Effect of Breed, Age and Storage Period on Fertility and Hatchability of Hatching Eggs of Commercial Broilers Breeders

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ABSTRACT

Hatching eggs used in the study were obtained from commercial broiler breeders: Cobb, Ross 308 and Arbor Acres. A total of 150 hatching eggs were obtained from each breed at age, 30-35, 40-45 and 50-55. Eggs for each age were randomly divided into three experimental group, 50 eggs (replicates) in each, stored either for 0, 7 or 14 days under 75-80% relative humidity and 16-18 ºC and incubated following standard hatchery practices. Eggs were candled at the end of the first week and 18th day of incubation period to determine percentages of fertile eggs and early and late embryonic mortality. Hatched chicks number was recorded to determine hatchability of fertile and total eggs and unhatched eggs were broken to verify early and late embryonic mortality. Data were statistically analyzed using the General Linear Models procedures of SAS described in the material and methods. The results indicate that breed and age had a significant ($P \leq 0.01$) effect on most studied traits. Cobb showed the best values in all studied traits followed by Ross and Arbor Acres. Young breeders had significantly ($P \leq 0.05$) better performance with regard to fertility and total eggs hatchability, whereas fertile hatchability and late and total embryonic mortality were the lowest for young and middle aged breeders. The results also indicated that storage period of hatching eggs had a significant ($P \leq 0.05$) effect upon all studied traits except fertility and pepped chicks percentages. Fresh hatching eggs had significantly ($P \leq 0.05$) the highest total and fertile eggs hatchability percentages and the lowest early, late and total embryonic mortality percentages followed by those of eggs stored for 7 days, whereas eggs stored for 14 days had the lowest values. From the results reported herein we concluded that breed had a significant effect upon hatchability parameters and Cobb had the best performance followed by Ross whereas Arbor Acres showed the lowest performance. Advancing age of breeders and length of egg storage period had a negative effect upon hatchability parameters. However the reproductive performance of the breeds used in the study performed far less than reported in theirs› companies guide lines.

Introduction

Several Investigators reported that advancing age of broiler breeders had a negative effect upon fertility, hatchability and embryonic mortality (Mather and Laughlin, 1979; Roque and Soars, 1994; Elibol and Brake , 2006; Zakaria et al., 2009; Abudabos, 2010). Susan et al., 1980 and Tona et al., 2001 also reported similar results with respect to hatchability and embryonic mortality. Seker et al. (2004) also found that advancing age of Japanese quail had a negative effect on fertility, hatchability and embryonic mortality. Several investigators found an inverse relationship between hatching eggs storage period length and hatchability and consequently increased embryonic mortality (Mather and Laughlin, 1977and 1979; Whitehead et al., 1985; Fasenko et al., 2001; Elibol et al., 2002; and Kuurman, et al., 2002 ; Fasenko, 2007; Reijrink et al., 2010). Some investigators reported similar results with respect to other species (turkey, Fasenko et al., 2001; ostrich, Hassan et al., 2005; pheasant, Demirel and kirike, 2009 and red legged partridges, Gonzalez –Redondo, 2010). On the opposite, Caglayan et al. (2009) noticed that fertility, hatchability and embryonic mortality of rock partridges hatching eggs were not affected by storage period up to 15 days. However, pepped chicks percentage was not affected by breeders' age (Roque and Soars, 1994) and storage period (Whitehead et al., 1985). Wineland (1995) and Christensen et al., (2001) found breed differences with respect to embryonic viability when broiler breeders' hatching eggs stored for 14 days or longer period, whereas advancing breeders' age had similar effect as reported by Elibol et al.(2002). Published informations on the performance of commercial broiler breeders raised in Saudi Arabia are almost lacking. Therefore, this study was conducted to evaluate the effects of breed, age and storage period on their fertility and hatchability parameters.

