Full Length Article

SELECTIVE BREEDING TO IMPROVE GROWTH AND REPRODUCTIVE TRAITS OF WHITE GUINEA FOWL

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ABSTRACT

To improve the production performance of white Guinea fowl, selective breeding was carried out continuously for six generation. A total 1000 Guinea fowl hatching eggs were procured from various government institutions and private entrepreneurs, and subsequently keets were hatched out and base population was created. The production traits were given due importance during selective breeding for six generations to improve both body weight and egg production. The traits such as hatch weight, 4th, 8th, 12th, 16th and 24th week body weight (g), FCR, livability, age at sexual maturity (days), Hen - Day Egg Production (HDEP) and Hen - Housed Egg Production (HHEP), annual egg number, egg weight (g), adult livability, total and fertile hatchability (%) were studied in all six generations. The day-old chick weight of all six generations ranged from 26.46 to 28.10 g. The 4th and 8th week mean body weight of the first generation white Guinea fowl was 180.85 g and 481.69 g respectively, which increased to 220.95 g and 494.13 g, respectively in 6th generation. Similarly, the 12th and 16th week body weights in 1st generation increased from 767.12 g to 805.29 g and 951.04 g to 1079.15 g , respectively, at 6th generation. The linear regression analysis of 4th and 8th week body weight over generations revealed significant increment of 7.59 g and 7.72 g, respectively, per generation. Similarly, the 12th, 16th and 24th week body weight in each generation had a positive change with high degree of goodness of fit. The 12 and 16th week FCR showed a positive change of high magnitude over generations. The hen day and hen housed egg production (29-51 weeks) from 1st generation to 6th generation increased from 39.26 to 40.55 % and 37.53 to 38.83 % , respectively, during the course of selection. The total and fertile egg hatchability also showed marked changes due to selection with values varying from 49.52 to 53.14 % and 71.37 to 72.38 % across the generations. This study concluded that the multi stage short-term selection can improve both body weight and egg production in white Guinea fowl.

Key words: Selective breeding, production performance, white Guinea fowl.

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INTRODUCTION

Guinea fowls are hardy birds and able to thrive in adverse climatic conditions (Nahashon *et al*., 2006). Advantages of guinea fowl farming include its unique ability to scavenge for insects, less production cost, hardy nature, thermal and disease tolerance, short reproductive cycles, attractive plumages and better ability to protect itself against predators (Mandal *et al*., 1999). Guinea fowl meat has been classed as game meat with premium quality (Bonkoungou, 2005). Many researchers were interested to study the performance of guinea fowls under different climatic conditions under both traditional and intensive management conditions due to its delicacy and high nutritional value (Embury, 2001). Poultry Research Station, TANUVAS, Chennai released Nandanam Guinea fowl 1 as a pearl variety during the year 2011. To meet the demand of Guinea fowl, white variety was introduced and propagation of white variety was started during the year 2013. Accordingly, selective breeding was carried out in white Guinea fowl to improve the productive and reproductive performance, which is suitable for both egg and meat production.

