SELECTION OF THE NIGERIAN INDIGENOUS FOWL FOR 12—WEEK BODY WEIGHT

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SUMMARY

A FOUNDATION stock of 1171 male and 1210 female indigenous fowl supplied a breeding population which increased from 858 — 1627 over a period of seven generations (about 7½ years). During the first three generations 30-38% of males and females and subsequently about 2.4 — 2.7% males and 25% females were selected positively for 12 weeks body weight. A non-selected flock mated population of 455 — 615 females and 53 — 70 males per generation provided basis for determining the response to selection. This amounted to $40.1 \pm 0.37g$, $36.9 \pm 0.37g$ and $39.4 \pm 0.37g$ per generation for male, female and the sexes combined respectively. The realised heritability estimates 0.27 ± 0.03 — 0.28 ± 0.03 appeared close to values obtained by within generation hierarchical classification and suggested, no sex-linked effects for the selected trait in this population. The relatively low ultimate male and female mean weights, $760.0 \pm 63.1g$ and $673.5 \pm 79.0g$ respectively combined with the marked reduction in the variation of body weight that occurred as selection progressed indicate that the Nigerian indigenous fowl is not a potential broiler strain.

INTRODUCTION

PREVIOUS findings reported by Goodman and Godfrey (1956) and Siegel (1963) show that the body weight of the fowl is moderately or highly heritable. This factor may account for the effectiveness of individual selection for improving body weights of the fowl obtained in several studies. Those include the reports by Siegel (1963), Maloney *et al* (1963), Nordskog and Festing (1963), Kinney and Shoffner (1966).

According to Jaap *et al* (1962), poultry breeders are estimated to have made a total genetic gain of 227g in the 8 week body weight of broilers between 1955 and 1959. However, the responses in the studies already cited varied due to factors which, according to Falconer (1960),

included the genetic properties of the populations.

It is noteworthy therefore that most, if not all, the reported studies on selection involved the developed or recognised breeds. However indigenous chickens abound in several countries and may contribute to germplasm resources for implementing indigenous poultry breeding programmes. For example, the potentialities for broiler production (Campos, 1954 and Desai, 1962) or egg production (Plojhar, 1948 and Desai, 1962) may exist in yet undeveloped chickens.

Within the last decade, genetic studies were initiated, in some Nigerian Universities, on the indigenous fowl of Nigeria. The birds were estimated to be 45 million in contrast to 5 million of imported birds of improved strains (FAO, 1966) Oluyemi and Oyenuga (1971) using the method of nested variance component analyses, estimated the heritability of the twelve week body weight of the birds to approximate 0.31 for both sexes. Individual selection for 12 week body weight for two generations resulted in gains of 32.4g and 26.4g in the first year, 23.6g and 21.1g in the second for males and females respectively (Oluyemi and Oyenuga, 1974). These two are included in seven generations of selection for twelve week body weight of the indigenous fowl presented in this report.

MATERIALS AND METHODS

The base population, comprising 1171 males and 1210 females utilized to obtain the heritability estimate originated largely from the South-Western part of Nigeria,

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now covering Oyo, Ogun, Ondo and parts of Kwara and Lagos States. Care was taken, as much as possible, to exclude imported birds and their F₁ crosses with indigenous by starting with chicks of known parents and largely from villages as foundation stock.

The first two 500-day generations of selection lasted May 1971 to January 1974 and the remaining five each of 270 days from August 1973 to March 1979 and there were no overlapping generations.

The birds were maintained at all stage in open sided deep litter houses, permitting straight-through ventilation. They were electrically floor brooded and were moved to their permanent quarters at 18 weeks.

The birds were fed diets composed as in Table 1. There was an improvement in the composition of the diet fed for up to 12 weeks of age of the birds starting with the fourth generation.