Materials and Methods

Hatching eggs were obtained from commercial broiler breeders: Cobb, Ross 308 and Arbor Acres which were raised in Saudi Arabia. A total of 450 hatching eggs were obtained from each breed at three different ages, 30-35, 40-45 and 50-55 weeks, 150 eggs for each age. Eggs for each age were randomly divided into three experimental groups, 50 eggs (replicates) in each experimental group. Eggs in the first experimental group were not stored whereas eggs in the second were stored for 7 and those of the third for14 days under 75-80% relative humidity and 16-18 ºC. Following

usual hatchery practices, eggs were incubated in moving air incubators (Maino Enrico, Co, Italy) under 37.5 ºC and 65% relative humidity and were turned automatically 6 times a day, once every 4 hours from the first day up to the 18th day of the incubation period. On the 18th day of incubation, the eggs were transformed to the hatcher where the temperature was 37 ºC and relative humidity was 65 %. The trays were designed to separate hatching chicks and do not allow them to move from their places and mix. The eggs were candled at the end of first week and 18th day of incubation period to determine percentages of fertility (F) and early (EEM) and late embryonic (LEM) mortality. Hatched chicks number was recorded to determine hatchability of fertile (HF) and total (HT) eggs percentages and unhatched eggs were broken to verify early and late embryonic mortality.

Statistical analysis: Data obtained were subjected to analysis of variance using the General Linear Models procedures of SAS Institute (SAS 1998) using the following statistical model:

$$Y_{ijkl} = \mu + B_i + A_j + S_k + BA_{ij} + BS_{ik} + AS_{jk} + BAS_{ijk} + e_{ijkl}$$

where Yijkl is the lth observation of ith breed (B), the jth breeder's age (A) and kth storage period (S). BAij is the interaction between breed ansd breeder's age and, BSik is the interaction between breed and storage period and ASjk is the interaction between breeder's age and storage period. μ is the general mean and eijkl is the random error associated with Yijkl observation. When the analysis of variance indicated the presence of significant differences between breeds, ages or storage period, means were separated using the least significant difference (LSD) test.

Results

As indicated in Table 1 only breed and breeder's age and their interaction had a significant (P≤0.01) effect on fertility percentage (F). Cobb had significantly (P≤0.05) higher F than that of Ross and Arbor Acres which had statistically similar values. Young breeders had significantly (P≤0.05) the highest F followed by that of middle aged and old breeders (Table 1). Cobb had significantly (P≤0.05) higher F compared to other breeds at 40-45 and 50-55 weeks of age (Fig. 1).

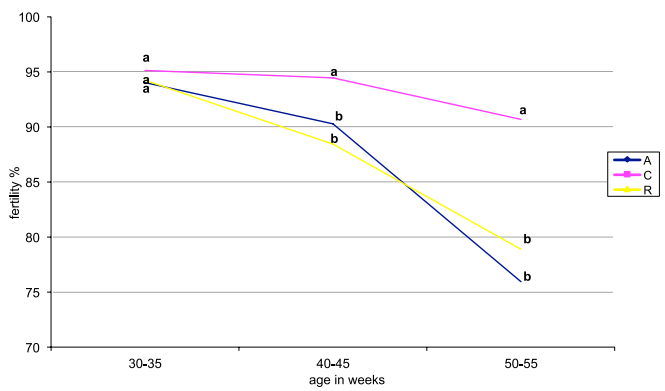

Fig. (1) Effect of breed X age interaction fertility(%) of commerecial broiler breeders, Arbo Acres (A), Cobb (C) and Ross (R).

Hatchability percentage of fertile eggs (FH) was significantly (P ≤ 0.01) affected by breed, breeder's age and storage period and the interactions, BxA and BxS (Table 1). The same Table shows that Cobb had significantly (P ≤0.05) the highest FH followed by Ross and Arbor Acres had the lowest value. Old breeders had significantly (P≤0.05) the lowest value whereas young and middle aged breeders had statistically similar values. Fresh eggs had significantly (P ≤0.05) the highest FH followed by eggs stored for 7 which had higher value than eggs stored for 14 days (Table 1). Cobb had significantly (P≤0.05) the highest value at 40-45 and 50-55 weeks of age, whereas Ross had significantly(P≤0.05) the highest and Arbor Acres the lowest value at 30-35 and 40-45 weeks of age, respectively (Fig. 2). Cobb had significantly (P≤0.05) the highest FH value for eggs stored for 7 days and Arbor Acres the lowest value for eggs stored for 14days (Fig. 3).

