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Determination of Proper Turning Frequency to Increase for Hatching Results in Hatching Eggs With Abnormal Shape Index

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ABSTRACT

The aim of this study was to determine the optimum turning frequency for increasing the hatchability results in hatching eggs with abnormal shape index. For this purpose, 4050 hatching eggs obtained from 56 weeks old ATAK-S hybrid hens were used. Shape index was divided into 3 groups as 71 and smaller, 72 – 76, 77 and higher. The research was conducted according to a completely randomized factorial experimental design. The hatching eggs were incubated with turning frequency of 30, 60 and 120 minutes. In the present study, fertility rate, hatchability, hatch of fertile, early, middle, late embryonic mortality, discard chick rate, chick quality, malformation and malposition rates were determined. The turning frequency was found to have a significant effect on hatch of fertile eggs and late embryonic mortality. It was found that turning frequency and shape index had no significant effect on the hatching results regarding discarded chicks, early embryonic mortality, malposition, malformation rate, and chick quality. Interaction between egg shape index and turning frequency did not influence hatching traits and chick quality. It was determined that there was no interaction effect between turning frequency and shape index on all the characteristics discussed. According to the results obtained from the research, it was observed that the 30 and 120 minute turning frequency of hatching eggs with different shape indexes had a negative effect on the hatchability of fertile eggs and late embryo mortality. It was concluded that even if the shape index of the hatching eggs were different, the optimum turning frequency should be every 60 minutes.

Keywords: Abnormal eggs, Hatching results, Shape index, Turning frequency

1. Introduction

Hatchery procedures is one of the important steps in poultry production, since nowadays hatching equipment of high-developed technology is available. Environmental factors such as temperature, humidity, ventilation and turning are automatically regulated, which provides more than 90% hatching efficiency (Yıldırım & Yetisir 2004; Bruggeman et al. 2007; Elibol 2009; King'ori et al. 2011).

Despite a visible effort by breeding enterprises, it has been determined that it is impossible to produce eggs at a level that will meet the incubation needs. In studies conducted up to date, it has been reported that some egg parameters could lead to embryo death (Narushin & Ramanov 2002; Durmuş 2014).

It has been reported that turning the eggs in the first 18th day of incubation is essential for the proper development of the embryonic membranes and the proper positioning of the embryo (Eycleshymer 1907; New 1957; Robertson 1961a; Robertson 1961b; Lundy 1969; Deeming 1989). While some studies have reported optimum turning frequency as 96 times daily (Elibol & Brake 2003; Wilson et al. 2003), turning 24 times a day was reported sufficient in commercial hatcheries due to similar results of 96 times a day (Freeman & Vince 1974). It was stated that the impairment of the position in the embryo may be due to insufficient turning frequency, improper turning angle (Byerly & Olsen 1931; Byerly & Olsen 1933; Robertson 1961a; Landauer 1967; Lundy 1969; Wilson et al. 2003), the absence of turning in the first week of incubation and older flock age (Elibol & Brake 2004).

Egg quality is an important factor that affects hatching results (Elibol 2009). Characteristics of the egg quality can be classified in two groups: internal and external quality. External quality characteristics are egg weight, shape index, and shell quality (Narushin & Romanov 2002; Sarıca & Erensayın 2009; Durmus 2014). Hatching eggs with a shape index of 72 - 76 have the optimum shape index value, while hatching eggs with shape index below and above these values have low hatchability and hatchability of fertile eggs, whereas late-stage embryo mortality and malposition rates are significantly increased (Ascı &

Durmus 2015). Although the low angle of turning of the eggs during incubation increases the malposition rate, it has been reported that this rate can be reduced by increasing the number of turning of the eggs (Elibol & Brake 2004).

As mentioned above, high rates of malposition have been reported to negatively affect hatching results. It has been predicted that the frequency of incubation may be the solution to this situation. In order to increase the hatching results of abnormal eggs, in this study, 30, 60 and 120 minutes of turning frequencies were applied to the eggs with low, high and normal shape indexes and the effects on hatching results have been determined.

2. Material and Methods

The research was implemented with 4050 hatching eggs obtained from 56 weeks old ATAK-S hybrid parents that were classified into shape index groups as described below with Rauch shape index measuring instrument.

