J. King Saud Univ., Vol. **4**, *Agric. Sci.* (1), pp. 47-54, Riyadh (A.H. 1412 / 1992).

Effect of Protein Rearing Diet and Age on Fertility and Hatchability Parameters of Saudi Arabian Baladi Chickens

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Abstract. A total of 4800 eggs was used in this study. The eggs were obtained from Saudi Arabian Baladi Chickens which have been subjected to four different protein rearing diets: conventional (C), reverse protein (RP), 12% CP from 1-6 weeks followed by a 15% CP from 6-14 weeks and 18% CP from 14-20 weeks of age, single stage low protein (SS_1) 15% CP and (SS_2) 12% CP diets from 1-20 weeks of age. All the birds received a conventional 18% CP diet during the first week of age and were offered a commercial ration during the laying period. Eggs were collected over three consecutive days at the first week of each month and incubated to determine percentages of fertility (F), fertile hatchability (FH), total emberyonic mortality (M) and emberyonic mortality during the 1-7 (M_1), 8-18 (M_2) and 19-21 (M_3) days of the incubation period.

The results indicated that protein rearing diet has no significant influence on any of the studied traits. The study also showed that a 12% CP rearing diet was adequate to support high fertility and hatchability precentages. Age effect was found to be significant ($P \leq .01$) for all studied traits. F, FH and M_2 decreased while M, M_1 and M_3 increased with increasing age. The overall averages were 95.69, 90.60 and 8.71% for F, FH and M respectively. These values were comparable to those of best hatch reported for standard breeds.

Introduction

Published data concerning the effect of reverse protein rearing diets on fertility and hatchability are lacking. However, single stage low protein rearing diets seem to have no adverse effect upon fertility and hatchability as reported by Sunde and Bird [1] and Lillie and Denton [2] who fed 15 and 12% CP diets for the entire rearing period,respectively.

Age of the hen appears to have influence upon fertility and hatchability. Insko *et al.* [3] reported the general tendency for fertility and hatchability to decline with age. Hays and Talmadge [4] and Tomhave [5, 6] concluded that hens are likely to show a decline in hatchability as they grow older. Sunde and Bird [1] reported that

eggs laid by hen which has just reached sexual maturity did not hatch as well as later eggs. Tomhave [6] also noticed greater variation in percentage of fertile eggs early in production cycle than later. According to Garwood and lowe [7], hatchability increased with chronological age and reached a maximum in the 6th week after maturity. Standard breeds were used in the previous works but no similar studies were carried out on Saudi Arabian Baladi chickens. The objective of the present study was to investigate the effect of reverse and single stage low protein rearing diets and age of the hen on fertility, hatchability and embryonic mortality at 1-7, 8-18 and 19-21 days of the incubation period.

Materials and Methods

Hatching eggs used in this study were obtained from Saudi Arabian Baladi chickens which have been divided into four experimental groups, four replicates in each. The experimental groups were randomly assigned to four different protein rearing diets: conventional (C) [8] reverse protein [RP), 12% CP form 1-6 weeks followed by a 15% CP from 6-14 weeks and 18% CP from 14-20 weeks of age, single stage low protein 15% CP (SS_1) and single stage low protein 12% (SS_2) from 1-20 weeks of age (Table 1). All the birds received the conventional 18% CP diet during the first week of age and were offered a commercial layer ration (Table 2) during the laying period. The experimental birds were grown under practical management condition and raised under decreasing natural light till 14 weeks of age. Thereafter, they were randomly allocated to 16 pens (30-33 birds in each) in an environmentally controlled house, where they received 10 hr light/day till 20 weeks of age. Light was increased by 0.5 hr each week to reach 15 hr/day. Feed and water were provided *ad libitum* during the entire experimental period. Flock mating was practiced with a cock to hen ratio of 1:10. For fertility and hatchability studies, 10 eggs, as possible, from each pen were collected over three consecutive days at the first week of each month for a period of 10 months beginning May 1988 when the birds were 6 months of age. Experimental eggs were stored at 10-12 C° and relative humidity of 55-60% and were incubated on the third day of collection following standard hatchery practices. Due to the brown color of the eggshell, determination of fertility by candling is not accurate. Therefore, eggs seemed infertile and unhatched eggs were broken-out to determine fertility (F) fertile hatchability (FH) and total embryonic mortality (M) percentages. Percentages of the embryonic mortality at 1-7, 8-18 and 19-21 days of the incubation period were also determined. Data collected were subjected to statistical analysis using SAS general linear model procedure, King Saud University Computer Center, according to the following model:

$$Y_{ijk} = U + T_i + A_j + (TA)_{ij} + e_{ijk}$$

where the Y_{ijk} is the K^{th} observation of the i^{th} treatment and j^{th} age. U is the general mean and e_{ijk} is the random error associated with Y_{ijk} observation [9].