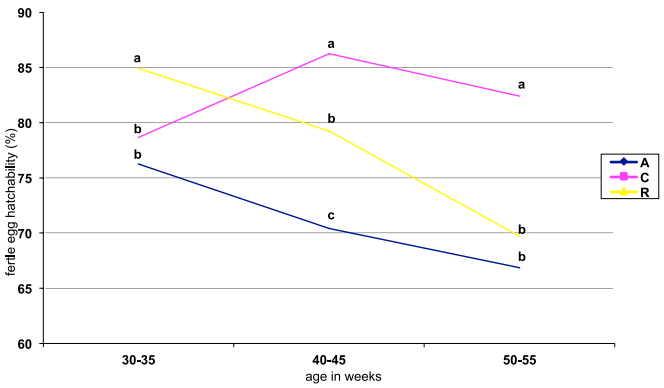

Fig. (2) Effect of breed X age interaction on fertle egg hatchability (%) of commerecial broiler breeders, Arbo Acress (A), Cobb (C) and Ross (R).

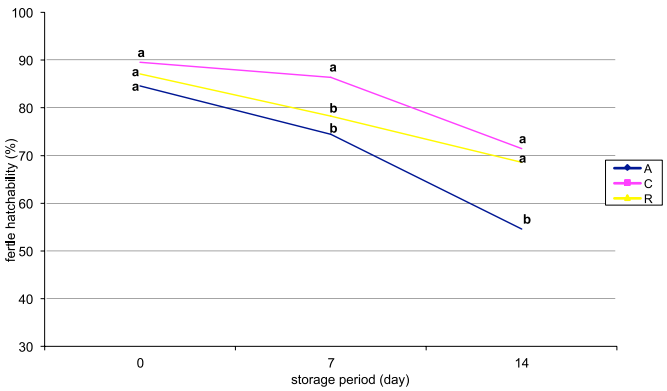

Fig. (3) Effect of breed X storage period interaction fertle egg hatchability (%) of commercial broiler breeders, Arbo Across (A), Cobb (C) and Ross (R).

Hatchability percentage of total eggs (TH) were significantly (P≤0.01) affected by breed, breeders' age, storage period and the interactions, BxA and BxS (Table 1). Cobb had

significantly (P ≤0.05) the highest TH followed by Ross and Arbor Acres had the lowest value. TH was significantly (P ≤0.05) the highest for young and the lowest for old breeders and was also significantly (P ≤0.05) the highest for fresh eggs and the lowest for those stored for 14 days (Table 1). Cobb had significantly (P≤0.05) the highest TH at 40-45 and 50-55 weeks of age, whereas Ross had significantly(P≤0.05) the highest TH at 30-35 and higher value than Arbor Acres

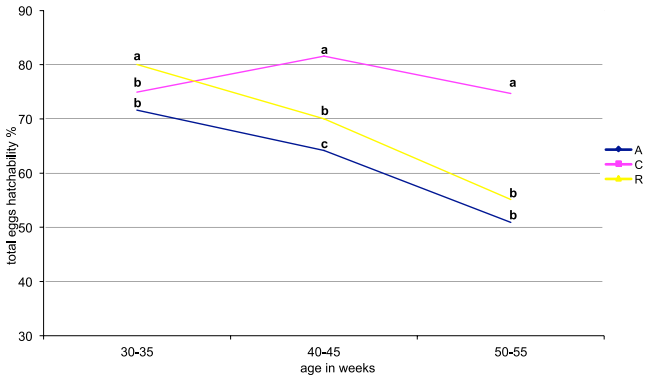

Fig. (4) Effect of breed X age interaction on total eggs hatchability (%) of commerecial broiler breeders, Arbo Acres (A), Cobb (C) and Ross (R).

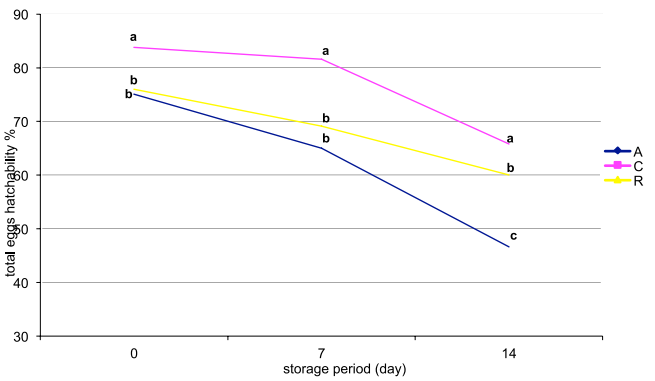

Fig. (5) Effect of storage period X breed on total eggs hatchability (%) of commercial broiler breeders, Arbo Acress (A), Cobb (C) and Ross (R).

at 40-45 weeks of age (BxA interaction, (Fig.4). Cobb had significantly (P≤0.05) the highest TH for all storage periods, whereas Ross had higher value than Arbor Acres for eggs stored for 14 days (Fig. 5).