1) Shape index 71 and smaller
2) Shape index 72 - 76
3) Shape index 77 and above

Hatching eggs were stored for 7 days in a room at 15 °C and 80% relative humidity. The turning frequency on the incubator was set to 30, 60 or 120 minutes. The study was carried out in random blocks in 3 * 3 factorial experimental designs with 3 replications. Incubation trays with a hatching capacity of 150 eggs were considered as replicate. Therefore 3 * 3 * 3* 150 = 4050 hatching eggs have been used. The eggs classified according to shape index were placed in trays and placed in Pas Reform brand 19.200 capacity smart type incubators, and pre-warmed in rooms with 24 °C and 75% relative humidity for 8 hours, then transferred to the incubator with a temperature of 37.8 °C and relative humidity of 50%. After incubation for 18 days and being checked for fertility, eggs were transported to hatching machines providing 36.5-37 °C temperature and 55 - 78% relative humidity. Chicks were hatched from the eggs that had been kept there for 3 days. During the research, the following characteristics have been determined and calculated with the formula below. Fertility was determined by cracking the eggs separated by lamp control on the 18th day of the incubation. Poor quality chicks that cannot be sold was described as discarded chick.

Fertility: (Number of fertile eggs / Number of eggs placed in incubator) * 100.
Hatchability: (Number of alive chicks hatched/ Number of eggs placed in incubator) * 100.
Hatch of fertile (Number of alive chicks hatched / number of fertile eggs) * 100.
Early embryonic mortality: (Number of embryos died between 0-6 days of incubation / Number of fertile eggs) * 100.
Mid embryonic mortality: (Number of embryos died between 7-18 days of incubation / Number of fertile eggs) * 100.
Late embryonic mortality: (Number of embryos died between 19-21 days of incubation / Number of fertile eggs) * 100.
Discarded chicks: (Number of discarded chicks / Number of eggs placed in incubator) * 100.
Chick quality: Pasgar score was used as chick quality determination method developed by Pas Reform (Boerjan 2006).
Malformation and Malposition: Eggs with death embryo in shell were examined and malformation and malposition rates were determined.

2.1. Statistical analysis

For all the examined parameters, normal distribution of the data was checked with the Kolmogorov-Simirnov test and the homogeneity of the group variances was assessed with the Levene test. General Linear Model (GLM) analysis was applied to evaluate the features that fulfill the assumptions, and Tukey multiple comparison tests at 5% significance level was used to detect significant differences. Minitab 16 package statistics program was used to evaluate the data.

The applied mathematical model is provided below.

$$Y_{ijk} = \mu + a_i + b_j + ab_{ij} + e_{ijk}$$

$Y_{ijk,}$The value of any of the research parameters; μ,Population average; $a_{i,}$ Effect of the turning frequency (30-60-120 minutes); $_{j,}$ Effect of the shape index (≤ 71, 72 – 76, ≥ 77); ab_{ij} = Interaction between turning frequency (i) and shape index (j); e_{ijk}, Experimental error

3. Results and Discussion

As indicated, results of the evaluation of the hatchability data are presented in Table 1. It was determined that the turning frequency, shape index and their interaction had an insignificant effect on hatchability (P>0.05).

Table 1- Effects of egg shape index and turning frequency on hatchability

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	68.44±2.62	71.11±1.78	71.33±7.33	70.17±1.80
60 minutes	73.56±1.82	75.78±0.80	74.33±2.33	74.58±0.87
120 minutes	69.56±1.60	70.89±0.589	75.62±0.39	71.57±1.07
Average	70.52±1.29	72.59±0.99	73.76±2.15	

Hatchability of fertile eggs data is shown in Table 2. It has been determined that the effect of turning frequency on this parameter was significant (P<0.05). The egg shape index value did not have a significant effect on the hatchability of fertile eggs and turning frequency * shape index interaction was insignificant (P>0.05).

Table 2- Effects of egg shape index and turning frequency on hatchability of fertile eggs

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	79.74±2.05	84.65±1.45	81.78±4.98	82.09±1.49 [b]
60 minutes	86.44±0.84	85.056±0.64	87.44±2.40	86.17±0.67 [a]
120 minutes	79.63±0.61	80.20±1.76	86.34±0.02	81.52±1.22 [b]
Average	81.94±1.31	83.30±1.04	85.19±1.80	

[ab] Values within a column with different superscripts differ significantly at P<0.05

The outcomes obtained as a result of the evaluation of the fertility data are presented in Table 3. It was found that the effects of turning frequency, shape index and turning frequency*shape index interaction on the fertility rate were also insignificant (P>0.05).

Table 3- Effects of egg shape index and turning frequency on fertility

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	85.78±1.24	84.00±1.39	87.00±3.67	85.42±1.03
60 minutes	85.11±2.26	89.11±1.46	85.00±0.33	86.58±1.15
120 minutes	87.33±1.54	88.44±1.24	87.58±0.42	87.81±0.68
Average	86.07±0.93	87.19±1.05	86.53±1.08	

The findings of early embryo mortality rate are provided in Table 4. On the early embryo mortality rate, the turning frequency, shape index and turning frequency*shape index interaction were determined to be insignificant (P>0.05).

