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EFFECT OF AGE AND SEX RATIO ON FERTILITY AND HATCHABILITY OF BALADI AND LEGHORN LAYING HENS

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ABSTRACT

The study was conducted to assess the effect of breed, age and sex ratio on fertility and hatchability of Saudi Arabian Baladi breed of poultry and to compare its' performance with that of Leghorns which, were maintained under similar conditions. 396, twenty week-old pullets of Baladi and Leghorn were randomly divided into three experimental groups of three replicates each and were assigned to one of the following cock to hen ratio 1:6, 1:10 and 1:14. The birds were randomly allotted to 9 2mx2m floor pens in an environmentally controlled house. 35 eggs of each replicate were collected at the last week of each production period and used for the study. Fertility (F) and hatchability of total eggs (HT) percentages were significantly affected ($P < 0.05$) by breed (B), treatment (T), age (A) and TxA interaction whereas other studied traits were not affected. Leghorn hens had significantly ($P < 0.05$) (9. write 0.05) higher F and HT and tended to have higher FH and lower TEM compared to their Baladi counterparts. F and HT of 1: 6 were significantly ($P < 0.05$) the highest followed by 1:10 and that of 1:14 sex ratio were the lowest at all studied age periods. Baladi and Leghorn hens had similar response to the different sex ratios used in the experiment though Leghorn hens tended to have higher values. From the results reported herein we suggest that breed, age and sex ratio significantly affect fertility and hatchability of total eggs but not fertile hatchability and embryonic mortality. The highest fertility and hatchability values were achieved by 1: 6 sex ratio and early age periods. The study also showed that lower sex ratio might enhance old hens' ability to be fertilized.

Key words: breed, age, sex ratio, fertility, hatchability, fertile hatchability embryonic mortality.

INTRODUCTION

Several factors have been reported to affect fertility and hatchability of chicken eggs. Age of the hen appears to have influence upon fertility, hatchability and embryonic mortality. Insko *et al.* (1947) reported the general tendency for fertility and hatchability to decrease with age. Hays and Talmadge (1949) and Tomhave (1956, 1958) concluded that hens are likely to show decline in hatchability as they grow older. Similar results were reported by several investigators for broiler breeders (Mather and Laughlin, 1979; Susan *et al*., *et al*., 1980; Roque and Soars, 1994; Lapao, 1999; Tona *et al*., *et al*., 2001; Bourassa, 2003; Seker, 2004; Vieira, *et al*., 2005, Yildirin, 2005; Elibol and Brake, 2006; Zakaria *et al*., *et al*., 2009; Abudabos, 2010; Almarshade, 2011). Sunde and Bird (1959) reported that eggs laid by hens just reached sexual maturity did not hatch as well as later eggs. Tomehave (1958) also noticed great variation in percentage of fertile eggs early in production cycle than later ones. Garwood and Lowe (1982) reported that hatchability increased with chronological age and reached a maximum in the sixth week after maturity. Alsobayel (1992) reported that fertility, hatchability and total embryonic mortality of Baladi chickens remained fairly constant from 7 up to 11 month of hen age, thereafter fertility and hatchability gradually decreased and embryonic mortality increased. However, Bramwell (2009) concluded that age does not negatively affect reproduction and fertility in broiler breeders but hens undergo some physiological changes as they age, and this affect their ability to be fertilized. In addition, the same author found a strong correlation between weight control in breeder and achieving a high fertility level throughout the life of a breeder flock.

Sex ratio is also an important factor affecting fertility, too many males and few males lead to reduced fertility, therefore it is recommended to have for commercial mini-leghorn, standard leghorn and medium size pullets raised on litter 8 males per 100 females, for commercial mini-meat-type broiler 9 and for standard meat-type pullets 10 per 100 female (North and Bell, 1990). However, Wilson (2003) suggested sex ratios of 1:12 to 1:15 for light breeds and 1:10 to 1:12 for heavy breeds. Published informations on fertility and hatchability of Saudi Arabian Baladi breed is sparse, therefore this study was conducted to assess the effect of age and sex ratio on fertility and hatchability in Saudi Arabian Baladi breed and to compare their its' performance with that of Leghorns which have been bred for many years under similar conditions.