MATERIALS AND METHODS

A total of 1000 Guinea fowl hatching eggs were procured from Government and private entrepreneurs to develop white Guinea fowl variety during the year 2013 and base population was created. Subsequently, in each generation a total of 400 day old keets in two hatches were taken as a replacement population and wing banded individually. The brooding keets (0-8 weeks) were housed in cage system of rearing and grower (9-19 weeks) and breeder birds (20-72 weeks) were housed in deep litter housing with standard managemental condition. In all six generation, the Guineal fowl brooder (24 % CP & 3000 ME Kcal/kg), grower (18 % CP & 2800 ME Kcal/kg) and breeder (16 % CP & 2800 ME Kcal/kg) mash were provided. In each generation a total of 35 males and 100 females were individually selected and kept as a breeder stock for each generation. During the breeding programme 4 individual pens housed each 8 males and 24 females (1:3 sex ratio) adopting pen matting for each generation with selection pressure of 1in 2 for females and 1 in 6 for males. The production traits were given due importance in the individual selection for 6 generations to improve 8^{th} and 16^{th} week body weight in males and family selection for high egg production in females. The traits such as hatch weight (g), 4^{th}, 8^{th}, 12^{th}, 16^{th} and 24^{th} week body weight (g), FCR at 12^{th} & 16^{th} week, livability at 16^{th} week, age at sexual maturity (days), HDEP (28-51 weeks) (%) and HHEP (28-51 weeks) (%), annual egg Nos. (28-72 weeks), egg weight (g), adult livability (20-72 weeks), total and fertile hatchability (%) were studied in all six generations. To assess the effect of short-term selection on various parameters such as day old chick weight, body weight, feed conversion ratio, hen day and hen housed egg production, livability, fertile and total egg hatchability time-trend and regression analysis were carried out as per standard statistical methods. (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Growth Performance: In the present study, the day-old chick weight of all six generations ranged from 26.46 to 28.10 g (Table 1). The time trend analysis (Fig.1) revealed an overall improvement of 2.10 g, which was significant ($P<0.05$) and reliable ($R^2 = 0.74$). The hatch weight of Guinea fowl recorded in this study was higher than those reported by Kerketta and Mishra (2016), Khairunnesa *et al*. (2016) and Prabakaran and Ezhil Valavan (2020) who recorded the hatch weight of 24.80 g, 25.8 g and 27.10 g , respectively in pearl Guinea fowl.

The 4th and 8th week mean body weight of the first generation was 180.85 g and 481.69 g, respectively, which was increased to 220.95 g and 520.13 g, respectively in 6th generation. Cumulative improvement in body weights of white Guinea fowl at 4th and 8th week in 6th generation were 40.10 g and 38.44 g, respectively. Similarly, the 12th and 16th week body weight in 1st generation increased from 767.12 g to 805.29 g and 951.04 g to 1079.15 g, respectively, at 6th generation. The linear regression analysis of 4th and 8th week body weight over generations (Fig. 2) revealed significant ($P<0.05$) increment of 7.59 g and 7.72 g, respectively, per generation. A very high R^2 value (0. 83 % and 0.99 %) indicates excellent goodness of fit and reliability of linear regression model over observed values. Similarly, the 12th, 16th and 24th week body weight also had a positive change (b = 8.86, 23.45 and 25.26 g) per generation with high degree of goodness of fit ($R^2 = 0.76$, 0.72 and 0.94). Saina *et al.* (2005) recorded higher body weight at 4th, 8th and 12th week of age (384.0 ± 71.6, 678.0 ± 73.8, 1480.2 ± 59.8 g) in pearl Guinea fowl. Similarly, Kerketta and Mishra (2016) and Khairunnesa *et al*. (2016) recorded higher body weight during 12th and 16th week of age in pearl Guinea fowl. On the other hand, Prabakaran and Ezhil Valavan (2020) recorded comparatively lower body weights at 4, 8, 12 and 16th week and the value were 207.85, 487.52, 816.74 and 1089.47 g, respectively in pearl Guinea fowls. In this study, it was evident that the gradual improvement of body weight in white Guinea fowl during each generation might be due to selective breeding adopted in the course of selection.

Feed conversion ratio: The cumulative feed conversion ratio at 12th and 16th week of white Guinea fowl during sixth generation was 3.5 and 4.0 respectively. The 12th and 16th week FCR showed a positive change of high magnitude ($b = -0.04$; $R^2 = 0.70$; $P<0.05$ and $b = - 0.00$; $R^2 = 0.57$; $P<0.05$, respectively) over generations (Fig 3). Comparatively, poor FCR was observed by Prabakaran and Ezhil Valavan (2020) who recorded 3.6 and 4.2 at 12th and 16th week, respectively. Whereas Khairunnesa *et al*. (2016) recorded better feed efficiency of 3.07 and 3.25 at 12th and 16th week of age, respectively.

