Estimation of genetic and non-genetic parameters for egg production traits in local strains of chickens

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Abstract

Two native strains namely Mandarah (MN) and Matrouh (MT) were used in a crossing experiment. Data on 668 pullets fathered by 71 sires and mothered by 462 dams produced from four genetic groups (the two purebred strains and their reciprocal crosses) were used. The conducted study was to estimate genetic and non-genetic parameters for traits of age (ASM) and body weight (BWSM) at sexual maturity; weight of the first egg (WFE); egg number (EN90D) and egg mass (EM90D) during the first 90-days; and total egg number (TEN) and total egg mass (TEM) during the 210-days of laying; as well as partial recording traits such as period (days) in which first ten eggs were laid (PF10E), egg mass for first ten eggs (EMF10E), egg number (EN1W/M) and egg mass (EM1W/M) for one week per month; egg number (EN2D/W) and egg mass (EM2D/W) for two days per week. Clutch size and pause period categories were also studied. Multi-trait animal model and multiple-trait Gibbs Sampler were used to analyze the data of egg production traits.

Results showed that MN strain had superiority ($p \leq 0.05$) in most the studied traits compared to MT strain. Averages of clutch size that contains more than five eggs and number of pause that equal one day were higher in the crossbreds than in the purebred parents. Heritability estimates were 0.01, 0.28, 0.08, 0.05, 0.06, 0.02 and 0.03 for ASM, BWSM, WFE, EN90D, EM90D, EN210D and EM210D, respectively; 0.14, 0.16, 0.12, 0.13, 0.08 and 0.10 for PF10E, EMF10E, EN1W/M, EM1W/M, EN2D/W and EM2D/W, respectively. Estimates of genetic correlation (r_G) were (0.84) between ASM and BWSM, (0.08) between ASM and WFE, (0.61) between BWSM and WFE, (0.98) between EN90D and EM90D and (0.97) between TEN and TEM. Estimates of r_G between partial recording traits were high and positively correlated. The higher rank correlation was found between partial recording system for EN2D/W and the total egg number trait (rank = 0.82, $p \leq 0.01$), followed by EN1W/M and total egg number (rank = 0.79, $p \leq 0.01$).

Thus, it is concluded that system of recording for two days per week, followed by one week per month could be used to improve egg production traits in chickens to short generation interval, then to save time, effort and money in chicken breeding programs.

Key words: chickens, genetic correlation, heritability, partial recording and egg production traits, rank correlation

Introduction

Egg production is a complex metric trait showing many variations during the period of production of the pullet. The study of egg production and its related traits such as age and body weight at sexual maturity, rate of laying and clutch size attracted the attention of several investigators who found that there were wide variation in these traits between different breeds and/or strains of chickens (Iraqi et al 2007). Partial recording of egg production in pullets is used to enhance and to increase the efficiency of genetic selection as well as shorten the generation interval.

Genetic estimates (heritability, genetic correlation) of egg production traits in different breeds and/or strains were cited by many investigators, who found that there were a lot of variations in these estimates according to the differences of the genetic make-up (El Labban et al 1991; Poggenpoel et al 1996; Khalil et al 2004; Nurgiartiningsih et al 2004 and Chen et al 2007). Precision of genetic estimates are required for the construction of multi-trait selection indexes to achieve the expected gains. Nowadays, the animal model is widely used all over the world for genetic analysis for productive traits in chickens, but till now it seems that it not been widely used for egg production traits in Egypt (Iraqi 2002).

The aims of this work were: (1) to estimate the additive genetic variance and heritability for egg production traits in purebreds and crossbreds using multi-trait animal models analyses, (2) to estimate genetic and phenotypic correlations between some productive traits and (3) to determine the best method of selection for pullets based on partial recording of egg production.

Materials and methods

This work was carried out in Poultry Breeding Research Station at Inshas, Sharkia Governorate, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt, during the period from 2005 to 2007. Two developed local strains of chicken were used in this study (i.e. Matrouh strain, MA), it is a synthetic strain which has been developed from a cross between Single Comb White Leghorn males and Dokki-4 females using system of breeding and selection for six generations (Mahmoud et al 1974). Mandarah strain (MN), it has been developed from cross between Alexandria males and inbred Dokki-4 females for four generations (Abdel-Gawad 1981).

