

Direct Selection Response for Egg Number of Baladi Fowl in Qassim Area

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Abstract. Fertile Baladi eggs in Al Qassim area were collected from local farms and incubated at Poultry Research station of Fac. of Agric. and Veter. Faculty of Agriculture and veterinary Medicine, Bureidah. Chicks were brooded and reared to produce the foundation stock. Mass selection was applied for egg number during the first 90 days of laying (part record). In selected generation one, body weights at different ages, egg production traits and egg quality traits were estimated and recorded for both selected and control lines. Results indicated that:

1. Selection for egg number in Baladi fowl are able to increase egg number during the first 90 days of laying by 7.1 eggs per generation (12 % as percentage of the control line).
2. Correlated selection responses for egg production traits were - 4.5 days , 0.6 eggs , - 0.4 days and - 1.0 g for age at sexual maturity, clutch size, interval between clutches and mature egg weight, respectively.
3. Correlations and heritabilities were estimated for different production traits. Realized heritability for egg number expressed as a ratio of total selection response to total selection differential (bR) was 0.35 ± 0.10 .
4. Selection increased egg number till 90 days of laying by 7.1 eggs.

Introduction

Local breed have some advantages over exotic breeds such as its resistance to many diseases, strong shell and its eggs are platable to local consumers. However, the productivity of local fowl is very low (60 - 150 eggs per hen per year) [1-3]. Poor performance of indigenous chickens is due to the fact that their genetic potential has not been developed through selection and breeding programs and also due to poor environmental conditions [4].

In the Riyadh area, some investigation studied the performance of Baladi fowl [1,2]. But, in Al-Qassim area, there is no detailed information about the productive performance of Baladi fowl. Therefore, the present experiment is aimed to investigate the productive performance of Baladi fowl and to study the possibility of improving egg number to an economic rates with selection methods.

Material and Methods

One thousand, Baladi fertile eggs were collected from local farms in different areas of Al-Qassim. Fertile eggs were incubated at Poultry Research Station of Faculty of Agriculture and Veterinary Medicine, King Saud University, Al Qassim, Bureidah. Hatched chicks were wing banded and brooded in floor pens till 16 weeks of age. Then pullets were transported to individual cages. Age at sexual maturity was recorded and body weights at this age was also measured. Egg number during the first 90 days of laying was recorded and egg weight for the first 5 eggs of laying and for mature egg (at 30 weeks of age) was also determined.

At the end of the first 90 days of laying egg quality traits were estimated. Selection for egg number during the first 90 days of laying was applied according to individual egg production record. One hundred female were selected and mated to non relative cocks to produce the first selected generation (300 hens) (Table 1). Chicks of generation one were brooded and reared on floor pens as the previous generation and body weights at hatch, 2, 4, 8, 16 weeks and at sexual maturity were estimated. At 16 weeks of age they were transferred to individual cages and the following traits were recorded and estimated.

1. Egg number of the first 90 days of laying
2. Average egg weight of the first 5 eggs
3. Average egg weight in the third month of laying
4. Clutch size and interval between clutches
5. Egg quality traits : egg weight, albumen weight, yolk weight, shell weight, yolk index, shape index and shell thickness.

Table 1. Breeding plan of Baladi fowl in different generations

1000 Fertile eggs: Foundation stock (200 f and 100 M)		
G ₀	Random mating	Mass selection (100 F ₁)
G ₁	Control line 50 F 20 M	Selected line 300 F
G ₂	Random mating 50 F 20 M	Mass selection (100 F ₁) 300 F
G ₃	Random mating 50 F 20 M	Mass selection (100 F ₁) 300 F
	Random control line	Selected line for egg number

F = Females, M = Males, F₁ = Selected females

The birds were fed *ad lib* on a starter diet containing 20 % crude protein till 12 weeks of age and was changed by a layer diet containing 17 % crude protein. Artificial insemination had been applied in all experiments by assigning females to the males, one sire for three females, avoided relative mating to prevent inbreeding depression.