TABLE 1
Composition of experimental diets

Ingredients	0 — 12 Week			
	First 3 generations	Last 4 generations	13-20 Weeks	Layers
Maize	62.93	50.78	79.85	64.68
Palm oil	3.53	5.19	1.00	—
Rice bran	2.00	2.00	2.00	4.43
Groundnut cake	23.24	28.73	8.85	12.9
Fish meal	3.00	6.00	3.00	4.50
Blood meal	2.00	4.00	2.00	3.00
Oyster shell	2.00	2.00	2.00	5.70
Bone meal	0.50	0.50	0.50	4.00
Salt	0.30	0.30	0.30	0.30
Feed supplement*	0.50	0.50	0.50	0.50
Calculated composition				
Crude protein %	20.0	25.0	15.0	18.0
Metabolizable energy (Kcal/kg)	3.200	3.200	3.200	2.850

* Pfizer

There were two hatches for the first two generations and subsequently three. Storing hatchable eggs for seven days at 130–150°C, hatches were spaced a week apart for each generation. This, combined with identical management conditions to which all chicks were exposed, resulted in non-significant differences between hatches of the same generations that were consequently pooled.

Selection response was based on an unselected flock mated control to monitor environmental changes. The number of female and male breeders ranged 455–615 and 53–70 respectively per generation while the number of birds in the selected populations and also the selection differentials are presented in Table 2. The birds were flock mated in the first three generations and subsequently, they

were pen-mated, 9–11 pullets per male pen. Floor egg laying by the birds was negligible. Realised or weighed selection differentials were also obtained only for the last four hatches. So also was the heritability estimate for 12 week body weight based on the statistical model.:

$$Y_{ijk} = N + a_i + B_{ij} + c_{ijk}$$

Where Y_{ijk} is the record of the K^{th} progeny of the j^{th} dam mated to the i^{th} sire (Becker, 1964).

Response to selection was predicted on the bases of the unweighed selection differentials combined for male and female and, in the case of the first three generations, the heritability estimate determined for the base population ($h^2=0.31$) Phenotypic response to selection and realised heritability estimate were determined in accordance with Falconer (1960).

TABLE 2
Number of birds weighed and selected and selection differentials

Generation	Number of birds weighed						Selection differentials (g)			
	Male			All	Female		Male	Female	Combined Male & Female	
	All	Selected			Selected	No.				%
		No.	%							
1	408	155	38.0	450	170	37.8	108.3	88.0	98.2	
2	424	161	38.0	447	171	38.3	109.1	86.6	196.1	
3	605	182	30.1	640	192	30.0	121.5	105.5	113.5	
4	822	22	2.7	801	202	25.2	220.0	129.4	174.7	
							(216.1)	(130.1)	(173.1)	
5	800	21	2.6	798	205	25.6	193.2	126.4	159.8	
							(185.8)	(131.0)	(158.4)	
6	791	19	2.4	811	200	24.7	180.3	113.4	146.9	
							(117.3)	(100.00)	(148.8)	
7	805	20	2.5	822	207	25.2	143.0	103.3	123.2	
							(140.1)	(100.1)	(120.1)	

Figures in parenthesis are realised selection differentials.

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RESULTS AND DISCUSSION

The management conditions under which the birds were selected were compatible with satisfactory growth rates as evidenced in nutritional studies reviewed by Olomu (1978). Furthermore midstream changes in nutritional regime and in selection intensity occurred with the objective of maximizing responses to selection. The improved diet conformed with those reported favourably by Mba *et al* (1974) and Babatunde *et al.* (1976). According to Falconer (1960) and Marks (1971), selection under poor environment results in reduced growth rates. Hence a change in dietary regime in the course of a selection experiment was made by Maloney *et al* (1963).

The change in selection intensity was notable. The truncated proportion of superior individuals fell from about 38% of either sex to about 2.4—2.7 and 25% of the male and female population respectively. The increase in selection intensity was easier to accomplish by increasing number of hatches and by hatching when hen-day production of the breeders peaked at about 55% as the birds were also un-improved for egg production. This time of hatching reduced the generation interval. Although the month of hatching also varied, the selected and the random control population were hatched simultaneously.

The selection differentials reflected the changes in selection intensity. Even though the weighted selection differentials were calculated for only the last four generations, they were close to the un-weighted. It may consequently be inferred that body weight was not associated with natural fitness, in terms of the surviving progeny in the flock (Kinney and Shoffner, 1966). However, a small and compact body would probably be more suited to the semi-wild existence under which the birds had been maintained for generations. Hence, the intensive management and improved feeding of the birds probably countered the effect of natural selection.