Breeding plan and management

Total numbers of 668 pullets fathered by 71 sires and mothered by 462 dams from the two strains. Sires and dams were chosen randomly from 300 cocks and 500 pullets to produce all genetic groups of purebred and crossbred. Each cock mated with 10 hens in each breeding pen. Pullets of each of the two strains were divided into two groups; the first group was mated with cocks from the same strain while the second group was mated with cocks from the other strain. Consequently, pedigreed eggs from each individual breeding pen for the four mating group (two purebreds of MN x MN and MA x MA and two crossbreds of MN x MA and MA x MN) were collected daily for ten days and incubated. All chicks of one-day old produced were wing banded and reared on floor brooder, then transferred to the rearing houses at 18 weeks of age. In laying period, the pullets transferred to the individual laying cages. Chicks were feed during rearing, growing and laying periods on diet containing 20.4%, 16% and 16.5% crude protein, 3.2%, 3.9% and 4.4% crude fiber, respectively, and the pullets were exposed to light for 17 hours per day from 22 weeks of age till end of the experimental period. All birds were treated and medicated similarly throughout the experimental work under the same managerial and climatic conditions. The first generation of purebreds and their crosses were produced in one hatch.

Data and studied traits

Numbers of sires, dams and pullets for each genetic group used are given in Table 1.

Table 1. Numbers of sires, dams and pullets from different breed

groups, which used in experimental work

Breed group	Number		
	Sire	Dam	Pullet
MN	17	135	190
MT	17	123	199
MN x MT	18	99	140
MT x MN	19	105	139
Total	71	462	668

Traits of egg production were age at sexual maturity (ASM), body weight at sexual maturity (BWSM), weight of the first egg (WFE), egg number at first 90-days (EN90D), egg mass at first 90-days (EM90D), total egg number for 210-days (EN210D) and total egg mass for 210-days (EM210D). The period (in days) for first ten eggs (PF10E) and egg mass for first ten eggs (EMF10E) were recorded. Partial recording traits for egg production were egg number for one week per month (EN1W/M), egg mass for one week per month (EM1W/M), egg number for two days per week (EN2D/M) and egg mass for two days per week (EM2D/M). Traits of clutch size and pause periods during first 90-days and 210-days were also studied.

Clutch size during the first 90-days and 210-days of laying were classified to categories as follows:

- <3: clutch size with lower than 3 eggs.
- =3: clutch size with only 3 eggs.
- =4: clutch size with only 4 eggs.
- =5: clutch size with only 5 eggs.
- >5: clutch size with more than 5 eggs.

Also pause periods during the first 90-days and 210-days of laying were classified to categories as follows:

- =1: pause period for one day.
- =2: pause period for two days.
- =3: pause period for three days.
- =4: pause period for four days.
- =5: pause period for five days.
- >5: pause period for more than 5 days.

Statistical analysis

Traits of age (ASM) and body weight (BWSM) at sexual maturity and weight of first egg (WFE) were analyzed using Multi-trait animal model (MTAM) (the three traits in the model) (Boldman et al 1995) using the following model.

$$y= Xb + Zu + e$$

Where:

y= nx1 vector of observed trait of hens;
n= number of records;
b= p x 1 vector of fixed effect of breed group; p= 4 levels;
X= design matrix of order n x p, which related records to fixed effect of breed group; u= the vector of random additive genetic effect of hen;

Z= the incidence matrix relating records to the additive genetic effect of hen; and
e= n x 1 vector of random residual effects.

Traits of EN90D, EM90D, EN210D, EM210D, EN1W/M, EM1W/M, EN2D/W and EM2D/W cannot be analyzed by MTAM because they were distributed as a binomial distribution. Thus, multiple-trait Gibbs sampler, MTGSAM, (Van Tassel and Van Vleck 1995) were used to analyses these traits which developed to implement the Gibbs sampling (GS) algorithm for Bayesian analysis of a broad range of animal models. The program of MTGSAM allows analysis of several continuous and categorical variables can have any number of levels (Bennewitz et al 2007).

Convergence was assumed when the variance of the log-likelihood values in the simplex reached $<10^{-9}$. Occurrence of local maxima was checked by repeatedly restarting the analyses until the log-likelihood did not change beyond the first decimal.

