Estimates of genetic and phenotypic parameters for egg production traits in indigenous fowl of the Sudan.

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SUMMARY

243 pullets the progeny of 40 sires and 120 dams were used in this experiment. Data were analysed using Harvey Program (1990) to estimate the genetic and phenotypic parameters for production traits which included age at sexual maturity (AS), body weight at sexual maturity (BW), egg production (EPT) and egg weight (EWT) for the whole period (180 days). The average AS, BW, EPT and EWT were 180.5 days, 998.8g., 3.00 egg/hen housed/week and 34.0g. respectively. Heritability estimates from sire component of variance were 0.081 for AS, 0.443 for BW and 0.397 for EPT. Heritability estimate from sire plus dam component of variance for EWT was 0.601. The genetic and phenotypic correlations among the traits studied were variable. The genetic correlation of BW with EPT from sire component of variance was high and positive (0.53). The genetic correlation of BW with EPT from dam component of variance was low and negative (- 0.167), whereas the genetic correlation of BW with EWT was high and positive (0.348). The phenotypic correlations seem to follow similar trend as genetic correlations.

INTRODUCTION

The high genetic potenials of modern poultry breeds are considered to be the key factor for the success of poultry industry. Egg production and other related traits such as age and body weight at sexual maturity are the most important factors which determine the overall profitability of the commercial flocks. Heritability estimate of a metric character is **an** essential genetic property, because of its predictive role in expressing the reliability of the phenotypic value as a guide to the breeding **value (Falconer, 1982).**

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One of the problems facing poultry breeders is the decision upon the selection procedure that may be followed to give maximum genetic improvement. Thus heritability magnitude is considered as a pre-disposing factor for taking the appropriate decision. Heritability estimates for egg production in the literature range from low to medium, whereas body weight at sexual maturity is highly heritable (Kinney, 1969 and Leenstra and Pit, 1988).

The local fowl of Sudan has been described as highly adapted to harsh and poor environmental conditions; a fact that enabled the breed to play an important socio-economic role among villagers in the remote areas. Yousif and Osman (1994) and Ismail (1998) reported high heritability estimates for body weight of the local chicken at various ages, however few or no research has been conducted to estimate genetic parameters for egg characteristics. The objective of this study is to estimate the genetic and phenotypic relationships for egg production and other associated traits in large Beladi type of Sudan local chicken.

MATERIALS AND METHODS

This experiment was part of a project designed to estimate the genetic and phenotypic parameters of productive traits in the local Sudanese chicken. The parent stock was constituted by purchasing 40 cockerels and 120 pullets of large Beladi type from remote villages. Although no intentional selection was applied, the description of local breed suggested by Desi, (1962) was used as criteria for choosing individual birds. The parent stock was subjected to adaptation period for two weeks during which they received vaccination for New-castle disease and prophylactic dose of antibiotics. Pullets and cockerels were allocated individually in battery cages and floor pens respectively. Each three pullets were assigned randomly to mate with one cockerel in a rotational pattern. Layer formulated ration was provided ad libitum and 14 hrs light / day was available. Fertilized eggs were collected, pedigreed, stored in a cold room at 19°C and then transferred for incubation at weekly intervals. Hatched chicks were identified using wing bands and reared in floor brooders up to 8 weeks of age. Lighting system was continuous during this period and chicks starter diet was available ad libitum. After 8th week, the birds were transfered to floor pens, provided with grower feed up to 16 weeks and then shifted to alayer ration. Vaccination for Newcastle disease was administered at 4 weeks of age and repeated at 16 weeks. Light was state how 14 hrs / day.

At 18 weeks of age about 243 pedigree pullets were randomly chosen and housed in individual cages for egg production traits genetic parameters estimates. Eggs were collected on daily basis, pedigreed and weighed. Physically abnormal eggs such as rounded, elongated or very small were also recorded and removed. Age at sexual maturity (AS) was determined by the date in which the first egg was laid and the bird was immediately weighed to determine body weight at sexual maturity (BW). Average weight of the first three eggs laid by each hen was calculated and considered as the initial egg weight (IEW). Egg production (EPT) was recorded on hen - day basis, however for practical purpose the production period was divided into first (EP1) and second (EP2) periods, each of three months length. Average egg weights were also reported for the first (EW1), second (EW2) and the whole (EWT) period respectively.

Data set was analysed by Harveys (1990) LSMLMW Program (Least Square and Maximum Likelihood Procedure) to estimate variance and covariance components.

The model used in the analysis was :-

$$Yijklm = \mu + Si + diSij + Hk + eijklm$$

Where

Yijklm = The individual observation for the trait Yijklm.

