GENETIC EVALUATION OF FEED EFFICIENCY TRAITS IN A WHITE LEGHORN POPULATION

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INTRODUCTION

Feed efficiency is now an important issue in poultry breeding industry. Generally breeders have relied on correlated improvement in feed efficiency due to direct selection for egg production. The improvement in feed efficiency is in fact primarily due to increased egg mass which today's hen produces. Direct measurement of feed consumption may become of more value if the present rate of progress in egg production cannot be maintained in future (Bentsen, 1983). In a comprehensive study Pauw *et al.* (1986) concluded that feed efficiency for egg production had a real genetic basis and information on feed consumption should be incorporated in a selection programme. Combined evidence of Hagger and Abplanalp (1978), Bentsen (1983) and Nordskog *et al*. (1991) suggested that information on feed consumption records if used in a selection programme should enhance genetic gain in egg production efficiency. Out of the total feed consumed after taking into consideration production and maintenance requirement, around 35-40% of feed consumed goes unexplained which is known as residual feed consumption. Recently residual feed consumption has been introduced as a measure of net feed efficiency. Hence any attempt to reduce the cost of feed at a genetic level will result in substantial improvement in income over production. For bringing about genetic improvement, nature of gene action involved and the association of the various feed efficiency traits with important production traits is necessary for formulation of appropriate breeding programme. Therefore in this study an attempt has been made to evaluate the inheritance of various feed efficiency traits and their association with other important production traits in a White Leghorn pure line previously selected for egg production.

MATERIAL AND METHODS

Population and selection method. Two White Leghorn populations viz. IWK and Control maintained as closed flock at Experimental Farm, Project Directorate on Poultry, Hyderabad, India was utilized in the present study. The chicks hatched in 2000-2001 were utilized. The IWK line was previously selected for increased egg production upto 64 weeks of age using a family index (Osborne, 1957 a,b). The Control line was maintained as a random bred pedigreed population. Both lines were reproduced simultaneously and were reared under identical conditions of feeding and management.

Traits measured. The individual traits measured included body weight (g) measured at four weekly interval starting from 20 weeks of age; average egg weight (g) at 24,28,32,36 and 40 weeks of age; egg production upto 20, 21-24,25-28,29-32,33-36, 37-40 and upto 40 weeks of age; feed consumption (g) from 21-24,25-28,29-32,33-36,37-40 and 21-40 weeks of age and age at sexual maturity (days). Utilizing the above information feed consumed per day (g), feed consumed per dozen egg (g) and feed consumed per kilogram of egg mass (g) were derived in the entire test periods as well as on over all period. Residual feed consumption was only

estimated in 21-40 weeks period as difference between expected feed consumption and actual feed consumption. Expected feed consumption was estimated using the following formula.

$$E(FC) = a + b_1 WG + b_2 EM + b_3 BW^{0.75}$$

Where ,

E (FC)	= Expected feed consumption. (gm/d)
WG	= Weight gain (gm/d)
EM	= Egg mass production (gm/d)
$BW^{0.75}$	= Metabolic body weight (g)
b_1, b_2, b_3	= Multiple regression coefficient
a	= Constant.

Statistical analyses. In IWK selected line data were analyzed using model 4 (Harvey, 1988) which included sires, dams within sires and progeny within dams within sires as random effects and hatch as fixed effect. Only hatch corrected data were utilized for calculation of least square means along with its standard errors in both selected and Control lines.

RESULTS AND DISCUSSION

The least square means along with their standard errors for various production traits in both selected (IWK) and Control line are presented in Table 1. A perusal of Table 1 indicates that, in IWK line, egg production peaked at around 85%, from 25th week till 36 weeks, and declined to 75% at the end of 40th week. In the control line the peak egg production was achieved at around 29th week. The average production up to 40 weeks was recorded to be 113.64 and 103.48 in IWK and Control respectively. The average feed consumed per day, feed per dozen egg and feed per kg egg mass production during 21-40 weeks of age were 88.21 g and 95.39g; 1382.38 g and 1555.89 g and 2332.27 and 2974.17g in IWK and Control line (Table 2). The selected line consumed 7g less feed per day, 174 g less feed to produce a dozen egg and 642 g less feed to produce a kilo egg mass. Jackson *et al*. (1983) reported that strains selected for early egg production were better in feed efficiency than their respective controls, which is in agreement with the present finding. Nesheim (1975) reported that hens producing a higher number of eggs in a year will have more efficiency of conversion of feed to product due to reduction in feed required for maintenance relative to product output. The four weekly means for egg and body weight indicate that egg weight was comparatively higher in IWK line as compared to Control whereas body weights at various ages was higher in Control line as compared to selected line. The residual feed consumption per day estimated as deviation of actual feed consumption from the predicted feed consumption from 21-40 weeks of age, estimated as a multiple regression of egg mass production , weight gain and metabolic body size was 2.36g in the IWK line and 1.72g in the Control. The heritability estimates of various feed efficiency traits in the selected line have been presented in Table 3. Egg production and feed efficiency traits were found to be lowly heritable. The genetic and phenotypic correlations of egg production with feed efficiency traits in the selected line are presented in Table 4.

