



Evaluation of a three-way crossbred chicken developed for rural poultry under farm and backyard conditions for growth and production traits

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ABSTRACT

The growth and production performance of a promising three way cross was evaluated under farm and backyard conditions to assess its suitability as backyard chicken variety. The data generated on 200 birds from backyard and 136 birds from farm conditions was analyzed to study the effect of sex on growth and rearing system on growth and production traits. Sex had significant influence on body weights from 6 to 16 weeks of age. Sexual dimorphism was clearly observed in three-way cross with significantly higher body weights in cocks than hens under both farm and backyard conditions. The body weight of male and female birds at 16 weeks of age was 1704.12±16.89 and 1308.22±15.11 g, under farm conditions, while it was 1504.44±32.33 and 962.45±28.22 g, respectively in backyard conditions. Sex had significant effect on the shank length at all ages with longer shanks in males. The laying period body weights were significantly higher in farm reared birds. The type of rearing system significantly influenced age at sexual maturity (ASM), egg weight and egg production till 52 weeks of age. The egg production at 40 and 52 weeks of age was significantly lower in scavenging birds grown in backyard conditions. The ASM was 144.55±1.38 and 198.32±12.23 days in farm and backyard conditions, respectively. The egg production at 52 weeks of age was 146.33±4.41 and 118.40±8.11 eggs in farm and backyard conditions, respectively. The annual egg production (72 weeks of age) was 227.81±6.75 eggs in farm. The study concluded that the better performance of this three-way cross under farm and backyard system with respect to growth and egg production makes it a promising egg type variety for rural poultry farming in the country.

Key words: Backyard poultry, Crossbred, Egg production, Growth

Backyard poultry farming with improved chicken varieties has been the proven technology for livelihood and nutritional security among rural and tribal areas of the country (Rajkumar and Rama Rao 2015). Poultry production has a major role in the economy of developing countries and plays an important role in poverty alleviation by income generation and household security (Abdelqader *et al.* 2007, Sambo *et al.* 2015). Backyard poultry farming is suitable for integrated farming with any other agriculture farming/activity as subsidiary activity. Backyard poultry is considered as less expensive activity to generate highly nutritious eggs and chicken meat at minimal cost (Picciamarra and Otte 2010). Chicken crossbreds were produced using exotic breeds which are improved through selection and are being crossed to develop crossbreds for backyard poultry farming (Ayyagari 2008, Khan 2008, Padhi *et al.* 2016). Backyard chickens are excellent transformers of low value natural food base in to highly nutritious animal protein i.e. egg and meat (Rajkumar *et al.* 2010). The basic advantage of backyard poultry is that mostly the activity

has been managed by women in the family leading to women empowerment (Aklilu *et al.* 2007, Rajkumar *et al.* 2010, Sambo *et al.* 2015, Rajkumar and Rama Rao 2015). Crossbreeding is widely used in commercial production as a means of exploiting heterosis when the desired phenotype is a combination of existing lines/breeds or to impose the efficiency of the operation through the use of specialized sire and dam lines (Rajkumar *et al.* 2011). The present 3-way cross was developed and tested under intensive system (Padhi *et al.* 2016) at ICAR-Directorate of Poultry Research, Hyderabad. However, the suitability of the cross for backyard system of rearing needs to be evaluated under free range backyard conditions. Therefore, the present study was undertaken to evaluate the performance of the three-way cross both under farm and backyard conditions to find out its suitability for backyard poultry farming.

MATERIALS AND METHODS

Experimental population: A total of 352 straight run chicks produced in a single hatch were utilized to evaluate the performance of the crossbred chicken involving (PD-1 × IWI) × PD-3 lines. PD-1 was used as a male line and IWI as female line for the production of 2-way cross (PD1 × IWI). PD-1 line was developed from a mediocre coloured

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Cornish population (Ayyagari 2008) and is being improved for higher shank length at 6 weeks of age. IWI is a White Leghorn strain being improved for higher 64 weeks egg production. PD-1 × IWI cross males were crossed with PD-3 line females to produce the three way cross (PD-1 × IWI × PD-3) for colour plumage and better egg production. PD-3 was developed from Dahlem Red population and being selected for higher egg mass up to 40 weeks of age since last three generations.

