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Improvement of PD-4 (*Aseel*), an indigenous chicken, for growth and production traits

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ABSTRACT

Backyard poultry production plays a vital role in providing animal protein at affordable and sustainable manner. Growth and production potential of indigenous chicken need to be improved through selective breeding to enhance the productivity of backyard farming. PD-4 birds (*Aseel,* indigenous breed) were subjected to selection for higher body weight over eight generations. Study investigated effect of selection on the performance of PD-4 birds with respect to economic traits. There was significant improvement in body weight and shank length at 8 weeks of age. Egg production up to 40 weeks had improved by 19.1 eggs. Egg weight at 28, 32, 36 and 40 weeks of age improved by 0.8, 1.3, 1.7 and 1.3 g respectively. Age at sexual maturity had declined by 14.2 days. There was no significant change in fertility and hatchability traits. Survivors' egg production up to 72 weeks of age was 156.5±2.79 eggs while hen day and hen housed egg production were 144.9 and 137.5 eggs respectively. Egg weight consistently improved from 35.13 g at age at first egg to 48.07 g at 40 weeks and to 49.63 g at 72 weeks of age. The study demonstrated that indigenous chickens could be improved for body weight and egg production without affecting other economic traits and improved PD-4 variety has the potential to be used as improved dual purpose indigenous chicken variety for low input backyard poultry farming.

Key words: *Aseel*, Growth, India, Indigenous, Production, Selection

Sustainable use, development and conservation of the poultry genetic resources are of vital importance to agriculture, food production, rural development and the environment (Besbes *et al*. 2007). Indigenous chickens (IC) continue to be the mainstay of self sustaining low input backyard or free range system of production in rural, tribal and semi-urban areas of the country. IC possess unique attributes such as hardiness, ability to adapt to harsh environment, broodiness, aggressiveness to protect their young ones, etc. Meat and eggs of native chicken perceived to be tastier and healthier as compared to the fast growing birds. Further, rearing of IC generate subsidiary income by utilizing minimum inputs and human attention. It also helps in gender empowerment and social upliftment of the rural/tribal people besides providing household nutritional security. However, low genetic potential is one of the constraints identified to increase the productivity of indigenous chicken besides inadequate nutrition and disease outbreaks (Magothe *et al.* 2012a). Therefore, improvement of indigenous 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*. 2012b).

Among native chicken breeds, *Aseel* is the most popular breed of India. Its breeding tract is located in Andhra Pradesh, Chhattisgarh and some parts of Rajasthan and Uttar Pradesh (Vij *et al*. 2006). At least varieties of *Aseel* breed, viz. *Peela* (Golden red), *Yakub* (black and red), *Nurie* (White), *Kagar* (black), *Sabja* (white and golden or black with yellow or silver), *Teekar* (brown) and *Reza* (light red) (Panda and Mohapatra 1989) had been reported. *Aseel* birds are known for their aggressiveness and fighting qualities but they are considered as poor egg producers with low to moderate growth rate. This breed could be the candidate germplasm for improvement of production potential through selective breeding as it is hardy, has ability to thrive under adverse rearing conditions and its meat and eggs command better price in the market. Introduction of improved varieties helps in improving the productivity of low input free range or backyard poultry farming. In the fast, few attempts were made to improve the growth of native chickens (Besbes 2009). In this paper, progress on the improvement of *Aseel* breed, designated as PD-4 with respect to body weight and egg production through selective breeding and its effect on other growth, production and reproduction traits has been presented.

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MATERIALS AND METHODS

Location of the experiment: The study on genetic improvement program was undertaken at the experimental poultry farm of the institute.

Germplasm: PD-4 evolved from *Aseel*, an indigenous breed of Indian chicken, was used in this study (Figs 1–2).

Selection criterion: The primary trait of selection practiced in this breed was mass selection for higher body weight at 16 weeks of age for initial 3 generations. Subsequently, selection criterion was changed to mass selection for higher body weight at eight weeks of age. Female birds were subjected for higher egg production up to 40 weeks of age by tandem method of selection. Hens (220–250) with higher body weight were housed at about 20 weeks of age in individual cages for recording egg production up to 40 weeks of age and 150 hens with higher egg production were selected after 40 weeks of age. Male birds were selected solely for higher body weight. Hence, in each generation about 50 males and 150 females were selected and mated in 1:3 ratio to produce the successive generations of pedigreed population.

