



## Effects of Different Fertility Rates on Chick Quality and Hatching Parameters in Hatching Eggs

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### ABSTRACT

This study was conducted to investigate the hatching parameters differences between the hatching eggs which were controlled or not for fertility at 18<sup>th</sup> day of embryo development in the hatchery unit. Hatching was conducted with hatching eggs of Atak-S commercial layers parent stocks. Four treatment groups were constituted; 1) 95% fertility, fertility control at 18<sup>th</sup> day, 2) 95% fertility, no fertility control at 18<sup>th</sup> day, 3) 75% fertility, no fertility control at 18<sup>th</sup> day and 4) 50% fertility, no fertility control at 18<sup>th</sup> day. There were no significant differences between the groups in terms of fertility rate, hatching efficiency hatchability of fertile eggs and early-, middle and late period embryo mortality. Chick quality according to Pasgar score chick quality assessment differed significantly between the treatment groups. The results of the present study indicate that transferring of eggs to the hatcher without fertility control at 18<sup>th</sup> day of embryo development did not affect the hatching results, but chick quality decreased when the fertility rate decreased below 45%.

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### Introduction

Hatchery procedures as a whole is one of the important steps in animal production and hatching equipments with developed technologies are produced nowadays. Environmental factors such as temperature, humidity, ventilation and turning are automatically regulated, which provides more than 90% hatching efficiency. In the early days of hatching, embryo is quite small and produces a small amount of metabolic heat. During this period, internal temperature of the embryo is lower than the environmental temperature. However heat production increases with growing of the embryo at 10-12<sup>th</sup> days of hatching Embryo temperature is higher than the environment temperature towards the end of hatching and therefore the temperature of the hatchery should be reduced in this period. Heat is generated from the incubator and embryo and should uniformly be spread through eggs to provide optimum embryo development. This condition is crucial in hatcheries with embryo development of 18-21 days. Today the removal of eggs with no fertility and embryo development at 18<sup>th</sup> day and the transfer of eggs with proper development to hatch equipment is a common procedure. The aim here is to prevent negative effects of eggs with no fertility or death embryos, which do not produce heat during hatching. This

procedure requires labor and leads to negative consequences on embryo development due to temperature decrease during fertility control of eggs. Since optimum environment temperature is controlled in modern hatcheries, there is no study on the influence of heat generated by embryos on hatching parameters. However, various studies describe optimum environmental conditions and indicate that hatching temperature should be regulated from the period when heat production increases (Bruggeman et al., 2007; Elibol, 2009; King'ori et al., 2011; Naas et al., 2008; Yildirim and Yetişir, 2004).

Studies indicated that large eggs generate more than small ones suggesting that hatchery temperature should be reduced at 15<sup>th</sup> day of hatching onwards (Lourens et al., 2006). It was reported that embryo development was slow when hatching temperature was low (36.7°C); on the other hand, the highest hatching efficiency could be obtained when eggshell temperature was kept at 37.8°C (Lourens et al., 2005).

This study aimed at investigating the effects of inclusion of eggs with no fertility into fertile eggs obtained from the parents of Atak-S commercial layers on hatching parameters and chick quality.

## Materials and Methods

In the present study a total of 2400 hatching eggs were used which were obtained from 48 week old parents of Atak-S layers, developed at the Poultry Research Station. Chick quality was determined based on the chick quality assessment of pasgar score. The study was carried out in completely randomized design with 4 replicates, 150 eggs in each and conducted at the same time at hatchery unit of the Agriculture Faculty of Ordu University, Department of Animal Science and at the Poultry Research Station. Treatment groups were designed as described below. Fertility rates differed due to fertility rates of hatching eggs. In this sense, predicted fertility rates and occurred fertility rates were presented below. The fertility rates that were considered in the present study were the occurred fertility rates.