Estimation of heritability:

Estimates of heritability were calculated according the following formula:

$$h_a^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}$$

Where $\boldsymbol{\sigma^2_a}$ and $\boldsymbol{\sigma^2_e}$ are variances due to the effects of additive genetic and random error, respectively.

Estimation of correlations:

The general formula used to calculate the genetic (r_g), and environmental (r_e) correlations between traits were as follow (Quaas et al 1984):

$$r = \frac{Cov(X)_{ij}}{\sqrt{Var(X_{ii}).Var(X_{jj})}}$$

Where:
$Cov(x)_{ij}$= the genetic (**a**), and environmental (**e**) covariances between the first and second trait, respectively.
x_{ii}= the genetic (**a**), and environmental (**e**) variances of the first trait, respectively.
x_{jj}= the genetic (**a**), and environmental (**e**) variances of the second trait, respectively.

Estimation of rank correlation:

Spearman's rank-order correlation (r_s) is a parameter's measure to calculate the correlation among ranks of the partial recording traits and some economic ones. The formula of r_s is:

$$r_s = \frac{\sum(R_i - \bar{R})(S_i - \bar{S})}{\sqrt{\sum(R_i - \bar{R})^2 (S_i - \bar{S})^2}}$$

Where $\mathbf{R}_i$ is the rank of the i^{th} X value, **S**i is the rank of the j^{th} Y value, and $\bar{R}$ and $\bar{S}$ are the means of the R_i and S_i values, respectively.

Spearman's rank correlations were computed using SAS procedure Guide, 1996 **(SAS, 1996)**.

Results and discussion

Actual means

Table (2) showed that mean of MN strain was favored ($p \leq 0.05$) in all the studied traits compared to MT strain.

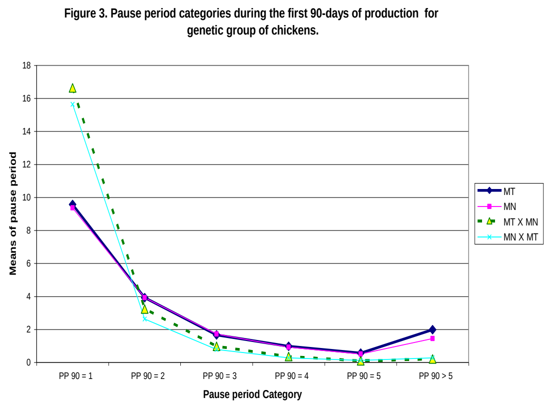
Table 2. Means and standard errors for productive and partial recording traits in Mandarah (MN), Matrouh (MT) and their reciprocal crosses in chickens

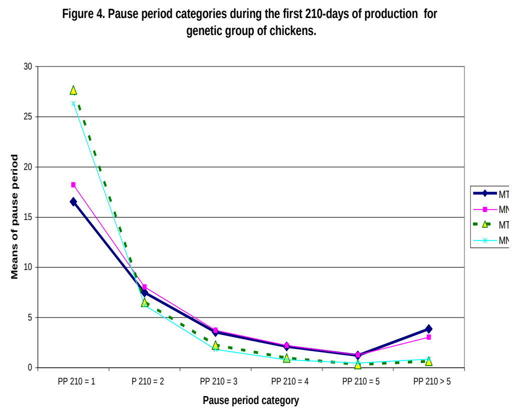
Trait[+]	MN		MT		MN X MT		MT X MN	
	No.	Mean[*]±S.E	No.	Mean[*]±S.E	No.	Mean[*]±S.E	No.	Mean[*]±S.E
Productive traits:								
ASM (days)	190	166±0.4[a]	199	166±0.4[a]	137	162±0.5[b]	134	162±0.5[b]
BWSM (kg)	190	1.47±0.02[b]	199	1.27±0.02[c]	137	1.45±0.02[b]	134	1.51±0.02[a]
WFE (gm)	190	38.5±0.3[a]	199	35.9±0.3[b]	137	35.5±0.4[b]	134	35.4±0.4[b]
EN90D (egg)	190	44.3±1.4[c]	199	36.9±1.4[d]	137	57.2±1.6[a]	134	53.4±1.7[b]
EM90D (kg)	190	2.01±0.06[b]	199	1.61±0.06[c]	137	2.40±0.07[a]	134	2.26±0.07[a]
EN 210D (egg)	189	79.6±2.5[b]	199	64.9±2.4[c]	137	93.8±2.9[a]	134	88.7±2.9[a]
EM 210D (kg)	189	3.81±0.11[b]	199	2.99±0.11[c]	137	4.20±0.14[a]	134	3.99±0.14[a]
Partial recording traits:								
PF10E (days)	184	27.9±1.1[a]	197	28.5±1.1[a]	128	16.2±1.3[b]	126	15.47±1.3[b]
EMF10E (gm)	184	411±1.8[a]	197	389±1.8[b]	128	373±2.2[c]	126	375±2.2[c]
EN2D/W (egg)	183	21.6±0.7[b]	199	17.4±0.6[c]	132	26.0±0.8[a]	130	24.66±0.8[a]
EM2D/W (kg)	183	1.04±0.03[b]	199	0.81±0.03[c]	132	1.16±0.04[a]	130	1.11±0.04[ab]
EN1W/M (egg)	183	20.2±0.6[b]	199	15.5±0.5[c]	134	22.7±0.7[a]	129	21.6±0.7[a]
EM1W/M (kg)	183	0.95±0.03[b]	199	0.71±0.03[c]	134	1.03±0.03[a]	129	0.99±0.03[ab]