Rearing conditions: Day–old chicks in each generation were wing banded, vaccinated against Marek's disease and reared on deep litter up to 20 weeks of age in open sided house. Mixed sex rearing was practiced up to 14–16 weeks of age. Subsequently male and female birds were reared separately. From 20 weeks onwards, female birds were reared in individual cages to record production parameters and male birds were reared in male cages in open sided houses.

The chicks were provided with *ad lib.* chick starter ration (2600 kcal/kg ME and 18% CP on calculated basis) up to eight weeks of age and grower ration (2500 kcal/kg ME and 16% CP on calculated basis) from nine to 20 weeks of age and pre-layer ration (mix of grower and layer ration in equal proportion) up to the appearance of first egg and subsequently layer ration (2600 kcal/kg ME and 16% CP on calculated basis) was provided to the birds. Feed ingredients used in ration formulations were maize, soybean meal, sunflower cake, de-oiled rice bran, salt and vitamin premix, lysine, DL methionine, trace minerals, shell grit and di-calcium phosphate. The layer ration was supplemented with extra shell grit to make the calcium content to 3.5% of the ration. Adult male birds were provided with the same layer ration with 1% calcium in the diet.

Figs 1–2. **1.** An adult PD-4 male bird, **2.** Flock of PD-4 female birds.

Traits studied: Body weight and shank length at different age were recorded respectively to the nearest of 0.1 g and 0.01 mm accuracy. Sex-wise body weight was recorded at 24 and 40 weeks of age. Shank length was also measured in male and female birds at 40 weeks of age. Age at sexual maturity, egg production up to 40 weeks of age and egg weights at 28, 32, 36 and 40 weeks of age were recorded. The weight of eggs produced consecutively for 5 days at each age was recorded using digital balance (nearest to 0.01 g accuracy). Egg production up to 40 weeks of age was recorded. All these traits were recorded at same age in each generation for 8 generations.

Statistical analysis: Means and standard errors of each trait was calculated using descriptive statistics. Regression analysis by plotting generation means over generation numbers was used to determine the significance of phenotypic response and to see the effect of on other economic traits over generations. All analyses were performed using MS Excel as per the standard statistical procedures described by Snedecor and Cochron (1994).

RESULTS AND DISCUSSION

High body weight and egg yield were reported to be the most important traits perceived to be desirable by both farmers and marketers besides disease tolerance, high growth rate, prolificacy, egg fertility, meat quality in indigenous chicken (Mahoro *et al.* 2018). The breeding objective of genetic improvement of ingenious chicken is to develop dual purpose indigenous breed with better growth and egg production potential (Dana *et al.* 2010, Okeno *et al.* 2013, Khobondo *et al.* 2014) besides retaining the traits of adaptability to local environment and disease resistance (Khobondo *et al.* 2015, Wilson *et al.* 2018). Therefore, PD-4 birds were subjected for selection to improve body weight as well as egg production for over 8 generations and effect of selection for higher body weight on performance of PD-4 birds with respect to various growth, production and reproduction traits was studied.

Growth traits (*Straight run*): There was significant (P<0.01) improvement in body weight recorded at 8 weeks of age by 113 g (Table 1). There was significant (P<0.01)

Table 1. Performance of PD-4 birds with respect to various growth traits in different generations on pooled sex

Generation	Body weight (g)		Shank length (mm)
	8 weeks	16 weeks	8 weeks
S-1	–	1110±7.90	–
S-2	–	1224±9.10	–
S-3	452.4±3.50	1170±8.89	69.8±0.30
S-4	428.4±3.88	1071±7.92	71.4±0.28
S-5	461.2±2.74	1197±7.31	73.4±0.19
S-6	473.4±2.58	–	74.7±0.17
S-7	554.5±2.97	–	79.1±0.18
S-8	565.4±3.21	–	79.2±0.19

improvement in body weight recorded at eight weeks of age by 113 g. Similarly, shank length measured at 8 weeks of age also improved significantly (P<0.0007) by 9.4 mm. This improvement in shank length was on expected line as both traits were highly (positive) correlated (Unpublished data). Similar to the present findings, previous study reported that selection for higher body weight at 8 weeks of age was effective in improving the body weight of indigenous chicken of Bangladesh (Faruque *et al*. 2015). Further, body weight recorded at 16 weeks of age during earlier 5 generations also improved by 87 g.