Table 1. Composition of experimental diets used in the rearing period (0 - 20 weeks)

Ingredient	Protein 18%	15%	12%
Corn, yellow ground	43.65	54.57	43.05
Barley	30.52	35.50	47.00
Soybean meal	14.20	12.00	3.00
Fish meal	5.00	—	—
Animal fat	1.00	1.00	1.00
Alfalfa	2.50	2.50	2.50
Dicalcium phosphate	1.25	1.55	1.55
Limestone	1.35	1.33	1.33
Salt	0.25	0.25	0.25
Sodium bicarbonate	0.10	0.10	0.10
Micro-mix[1]	0.15	0.15	0.15
DL-Methionine	0.03	0.05	0.04
Lysine	—	—	0.03
Calculated analysis:			
Metabolizable energy Kcal/kg	2900	2900	2900
Protein %	18	15	12

[1] Supplied per kilogram of diet: vitamin A, 10.000 IU; Vitamin D_3, 2000 ICU; vitamin E, 10 mg; vitamin B_1, 0.5 mg; vitamin B_2, 3 mg; Pantothenic acid, 61 mg; Niacine, 10 mg; vitamin K_3, 0.2 mg; vitamin B_{12} 0.01 mg; cholin, 200 mg; Manganese, 30 mg; Zinc, 30 mg; Iron, 10 mg; Copper, 1 mg; Iodine, 0.3 mg; Cobalt, 0.1 mg; Selenium 0.03 mg.

Table 2. Nutrients composition of the laying ration*

Nutrients	%
Crude protein	(Min.) 17.00
Crude fat	(Min.) 3.00
Crude fiber	(Max.) 5.00
Calcium	(Min.) 3.50
Phosphorus	(Min.) 0.60
Salt	(Max.) 0.35
Met|Energy Kcal/kg.	2695.00

* Manufactored By:
Grain Silos and Floor Mills organization, Riya·lh, Saudi Arabia.

Results and Discussion

Overall and treatments means and standard errors of fertility (F), fertile hatchability (FH), total embryonic mortality (M) and embryonic mortality during the different stages of the incubation period (M_1, M_2 and M_3) are presented in Tables 3 and 4. Statistical analysis did not detect any significant differences attributed to protein rearing diets in all studied traits (Tables 3 and 4). These results agree with those

Table 3. Effect of protein rearing diets (C, RP, SS_1 and SS_2) and age on fertility (F) fertile hatchability (FH) and total embryonic mortality (M).

Parameter	n	F $\bar{X} \pm$ S.E. %	FH $\bar{X} \pm$ S.E. %	M $\bar{X} \pm$ S.E %
Treatment		n.s.	n.s.	n.s.
CP	1200	96.25 ± .59	90.68 ± 1.06	8.92 ± 1.00
RP	1200	95.92 ± .65	90.44 ± 1.05	8.67 ± .93
SS_1	1200	95.50 ± .73	90.83 ± 1.07	8.58 ± .99
SS_2	1200	95.11 ± .68	90.46 ± 1.26	8.62 ± 1.07
Age		**	**	**
Tx Age		n.s.	*	*
Overall mean	4800	95.69 ± .33	90.60 ± .56	8.71 ± .50

* $P \leq 0.05$, ** $P \leq 0.01$ n.s.: nonsignificant

a) C = Conventional, SS_1 = Single stage low protein 15%
RP = Reverse protein, SS_2 = Single stage low protein 12%

Table 4. Effect of protein rearing diets (CP, RP, SS_1 and SS_2)[a] and age on enbryonic mortality at 1-7 (M_1), 8-18 (M_2) and 19-21 (M_3) day of the incubation period.