Livability: The mean 16th week livability ranged from 92.50 to 95.10 % and that of adult livability (20-72weeks), from 97.10 to 98.50 % (Table 2). The linear regression analysis of livability at 16 weeks of age revealed an increment of 0.47 % ($P<0.05$) per generation

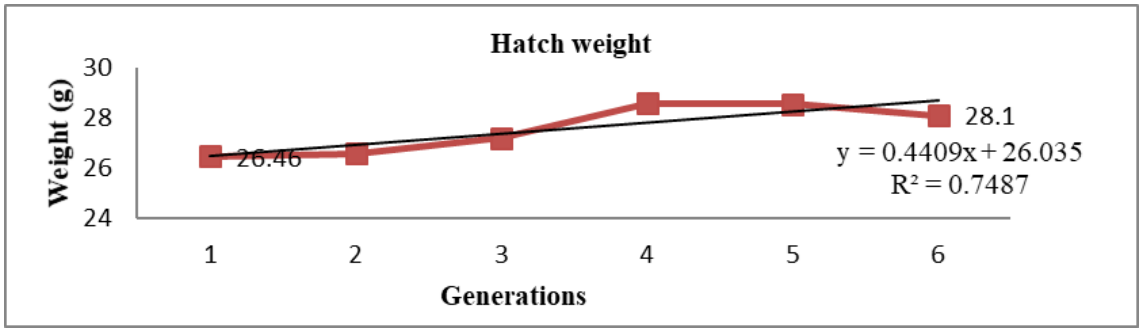

Fig 1. Time trend analysis of change in hatch weight due to selection over generations

Table 1. Effect of selection on body weight performance of white Guinea fowl in different generations (Mean ± SE)

Sl. No	Parameters	2014-15 G1	2015-16 G2	2016-17 G3	2017-18 G4	2018-19 G5	2019-20 G6
1.	Hatch weight (g)	26.46±0.09 (350)	26.59±0.07 (400)	27.21±0.02 (420)	28.56±0.02 (390)	28.55±0.03 (400)	28.10±0.09 (390)
2.	4th week body weight (g)	180.85±2.16 (345)	198.93±2.23 (394)	212.25±3.41 (412)	216.50±2.62 (384)	219.25±2.73 (396)	220.95±2.01 (384)
3.	8th week body weight (g)	481.69±3.03 (331)	488.13±3.12 (392)	465.42±4.36 (401)	501.15±3.41 (381)	512.25±2.48 (390)	520.13±3.52 (380)
4.	12th week body weight (g)	767.12±4.48 (328)	757.65±4.62 (387)	764.23±4.69 (398)	771.28±3.75 (377)	795.14±3.81 (388)	805.29±4.87 (376)
5.	16th week body weight (g)	951.04±5.83 (323)	938.15±4.91 (374)	952.30±5.97 (395)	973.12±5.01 (368)	991.28±5.11 (379)	1079.15±4.14 (370)
6.	24th week body weight (g)	1305.35±5.01 (110)	1330.58±4.13 (105)	1340.21±5.18 (100)	1395.22±4.20 (100)	1415.13±4.36 (110)	1420.20±4.45 (105)

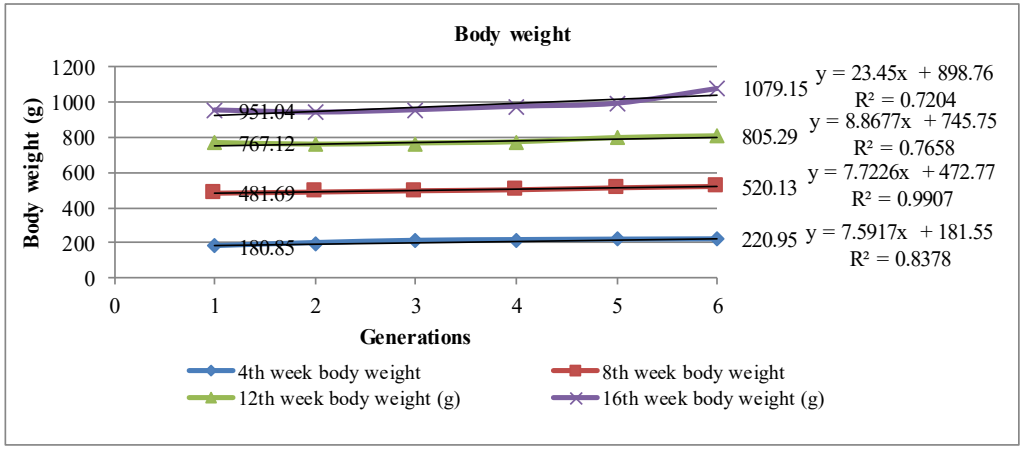

Fig 2. Time trend analysis of change in body weight due to selection over generations