MATERIALS AND METHODS

396 Three hundered and ninty six, twenty- 20 weeks-old pullets of Baladi and Leghorn breeds were obtained from the Baladi and Leghorn populations which have been randomly bred for several years in the Experimental Poultry and Live-Stock farm of the Animal Production Department, College of Food and Agricultural Sciences, King Saud University. The Pullets of both breeds were randomly divided into three experimental groups of three replicates each and were assigned to one of the following cock to hen ratio: 1:6, 1:10 and 1:14. The birds were randomly allotted to 9 2mx2m floor pens bedded with sand litter in an environmentally controlled house. The birds received water and the commercial laying ration *ad libitum* throughout the experimental period. *The* ration was purchased from Arabian Agricultural Services Company (ARASCO) and contained 17% crude protein and 2700 Kcal /kg metabolizable energy (Table 1). During the growing period, birds were exposed to decreasing light program up to 18 weeks of age, thereafter light was increased by half an hour weekly and maintained constantly at 15 h light: 9h dark during the whole experimental period. The trial lasted for nine 28 days production periods starting after the birds reached 50% hen day egg production and no mortality was recorded during the studied production periods. 35 eggs were collected from each replicate during the last week of each production period and were stored at 14-16^{0}C and 55- 60 % relative humidity and incubated at the end of each production period, following standard hatchery practices. Eggs were candled on the seventh and eighteenth day of the incubation period to determine infertile eggs and eggs with early and late dead embryos. At the end of the incubation period, all the unhatched eggs were broken to accurately calculate fertility (F), fertile hatchability (HF), hatchability of total eggs (HT), early embryonic mortality (EEM), late embryonic (LEM) and total embryonic mortality (TEM) percentages.

Statistical Analysis: The data thus obtained were subjected to statistical analysis using the General Linear Models procedures of SAS Institute (2000) using the following statistical model:

$$Y_{ijkL} = \mu + B_j + T_j + A_k + BT_{ij} + BA_{jk} + TA_{jk} + BTA_{ijk} + e_{ijkL}$$

Where Y_{ijkl} is the k_{th} observation of the i_{th} breed (B) and j_{th} sex ratio (T) and k_{th} age (A). BT_{ij} is the interaction between breed and treatment, BA_{jk} is the interaction between breed and age TA_{jk} is the interaction between treatment and age and BT_{ij} is the interaction between breed and treatment BTA_{ijk} is the interaction between breed, treatment and age. μ is the general mean and e_{ijkl} is the random error associated with Y_{ijkl}. observation. Fertility, hatchability and mortality percentages were transformed to arc sin $\sqrt{\ }$ proportion prior to statistical analysis. When significant differences among treatments were found, means were separated using LSD test.

RESULTS AND DISCUSSION

As it is shown in the results of the present study, Table 2 indicates that breed (B), treatment (T) and age (A) and only TxA interaction had a significant ($P < 0.05$) effect upon percentages of fertility (F) and hatchability of total eggs (HT), whereas, percentages of fertile hatchability (FH), early (EEM), late (LEM) and total (TEM) embryonic mortality were not significantly affected by any of the included factors. As it is indicated in Table 2 Leghorn hens had significantly ($P < 0.05$) higher F and HT and tended to have higher FH and lower EEM, LEM and TEM compared to their Baladi counterparts. Similar breed differences were also reported by Almarshade (2011) who compared fertility and

Table 1. Composition of laying ration

Ingredients and calculated analysis	g Kg-1
Ingredient	
Ground yellow corn	100.0
Soybean meal	141.1
Ground wheat	515.7
Fish meal	21.0
Bran meal	80.0
Alfalfa meal	11.0
Limestone	99.0
Dicalcium phosphate	9.5
Concentrate[a]	4.0
Palm oil	11.0
Pigments[b]	3.7
Salt (NaCl)	2.4
Enzyme preparation[c]	1.0
DL-Methionine	0.6
Calculated analysis	
Crude Protein	170.0
Men (Kcal g-1)	2.70
Ether extract	30.0
Calcium	35.0
Phosphorus	6.0
Sodium	3.5

[a]Provided the following per Kilogram of diet: vitaminA,12000IU; vitamin D3, 6000 ICU; vitamin E, 8mg; choline chloride, 20 mg; vitamin K, 1.6 mg; vitamin B1, 1.6 mg; vitamin B2, 4mg; vitamin B6, 0.8 mg; niacin, 20 mg, pantothenic acid, 8mg; folic acid, 0.8 mg; biotin, 0.08 mg; vitamin C,80 mg; ethoxyquin, 56 mg; Cu 12 mg; I,0.8 mg; Fe, 40 mg; Mn, 80 mg; Zn, 48 mg; Co,.04 mg; Se, 0.16 mg. [b]Provided the following per Kilogram of diet: xanthophyls 1.15-4 mg; ethoxyquin 2.3-4 mg; emulsified fat, 9.55-3 mg; silica, 6.21-3 mg; carrier, 6.9-3 mg.