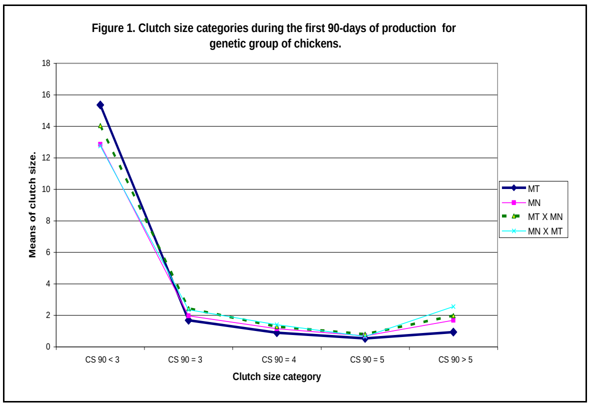
[+] ASM, BWSM, WFE, EN90D, EM90D, EN210D, EM210D, PF10E, EMF10E, EN1W/M, EM1W/M, EN2D/M, EM2D/M= age at sexual maturity, body weight at sexual maturity, weight of the first egg, egg number at first 90-days, egg mass at first 90-days, total egg number for 210-days, total egg mass for 210-days, period for first ten eggs, egg mass for first ten eggs, egg number for one week per month, egg mass for one week per month, egg number for two days per week, egg mass for two days per week, respectively.

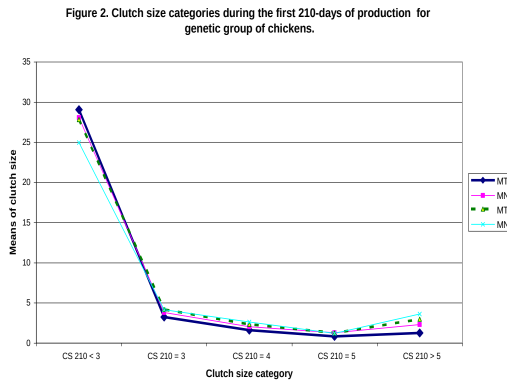
[*] Means with the same letters for trait in each row are not significantly ($p \leq 0.05$) different.

This may be due to genetic make up of the two strains (Mahmoud et al 1974 and Abdel-Gawad 1981). Figures (1&2) showed that the average of clutch size during the first 90 days, which contains lower than three eggs was the highest in purebreds (12.85 clutches in MN and 15.35 clutches in MT) compared to in crossbreds (12.75 clutches in MN x MT and 14.04 clutches in MT x MN crosses), these numbers are gradually decreased for each of clutches equals three, four and five eggs.









While the average of clutch size that contained more than five eggs was higher than those for clutches with four and five eggs. For number of clutch size during the period of 210-days egg production, it is showed that the same trend as found in the first 90 days. Results in Figures (3&4) showed that pause period that equal one day was the highest number in both purebreds and crossbreds during first 90 days and 210-days of egg production, the number of pauses is decreased for each of pause length that equal two, three, four and five days. These results fall within the range of 1.5 and 14.44 as obtained by Chih-Feng chen et al (2007) in different purebreds and crossbreds of chickens.