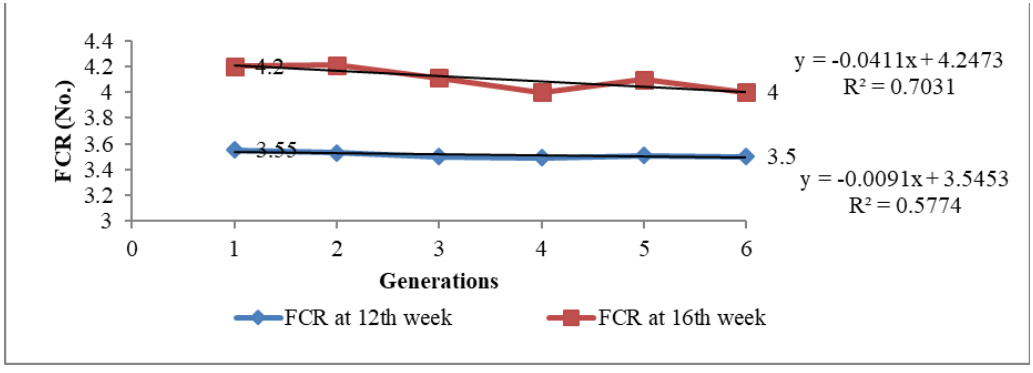

Fig 3. Time trend analysis of change in feed conversion ratio due to selection over generations

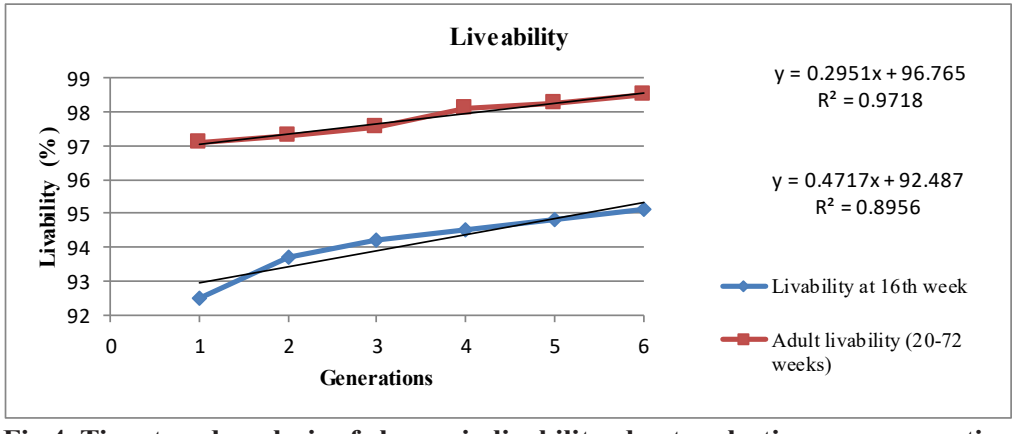

Fig 4. Time trend analysis of change in livability due to selection over generations

Table 2: Effect of selection on livability performance of white Guinea fowl in different generations (Mean ± SE)

Sl. No	Parameters	2014-15 G1	2015-16 G2	2016-17 G3	2017-18 G4	2018-19 G5	2019-20 G6
01	Livability at 16th week	92.50± 1.10 (323)	93.73± 1.05 (374)	94.20± 1.03 (395)	94.50± 0.98 (368)	94.80± 1.12 (379)	95.10± 1.15 (370)
02	Adult livability (20-72 weeks)	97.10± 1.42 (135)	97.31± 1.63 (135)	97.54± 1.89 (135)	98.11± 2.54 (135)	98.23± 1.71 (135)	98.50± 1.04 (135)

Table 3. Effect of selection on egg production performance of white Guinea fowl in different generations (Mean ± SE) (n=100)