Table 1. Mean production performance in IWK and Control line of White Leghorn

Line/ Trait	Selected (IWK)	Control
Egg Production		
Upto 20wk	5.57±0.17	3.43±0.61
21-24wk	18.32±0.23	13.16±0.54
25-28wk	23.68±0.16	21.99±0.42
29-32wk	23.94±0.14	23.55±0.30
33-36wk	23.36±0.15	22.57±0.44
37-40wk	21.20±0.18	22.78±0.24
Upto 40wk	113.64±0.63	103.48±1.61
Egg weight (g)		
24wk	43.60±0.12	42.16±0.27
28wk	47.97±0.12	46.52±0.42
32wk	51.78±0.66	49.11±0.29
36wk	51.91±0.14	49.93±0.34
40wk	53.38±0.14	51.27±0.38
Body weight (g)		
20wk	1089.01±4.64	1098.82±16.70
24wk	1211.73±4.04	1312.16±12.36
28wk	1287.25±4.85	1414.00±15.45
32wk	1353.77±7.19	1493.69±10.15
36wk	1366.09±5.51	1532.24±16.65
40wk	1385.62±5.72	1531.91±17.10
Age at sexual maturity (d)	139.41±0.39	148.02±1.52

Table 2. Period wise feed efficiency parameters in IWK(Selected) and Control line

Line	Trait	21-24	25-28	29-32	33-36	37-40	21-40
IWK	F/day (g)	82.21	93.51	91.91	88.73	84.71	88.21
		±0.19	±0.18	±0.21	±0.24	±0.25	±0.11
	F/DE (g)	1962.82	1367.02	1328.81	1336.88	1401.58	1382.35
		±95.01	±16.02	±16.08	±19.90	±29.35	±11.17
	F/KEM (g)	3786.67	2381.83	2184.02	2156.72	2201.31	2332.27
		±185.22	±28.46	±29.09	±32.50	±47.35	±20.12
Control	F/day (g)	76.60	94.15	101.98	104.29	100.38	95.39
		±0.49	±0.36	±0.47	±0.45	±0.34	±0.22
	F/DE (g)	2377.74	1494.95	1493.52	1593.01	1547.63	1555.89
		±135.47	±43.01	±31.35	±65.82	±46.27	±3.59
	F/KEM (g)	4751.08	2654.70	2539.1	2582.46	2471.11	2974.17
		±292.83	±78.10	±57.65	±84.37	±62.19	±90.08

Genetic correlations of part period egg production with feed efficiency traits in the selected line were in general negative indicating that any attempt to improve feed efficiency would result in improvement in egg production efficiency.

Table 3. Heritability estimates in various feed efficiency traits in IWK (Selected) line

Trait	h^2_S
Feed/ Doz.Egg	0.13±0.08
Feed/ kg. Egg	0.20±0.09
Residual feed Consumption (21-40 week)	0.09±0.06

Table 4. Genetic and phenotypic correlation of EP 40 with feed efficiency traits in the selected line

EP40 with	$r_{G(S)}$	r_P
F/doz. egg	-0.94±0.06	-0.89±0.02
F/kg egg	-0.79±0.16	-0.86±0.05
Residual feed (21-40 week)	-0.14±0.50	-0.13±0.05

CONCLUSION

The results clearly show that the line selected for increased egg production is more efficient in utilization of feed as compared to control. Residual feed consumption is a lowly heritable trait in this line suggesting that it cannot be utilized as a selection criterion to enhance efficiency of egg production. It will be more appropriate to select on the basis of feed consumed per kilogram egg mass production that will not only take care of egg production because of it favorable association with egg production but also for egg weight since it is one of the component traits. Genetic correlations of part period egg production with feed efficiency traits in the selected line were in general negative indicating that any attempt to improve feed efficiency would result in improvement in egg production efficiency.

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