	1770.88 ±25.72	1751.25 ±58.96	1752.50 ±31.44	1545.63 ±59.63	1100.50 ±53.17	1104.50 ±35.82	1084.75 ±51.57	983.25 ±32.89
Dressing Percentage (%)	82.41 ±1.91	85.27 ±0.96	81.54 ±2.00	75.18 ±0.97	78.54 ±1.63	75.66 ±1.14	77.43 ±1.54	67.32 ±1.65

Field=FD, Farm=FR

Conclusions

Based on phenotypic and performance characters of Aravali breed of North Gujarat, it was concluded that plumage colour of male was highly characterized by black-breasted silver red followed by brown-breasted golden red, while in female highest frequency of plumage colour was buff-brown followed by silver black. The highest proportion of plumage pattern was birchen in males and shafty in females followed by laced plumage pattern. Proportion of white skin colour was higher in males and females. Yellow colour of shank was found highest in males and females. In males, pre-dominantly red ear lobe was found, while in females ear lobe was pre-dominantly white. Comb colour was red and comb type was single in major proportion in males and females. Yellow eye colour was in highest proportion in both males and females. AFE was higher in the field birds while egg production was higher in the farm birds. Fertility % and hatchability % on the basis of total egg set was found to be higher in field birds. Dressing percentage was higher in males than the females. Looking to all these differentiating characters, this native chicken has been recently registered as "Aravali" a new chicken breed of Gujarat, by ICAR-NBAGR, Karnal (Haryana).

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