Data were computerized using SPSS, PC program. Heritabilities were estimated according to [5,pp.20-80]. Realized selection response and selection differential were to [7] as ratio of total selection response to total selection differential (b_R).

where : $b_R = R_t/S_t$

R_t = Total selection response.

S_t = Total selection differential (as difference between average of selected hens and population mean)

In each generation males and females of the control line were randomly mated. Family size of control line was maintained constant in order to minimize inbreeding effect [8].

Results and Discussion

1. Direct response for egg number

Table 2 presents egg number per hen of the foundation stock and the selected and control line after one round of selection (generation) for egg number. Egg number per hen during the first 90 days of laying in the foundation stock was 49.6 ± 1.8 eggs. In the selected line egg number per hen was 66.1 ± 0.6 in generation 1 and it was 59.0 ± 2.1 for the control line. Difference between average egg number in the foundation stock and average egg number of the control line was 9.4 eggs. This may be due to environmental conditions in research station or to random effects.

Table 2. Egg production traits in the foundation stock, selected and control lines after one round of selection for egg number

Trait	Foundation stock Go	Selected line (G1)	Control line (G1)
Age at sexual mat. (days)	163.2 ± 1.1 a	142.8 ± 1.4 c	147.3 ± 3.2 b
Egg number during 90 days of laying (eggs)	49.6 ± 1.8 c	66.1 ± 0.6 a	59.0 ± 2.1 b
Clutch size (eggs)	2.9 ± 0.3 b	3.9 ± 0.1 a	3.3 ± 0.2 b
Interval between clutches (days)	2.6 ± 0.3 a	1.4 ± 0.1 c	1.8 ± 0.2 b
Egg weight (first 5 eggs) (g)	25.8 ± 0.3 b	26.6 ± 0.2 a	27.7 ± 0.4 a
Egg weight (mature weight) (g)	36.5 ± 0.2 c	41.6 ± 0.3 b	42.6 ± 0.6 a

a, b, c means within a raw having the same subscript are not significantly different ($P \leq 0.05$).

Difference between the selected and control lines in egg number was significant and it was equal to 7.1 eggs, which it was expressed as selection response or genetic improvement for egg number. This improvement can be explained by larger clutch size (3.9 eggs in the selected line and 3.3 eggs in the control line) and shorter interval between clutches (1.4 days in the selected line and 1.8 days in the control line) in the selected line than those in the control line.

Calculated heritability estimate for egg number was 0.06 (Table 2) and it was in agreement with that obtained by [4] and [9]. Realized heritability for egg number expressed as a ratio of total selection response to total selection differential (b_R) was 0.35 ± 0.10 and it was in harmony with that found by [10, p.90].

In general, selection had increased egg number till 90 days of laying. This gives a very important tool to the poultry breeder to select strains of hens on the base of part records in Baladi fowl. It is clear also that Baladi fowl ability to produce higher egg number can be realized by both environmental condition and genetic selection method.

2. Correlated selection responses in the correlated traits

Table (3) presents correlated selection response for all production traits. Also Tables 4 and 5 illustrate averages of different production traits in the selected and control lines. It is clear that body weights at different ages were smaller in the control line than those obtained in the selected line. Correlated selection response for body weights in the selected line were -0.3, -10.0, -11.9, -246, -20.3 and -55.7 grams for body weight at hatch, 4, 8, 12, 16 weeks and at sexual maturity.

Table 3 illustrates positive correlated selection response for clutch size. In contrary negative correlated selection responses were obtained for interval between clutches, age at sexual maturity. This finding may be reasons for the realized selection response for the selected trait (egg number). Means of egg quality traits in the selected and control lines are presented in Table 5. There were no significant differences between the selected and control lines in most of egg quality traits. However correlated selection responses for egg weight (-1.07 g), alb. wt. (-0.5 g) and shell wt. (-0.1 g) and yolk wt. (-1.0 g) were obtained in Table (3). The reduction in egg weight can be explained by the reduction in albumen wt., yolk and shell weights. Shell thickness was increased by 31 to 40 μm (Table 3).