Rearing and management practices: The chicks were wing banded on day one and brooded in deep litter system, with a decreasing temperature schedule from 33°C during first week to 23°C at the end of fifth week in an open-sided house. Chicks were fed *ad lib.* with layer starter ration (2800 kcal/kg ME and 20% CP) up to 6 weeks of age. Chicks were sexed at the end of the sixth week based on the morphological features. Chicks (200: 90 females and 110 males) were distributed to 20 farmers in Korravani Thanda, an adopted village of the institute. The birds were reared under free range conditions with additional supplementary feeding with available grains, rice bran, broken rice etc. The remaining 136 chicks (66 females and 70 males) were maintained at institute experimental farm under standard management practices on grower ration (2,600 kcal/kg ME and 16% CP) upto 16 weeks of age *ad lib.* At the end of 16 weeks, all females were housed in individual cages till the completion of laying cycle i.e., 72 weeks of age. All males were sold at 16 weeks of age. The female were fed with layer ration (2,700 kcal/kg ME and 18% CP) *ad lib.* during laying period. The layer ration was supplemented with extra shell grit to maintain calcium at 3.5% of the ration. The chicks were vaccinated against Marek's disease, Newcastle disease, infectious bursal disease and fowl pox.

Traits measured: Body weight were measured at 0 day, 2 and 4 weeks of age during juvenile stage on combined sex and at 8, 12 and 16 weeks of age during growing period in both the sexes. Adult body weights at 20, 40, 52, 64 and 72 weeks of age were recorded in female. Shank lengths were measured at 6, 8, 12 and 16 weeks of age in both the sexes. The production parameters like age at sexual maturity (ASM), egg weight (28, 40, 52, 64 and 72 weeks) and egg production (40, 52, 64 and 72 weeks) were recorded in hens up to 72 weeks of age in farm. The data on backyard birds were measured up to 52 weeks of age. The egg production was divided in to 4-week intervals starting from 17 to 72 weeks of age and analyzed for persistency and distribution of egg production.

Statistical analysis: The data were analysed using standard statistical methods (Snedecor and Cochran 1994). Data were subjected to single factor ANOVA model to study the effect of sex and system of rearing on different traits.

RESULTS AND DISCUSSION

The least squares means for body weights are presented Table 1. Sex had significant ($P \geq 0.05$) influence on body weights from 6 to 16 weeks of age. Sexual dimorphism

was clearly observed in three-way cross with significantly higher body weights in cocks than hens under both farm and backyard conditions. The body weights in male and female birds under free range backyard conditions were 1120.12 ± 31.21 and 820.54 ± 26.15 g at 12 weeks and 1504.44 ± 32.33 and 962.45 ± 28.22 g at 16 weeks of age, respectively. The cocks were sold at 16 weeks of age and only hens were maintained for egg production till the end of the production cycle. The sexual dimorphism observed in the present study was similar to the findings of Ajayi and Ejio (2009) and Padhi *et al.* (2012, 2016). The body weights recorded in the present cross were higher than Gramapriya and lower than Vanaraja chicken varieties developed for rural poultry (Haunshi *et al.* 2009); higher than three-way cross (Padhi *et al.* 2016); lower than two-way cross (Padhi *et al.* 2014). Higher juvenile body weights than the present findings were reported in broiler crosses (Rajkumar *et al.* 2011). Shank length is the important trait in chicken varieties developed for rural poultry for fast movement of the birds to escape from the predators in free range conditions. Sex had significant ($P \geq 0.05$) effect on the shank length at all ages with longer shanks in males (Table 1). The shanks were longer in the present cross at 8, 12 and 16 weeks of age compared to a three-way cross

Table 1. Growth performance of three-way cross under farm conditions

Trait	Female	n	Male	n
<i>Body weight, g</i>				
Day old	31.96±0.24	352		
2	115.80±1.31	341		
4	291.81±3.44	337		
6	371.22±7.34 ^b	154	589.01±6.22 ^a	182
8	683.94±11.32 ^b	66	842.40±12.21 ^a	70
12	1120.1±14.92 ^b	65	1463.4±16.32 ^a	68
16	1308.22±15.11 ^b	65	1704.12±16.89 ^a	68
<i>Shank length, mm</i>				
6	67.84±0.31 ^b	154	74.36±0.28 ^a	182
8	81.19±0.56 ^b	66	89.54±0.90 ^a	70
12	94.56±0.63 ^b	65	112.38±0.94 ^a	68
16	100.62±0.57 ^b	65	123.88±0.67 ^a	68

^{a,b}Means with different superscripts differ significantly ($P \geq 0.05$) within a row.

