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Characterization of *Ghagus* breed *vis-a-vis* PD–4 birds for production, adaptability, semen and egg quality traits

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ABSTRACT

The present study was conducted to characterize *Ghagus*, a native breed of chicken for production, adaptability, semen and egg quality traits in comparison with PD4 birds. Sex wise body weight and shank length of *Ghagus* birds recorded at 40 weeks of age were significantly lesser than those of PD4 birds. *Ghagus* birds had significantly higher tonic immobility (TI) duration and asymmetry of shank length than those of PD4 birds but no differences were observed for number of attempts to induce TI and asymmetry of shank width and middle toe length. Mean shank width and middle toe lengths were significantly higher in PD4 birds. *Ghagus* birds produced significantly lesser number of eggs up to 40 weeks of age with smaller egg size. With respect to semen quality traits, *Ghagus* roosters had significantly better appearance and concentration of spermatozoa than PD4 birds. Study of egg quality traits revealed significantly better albumen index in *Ghagus* as compared to PD4 birds. However, significantly higher egg weight, yolk, albumen and shell weights were observed in PD4 birds as compared to *Ghagus* breed with no significant differences in other egg quality traits. The study indicated that, there is a scope for improvement of this important native chicken breed for growth and production traits as semen and egg quality traits were at desirable levels.

Key words: Adaptability, Egg quality, *Ghagus*, PD4, Production, Semen

Ghagus is one of the important native chicken breeds of India (Singh and Singh 2000). Its native tract is located in Kolar district of Karnataka and adjoining border areas of Andhra Pradesh and Karnataka (Vij *et al*. 2006). It is a medium size bird with good mothering ability and broodiness character. Male birds of this breed are morphologically characterized by the shining bluish black feathers on tail (Sickle feathers) and golden yellow feathers at neck and wings. Female birds have mostly brown plumage mixed with black and white coloured feathers. Pea comb is predominantly observed but single and strawberry combs are also noticed. Ear lobes are red while wattles are absent and skin is yellow or white in colour (Anonymous 2011). Native chicken breeds are increasingly facing the threat of genetic erosion/dilution due to large scale introduction of high yielding varieties or crosses in order to increase productivity of backyard system of poultry production. This is a gravest concern as 30% of poultry breeds are at risk and 9% are already extinct globally. Further the proportion of breeds at risk and extinction are highest in chickens (Hoffmann 2009). Situation is similar in India as well. Therefore, native breeds need to be conserved in pure form at least in *ex-situ* for future needs in genetic improvement programs. Alternatively, genetic improvement of native chicken breeds through selective breeding could be used to increase the productivity of backyard/free range farming without increasing the production cost or loss of biodiversity (Magothe *et al*. 2012). Thus, efforts are being made to conserve *Ghagus* breed under intensive system of rearing at ICAR-Directorate of Poultry Research, Hyderabad so as to use this population for genetic improvement in future. Adaptability of native birds to intensive system of rearing is another issue that needs to be studied as it will aid in successful conservation at new location. However, there is a paucity of information in the literature about the performance of this breed with respect to traits of economic importance. Therefore, the present study was carried out to characterize *Ghagus* breed of chicken for production, adaptability to intensive system of rearing, semen and egg quality traits *vis-a-vis* PD4 breed under similar management conditions.

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MATERIALS AND METHODS

Experimental animals and management conditions: Ghagus breed of chicken is being conserved by procuring fertile eggs of this breed from farmers of its native breeding tract i.e., Bangarpet, Mulabagilu and Kolar taluks of Kolar district of Karnataka. This study was undertaken in second

generation under intensive system of rearing while PD4 birds evolved from *Aseel* (Peela) breed was undergoing mild selection for higher body weight at 16 or 8 weeks of age for four generations. The experiment was conducted at Institute farm. Birds of both breeds were hatched simultaneously, wing banded and reared in deep litter system up to 20 weeks of age. Chicks were provided layer chick starter ration [2600 kcal/kg metabolizable energy (ME) and 18% crude protein (CP)] up to 8 weeks of age and grower ration (2,500 kcal/kg ME and 16% CP) from 9 to 20 weeks of age in *ad lib*. At about 20 weeks of age, male birds were housed in male cages and female birds were housed in individual (layer) cages in separate houses and layer ration (2,600 kcal/kg ME and 16% CP) was provided from the onset of egg production till the completion of experiment. Light for 16 h (including natural day light) was provided during laying period. Management and rearing conditions during the period of experiment were similar for both genetic groups. On the day of hatch chicks were vaccinated against Marek's disease and subsequently birds were protected against important diseases like RD, IBD and fowl-pox using standard vaccination program.