Percentage of total embryonic mortality (TM) was significantly (P≤0.01) affected by breed, breeder's age, storage period and the interactions, BxA and BxS (Table 1). Arbor Acres had significantly (P ≤0.05) the highest TM followed by Ross and Cobb had the lowest value (Table 1). Old breeders had significantly (P ≤0.05) the highest whereas young and middle aged breeders had statistically similar values. Hatching eggs stored for 14 days had significantly (P ≤0.05) the highest TM followed by that of eggs stored for 7 days and fresh eggs had significantly (P ≤0.05) the lowest

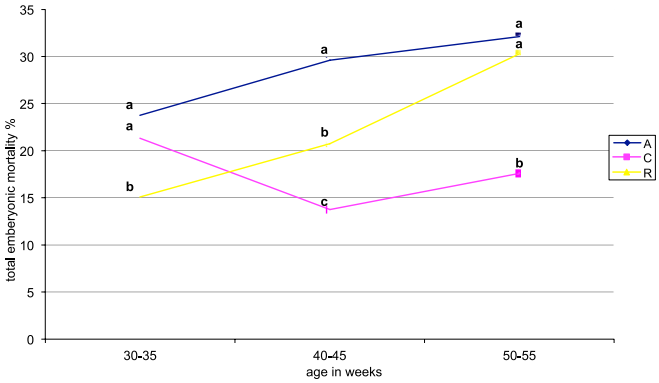

Fig. (6) Effect of breed X age interaction on total emberyonic mortality (%) of commerecial broiler breeders, Arbo Acres (A), Cobb (C) and Ross (R).

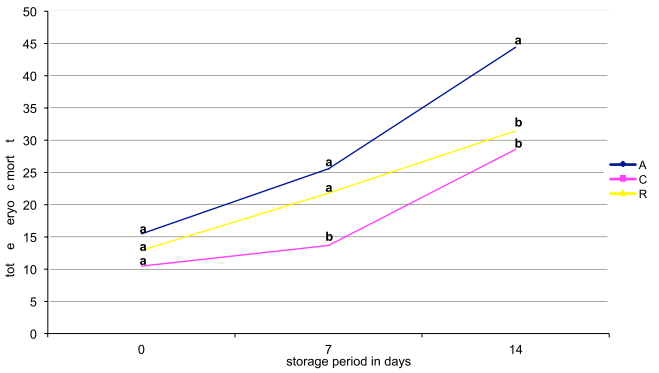

Fig. (7) Effect of storage period X breed interaction on total emberyonic mortality (%) of commerecial broiler breeders, Arbo Acres (A), Cobb (C) and Ross (R).

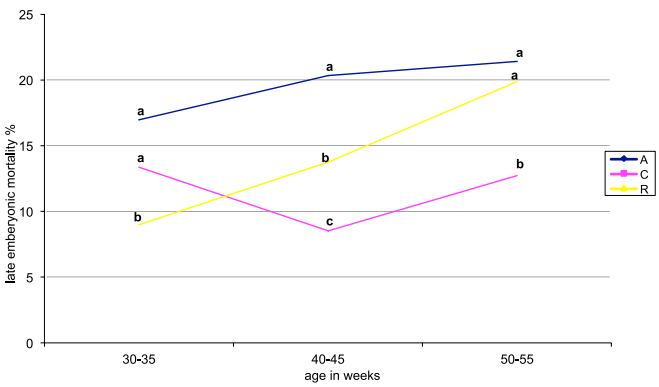

Fig. (8) Effect of breed X age interaction on late emberyonic mortality (%) of commercial broiler breeders, Arbo Acres (A), Cobb (C) and Ross (R).

value (Table 1). Cobb had significantly (P≤0.05) the lowest TM at 40-45 and 50-55 weeks and Ross the lowest value at 30- 35 weeks of age, whereas Arbor Acres the had the highest value at 40-45 weeks of age (Fig. 6). Fig. 7 shows that Cobb had significantly (P ≤0.05) the lowest and Arbor Acres the highest TM for eggs stored for 7 and 14 days , respectively.