### *Treatment Groups based on fertility rate (planned)*

1. Group (control) : 95% fertile eggs, candling made
2. Group : 95% fertile eggs, no candling
3. Group : 75% fertile eggs, no candling
4. Group : 50% fertile eggs, no candling

### *Treatment Groups based on fertility rate performed at the Department of Animal Science*

1. Group : 93.75% fertile eggs, candling made
2. Group : 96.56% fertile eggs, no candling
3. Group : 69.44% fertile eggs, no candling
4. Group : 45.83% fertile eggs, no candling

### *Treatment Groups based on fertility rate performed at the Poultry Research Station*

1. Group : 96.00% fertile eggs, candling made
2. Group : 94.33% fertile eggs, no candling
3. Group : 69.46% fertile eggs, no candling
4. Group : 43.00 % fertile eggs, no candling

Hatching parameters described below were determined in each group. Fertility rate was calculated based on the fertile eggs in the hatching eggs.

*Fertility rate:* (Number of fertile eggs/Number of hatching eggs placed in the hatchery)\*100

*Hatchability:* (Number of chicks from the hatchery /Number of eggs placed in the hatchery)\*100

*Hatchability of fertile eggs:* (Number of chicks from the hatchery/ Number of fertile eggs placed in the hatchery)\*100

*Early-period embryo mortality :*(Number of embryos died between 0-6 days of hatching/Number of fertile eggs)\*100

*Middle-period embryo mortality:* (Number of embryos died between 7-18 days of hatching/Number of fertile eggs)\*100

*Late-period embryo mortality:* (Number of embryos died between 19-21 days of hatching/Number of fertile eggs)\*100

*Chick quality:* Fifty chicks were randomly taken based on pasgar quality assessment criteria from each group (Boerjan, 2006).

## Statistical Analysis

Normal distribution of data collected for the parameters in the present study was controlled by Kolmogorov-Smirnov Test. Homogeneity control of group variances was carried out by Levene Test. Difference between the groups was determined by One-way Variance Analysis (one-way ANOVA). Tukey Multiple Comparison Test was used to determine difference means. Kruskal-Wallis and Dunn multiple tests were applied to the data of pasgar chick quality, which did not meet the pre-conditions of variance analysis. Minitab 16 package program was used in the statistical analyses.

## Results and Discussion

The hatching parameters results conducted at the Department of Animal Science are shown in Table 1. Similar results conducted at the Poultry Research Station are presented in Table 3. Chick quality values derived from the two studies are given in Table 2.

Following the analysis of the data, no differences between the groups were found in terms of fertility rates of eggs obtained from the parent stock, hatchability of fertile eggs, hatchability, early-, middle- and late-period embryo ( $P>0.05$ ). However, chick quality values based on pasgar score differed between the groups ( $P<0.01$ ). The quality of chicks was lower in Groups 3 and 4 with lower fertility rates than that of the chicks in groups 1 and 2 in the study at the Department of Animal Science. Likewise, group 4 had a lower chick quality than did the groups 1 and 2 in the study at the Poultry Research Station.

No presence of difference between the fertility rates of the groups is an expected situation. It is a fact that fertility rate is associated with the flock from which hatching eggs are obtained and that no difference in the fertility rates of eggs was found from randomized chosen eggs of the groups. This situation indicates that research material is homogeneous in terms of this parameter. In the study, occurred fertility rate was tried to be determined in comparison to predicted fertility rate. The lack of difference in parameters that are directly influenced from hatchery conditions such as embryo mortality, hatchability and hatching efficiency suggests that non-fertility rates which were artificially created did not have any effect on these parameters. However this is not the case in chick quality. In the study carried out at the Department of Animal Science, chick quality started to decrease with the increase in non-fertility rate and the quality of chicks, which were obtained from the group with about 70% fertility rate were significantly lower than that of the chicks from other groups. A similar phenomenon was observed in the chicks of the 4<sup>th</sup> group with 43% fertility rate in the study, which was conducted at the Poultry Research Station. The difference between the two studies is thought to be pasgar chick quality assessment method, which is based on subjective criteria. It is possible to speculate that the decrease in chick quality along with the increase in non-fertility rate can be attributed to inadequate temperature in the incubator section, which does not support optimum embryo development. Although new generation hatcheries are equipped with developed technologies, the positive effect of embryo-borne heat production is not balanced after a

certain point. No differences were found in the hatching parameters concerned in the present study after the transfer of hatching eggs with 95% fertility rate with or without non-fertile or death embryos containing eggs into the hatching equipment at 18<sup>th</sup> day of embryo development. This finding indicates that fertility control is not required in hatchery procedures dealing with hatching eggs with enough fertility rates. Studies carried out so far have demonstrated that maximum hatching results can only be obtained as long as optimum hatching conditions are provided. Embryo development stages have been

taken into account to determine hatching conditions and incubators have been designed for embryo development. However this is more difficult in multiple hatching incubators as compared to single ones. Single hatching incubators therefore provide better results than multiple ones in terms of hatching results, embryo mortality and chick quality (Garrison, 2010). It is more probable to face problems with multiple hatching incubators since hatching eggs with 70 and 45% fertility rates would not generate metabolic heat as much as the hatching eggs with higher fertility rates.