Growth and production traits: Body weight of individual birds of both sexes were recorded at 40 weeks of age to the nearest of 1 g accuracy. Shank length of female birds were measured at 40 weeks of age to the nearest of 0.1 mm using digital vernier callipers. Egg production was calculated by averaging egg produced by each hen up to 40 weeks of age, while egg weight was recorded to the nearest of 0.1g accuracy by taking average weight of eggs laid by each hen during 40th week of age.

Adaptability traits

Tonic immobility duration: Base level of fear response was measured in 24 *Ghagus* and 25 PD4 male birds as per Jones and Faure (1981) through the duration of Tonic Immobility (TI). Values of TI duration were transformed logarithmically before they were subjected to data analysis.

Asymmetry: Shank length and width of shank at fur and middle toe length of male birds were measured at 40 weeks of age to the nearest of 0.1 mm using digital vernier callipers. Asymmetry of shank length, shank width and middle toe length were determined by subtracting the figures of right with left rear limbs.

Semen quality traits: Semen quality analysis was carried out in 20 cocks each from *Ghagus* and PD4 birds at 40 weeks of age. Semen was collected following standard practice of massage method (Burrows and Quinn 1937) from cocks of each genetic group housed in individual cages. The collection and examination of the semen were done by single investigator during the study to avoid biasness. The semen was collected in sterile glass funnels and the volume of semen ejaculate was assessed by drawing the collected sample into 1 ml syringe with an accuracy of 0.02 ml. The appearance of semen was scored on a scale of 1 to 5 by visual examination (McDaniel and Craig 1959). Subsequently, individual samples were diluted four times using high temperature diluent (suitable for storing semen at 20 or 40°C) having NaCl, glucose and TES (Chaudhuri and Lake 1988) which was then used for evaluation of semen quality traits. Individual motility of spermatozoa was assessed as percentage of progressively motile spermatozoa by following the light microscopy method. The concentration of spermatozoa was estimated by the method described by Taneja and Gowe (1961) using a colorimeter. Proportions of live and abnormal spermatozoa were estimated by differential staining technique using eosin–nigrosin stain (Campbell *et al*. 1953).

Egg quality traits: External and internal egg quality traits were studied at 40 weeks of age. A total of 58 eggs from *Ghagus* and 60 eggs from PD4 were used for the study of egg quality traits. The external egg quality traits such as shape index were measured while internal egg quality traits like albumen index, yolk index, Haugh unit, and yolk colour were recorded using standard procedures. Percent albumen, percent yolk and percent shell weights were also recorded. Length and breadth of eggs were measured using digital vernier callipers (least count 0.01mm).

Feed intake: Average daily feed intake of *Ghagus* female birds was determined during 21 to 40 weeks of age in individual cages.

Statistical analysis: The means and standard errors of various traits were calculated as per the standard statistical procedures using Excel (MS Office 2010) software. Means of various traits between two genetic groups were compared using '*F*' test or students' 't' test (Snedecor and Cochran 1994).

RESULTS AND DISCUSSION

Native chicken breeds due to their unique attributes such as hardiness, desirable flavour of meat and eggs, coloured plumage and ability to thrive on meagre feed resource are gaining attention for conservation and development of improved or suitable varieties for low input free range or backyard system of poultry farming. *Ghagus* is one of the important native chicken breeds of India which was recently collected and reared under intensive system of rearing. There was a need for characterization for various economic traits before this population is being subjected for improvement program. Results of growth and production traits are presented in Table 1. Body weight ($P<0.0001$) and shank length of male ($P<0.033$) and female birds of *Ghagus* at 40 weeks of age were significantly lesser than those of PD4 birds. Shank width and middle toe lengths were also significantly higher in PD4 birds. This finding is on expected line since, *Ghagus* birds are medium sized birds while PD4 birds evolved from *Aseel* (Peela) breed are meat type game birds and hence they are expected to have higher body weight and shank length. Body weights of *Ghagus* observed in this study were higher than those reported by Vij *et al*. (2006) for same breed recorded under field conditions. When compared to other native breeds, body weight, shank length and middle toe lengths of *Ghagus* were higher than those reported for Kadankanth and Miri breeds

Table 1. Comparative performance of *Ghagus* and PD4 hens

Parameters		*Ghagus*	PD4	P value
Body weight at 40 wks of age (g)	Males	2537±46.98 [b]	2819±22.6 [a]	0.0001
	Females	1609±36.3 [b]	1832±12.8 [a]	0.0001
Shank length at 40 wks of age (mm)	Males	127.9±0.79 [b]	129.5±0.43 [a]	0.0333
	Females	100.3±0.61 [b]	105.7±0.33 [a]	0.0001
Survivors' egg production up to 40 wks (Nos.)		29.58±1.81 [b]	50.90±1.43 [a]	0.0001
HDEP up to 40 wks of age (Nos.)		32.24	50.66	-
HHEP up to 40 wks of age (Nos.)		28.95	47.58	-

Wks, Weeks; HDEP, Hen Day Egg Production; HHEP, Hen Housed Egg Production.

under intensive system of rearing at same age (Haunshi *et al*. 2011, Haunshi *et al*. 2009).