Early embryonic mortality percentage (EEM) was only

significantly (P ≤0.01) affected by breed and hatching eggs storage period (Table 2). Ross and Arbor Acres had statistically similar EEM which were significantly (P ≤0.05) higher than that of Ross, whereas breeders of different ages had statistically similar values (Table 2). With respect to storage period , eggs stored for 14 days had significantly (P ≤0.05) the highest value followed by eggs stored for 7 days whereas fresh eggs had the lowest EEM.

Late embryonic mortality percentage (LEM) was significantly (P ≤0.01) affected by breed, breeder's age, storage period and the interaction BXA (Table 1). Cobb and Ross had statistically similar LEM and had significantly (P ≤0.05) lower values than Arbor Acres (Table 2).Old breeders had significantly (P ≤0.05) higher LEM than young and middle aged breeders which had statistically similar values (Table 2). The same Table shows that hatching eggs stored for 14 days had significantly (P ≤0.05) the highest LEM

Table 1. Effect of breed, age and storage period on fertility (F), fertile eggs hatchability (FH), total eggs hatchability (TH) and total embryonic mortality (TM) percentages.

	F	FH	TH	TM
Breed (B)				
Arbor Acres	[b] 86.7±0.83	[c] 71.2±1.18	[c] 62.2±1.20	[a]28.5±1.18
Cobb	[a]93.4±0.83	[a]82.4±1.13	[a]77.0±1.20	[c] 17.6±1.13
Ross	[b] 87.2±0.83	[b] 78.0±1.17	[b] 68.4±1.20	[b] 22.1±1.17
Breeder Age in weeks (A)				
30-35	[a]94.5±0.82	[a]79.9±1.12	[a]75.5±1.19	[b] 20.1±1.12
40-45	[b] 91.1±0.83	[a]78.6±1.14	[b]71.9±1.20	[b] 21.4±1.14
50-55	[c] 81.8±0.83	[b] 73.0±1.22	[c] 60.2±1.21	[a]26.7±1.22
Storage period in days (S)				
0	89.7±0.83	[a]87.1±1.16	[a]78.3±1.20	[c] 12.9±1.16
7	89.7±0.83	[b] 79.7±1.16	[b] 71.9±1.20	[b] 20.4±1.16
14	88.0±0.83	[c] 64.9±1.17	[c]57.5±1.20	[a]34.8±1.17
SEM	±0.48	±0.67	±0.69	±0.67
Source of Variation	Probability			
Breed	≤0.01	≤0.01	≤0.01	≤0.01
Age	≤0.01	≤0.01	≤0.01	≤0.01
Storage period	NS	≤0.01	≤0.01	≤0.01
B * A	≤0.01	≤0.01	≤0.01	≤0.01
B * S	NS	≤0.01	≤0.01	≤0.01
A* S	NS	NS	NS	NS
B* A * S	NS	NS	NS	NS

NS Not significant Highly significant (P≤ 0.01)

[abc] Means in the same column with different superscript differ significantly (P≤ 0.05).

Table 2.Effect of breed, age and storage period on early (EEM) and late (LEM) embryonic mortality and pepped chicks (PC) percentages.

	EEM	LEM	PC
Breed (B)			
Arbor Acres	[a]6.5±0.62	[a] 19.6±1.02	2.5±0.48
Cobb	[b] 2.7±0.59	[b] 11.5±0.98	3.3±0.46
Ross	[a]5.2±0.61	[b] 14.2±1.01	2.7±0.48
Breeder Age in weeks (A)			
30-35	4.1±0.58	[b] 13.1±0.97	2.9±0.46
40-45	4.6±0.60	[b] 14.2±0.99	2.5±0.47
50-55	5.6±0.64	[a] 18.0±1.05	3.1±0.50
Storage period in days (S)			
0	[c] 2.0±0.60	[c] 8.6±1.00	2.4±0.48
7	[b] 4.6±0.60	[b] 13.1±1.00	2.7±0.48
14	[a] 7.8±0.61	[a] 23.7±1.01	3.3±0.48
Source of variation	Probability		
Breed	≤0.01	≤0.01	NS
Age	NS	≤0.01	NS
Storage period	≤0.01	≤0.01	NS
B * A	NS	≤0.01	NS
B * S	NS	NS	NS
A* S	NS	NS	NS
B* A * S	NS	NS	NS
SEM	±0.35	±0.58	±0.27