The closeness between realised and estimated selection differential seems to

justify the use of the latter for predicting response to selection especially as realised selection differentials were not available for all the generations. Estimates of realised selection differentials for the first two generations previously reported was not considered sufficiently valid as it was based on only a small fraction of the selected birds.

Table 3 shows that the obtained responses appeared slightly lower than the predicted for both sexes combined and were mostly higher for males. The phenotypic response obtained by regressing cumulative response on generations were statistically greater than zero and slightly greater for males. The responses were lower than 52—56g obtained by Kinney and Shoffner (1966), 63—63g obtained by Siegel (1963). This might be due to the initial body size of the fowl since the same percentage increase would cause larger weight increase in the larger birds. However it is not certain why the changed diet improved weight gains which were measured as deviations from control populations.

The heritability estimate for the fourth generation appeared slightly high whereas with the improved regime a lower phenotypic variation might be expected and was actually obtained (Table 4). Perhaps the improved environment had better effect of unmasking genetic variation in the flock. There appeared a subsequent decline in heritability estimates and seemingly selection reduced genetic variation in the flock. Such reduction will be consistent with the high intensity of selection employed especially on the male.

The realised heritability estimates appeared fairly close although lower than the estimated. These estimates indicated little or no sex-linked effects on the 12-week body weight of the birds in accordance with the evidence of Oluyemi and Oyenuga (1971). Since the birds had previously not been artificially selected it was uncertain why the heritability for 12-week body weight was thus low. Probably natural selection was strongly in favour of small body size and there might be a preference for slaughtering

TABLE 3
Predicted and obtained responses to selection

Generation	h ²	For male and female combined			
		Predicted		Obtained	
		Per generation	Cumulative	Per generation	Cumulative
1	0.31	29.4	29.9	32.4	32.4
2	0.31	22.3	51.8	23.6	56.0
3	0.31	20.0	71.8	27.0	83.0
4	0.34	54.0	125.8	46.6	129.6
5	0.28	48.2	174.2	49.8	179.4
6	0.29	40.4	214.4	48.0	227.4
7	0.27	32.4	254.8	33.6	261.0
Obtained response	..	..	39.4 ± 0.37	..	40.1 ± 0.37
Realised h ²	..	..	0.28 ± 0.03	..	0.27 ± 0.03
					36.9 ± 0.37
					0.28 ± 0.03

TABLE 4
Mean body weights with their standard deviation (SD) and their coefficients of variation (CV) at 12 weeks of age for random bred control and selected populations by generations

Generation	M A L E					F E M A L E				
	Random-bred Control			Selected population		Random-bred control			Selected population	
	Mean (g)	SD (g)	CV %	Mean (g)	SD (g)	Mean (g)	CV %	SD (g)	Mean (g)	SD (g)
0	463.7	105.3	23.4	463.7	108.3	391.0	23.1	110.1	391.0	88.0
1	459.6	98.1	22.3	492.0	109.5	395.0	22.8	102.3	422.4	86.0
2	466.0	100.2	20.0	522.0	104.7	389.0	22.1	100.0	432.5	105.5
3	463.7	110.1	17.5	546.7	95.6	395.2	23.2	105.1	457.7	101.9
4	501.5	107.0	13.3	631.1	84.0	439.0	21.0	102.2	556.7	99.6
5	507.2	101.1	10.8	686.6	74.8	440.1	22.2	98.9	608.4	89.3
6	499.0	98.1	8.7	736.4	64.1	450.3	22.5	103.1	651.6	81.4
7	510.0	102.0	8.3	760.0	63.1	441.0	22.7	100.0	673.5	79.0
										11.7

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larger size birds.

As the males gained faster per generation, the significant difference between male and female mean body weights increased with selection (Table 4). However, after seven generations of selection, the males were less than 1kg or half the weight of modern broilers, suggesting that the Nigerian indigenous fowl is not a potential broiler strain.

There was moreover, a marked reduction in the co-efficient of variation in body weight that occurred as selection progressed which is in accordance with the evidence of *Maloney et al* (1963). The reduction obtained in this experiment might reflect that of non-additive genetic variance since there was no deliberate change in environmental conditions during the experiment other than in the nutrient regime.

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