[c]Xylanase (EC 3.2.1.8) 12000 fxu/g; *B*- glucanase (EC 3.2.1.6) 5000 bgu/g.

hatchability of different commercial broiler strains. F and HT of 1 male: 6 females ratio were significantly (P < 0.05) the highest followed by 1:10 and that of 1:14 were the lowest. However, in our study, FH, EEM, LEM and TEM for the different sex ratios were not significantly different though the 1:6 tended to have the best FH, EEM and TEM values, while 1:14 tended to have the lowest LEM and TEM values. The best sex ratio in our study was 1:6 which differs from that recommended by North and Bell (1990) and Wilson (2003). Table 2 also shows that F and HT decreased with advancing hens' age. Similar results were reported by several investigators (Insko *et al*., 1947; Hays and Talmadge, 1949; Tomhave, 1956, 1958; Mather and Laughlin, 1979; Susan *et al*., 1980; Roque and Soars, 1994; Lapao, 1999; Tona *et al*.,2001; Bourassa, 2003; Seker, 2004; Vieira,*et al*., 2005, Yildirin, 2005; Elibol and Brake, 2006; Zakaria *et al*., 2009; Abudabos, 2010; Almarshade, 2011). Table 2 also indicates that F and HT reached their highest values at 32 weeks of age, thereafter significantly (P < 0.05) decreased with advancing age and reached their lowest values at 52 weeks of age. Similar findings were reported by Alsobayel (1992) with respect to fertility and hatchability of Saudi Arabian Baladi. On the other hand FH, EEM, LEM and TEM values did not differ significantly with advancing hens' age and approximately remained constant throughout the whole production periods. This result differs from that reported by Alsobayel (1992) who noticed increased total embryonic mortality with advancing hens' age.

Fig. (1 and 2) shows that 1: 6 sex ratio had significantly (P < .05) the highest F and HT at all studied age periods and 1:10 ratio ranked second whereas 1:14 had significantly (P < .05) the lowest values during all studied age periods. The same figures shows that 1:6 ratio had the least and the 1:14 the highest decrease in F and TH from 24 to 52 weeks of hens' age. These results agree with that of Bramwell (2009) who concluded that age does not negatively affect reproduction and fertility but hens undergo some physiological changes as they age that affect their ability to be fertilized. However our results shows that lower sex ratio seems to enhance old hens' ability to be fertilized. Fig. (3 and 4) shows that Baladi and Leghorn hens had similar response to the different sex ratios used in the experiment though Leghorn hens tended to have higher values.

From the results reported herein we suggest that breed, age and sex ratio may affect fertility and hatchability of total eggs but not fertile hatchability and embryonic mortality. The highest fertility and hatchability values were achieved by 1 male: 6 female ratio and early age periods. It is also shown that lower sex ratio might enhance old hens' ability to be fertilized.

Table 2. Effect of sex ratio (T) and age (A) on fertility (F), hatchability of fertile eggs (FH), hatchability of total eggs (HT) and early embryonic mortality (EEM), late embryonic mortality (LEM) and total embryonic mortality (TEM) in Leghorn (LG) and Baladi breeds of chickens raised in Riyadh area.

	F (%)	FH (%)	HT (%)	EEM (%)	LEM (%)	TEM (%)
Breeds (B)	**	N.S.	**	N.S.	N.S.	N.S.
LG	91.35 A	97.79	89.37 A	1.10	1.15	2.25
BL	90.12 B	97.55	87.94 B	1.23	1.26	2.49
Sex ratio (T)	**	N.S.	**	N.S.	N.S.	N.S.
1:6	97.92 A	98.12	96.07 A	0.72	1.22	1.94
1:10	94.05 B	97.79	91.96 B	1.50	0.77	2.27
1:14	80.24 C	97.11	77.92 C	1.27	1.62	2.89
Age (A) in weeks	**	N.S.	**	N.S.	N.S.	N.S.
24	94.60 A	97.47	92.22 A	1.01	1.68	2.69
28	94.44 A	97.61	92.22 A	1,52	0.87	2.39
32	93.49AB	97.97	91.59 A	0.99	1.04	2.03
36	92.54 B	97.73	90.48 B	1.56	0.87	2.43
40	90.16 C	97.87	88.25 C	1.04	1.09	2.13
44	87.78 D	97.41	85.56 D	1.28	1.31	2.59
48	87.14 D	97.55	85.08 D	0.98	1.47	2.45
52	85.71 E	97.75	83.81 E	0.95	1.30	2.25
B x T	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
B x AG	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
T x AG	**	N.S.	**	N.S.	N.S.	N.S.
BxTxAG	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
SEM	± 0.156	± 0.188	± 0.220	± 0.171	± 0.163	± 0.199

*Significant (P<0.05). **Highly Significant (P<0.01). NS Non-significant.
Means in the same column with different superscripts differ significantly (P0<0.05).