Growth traits in adult male birds: There was significant improvement in body weight (P<0.02) and shank length (P<0.034) recorded at 40 weeks of age by 227 g and 4.7 mm respectively over eight generations (Table 2). There was also an improvement of 335 g in body weight recorded at 24 weeks of age over 5 generations. These results suggests that selection for higher body weight at early age also leads to improvement of growth traits recorded at later age as body weights at different age are positively correlated (Sang *et al*. 2006, Niknafs *et al*. 2012).

Growth traits in adult female birds: Body weight of female birds recorded at 40 weeks of age has also improved significantly (P<0.026) by 223 g over 8 generations. Shank length of female birds recorded at 40 weeks of age also improved by 1.4 mm (Table 3). There was also improvement of 167 g in body weight of female birds recorded at 24 weeks of age. Overall there was improvement in growth traits recorded at different age in female birds.

Table 2. Performance of PD-4 male birds with respect to growth traits in different generations

Generation	Body weight (g)		Shank length (mm) 40 weeks
	24 weeks	40 weeks	
S-1	1966±26.2	2827±28.0	129.3±0.43
S-2	2298±16.6	2851±23.7	-
S-3	-	2657±26.1	130.3±0.51
S-4	2155±18.2	2819±22.6	129.5±0.43
S-5	2301±17.7	2927±20.9	130.3±0.47
S-6	-	2929±18.4	131.3±0.44
S-7	-	3069±28.3	-
S-8	-	3054±30.9	134.0±0.59

Production traits: Age at sexual maturity declined by 14.2 days over 8 generations and it was mostly in the range of 162 to 180 days (Table 3). Average hen housed egg production up to 40 weeks of age improved by 19.1 eggs from 59.5 to 78.6 eggs with highest egg production being recorded in latest generation. Improvement in egg number could be explained from the fact that all male birds were subjected to selection for higher body weight while females were selected for both higher body weight at 8 weeks of age as well as higher egg production up to 40 weeks of age by tandem method of selection. Further, there was no or low correlation (phenotypic) between body weight recorded at 8 weeks of age and egg production up to 40 weeks of age as seen in this line during different generations. However, it had been reported that body weight at 16 weeks of age was positively correlated with 40 weeks egg production in Horro chicken of Ethiopia (Dana *et al*. 2011). Simultaneous improvement of both body weight at 8 weeks of age and egg production up to 40 weeks of age was observed in indigenous chickens of Bangladesh which were subjected for selective breeding (Faruque *et al*. 2015). This finding emphasise the fact that genetic improvement of indigenous chickens is possible for improving both growth and egg production traits as both traits are important in breeds developed for low input backyard poultry production.

Egg weights recorded at 28, 32, 36 and 40 weeks of age improved by 0.8, 1.3, 1.7 and 1.3 g respectively (Table 3). Egg weight at 36 (P<0.029) and 40 (P<0.018) weeks of age improved significantly over generations. Improvement in egg weight is on expected line as egg weight and body weight traits were reported to be positively correlated (Niknafs *et al*. 2012) and body weight consistently improved over generations. The present study as well as earlier studies demonstrate the fact that there is a potential to improve the performance of indigenous chicken breeds as it is evident from the response for selection to higher body weight and egg production (Faruque *et al*. 2015) due to the presence of genetic variation in indigenous germplasm (Magothe *et al*. 2012a, b).

Reproduction traits: There was no significant change in fertility status of the germplasm recorded over the generations. Highest fertility recorded was 87.0% and lowest was 80.7% with average fertility over 8 generations

Table 3. Growth and egg production traits in different generations of PD-4 female birds

Generation	Body weight (g)		SL at 40 weeks (mm)	ASM (d)	Egg weight (g)				EP to 40 weeks (Nos.)
	24 weeks	40 weeks			28 weeks	32 weeks	36 weeks	40 weeks	
S-1	1502±12.7	1850±13.7	105.6±0.54	173.9±0.86	42.6±0.30	44.6±0.28	45.8±0.27	47.6±0.34	59.5±1.37
S-2	1675±10.3	1888±12.4	106.3±0.27	162.8±0.52	43.7±0.18	44.7±0.20	-	47.3±0.28	73.3±1.33
S-3	1617±10.6	1987±13.2	106.4±0.27	162.3±0.62	42.2±0.21	44.3±0.51	45.9±0.22	47.1±0.24	52.0±1.09
S-4	1524±10.7	1831±12.8	105.7±0.33	168.6±1.16	41.6±0.28	43.3±0.29	-	48.1±0.30	50.9±1.43
S-5	1669±10.6	1905±19.0	105.0±0.28	162.3±0.81	40.9±0.25	44.5±0.27	46.1±0.30	47.5±0.33	59.7±1.67
S-6	-	1956±15.2	105.5±0.24	174.9±1.26	42.7±0.25	45.1±0.26	47.4±0.25	49.3±0.27	62.0±1.39
S-7	-	2062±13.6	106.9±0.23	180.3±0.58	44.5±0.22	47.2±0.24	48.2±0.24	48.8±0.27	69.2±1.11
S-8	-	2073±14.8	107.0±0.24	159.7±0.97	43.4±0.23	45.9±0.23	47.5±0.25	48.9±0.28	78.6±1.52