Genetic parameters

Variance components of Productive and Partial recording traits

Estimates of additive (σ^2_a) and residual (σ^2_e) variances for productive traits are given in Table (3).

Table 3: Estimates of additive genetic (σ^2_a), phenotypic (σ^2_p) variances and heritability (h^2) for productive and partial recording traits in chickens

Trait[+]	σ^2_a	σ^2_a %	σ^2_e	σ^2_e %	σ^2_p	h^2
Productive traits:						
ASM (days)	0.33	1.3	25.2	98.7	26	0.01
BWSM (gm)	95.5	27.6	250	72.4	346	0.28
WFE (gm)	1.25	8.4	13.7	91.6	15	0.08
EN90D (egg)	14.1	4.5	297	95.5	311	0.05
EM90D (gm)	37.6	6.1	580	93.9	618	0.06
EN 210D (egg)	2.37	2.3	102	97.7	104	0.02
EM 210D (gm)	7.99	3.4	226	96.6	234	0.03
Partial recording: traits:						
PF10E (days)	26.8	14.0	165	86.0	192	0.14
EMF10E (gm)	64.5	15.7	347	84.3	412	0.16
EN1W/M (egg)	6	11.5	46	88.5	52	0.12
EM1W/M (gm)	16	13.3	104	86.7	120	0.13
EN2D/W (egg)	6.2	8.4	67.2	91.6	73	0.08
EM2D/W (gm)	16.1	9.6	152	90.4	168	0.10

[+] Traits as defined in Table (2)

Results showed that percentages of σ^2_a were low and moderate in magnitude for all the studied traits. Percentages of additive genetic variance for productive traits of egg production in the present study are fall within the ranges of 6.8 and 35.5% for ASM, 3.0 and 30.9% for BWSM, 18.8 and 45.3% for WFE and 2.0 and 40.95% for total egg number due to sire components as found by Wei and van der Werf (1995) and El-Labban (2000).

Percentages of σ^2_a in Table (3) were 14.0, 15.7, 11.5, 13.3, 8.4 and 9.6% for PF10E, EMF10E, EN1W/M, EM1W/M, EN2D/W and EM2D/W, respectively. Percentages of additive genetic variance for partial recording of egg production traits in the present study are fall within the range of results obtained by El-Labban (1984).

Clutch size and pause period traits

Percentages of σ^2_a ranged from 0.0 to 4.72 for clutch size traits and 0.0 to 12.5 for pause period traits (Table 4).

Table 4. Estimates of additive genetic (σ^2_a), phenotypic (σ^2_p) variances and heritability (h^2) for clutch size and pause period traits in chickens

Trait[+]	σ^2_a	σ^2_a %	σ^2_e	σ^2_e %	σ^2_p	h^2
Clutch size:						
CS 90 < 3	0.00	0.00	43.8	100	43.8	0.00
CS 90 = 3	0.08	2.99	2.62	97	2.69	0.03
CS 90 = 4	0.06	4.04	1.37	96	1.43	0.04
CS 90 = 5	0.00	0.00	0.71	100	0.71	0.00
CS 90 > 5	0.02	0.73	2.15	99	2.16	0.01
CS 210 < 3	0.00	0.00	110	100	110	0.00
CS 210 = 3	0.29	4.72	5.75	95	6.04	0.05
CS 210 = 4	0.00	0.00	3.19	100	3.19	0.00
CS 210 = 5	0.00	0.00	1.48	100	1.48	0.00
CS 210 > 5	0.00	0.00	3.78	100	3.78	0.00
Pause period:						
PP 90 = 1	2.16	7.19	27.8	93	30.0	0.07
PP 90 = 2	0.14	2.79	4.73	97	4.87	0.03
PP 90 = 3	0.00	0.00	1.65	100	1.65	0.00
PP 90 = 4	0.00	0.00	0.81	100	0.81	0.00
PP 90 = 5	0.00	0.00	0.43	100	0.43	0.00
PP 90 > 5	0.06	3.08	1.85	97	1.91	0.03
PP 210 = 1	11.4	12.5	80.0	88	91.4	0.12
PP 210 = 2	0.54	3.93	13.2	96	13.7	0.04
PP 210 = 3	0.07	1.43	4.50	99	4.56	0.01
PP 210 = 4	0.02	1.00	1.89	99	1.91	0.01
PP 210 = 5	0.00	0.00	1.06	100	1.06	0.00
PP 210 > 5	0.00	0.00	5.59	100	5.59	0.00