Sl. No	Parameters	2014-15 G1	2015-16 G2	2016-17 G3	2017-18 G4	2018-19 G5	2019-20 G6
01	Age at sexual maturity (days)	158	156	154	157	153	155
02	HDEP (28-51 weeks) (%)	39.26±2.56	39.12±1.15	39.10±1.69	40.22±1.42	40.35±1.13	40.55±1.38
03	HHEP (28-51 weeks) (%)	37.53±1.63	37.01±1.24	37.21±1.80	38.25±1.23	38.23±1.11	38.83±1.94
04	Annual egg Nos. (28-72 weeks)	115	114	115	117	118	120
05	Egg weight (g) at 40 weeks	38.19±0.58 (60)	37.44±0.29 (70)	38.23±0.21 (50)	38.25±0.12 (60)	38.31±0.22 (70)	39.01±0.58 (60)

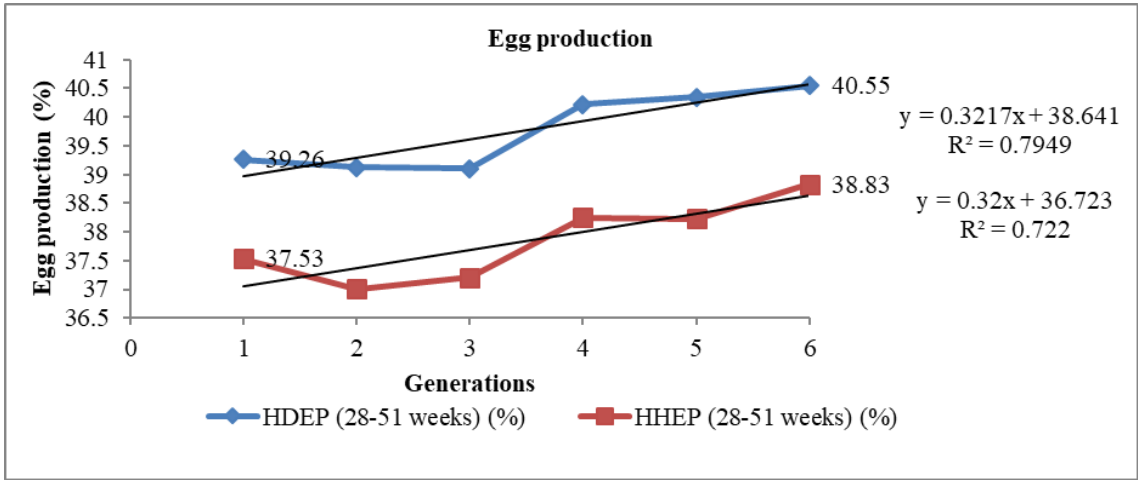

Fig 5. Time trend analysis of change on egg production performance due to selection over generations

Table 4. Effect of selection on reproductive performance of white Guinea fowl in different generations (Mean ± SE)

Sl. No	Parameters	2014-15 G1 (n=300)	2015-16 G2 (n=425)	2016-17 G3 (n=375)	2017-18 G4 (n=600)	2018-19 G5 (n=450)	2019-20 G6 (n480)
01	Total egg hatchability (%)	49.52±1.29	49.03±1.56	51.19±2.01	51.282.64	52.33±2.73	53.14±3.14
02	Fertile egg hatchability (%)	71.37±2.14	72.49±2.51	72.14±3.12	71.533.53	72.61±3.84	72.38±4.46
03	Fertility (%)	79.10±1.23	80.47±1.34	81.63±1.94	83.17±1.05	84.211.14	85.19±2.13