Table 3. Correlated selection responses and heritabilities estimate for different production traits

Trait	Correlated response ΔG^*	Heritability h^2
I. Body weights		
At hatch	- 0.3	0.68
4 wks	-10.0	0.36
8 wks.	-11.9	0.24
12 wks.	-24.6	0.06
16 wks.	-20.3	0.20
At sexual maturity	-55.7	0.20
II. Egg production		
Age at sexual maturity	- 4.5	0.43
Clutch size	+ 0.6	0.06
Interval between clutches	- 0.4	0.08
Egg wt. of the first 5 eggs	- 1.1	0.26
Mature egg wt.	- 1.0	0.40
III. Egg quality		
Egg wt.	- 1.07	-
Yolk wt.	- 1.1	-
Alb. wt.	- 0.5	-
Shell wt.	- 0.1	-
Shell thick. 1	+ 31	-
Shell thick. 2	+ 40	-

* (1) Shell thickness from the narrow edge.

** (2) Shell thickness from the broad edge.

Table 4. Body weights of selected and control Baladi lines at different ages

Trait	Selected line $\bar{X} + SE$	Control line $\bar{X} + SE$
Body weights:		
At hatch (g)	28.7 \pm 0.1 a	29.0 \pm 0.3 a
At 4 weeks (g)	192.3 \pm 3.9 b	202.3 \pm 2.1 a
At 8 wks (g)	548.7 \pm 6.3 b	560.6 \pm 11.5a
At 12 wks.	780.3 \pm 9.3 b	804.9 \pm 19.5a
At 16 wks. (g)	1109.3 \pm 18.7 b	1129.6 \pm 40.5a
Atsexual maturity (g)	1140.7 \pm 18.9 b	1195.9 \pm 22.7a

a, b means within a row having the same subscript are not significantly different ($P \leq 0.05$).

Table 5. Body weights of selected and control Baladi lines at different ages

Trait	Selected	Control
Egg weight (g)	41.1 ± 0.7 b	42.2 ± 0.7 a
Yolk weight (g)	14.7 ± 0.2 b	15.8 ± 0.2 a
Albumen weight (g)	21.4 ± 0.7 a	21.9 ± 0.7 a
Shell weight (g)	4.1 ± 0.1 a	4.2 ± 0.1 a
Shell thickness (µm) (1)	401 ± 9 a	370 ± 8 b
Shell thickness (µm) (2)	333 ± 12 a	293 ± 12 b
Yolk index %	51.2 ± 0.4 a	51.2 ± 0.4 a
Shape index %	64.4 ± 0.9 a	68.9 ± 0.9 a

a, b means within a row having the same subscript are not significantly different ($P \leq 0.05$).

(1) shell thickness from the narrow edge.

(2) shell thickness from the broad edge.

These results were in harmony with that obtained by [3], [4] and [10, p., 80].

3. Correlation between the selected trait and other production traits

Table 6 shows correlation coefficient between egg number and each of age at sexual maturity, clutch size, interval between clutches, egg weight of the first 5 eggs and egg weight of mature eggs. High positive correlation was obtained between egg number and clutch size (0.64). High negative correlation between egg number and each of age at sexual maturity (-0.25), body weight at sexual maturity (-0.23) and interval between clutches (-0.35). Moderate negative correlations between egg number and egg weight of the first 5 eggs as well as mature egg weight were observed.

Table 6. Correlations between egg production traits in selected Baladi line

	1 Body weight at sexual mat.	2 Age at sexual mat.	3 Egg no.	4 Clutch size	5 Interval bet. clutc	6 egg wt. of (first eggs)	7 egg wt. of mature egg
1	-	0.32	-	-0.16	0.06	0.26	0.36
2		-	-	-0.13	0.03	0.36	-0.02
3			-	0.64	-0.35	-0.15	-0.12
4				-	0.02	-0.18	0.10
5					-	-0.01	-0.06
6						-	0.10
7							-

Table 7 shows that correlations between body weights at later ages (8, 16 and 20 wks) were higher than those obtained between earlier ages (hatch and 4 weeks). This trend was observed also by [11]. They suggested that some of the genes that controlled body weights differ at different ages. Similar trends have been reported [12]. High correlations between egg weight and each of yolk, albumen and shell weights were 0.30,

0.51 and 0.39, respectively (Table 8). These correlations explained the negative correlated selection response for egg weight, yolk, shell and albumen weights.