[+] CS90D =Clutch size during first 90-days, CS 210 = Clutch size during 210-days; = <3: clutch size with lower than 3 eggs, =3: with only 3 eggs, =4: with only 4 eggs, =5: with only 5 eggs, >5: with more than 5 eggs, PP 90 = pause periods during the first 90-days, PP 210 = pause periods during 210-days; =1: pause period for one day,=2: for two days, =3: for three days,=4: for four days, =5: for five days, >5: for more than 5 days.

It is showed also that PP 90 = 1 and PP 210 = 1 had the highest percentages of σ^2_a compared to other pause categories (Table 4). Most percentages of σ^2_a for clutch sizes and pause periods were low for all categories. These percentages are in agreement with findings of El-Labban (1984). He found that percentage of variance due to sire component was 6.8% for clutch size in Dokki-4 chickens.

In general, percentages of σ^2_a for most partial recording traits were moderate and higher than those for productive traits, clutch size and pause period, therefore, the improvement of partial recoding for egg production traits by selection could be possible.

Heritability (h^2)

Productive and partial recording traits

Estimates of $\mathbf{h^2}$ presented in Table (3) were 0.01, 0.28, 0.08, 0.05, 0.06, 0.02 and 0.03 for traits of ASM, BWSM, WFE, EN90D, EM90D, EN210D and EM210D, respectively. It is showed that BWSM trait had the highest $\mathbf{h^2}$. These estimates are fall within the ranges of 0.05 and 1.212 for ASM, 0.226 and 1.012 for BWSM, 0.13 and 0.31 for EN90D, 0.08 and 0.69 for TEN, 0.06 and 0.5 for TEM and 0.34 and 1.026 for WFE (El-Labban, 1984, Wei and Van Der Werf, 1995, El-Labban, 2000 and Kosba et al 2006) when used sire and/or animal model analysis.

Partial recording of egg production traits had low and moderate heritability (Table 3). Estimates of $\mathbf{h^2}$ for traits of PF10E, EMF10E, EN1W/M, EM1W/M, EN2D/W and EM2D/W were 0.14, 0.16, 0.12, 0.13, 0.08 and 0.10 respectively. EL-Labban (2000) found that estimates of $\mathbf{h^2}$ ranged from 0.211 to 0.984 for PF10E. The same author (1984) found estimates of h^2 were 0.494, 0.424 and 0.124 for EN2D/W, EM2D/W and EN1W/M, respectively.

Clutch size and pause period traits

Estimates of $\mathbf{h^2}$ in Table (4) were low for both clutch size and pause period traits. These estimates ranged from 0.0 to 0.05 for clutch size and 0.0 to 0.12 for pause period. Estimates of h^2 for clutch size in the present study were lower than those findings of Chen and Tixier-Boichord (2003).

From the previous results, one would recommended the poultry breeder in Egypt to improve egg production traits through selection for partial recording of periods (in days) of first-ten eggs and egg mass for first-ten eggs. This recommendation is very important to be short the generation intervals and then the expected genetic gain is increased.

Genetic correlation (r_G) between some productive traits

Estimates of r_G between some economic traits are presented in Table (5).

Table 5. Estimates of genetic (r_G) and environmental (r_E) correlations between some productive and partial recording traits

Traits correlated	r_G	r_E
Productive traits:		
ASM & BWSM	0.84	0.01
ASM & WFE	0.08	0.30
BWSM & WFE	0.61	0.05
EN90D & EM90D	0.98	0.99
TEN & TEM	0.97	0.99
Partial recording traits:		
PF10E & EMF10E	0.47	0.15
EN2D/W & EM2D/W	0.99	0.99
EN1W/M & EM1W/M	0.99	0.99

+ Traits as defined in Table (2)

It showed that ASM is closely correlated and positive (r_G = 0.84) with BWSM trait and weak correlated (r_G = 0.08) with WFE. This indicates that when the pullet reached to its sexual maturity at early age, it has lighter body weight at that age. These results are in agreement with reports of Jeyaruban and Gibson (1996), they found that estimates of r_G ranged from 0.32 to 0.492. Also, high and positive estimate of r_G (0.61) between BWSM and WFE in the present study indicates that pullets with high body weight have higher weight for the first egg. These results are in agreement with Jeyaruban and Gibson (1996).