Table 1 Hatching parameters in the Department of Animal Science

| Groups | Fertility (%) | EPEM (%)  | MPEM (%)  | LPEM (%)  | HFE (%)    | Hatchability (%) |
|--------|---------------|-----------|-----------|-----------|------------|------------------|
| 1      | 93.75±0.72    | 6.20±1.75 | 0.44±0.44 | 5.34±0.79 | 88.02±2.28 | 82.50±1.91       |
| 2      | 96.56±0.79    | 7.45±0.36 | 0.00±0.00 | 7.14±0.87 | 85.41±1.19 | 82.50±1.77       |
| 3      | 69.44±2.00    | 4.07±1.46 | 0.00±0.00 | 4.10±0.49 | 91.84±1.93 | 86.67±0.96       |
| 4      | 45.83±0.83    | 5.24±1.54 | 0.00±0.00 | 5.20±2.60 | 89.56±3.04 | 85.83±3.00       |

EPEM=Early period embryonic mortality (%); MPEM=Middle period embryonic mortality (%); LPEM=Late period embryonic mortality (%); HFE=Hatchability of fertile eggs (%)

Table 2 Multiple comparison results for the quality of chicks

| Groups | n  | Median |      | Average of line    |                    |
|--------|----|--------|------|--------------------|--------------------|
|        |    | DAS    | PRS  | DAS                | PRS                |
| 1      | 40 | 10.0   | 10.0 | 101.9 <sup>a</sup> | 92.8 <sup>a</sup>  |
| 2      | 40 | 9.5    | 10.0 | 95.0 <sup>a</sup>  | 90.5 <sup>a</sup>  |
| 3      | 40 | 9.0    | 9.0  | 65.5 <sup>b</sup>  | 79.4 <sup>ab</sup> |
| 4      | 40 | 9.0    | 9.0  | 59.6 <sup>b</sup>  | 59.3 <sup>b</sup>  |

DAS=Department of Animal Science; PRS=Poultry Research Station; within columns, means followed by different letters are significantly different at (P<0.01)

Table 3 Hatching parameters in the Poultry Research Station

| Groups | Fertility (%) | EPEM (%)  | MPEM (%)  | LPEM (%)  | HFE (%)    | Hatchability (%) |
|--------|---------------|-----------|-----------|-----------|------------|------------------|
| 1      | 96.00±0.72    | 5.89±0.57 | 1.22±0.44 | 5.38±0.65 | 87.51±0.68 | 84.00±0.39       |
| 2      | 94.33±1.00    | 4.75±1.30 | 0.07±0.22 | 6.19±0.97 | 87.99±0.40 | 83.00±0.69       |
| 3      | 69.46±0.82    | 2.09±1.02 | 0.48±0.48 | 6.29±1.14 | 90.91±1.10 | 86.83±0.67       |
| 4      | 43.00±1.58    | 3.20±1.03 | 0.73±0.42 | 6.51±2.08 | 89.57±1.63 | 83.33±2.52       |

EPEM=Early period embryonic mortality (%); MPEM=Middle period embryonic mortality (%); LPEM=Late period embryonic mortality (%); HFE=Hatchability of fertile eggs (%)

## Conclusion

The results of the present study suggest that fertility control, which is routinely applied in hatchery procedures, is not required for hatching eggs with a fertility rate above 70%. However hatching eggs with higher fertility rates provide better results in terms of chick quality. Chick quality starts to decrease in hatching eggs with fertility rates below 70%. Since chick quality is one of the important factors influencing production period, the fertility rate of hatching eggs should be taken into account in order to carry out a successful hatchery procedure.

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