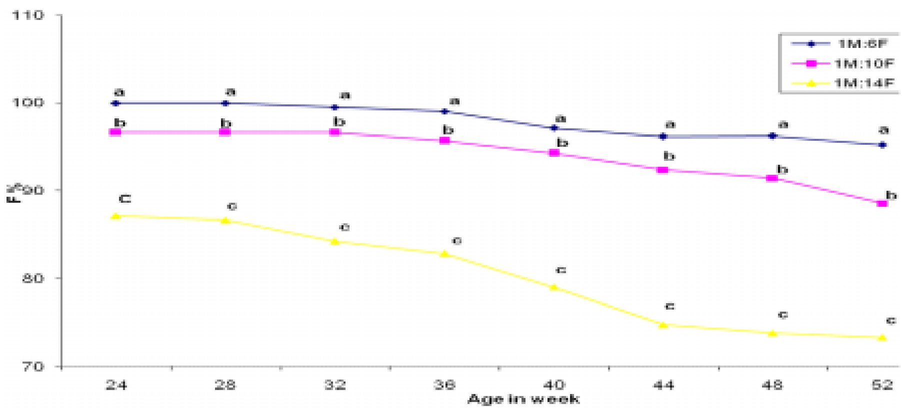

Fig. (1) Effect of TxA interaction on Fertility Percent (F).

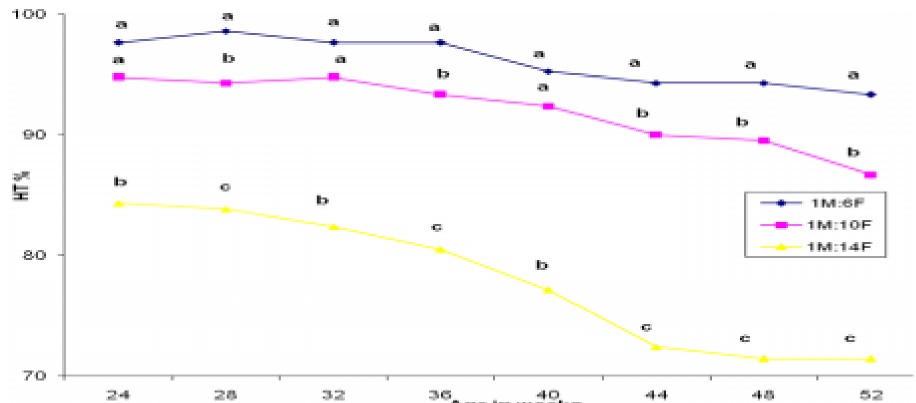

Fig. (2) Effect of TxA interaction on Hatchability Percent of Total Eggs (HT).

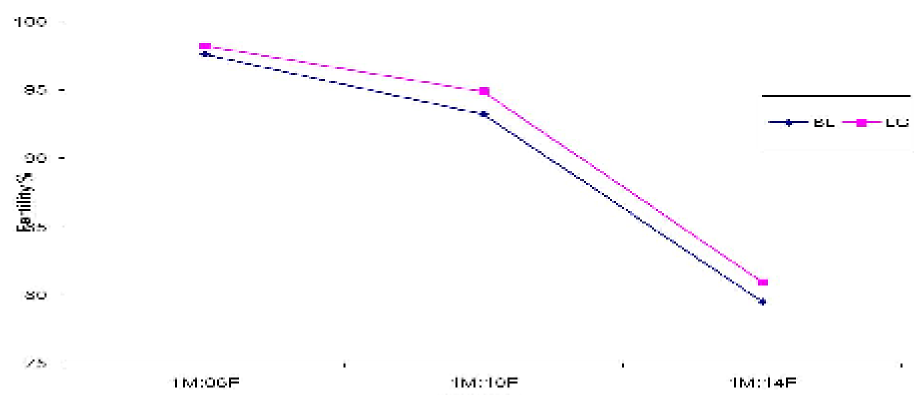

Fig (3) Effect of BxT interaction on fertility (F)

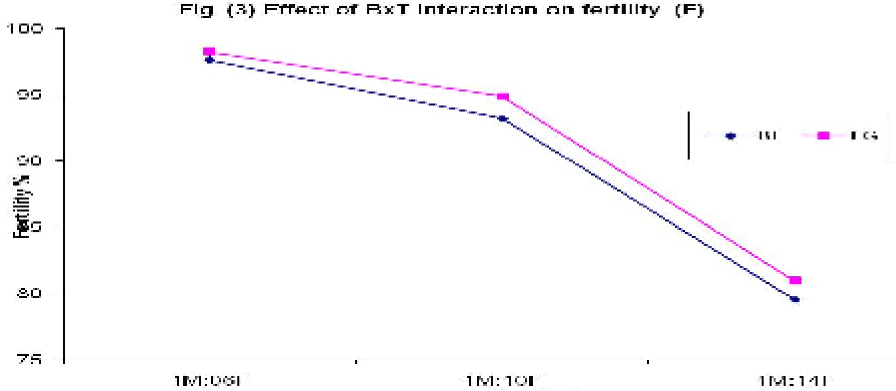

Fig. (4) Effect of BxT interaction on fertility (F).

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