Table 2. Adult body weight (g) in three-way crosses hens under farm and backyard conditions

Age	Farm		Backyard	
	Mean	n	Mean	n
20 wks	1626.79±27.84 ^a	60	1122.87±44.32 ^b	81
40 wks	1901.93±40.50 ^a	57	1509.20±68.37 ^b	73
52 wks	1933.81±46.55 ^a	56	1618.52±87.11 ^b	66
64 wks	1898.33±44.51	56		
72 wks	2041.33±42.88	55		

^{a,b}Means with different superscripts differ significantly ($P \geq 0.05$) within a row.

Table 3. Production performance of 3-way crosses under farm and backyard conditions

Trait	Farm		Backyard	
	Mean	n	Mean	n
ASM, days	144.55±1.38 ^b	60	198.32±12.23 ^a	
<i>Egg weight, g</i>				
28 wks	45.34±0.52			
40 wks	54.40±0.70 ^a	55	51.89±1.22 ^b	73
52 wks	56.35±0.55 ^a	53	52.74±1.58 ^b	66
64 wks	57.58±0.70	52		
72 wks	58.05±0.67	48		
<i>Egg production, n</i>				
40 wks	84.79±3.59 ^a	55	63.34±5.67 ^b	73
52 wks	146.33±4.41 ^a	53	118.40±8.11 ^b	66
64 wks	198.95±5.67	52		
72 wks	227.81±6.75	48		

^{a, b}Means with different superscripts differ significantly ($P \geq 0.05$) within a row.

(Padhi *et al.* 2016). The present findings were in agreement with the reports of Padhi *et al.* (2016) and Rajkumar *et al.* (2017), who observed the significant effect of sex on body weight and shank length in chicken. The laying period body weights were significantly higher in farm reared birds (Table 2) which was on expected ration lines as the farm reared birds were on a balanced ration while the field birds were on scavenging with or without supplementary feeding. The adult body weights observed in the present study were lower than that of four rural crosses (Niranjan *et al.* 2008) developed for rural poultry including Vanaraja and Gramapriya, which might be due to the presence of layer inheritance in this three-way cross. The adult body weights

recorded in the present study were comparable to the findings of Padhi *et al.* (2016) in three-way cross chicken. The body weights at 72 weeks of age were reasonable which may fetch better sale price at the end of the laying cycle for the farmers.

The data on ASM, egg weight and egg productions are presented in Table 3. The type of rearing system significantly ($P \geq 0.05$) influenced ASM, egg weight and egg production till 52 weeks of age. The delay in ASM in free range conditions was obvious as the birds were on scavenging system where in nutrient requirements of birds might not have fulfilled. Higher ASM than the present results were reported by Haunshi *et al.* (2009) in Vanaraja (163.14 days); Niranjan *et al.* (2008) in Vanaraja (164.79) and Gramapriya (160.89 days); Padhi *et al.* (2016) in 3-way cross (163.14 days) under farm conditions, which might be due to the presence of layer inheritance in the present cross as layers mature at early age. The egg weights were significantly higher in farm birds, which might be due to the higher body weights of the birds. The egg weights at different ages in the present cross were lower than that reported by Niranjan *et al.* (2008) and Padhi *et al.* (2016) in rural crosses.

The egg production up to 40 and 52 weeks of age was significantly ($P \geq 0.05$) lower in scavenging birds, which might be due to the non-availability of required nutrients. The egg production up to 52 weeks of age was 118.4±8.11 eggs in the cross under backyard conditions, which is quite satisfactory for a rural chicken variety in challenging environmental conditions in the backyards. The free range birds were on scavenging feeding in the farmer's fields/backyards with varying levels of natural food base which determines the birds' performance. In addition, improper