Estimates of r_G were 0.98, and 0.971 between EN90D & EM90D and TEN & TEM, respectively. These estimates are positive and closely correlated, which means that pullets produce more number of eggs, have higher egg mass. EL-Labban (2000) found that estimates of r_G between TEN and TEM ranged from 0.50 to 0.81 in different chicken strains in Egypt.

Genetic correlation between partial recording traits

Estimates of r_G in Table (5) between partial recording traits were high and positively correlated. These estimates were 0.47, 0.99 and 0.99 between PF10E & EMF10E, EN1W/M & EM1W/M and EN2D/W & EM2D/W, respectively. No reports are available on genetic correlations between these traits.

Environmental correlation (r_E)

Productive traits

Estimates of r_E presented in Table (5) showed that some estimates were positive and very low between ASM & BWSM and BWSM & WFE (r_E = 0.01 and 0.05, respectively).While moderate estimates of r_E between ASM & WFE but very high between EN90D & EM90D, and TEN & TEM (r_E = 0.99 and 0.99, respectively) were observed. Abd-EL-Gawad (1975) found that estimates of r_E were 0.46 between ASM and BWSM and -0.04 between BWSM and WFE, respectively.

Partial recording traits

Estimates of r_E presented in Table (5) showed that some estimates were positive and very low between PF10E & EMF10E (r_E = 0.15).While very high estimates between EN1W/M & EM1W/M and EN2D/W & EM2D/W (r_E = 0.99 and 0.99, respectively) were observed.

In some cases, estimates of r_G and r_E are different in magnitude, or even in sign, while in other cases the two correlations are of the same sign and not very different in magnitude and this is the more usual situation in the present study. A large difference and particularly a difference in sign, shows that genetic and environmental sources of variation affect the characters through different physiological mechanism (Falconer and Mackay, 1996).

Correlations among ranks of predicted breeding values

Estimates of rank correlation between ranks of predicted breeding values (PBV) for egg production traits were, in general, moderate and high (Table 6).

Table 6. Estimates of rank correlation between ranks of predicted breeding values of partial recording systems for egg production traits

Trait[+]	EMF10E	EN90D	EM90D	EN1W/M	EM1W/M	EN2D/W	EM2D/W	TEN	TEM
PF10E	0.58**	-0.30**	-0.26**	-.026**	-0.24**	-0.23**	-0.21**	-0.10**	-0.05**
EMF10E		0.16**	0.20**	0.04	0.06*	0.08**	0.12**	0.23**	0.28**
EN90D			0.20**	0.67**	0.66**	0.68**	0.67**	0.75**	0.70**
EM90D				0.67**	0.66**	0.67**	0.68**	0.76**	0.73**
EN1W/M					0.20**	0.89**	0.88**	079**	0.75**
EM1W/M						0.88**	0.87**	0.79**	0.76**
EN2D/W							0.20**	0.82**	0.79**
EM2D/W								0.83**	0.81**
TEN									0.99**

[+] Traits as defined in table (2)

The estimates ranged from 0.04 to 0.99 ($p \leq 0.01$). The high and/or moderate estimates of rank correlation in this study have a meaningful to apply selection program for one of partial recording system to improve egg production traits in chickens. The higher rank correlations between partial recording system for EN2D/W and the total egg number trait (rank = 0.82, $p \leq 0.01$), followed by EN1W/M and total egg number (rank = 0.79, $p \leq 0.01$) and the latest for EN90D and total egg number (rank = 0.75, $p \leq 0.01$). This indicate that the system of partial recording based on egg number for two day per week and/or egg number for one week per month is preferred to improve egg production traits in chickens. This is a good indicator to be short the generation intervals and, consequently, to save money and time, as well as effort required to improve egg production traits in Egyptian local strains of chickens.

Conclusion

- Estimates of rank correlation between ranks of predicted breeding values indicate that system of partial recording for two day per week could be preferred, followed by one week per month to improve egg production traits in chickens.
- This may be encourage the poultry breeders to use the partial recording to obtain short generation interval and, consequently, save money and time, as well as effort required to improve egg production traits.

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