= Overall mean for trait Y.

S_i = Random effect of the i^{th} sire.

d/sii = Random effect of the i^{th} dam mated to to the i^{th} sire.

Hk = Fixed effect of the k^{th} hatch.

eijklm The random error associated with the measurement of each individual which assumed to be randomly and independently distributed with a mean of zero and a variance of 6^{-2}.

Heritability estimates were obtained from sire, dam and sire plus dam components of variance.

RESULTS AND DISCUSSION

Table 1. presents the overall means, standard deviations and coefficient of variation of the various traits studied. Age (AS) and body weight (BW) at sexual maturity were 180.5+18.9 days and 998.8+107.3 g. respectively. These results are within the range of those reported for the indigenous fowl (Nwosu, 1979; Hanafi and El Labban, 1984; Desi, 1962 and Kicka, 1978). The average number of eggs per hen produced during the experimental period (180 days) was 72.4 this is equivalent to 3.0 egg / hen / week and the rate of lay was 40.2% . Sulieman (1996) reported higher result (49.0%) for the same breed. There was no significant difference between egg production in the first (EP1) and second (EP2) periods. The average egg weight in this study is lower than those reported by Yousif and Osman (1994) for the large -Beladi type; however this result is similar to that reported by Kuit *et al.* (1986) for the native fowl of Somalia. The average egg weight in the second period (EW2) was significantly ($P<0.01$) larger than the initial egg weight (IEW) and egg weight in the first period (EW1). This indicates that eggs in the present study may have not yet attained the maximum size. The CV of egg production in the first, second and the whole periods were considerably high, reflecting a substantial variation in egg production pattern of the indigenous fowl.

Table 2. shows the heritability estimates and standard errors for the traits studied. Heritability estimates for age at sexual maturity obtained from sire component variance was 0.081 . This is consistant with the estimates obtained by Malik *et al.* (1991) and Sharma et al. (1992); but higher than those reported by El Hossari (1970) and Kumar and Acharya (1980). Generally the heritability estimates for age at sexual maturity was found to range between 0.15 and 0.3 (Johansson and Rendel, 1968). These relatively low estimates may indicate the existence of low genetic variability for the trait and that most of the phenotypic variance is environmental, thus improvement effort must be directed primarily towards improving managerial conditions_ Heritability estimates for body weight at sexual maturity in this study was found to be 0.443 and 0.249 from sire and dam components of variance respectively. This result is fairly within the range of the estimates reported by Johansson and Rendel (1968). However Malik *et al.* (1991) reported higher estimates from dam component of variance. Traits which are related to reproductive

Table 1. Overall means (X) standard deviations (SD) and coefficient of variation (CV) of various traits studied.

Trait	Mean + S.D.	C.V.
AS (days)	180.5+18.9	10.4
BW (g.)	998.8+107.3	10.8
EP1 (Egg)	35.7+12.6	35.2
EP2 (Egg)	36.8+12.5	33.9
EPT (Egg)	72.4+21.0	29.0
IEW (g.)	28.4+3.2*	11.1
EW1 (g.)	31.9+2.4*	7.5
EW2 (g.)	36.1+2.4*	6.5
EWT (g.)	34.0+2.1*	6.1

In this and the following tables:

AS = Age at sexual maturity
BW = Body weight at sexual maturity.
EP1, EP2, EPT = Egg production in the first, second and the whole period respectively.
IEW = Initial egg weight.
EWI, EW2 , EWT = Average egg weight in the first, second and the whole period respectively.

Table 2 . Heritability estimates and standard errors for the various traits studied obtained from sire, dam and sire plus dam components of variance.

Trait	Sire	Dam	Sire + Dam
AS	0.081±0.481	NE	0.041±0.274
BW	0.443±0.517	0.249±0.656	0.349±0.277
EP1	0.219±0.496	0.238±0.657	0.229±0.278
EP2	0.166±0.491	0.266±0.658	0.196±0.277
EPT	0.397±0.513	0.178±0.663	0.288±0.278
EW1	NE	0.534±0.627	0.267±0.278
EW2	NE	1.502±0.502	0.751±0.255
EWT	NE	1.202±0.545	0.601±0.267
IEW	NE	0.066±0.673	0.033±0.273

* $P<0.05$.

fitness such as egg production have been characterized with low estimates (Falconer, 1982). In the present study egg production estimates from sire component of variance ranged from 0.17-0.4; these are in agreement with the heritabilities reported by Amer (1967) and Rai *et d.* (1992). Heritability estimates for egg weight have been described as high (King and Henderson, 1954). In the present study, heritability estimates for egg weights from sire component at different periods were non-estimatable indicating negative covariance, whereas the estimates from dam component were variable (0.07-0.53). These results are in accordance with those reported by Wang and Pirchner (1992) who found a range of heritabilities for egg weight in Rhode Island Red to be from 0.10 to 0.60. low estimates from dam component was also reported by Amer (1967) for egg weight of Fayoumi breed. High estimate from sire component than that from dam component reflects more additive genetic variance for the trait.