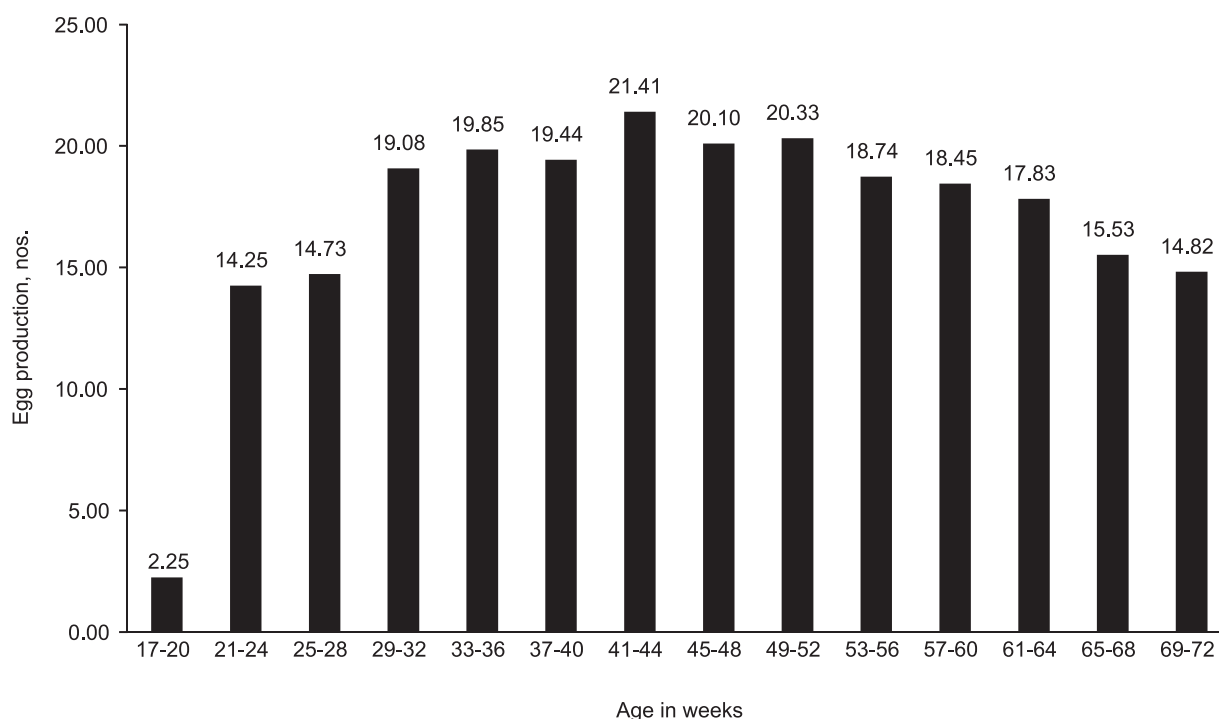


Fig. 1. Egg production per bird at 4 week intervals in farm conditions.

lighting period might be another possible reason for reduced production in free range conditions as 16 hour light is essential for proper egg production in hens (Bell 2002) which was practiced in farm conditions with artificial lighting. Therefore, supplementary feeding becomes essential for optimum production from free range birds. The distribution of egg production at four week intervals (Fig. 1) indicated that the birds were laying reasonably good number of eggs with peak production of 21.4 eggs during 41–44 weeks of age. The hens laid between 18 (29–33 weeks) to 21 (61–64 weeks) eggs per bird in 28 days indicating the high production potential of the bird (Fig. 1). The higher egg production in the cross might be due to the presence of White Leghorn (25%) and Dahlem Red (50%) inheritance, the established commercial layer strains. The production gradually reduced from 64 weeks of age in farm reared hens as age advanced. The gradual decrease in egg production towards later part of laying cycle was reported in PD-1 chicken (Padhi *et al.* 2012). Niranjan *et al.* (2008) reported higher annual egg production in Gramapriya (237 eggs) and lower egg production in Vanaraja (150 eggs) and C2 cross (209 eggs) than the present results. The annual egg production of the cross was 227.81 eggs in farm conditions, which was comparable to the results of Padhi *et al.* (2016) in three-way cross. The egg production was similar to the findings of Niranjan *et al.* (2008) in C1 cross (227) developed for rural poultry farming. The three way cross has a potential to produce 180–190 eggs, which offers a bright scope as egg type variety for rural poultry farming.

Mortality rate determines the success of poultry farming, especially backyard poultry farming. The mortality rate was 4.5% up to 6 weeks of age, which was within the permissible range during the juvenile phase in three-way cross. During the growing phase (6–18 weeks), mortality was 2.2% in farm and 8.9% in backyard conditions. The mortality was 8.3% in farm and 18.5% in backyard conditions during the laying phase. The overall mortality rates were within the admissible ranges under farm and backyard conditions making the cross suitable for rural poultry farming. Higher mortality rates than the present study were reported by Padhi *et al.* (2016) in three-way cross in farm and Padhi *et al.* (2014) in two-way cross under field conditions.

The present study concluded that the performance of three-way cross under farm and backyards was better with respect to growth and egg production, which make this cross a promising egg type rural chicken variety for backyard poultry farming in rural and tribal areas of the country.

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