Fear and social reinstatement behaviour are the indicators of general adaptability in chicken (Faure and Millis, 2014). High level of fear evidenced by higher tonic immobility (TI) duration may impair the ability of birds to adapt to environmental change and utilize new resources (Jones 1996). Study of the adaptability traits (Table 2) revealed that TI duration and asymmetry of shank length were significantly (P<0.030) higher in *Ghagus* birds as compared to their PD4 counterparts. TI duration is a measurement of the fearfulness (Gallup 1979) and it could be used as criterion for measuring the level of stress of the birds. Similarly, the magnitude of asymmetries might be used as a valid measure of stress and as a means of identifying the optimal rearing conditions (Satterlee *et al.* 2000. Higher the adaptability lesser will be the stress and hence lesser TI duration and asymmetry. These findings suggest that *Ghagus* birds may need somewhat more time to adapt to the intensive system of rearing as they were recently (two generations before) procured from field when compared to PD4 birds which have undergone several generations of rearing in intensive system.

Survivors' egg production up to 40 weeks of age in *Ghagus* was significantly (P<0.0001) lesser than that of PD4 birds. Similarly, hen day and hen housed egg production up to 40 weeks of age were also lesser in *Ghagus* than that of PD4 birds (Table 1). Most of the *Ghagus* birds were exhibiting broodiness characters as compared to PD4 birds. Egg production and broodiness traits are negatively correlated and hence, lesser egg production was noticed in *Ghagus* birds. However, broodiness trait in native chickens is a desirable trait under field conditions for self multiplication and therefore this trait needs to be maintained in this breed. When compared to other native breeds egg production of *Ghagus* was lesser than those reported for Kadankanth, Miri and Nicobari breeds (Haunshi *et al*. 2011, Haunshi *et al*. 2009, Chatterjee *et al*. 2007).

Daily feed intake pattern of *Ghagus* birds during 21–40 weeks of age was presented in Fig. 1. There was a definite trend in the feed intake of birds as it has increased from 103.2 g at 21 weeks of age to 110.2 g at 30 weeks of age and there after it started declining and reached to lowest feed intake (87.79 g) during 36 weeks of age and maintained at 99 g during 39– 40 weeks of age. This kind of declining trend in feed intake could be attributed to increasing broodiness observed during this period. Broody hens stop laying eggs and will have reduced activity (standing and moving) and hence, their requirement of nutrients decreases and hence results in reduced feed intake. Average daily feed intake per bird during 21–40 weeks of age of this breed (101.5±1.6 g) was lesser than that of PD4 birds (107 g) as reported previously (Haunshi *et al*. 2012).

Results of egg quality traits studied at 40 weeks of age are presented in Table 3. Egg weight, albumen, yolk and shell weights were significantly (P<0.001) lesser in *Ghagus*

Table 2. Adaptability traits in *Ghagus* and PD4 male breeds

Parameters	*Ghagus*	PD4	P value
TI duration (log)	2.10±0.05 [a]	1.93±0.07 [b]	0.030
TI duration (s)	145.3±15.2	118.4±18.9	-
TI Attempts (Nos.)	1.27±0.09	1.41±0.14	0.211
Asymmetry of shank length (R-L) (mm)	0.64±0.34 [a]	–0.34±0.48 [b]	0.030
Asymmetry of shank width (R-L) (mm)	1.10±0.28	0.94±0.25	0.334
Asymmetry of middle toe length (R-L) (mm)	0.08±0.24	0.10±0.24	0.474
Shank width (R+L)/2 (mm)	14.4±0.31	16.1±0.20 [a]	0.0001
Middle toe length (R+L)/2 (mm)	44.6±0.54	47.4±0.43 [a]	0.0002

R, right; L, left.