SL, Shank length; ASM, Age at sexual maturity; EP, Egg production; wks, weeks.

recorded was 83.0% (Table 4). Similarly, no significant change was observed in hatchability on total (TES) and fertile eggs set (FES). Highest and lowest hatchability recorded on FES were 83.2% and 70.7% respectively with average of 77.8%. Highest and lowest hatchability recorded on TES were 71.4% and 57.0% respectively with average of 64.6%. Fertility and hatchability of this breed were comparable with those reported for other indigenous chickens (Ndofor-Foleng *et al*. 2015). Several factors like strain, age of birds, nutrition, management, hatching conditions, season, genetic selection, etc. affect reproductive traits. Finding of no significant reduction or change in reproductive traits over the generations in spite of selection for higher body weight is in desirable direction as these traits need to be maintained at optimum level in the population. Slight variation in reproductive traits from generation to generation may be due to either environmental differences or slight difference in age at regeneration or both.

Production performance up to 72 weeks of age: Full production potential of PD-4 birds, i.e. up to 72 weeks of age in one generation was evaluated (Table 5). It was observed that birds started laying eggs at 21 weeks of age (8 eggs) and egg production peaked during 33–36 weeks (16.4 eggs) and thereafter it declined slowly up to 65–68 weeks (10.8 eggs) but again increased marginally during 69–72 weeks of age (12.4 eggs). The 72 weeks egg production was comparable with that of Nicobari breed which is reported to lay about 142 eggs in 72 weeks (Chatterjee *et al*. 2007). Egg weight consistently improved as age increased. It increased by 6.61 g from age at first egg (35.13 g) to 28 weeks (41.74 g), 1.89 g from 28 to 32 weeks (43.63 g), 4.44 g from 32 to 40 weeks (48.07 g) and by 1.56 g from 40 to 72 weeks of age (49.63 g). The trend suggests that maximum increase in egg weight happened before 40 weeks of age (12.94 g) in this germplasm. With respect to growth traits, there was a moderate improvement in body weight from 40 weeks of age (1821±0.81) to 72 weeks of age (1949±19.1 g). However, there was no significant change in shank length recorded at 40 weeks and at 72 weeks of age.

Table 4. Fertility and hatchability traits of PD-4 birds in different generations

Generation	Fertility (%)	Hatchability (%)	
		FES	TES
S-1	87.0	82.0	71.4
S-2	82.9	78.4	65.0
S-3	80.9	76.0	61.4
S-4	80.7	73.1	59.0
S-5	80.7	70.7	57.0
S-6	85.0	83.2	70.7
S-7	82.1	77.2	63.4
S-8	84.8	81.6	69.2
Average	83.0	77.8	64.6

FES, Fertile eggs set; TES, Total egg set.

Table 5. Production traits of female PD-4 birds up to 72 weeks of age (n=140)

Trait	Mean±SE
Body weight at 72 wks of age (g)	1949±19.1
Shank length at 72 wks of age (mm)	104.5±0.31
Survivors' egg production (Nos.)	156.5±2.79
Hen day egg production up to 72 weeks of age (Nos.)	144.9
Hen housed egg production up to 72 weeks of age (Nos.)	137.5
Egg weight at 72 weeks of age (g)	49.63±0.43

Indigenous chicken are the mainstay of backyard poultry production. Improvement of performance of indigenous chicken through selective breeding leads to improvement of productivity of backyard poultry farming. This in turn enhances the household nutritional and livelihood security of people in rural, tribal and semi-urban areas. The present study establishes that indigenous chicken breeds can be improved both for body weight and egg production in reasonably short period of time without adversely affecting other production and reproduction traits and this PD-4 (*Assel*) breed has the potential to be a promising dual purpose indigenous chicken variety for low input backyard farming in rural and tribal areas of the country.

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