[NS] Not significant ** Highly significant (P≤ 0.01)

[abc] Means in the same column with different superscript differ significantly (P≤ 0.05).

followed by that of eggs stored for 7 days whereas fresh eggs had the lowest value. Cobb had significantly (P≤0.05) the lowest LEM at 40-45 and 50-55, whereas Arbor Acres had the highest value at 30-35 and 40-45 weeks of age (Fig. 8). Pepped chicks percentages (PC) were not significantly affected by breed, breeder's age, storage period and their interactions (Table 2). However Cobb, old breeders and eggs stored for 14 days tended to have the highest values.

Discussion

The results indicated a significant breed effect upon all studied traits except on pepped chicks. Cobb had significantly the best performance followed by Ross whereas Arbor Acres was inferior to both breeds in most studied traits. Though Cobb seems to have better reproductive performance under local conditions, fertility percent of the three breeds (93.55, 86.89 and 88.60 for Cob, Ross and Arbor Acres, respectively) were far less than that reported in their companies' guidelines 97.14, 97.22, and 95.68%, for the three breed, respectively (Almarshade, 2011). This might be mainly due to management malpractices of breeders' flocks. The results also showed a significant age effect upon all studied traits except early embryonic mortality and pepped chicks. Young breeders had significantly better fertility and total eggs hatchability than middle aged and old breeders. Young and middle aged breeders also showed better fertile hatchability and lower late embryonic mortality than old breeders. Similar results were reported by several investigators (Mather and Laughlin, 1979; Roque and Soars, 1994; Elibol and Brake ,

2006; Zakaria et al., 2009; Abudabos, 2010). The results also agree with that of Susan et al.(1980) and Tona et al. (2001) who reported that advancing age of breeders had a negative effect upon hatchability and embryos viability. This might be attributed to the deterioration in egg quality with advancing breeder' age (Tona et al., 2004). Pepped chicks percentage was not significantly affected by advanced age of breeders which agrees with the results of Roque and Soars (1994) who found no relation between pepped and advancing age of the breeders. The results also indicated a significant storage period effect on all studied traits except fertility and pepped chicks. Total and fertile eggs hatchability were higher and total, early and late embryonic mortalities percentages were lower for not stored eggs followed by those of eggs stored for 7 days whereas those of eggs stored for 14 days were inferior to both. However fertility and pepped chicks percentages were not affected by storage period. These results agree with those of several investigators (Mather and Laughlin, 1977 and 1979; Whitehead et al., 1985; Fasenko et al., 2001; Elibol et al., 2002; Kuurman, et al., 2002; Fasenko, 2007; Reijrink et al., 2010) who reported an inverse relationship between storage period length and total and fertile hatchability percentages and a direct relationship between total, early and late embryonic mortalities percentages and storage period length. Stored eggs for 7 days had lower egg quality which negatively affect hatchability and chick viability and quality as reported by Tona et al., 2004 and Lapao, 1999). The same authors also noticed more pronounced negative storage effect on egg quality and hatchability of eggs obtained from old breeders (45 wk). On the contrary our study did not show any significant age x storage period effect, regarding hatchability parameters. These differences in the results might be attributed to the different breed, age used and/or different management practices. Hatchability parameters with advancing age and prolonged storage of eggs were significantly better for Cobb compared with other breeds, Which means that Cobb might be better suited to our conditions. Similar breed differences were reported by Wineland (1995), Christensen et al., (2001) and Elibol et al.(2002).

Conclusion

From the results reported herein and under the study conditions, we concluded that breed had a significant effect upon hatchability parameters and Cobb had the best performance followed by Ross whereas Arbor Acres showed the lowest performance. Advancing age of breeders and length of egg storage period had a negative effect upon hatchability parameters. However the reproductive performance of the breeds used in the study was far less than that reported in theirs' companies guidelines.

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