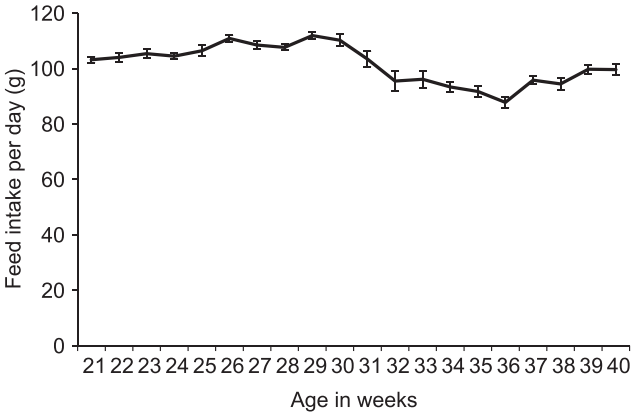

Fig. 1. Average daily feed intake of *Ghagus* hens during 21–40 weeks of age.

Table 3. Egg quality traits of *Ghagus* and PD4 breeds at 40 weeks of age

Traits	*Ghagus*	PD4	P value
Egg weight at 40 weeks (g)	45.67 ± 0.52[b]	50.26 ± 0.45[a]	0.001
Shape index	76.26 ± 0.46	76.74 ± 0.44	0.223
Yolk colour	7.60 ± 0.16	7.13 ± 0.18	0.027
Haugh unit	80.02 ± 1.03	82.02 ± 1.08	0.091
Albumen index	0.098 ± 0.002 [a]	0.088 ± 0.003 [b]	0.002
Yolk index	0.44 ± 0.004	0.43 ± 0.006	0.153
Yolk weight (g)	14.74 ± 0.17 [b]	16.68 ± 0.20 [a]	0.001
Albumen weight (g)	26.57 ± 0.44 [b]	28.86 ± 0.45 [a]	0.001
Shell weight (g)	4.34 ± 0.04 [b]	4.72 ± 0.08 [a]	0.001
Shell thickness	0.331±0.004	0.335±0.004	0.271
Yolk percentage	32.41 ± 0.39	33.34 ± 0.51	0.082
Albumen percentage	58.01 ± 0.44	57.28 ± 0.54	0.152
Shell percentage	9.58±0.17	9.38 ± 0.13	0.174
Yolk to Albumen ratio	0.56 ± 0.011	0.59 ± 0.016	0.092

Table 4. Semen quality traits in *Ghagus* and PD4 breeds

Parameters	*Ghagus*	PD4	P value
Ejaculate volume (ml)	0.27±0.03	0.26±0.02	0.323
Appearance	4.25±0.19 [a]	3.55±0.18 [b]	0.006
Motility (%)	68.25±3.70	71.58±2.02	0.221
Concentration (million sperm/μL)	5.48±0.47 [a]	3.97±0.27 [b]	0.005
Live sperm (%)	89.52±0.85	89.49±1.04	0.491
Abnormal sperm (%)	2.05±0.61	1.81±0.39	0.374

as compared to PD4 birds. However, albumen index (P< 0.002) and yolk colour (P<0.027) were significantly higher in *Ghagus* birds. Egg weight and body weights are positively correlated and lesser egg weight noticed in *Ghagus* breed can be attributed to lesser body weight of this breed as compared to that of PD4 birds. Among other native breeds, egg weight of *Ghagus* was higher than those of Kadanknath, Miri and Mizo-local birds and comparable to that of Nicobari recorded at 45 weeks of age (Haunshi *et al*. 2011, Haunshi *et al*. 2010, Haunshi *et al*. 2009, Chatterjee *et al*., 2007). Most of the egg quality traits of *Ghagus* were comparable to those of Kadanknath and Nicobari breeds of chicken (Haunshi *et al*. 2011, Chatterjee *et al*. 2007) although albumen index and Haugh units were better in the *Ghagus* as compared to other native breeds. Having higher albumen index and/or Haugh unit is a desirable attribute as it is directly related with the albumen quality.

With regard to semen quality traits (Table 4), it was observed that concentration of spermatozoa (P<0.005) and appearance of semen (P<0.006) in *Ghagus* breed were significantly higher than those of PD4 birds. Semen qualities of *Ghagus* birds were by and large comparable to those reported for Kadanknath breed at 42 weeks of age (Haunshi *et al*. 2011) and 30 weeks of age (Biswas *et al*. 2009). Higher concentration of spermatozoa and appearance of semen could be responsible for better fertility reported in *Ghagus* breed as compared to PD4 birds (Haunshi *et al*. 2013).

From the results of the present study it can be concluded that there is a scope for improvement of *Ghagus* as a dual purpose bird for low input free range system of rearing as evidenced by its size and egg production. Information gathered on various production traits of this breed could be useful in deciding improvement criterion as well as documentation of its actual genetic production potential under intensive system of rearing.

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