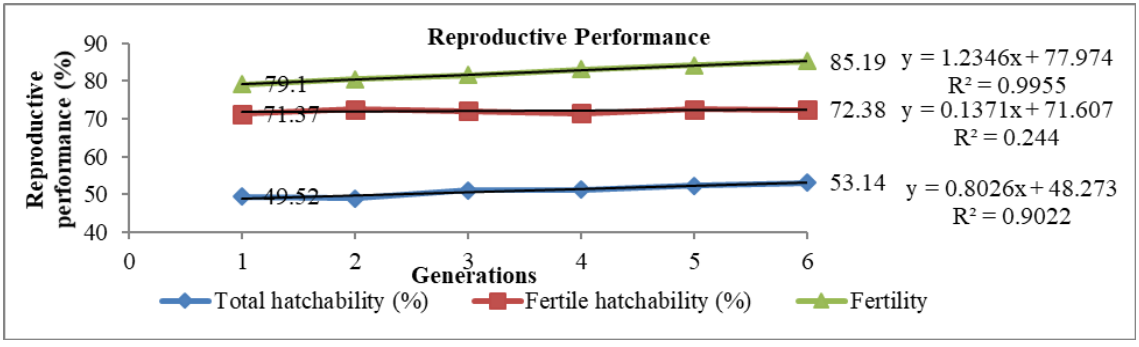

Fig 6. Time trend analysis of change reproductive performance due to selection over generations.

with high degree of goodness of fit (R^2 = 0.89) of regression equation with the observed values (Fig 4). Similarly, the adult livability (20-72 weeks) over generations revealed significant (P<0.05) change of goodness of fit (R^2 =0.97). The per cent livability observed in our study is comparable with Prabakaran and Ezhil Valavan (2020) who recorded 95.68 % at 16th week of age. Improvement in fitness traits in each generation observed in our study might be due to application of intense selection resulted in better exploitation of superior genes, which leads to increased livability and similar observation as reported by Pandian *et al*. (2021) in synthetic strain of chicken.

Egg production performance: The age at sexual maturity of white Guinea fowl was reduced from 158 in first generation to 155 days in sixth generation (Table 3). The hen day and hen housed egg production (29-51 weeks) from 1st generation to 6th generation were increased from 39.26 to 40.55 % and 37.53 to 38.83 % respectively, during the course of selection. Linear regression analysis on hen day egg production revealed that the increase was significant (P<0.05), with appreciable magnitude in positive direction (b=0.32) with high degree of goodness of fit (R^2 =0.79) (Fig 5). Similarly, the hen housed egg production during this period also showed significant (P<0.05) upward trend (b=0.32) over generations with the trend line showing goodness of fit with observed values (R^2 = 0.72). With this degree of improvement the annual egg number (28-72 weeks) reached to 120 eggs in sixth generation from 115 eggs in the first generation. Prabakaran and Ezhil Valavan (2020) found that an overall hen day and hen housed egg production in layer pearl Guinea fowl from 28 to 51 weeks were 49.51 and 47.38 %, respectively. Gwaza and Elkanah (2017) assessed the egg production performance of French Guinea fowl and found that the average egg production was about 32.7 %. The average egg produced per bird in this study is comparable with range of 90-120 eggs per annum reported by Apiiga (2007). These variations could be due to genetic potential, length of photoperiods and managemental condition.

The mean egg weight showed a non-significant trend over generations during selection and it ranges from 38.19 g to 39.01 g. Prabakaran and Ezhil Valavan (2020) found that the average egg weight was 38.01 g in pearl guinea fowl. Khairunnesa *et al.* (2016) reported that the weight of guinea fowl eggs ranges from 32 g to 42 g, with the average egg weight of 38 g.

Reproductive performance: The parameters like total and fertile egg hatchability and fertility of eggs were improved due to selection (Table 4). The fertility of eggs in the first generation was 79.10 %, which was increased to 85.19 % in the sixth generation. Similarly, the total and fertile egg hatchability also showed marked changes due to selection with values varying from 49.52 to 53.14 % and 71.37 to 72.38 % across the generations. The regression analysis also revealed upward change of fertility (b = 1.23; R^2 = 0.99), total hatchability (b = 0.80; R^2 = 0.90) and fertile hatchability (b = 0.13; R^2 = 0.24) values

across generations (Fig 6). Similar to this study, Prabakaran and Ezhil Valavan (2020) observed an average total hatchability of 51.87 % and fertile hatchability of 70.84 % in pearl guinea fowls.

CONCLUSION

It can be concluded that the selective breeding in progressive generations of white Guinea fowl variety can improve the growth, productive and reproductive performances and this type of selection programme can be adopted for exploiting body weight and egg number simultaneously to develop dual purpose Guinea fowls which is more suitable for both meat and egg production.

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