Tables 3 and 4 present the genetic correlations for the various traits studied. Most of the correlations from sire and dam components of variance in the present study were either over-estimated as the result of sampling and / or maternal effect or non-estimatable due to negative covariance. As a general trend, Pirchner (1969) and Falconer (1982) stated that heritability estimates coefficients and genetic correlations among metric traits were most sensitive and subjected to sample errors. The genetic correlations of egg production in the first and second periods with that in the whole period from dam component were positive and high (0.712 and 0.670). This may reveal that selection for the whole egg production record can be based on part record efficiently. Moreover the genetic correlations of body weight at sexual maturity with egg weight in the first period was high and negative, (-0.365) whereas the corresponding correlations in the second and whole periods were also high but positive (0.322 and 0.348). This could reflect a variable trend between these traits with increased time. The genetic correlation of age at sexual maturity with egg weight in the second period was high and positive, which is in agreement with that reported by Krishna and Chaudary (1987).

The relatively high standard errors of the estimates in the present study may emphasize that the genetic parameter estimates would have been more precise if large amount of data is envolved in the analysis.

Although the phenotypic correlations were relatively low than the genetic correlation, they were almost flowing similar trend (Table 5 and 6). The phenotypic correlations of age at sexual maturity with body weight and egg production in the whole period were low and positive which are in accordance with those reported by Jain *et al.* (1980) and Yadav *et d.* (1992).

Table 3 . Genetic correlation estimates for various traits studied obtained from sire component (above diagonal) and dam component (below diagonal).

Trait	AS	BW	EP1	EP2	EPT	EWT
AS		1.87±4.76	4.46±11.65	6.05±16.94	4.54±11.45	NE
BW	NE		-0.638±1.012	0.876±1.720	0.53±0.741	NE
EP1	NE	3.429±8.371		1.615±2.191	1.123±0.410	NE
EP2	NE	-3.825±10.95	-0.032±2.63		1.165±0.636	NE
EPT	NE	-0.167±2.878	0.712±1.271	0.679±1.418		NE
EWT	NE	0.348±1.056	-2.65±4.103	-1.768±3.62	-2.759±6.956	

Table 4. Genetic correlation estimates for various traits studied obtained from dam component (above diagonal) and sire plus dam component (below diagonal).

Trait	EW1	EW2	EWT	IEW	AS	BW
EW1		0.932±0.376	0.848±0.226	0.878±4.224	NE	-0.365±1.564
EW2	0.992±0.257		1.046±0.068	1.034±0.850	NE	0.322±0.940
EWT	0.887±0.153	0.950±0.043		0.886±4.455	NE	0.348±1.056
IEW	0.767±2.233	0.689±2.282	0.595±1.804		NE	-6.092±39.76
AS	-1.743±5.065	0.461±1.701	-0.409±1.477	-0.085±5.174		NE
BW	0.174±0.647	-0.065±0.421	0.148±0.451	-1.276±4.936	3.162±10.562	

Table 5. Phenotypic correlation estimates for various traits studied.

Trait	AS	BW	EP1	EP2	EPT	EWT
AS		0.038	0.079	-0.007	0.046	0.301
BW			0.143	-0.123	0.014	0.214
EP1				0.262	0.798	-0.047
EP2					0.79	0.919
EPT						-0.018
EWT						

Table 6. Phenotypic correlation estimates for various traits studied.

Trait	EW1	EW2	EWT	IEW	AS	BW
EW1		0.707	0.842	0.517	0.403	0.181
EW2			0.917	0.472	0.162	0.222
EWT				0.544	0.301	0.214
IEW					0.177	0.224
AS						-0.038
EWT						

CONCLUSION

The experiment was conducted to estimate the genetic and phenotypic parameters for production traits in the indigenous chicken. Heritability estimates were within the range reported in the literature. Genetic and phenotypic correlations were variable but following similar trend. Further genetic parameters estimates for these production traits using relatively large data is essential to eliminate the effect of sample errors in order to establish a reliable selection program for genetic improvement of the local chicken.

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