Parameter	n	M_1 $\bar{X} \pm$ S.E. %	M_2 $\bar{X} \pm$ S.E. %	M_3 $\bar{X} \pm$ S.E %
Treatment		n.s.	n.s.	n.s.
CP	1200	2.67 ± .44	2.25 ± .43	4.00 ± .52
RP	1200	2.50 ± .46	1.75 ± .39	4.41 ± .62
SS_1	1200	1.92 ± .48	1.83 ± .41	4.83 ± .58
SS_2	1200	2.75 ± .42	1.58 ± .37	4.33 ± .51
Age		**	**	**
Tx Age		n.s.	*	n.s.
Overall mean	2800	2.46 ± .22	1.85 ± .19	4.40 ± .26

* $P \leq 0.05$, ** $P \leq 0.01$

a) See footnote table (4)

reported by Sunde and Bird [1] and Lillie and Denton [2] in respect to single stage low protein rearing diets. As it is shown in Table 3 the CP group tended to have the highest fertility and total embryonic mortality, while SS_1 group attained the highest fertile hatchability and lowest total mortality. SS_2 and RP groups had numerically the lowest fertility and fertile hatchability respectively. SS_1, SS_2 and CP groups also tended to have the lowest M_1, M_2 and M_3 and the highest M_3, M_1 and M_2 (Table 4) respectively. However, the reported averages for all studied traits are comparable with those of best hatch indicated by North [10]. As reported by Alsobayel *et al.* [11], the different experimental groups had also no significant difference in overall egg production, feed intake and feed consumed/dozen eggs.

Age of the hen appears to have a significant ($P \leq 0.1$) effect upon all studied traits, while treatment × age interaction was only significant ($P \leq 0.5$) for fertile hatchablity and embryonic mortality, M and M_2 (Tables 3 and 4). Fig. 1 shows that F, FH and M remaind fairly constant up to 11 months of age. Thereafter F and FH decreased and M increased with increasing age. Similar results were reported by several investigators [3-6]. The low hatchability at early age reported by Sunde and Bird [1], Tomhave [6] and Garwood and Lowe [7] was not noticed in our study. This might be due to the fact that our study started 3 weeks after the birds reached sexual maturity which was at 23 weeks of age on the average for the different experimental groups. As it is shown in Fig. 2, M_1 decreased at early age then started to increase at later age.

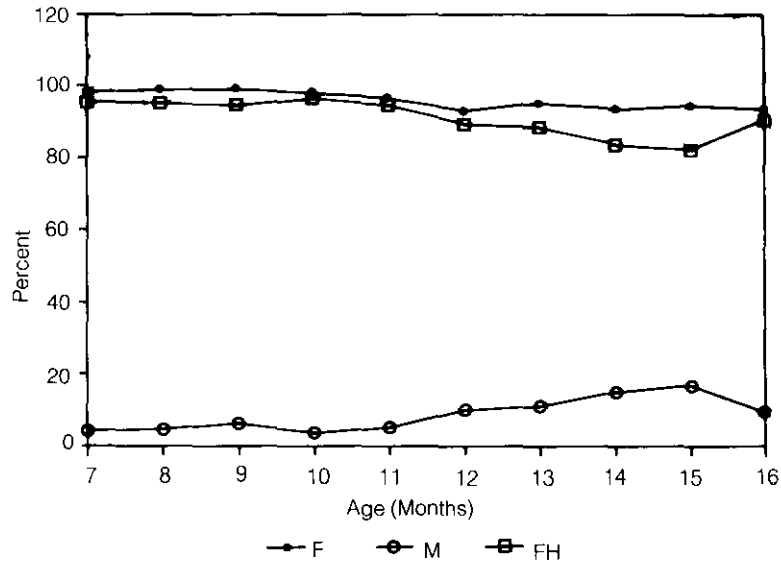

Fig. 1. Effect of age on fertility (F), fertile hatchability (FH) and mortality (M)