Table 7. Correlations between body weight at different ages.

	1 At hatch	2 At 4 wks	3 At 8 wks	4 At 16 wks	5 at 20 wks	6 At sexual aturity
1	-	0.07	-0.05	-0.06	-0.13	0.04
2	-	-	0.72	0.58	0.22	-0.02
3	-	-	-	0.61	0.27	-0.09
4	-	-	-	-	0.39	-0.04
5	-	-	-	-	-	0.06
6	-	-	-	-	-	-

Table 8. Correlation between egg quality traist in the selected Baladi line

	1 shape index	2 Yolk wt.	3 Album en wt.	4 Sheel wt.	5 Yolk index	6 Shell thickness (1)	7 Shell thickenss (2)	8 egg weight
1	-	-0.04	0.2	-0.07	-0.04	-0.03	0.02	0.09
2	-	-	-0.07	0.02	0.04	0.14	0.25	0.30
3	-	-	-	-0.05	-0.17	-0.12	-0.06	0.50
4	-	-	-	-	-0.21	0.10	0.11	0.19
5	-	-	-	-	-	-0.12	-0.12	-0.16
6	-	-	-	-	-	-	0.32	0.23
7	-	-	-	-	-	-	-	0.25
8	-	-	-	-	-	-	-	-

4. Heritabilities estimate

Table 3 presents heritability estimates for body weight at different ages and egg production traits. Body weights at different ages have high heritability estimates 0.20 to 0.68. These results were in agreement with those obtained by [4, 10, p. 100]. Heritabilities for age at sexual maturity, clutch size, interval between clutches and egg weights were 0.43, 0.06, 08 and 0.26 - 0.40 (Table 3), respectively. These values were in harmony with those obtained in literature [4, 10, p. 100,11].

Finally, selection for egg number in Baladi fowl are able to increase egg production. This improvement was associated with early sexual maturity, shorter

interval between clutches and larger clutch size. Longer selection generations and other selection methods may produce more responses in egg production.

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الاستجابة المباشرة للانتخاب لعدد البيض في دجاج البلدى في منطقة القصيم

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ملخص البحث . البيض المحصص للدجاج البلدى تم جمعه من المزارع الأهلية وتم تفرينه في محطة أبحاث الدواجن بكلية الزراعة والطب البيطرى بريدة . تم تحضين الكناكيت الناتجة ورعايتها لانتاج قطيع الأساس ، تم تطبيق الانتخاب الاجمالى لعدد البيض خلال التسعين يوم الأولى من الانتاج . في الجيل الانتخابى الأول تم قياس وتسجيل أوزان الجسم عند الأعمار المختلفة وصفات انتاج البيض وجودة البيض في كل من الخط المنتخب والكنترول . وبينت النتائج :

١- أن الانتخاب لعدد البيض في الدجاج البلدى له القدرة على زيادة عدد البيض الناتج خلال التسعين يوم الأولى بمقدار ٧١ بيضة أى بنسبة ١٢% زيادة في الجيل الواحد عن قطيع المقارنة .

٢- قدرت الاستجابة المرتبطة للانتخاب لصفات انتاج البيض وكانت -٤ر٥ يوم ، ٦ بيضه ، -٤ر٥ يوم و -١٠ر١ جرام لكل من العمر عند النضج الجنسى ، حجم السلسلة ، فترات التوقف بين السلاسل ، ووزن البيضه الناضجه على التوالى .

٣ - تم قياس الارتباط المظهري والقيمة الوراثية لمعظم الصفات الانتاجية . وكانت القيمة الوراثية المحققة معبرا عنها كنسبة الاستجابة الكلية للانتخاب الى الفارق الانتخابى الكلى (bR) مساوية ٣٥ر + ١٠ر .

٤- حقق الانتخاب زيادة في عدد البيض المنتج خلال التسعين يوم الأولى من الانتاج درت بحوالى ٧١ بيضه .