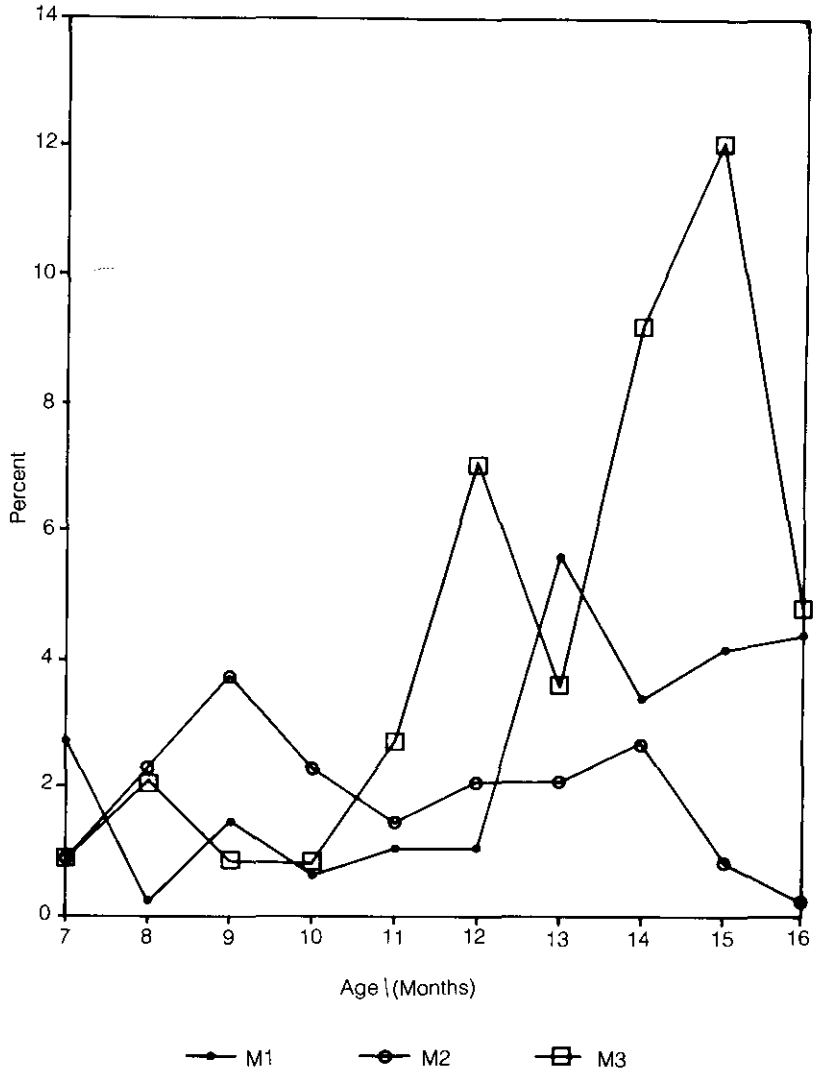

Fig. 2. Effect of age on embryonic mortality during the 1-7 (M_1), 8-18 (M_2) and 19-21 (M_3) days of the incubation period

M_2 was fairly uniform during most of the age periods but was very low at the start and end of the laying period. M_3 started to increase at early age and reached a maximum at 15 months of age. These results disagree with that of Sunde and Bird [1] who reported a decrease in M, M_1 and M_3 and an increase in M_2 with increasing age.

From the results reported herein it seems that a 12% CP rearing diet is adequate to support high fertility and hatchablity percentages. We also conclude that Saudi Arabian Baladi Chickens when kept in an environmentally controlled house had fertility, fertile hatchability and embryonic mortality percentages comparable to those of standard breeds.

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تأثير بروتين العليقة خلال فترة النمو والعمر على الخصوبة ومعايير الفقس في الدجاج البلدي

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ملخص البحث. استخدم في هذه الدراسة ٤٨٠٠ بيضة جمعت من ٤٦٥ من الدجاج البلدي الذي غذي على علائق مختلفة من حيث محتواها من البروتين خلال فترة النمو: عليقة تقليدية (C) ، عكس تقليدية تحتوي على ١٢٪ بروتين خامًا من عمر ١-٦ أسابيع ، عليقتين منخفضتي البروتين ١٥٪ (SS_1) و١٢٪ (SS_2)، جميع الطيور حصلت على عليقة تقليدية تحتوي على ١٨٪ بروتين خامًا خلال الأسبوع الأول من العمر وعلى عليقة دجاج بياض تجارية خلال فترة الإنتاج. جمع البيض خلال ثلاثة أيام متتالية من كل شهر وتم تفريخه من أجل تحديد نسب كل من الخصوبة (F) ، الفقس (FH) ، هلاكات الأجنة الكلية (M) وكذلك هلاكات الأجنة خلال المراحل ١-٧ (M_1) ، ٨-١٨ (M_2) و١٩-٢١ (M_3) يومًا من فترة التفريخ.

دلت النتائج على أن محتوى العليقة من البروتين خلال فترة النمو ليس له تأثير معنوي على أي من الصفات المدروسة، وقد اتضح من الدراسة أن ١٢٪ من البروتين الخام في العليقة كانت كافية للحصول على أداء تناسلي متميز.

كذلك أظهرت الدراسة أن العمر له تأثير معنوي ($p \leq .01$) على جميع الصفات المدروسة، لقد تناقصت كل من نسب الخصوبة، الفقس، وهلاكات الأجنة (M_3) وازدادت هلاكات الأجنة M ، M_1 وM_2 مع زيادة العمر وكانت المتوسطات العامة ٩٥,٦٩، ٩٠,٦٠، ٨,٧١٪ لكل من الخصوبة، الفقس، هلاكات الأجنة الكلية على التوالي وتعتبر هذه القيم مشابهة لما ذكر بالنسبة للسلالات القياسية.