Table 4- Effects of egg shape index and turning frequency on early period embryo mortality rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	12.22±1.49	6.08±1.29	9.07±6.13	9.13±1.66
60 minutes	7.01±0.74	7.48±1.31	5.49±0.76	6.81±059
120 minutes	9.91±1.23	8.75±1.66	7.91±2.61	8.97±0.89
Average	9.71±0.96	7.44±0.81	7.49±1.86	

The findings of the mid-term embryo mortality rate are illustrated in Table 5. Turning frequency, shape index and turning frequency*shape index interaction were also found to be insignificant on medium-term embryo mortality rate (P>0.05).

Table 5- Effects of egg shape index and turning frequency on mid-term period embryo mortality rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	2.61±0.73	1.58±0.45	1.17±0.43	1.86±0.37
60 minutes	2.07±0.90	2.50±0.28	3.14±1.58	2.50±0.46
120 minutes	2.30±0.46	1.99±0.64	0.38±0.38	1.70±0.40
Average	2.33±0.37	2.02±0.27	1.56±0.68	

Data related to the late embryo mortality rate are presented in Table 6. It has been determined that the effect of turning frequency on this feature was significant (P<0.05). It was determined that the egg shape index value did not have a significant effect on the late embryo mortality rate and the turning frequency*shape index interaction was insignificant (P>0.05).

Table 6- Effects of egg shape index and turning frequency on late period embryo mortality rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 – 76*	*≤ 71*	
30 minutes	5.43±0.72	7.43±0.82	6.81±2.01	6.53±0.62 [b]
60 minutes	3.93±0.47	4.47±0.80	3.93±1.58	4.13±0.44 [a]
120 minutes	7.65±1.19	8.56±0.58	4.99±1.83	7.32±0.77 [b]
Average	5.67±0.69	6.82±0.71	5.24±0.97	

[ab] Values within a column with different superscripts differ significantly at P<0.05

Data on discarded chicks (Table 7), malposition rate (Table 8), malformation rate (Table 9) and pasgar score chick quality values (Table 10) were not significantly affected by the turning frequency, shape index and turning frequency*shape index interaction (P>0.05).

Table 7- Effects of egg shape index and turning frequency on discarded chick rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	0.00±0.00	0.22±0.22	1.00±0.33	0.33±0.18
60 minutes	0.44±0.44	0.44±0.22	0.00±0.00	0.33±0.18
120 minutes	0.44±0.22	0.44±0.22	0.33±0.33	0.42±0.12
Average	0.30±0.16	0.37±0.12	0.44±0.22	

Table 8- Effects of egg shape index and turning frequency on malposition rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	2.59±0.24	3.19±0.50	3.44±0.24	3.03±0.23
60 minutes	2.60±0.65	4.72±0.86	4.32±1.19	3.83±0.55
120 minutes	5.12±1.15	6.05±0.80	3.70±160	5.11±0.65
Average	3.44±0.57	4.65±0.55	3.82±0.54	

Table 9- Effects of egg shape index and turning frequency on malformation rate

Turning Frequency	*Shape Index*			*Average*
	≥ 77	*72 - 76*	*≤ 71*	
30 minutes	0.51±0.26	0.27±0.27	0.40±0.40	0.39±0.15
60 minutes	0.53±0.27	0.00±0.00	0.00±0.00	0.20±0.13
120 minutes	0.50±0.25	0.25±0.25	0.38±0.38	0.38±0.14
Average	0.52±0.13	0.17±0.12	0.26±0.16	

Table 10- Effects of egg shape index and turning frequency on chick quality pasgar score values

	Shape Index			
Turning Frequency	*≥ 77*	*72 - 76*	*≤ 71*	*Average*
30 minutes	9.76±0.003	9.81±0.017	9.74±0.134	9.77±0.028
60 minutes	9.76±0.047	9.80±0.026	9.77±0.043	9.78±0.021
120 minutes	9.67±0.090	90.79±0.020	9.77±0.013	9.74±0.036
Average	9.73±0.032	9.80±0.011	9.76±0.037	

Late embryo mortality rate was significantly lower at 60 minutes of turning frequency than the other frequencies. The hatchability of fertile eggs was significantly higher at the turning frequency of every 60 minutes compared to the other frequencies. In the case of the eggs with different shape indexes, it was observed that the turning done at an angle of 90^0 degrees every 60 minutes gave better results. It is considered that the hatchability of fertile eggs is higher in this group than the other turning groups due to the lower rate of late embryo mortality. However, this situation does not appear to have a positive effect on hatchability. It is suggested that a positive effect will occur on hatchability by increasing the number of replicates. It has been observed that egg shape index and turning frequency have no effect on the other hatching features that are examined in the present study.

Freeman & Vince (1974) stated that it is enough to turn eggs 24 times a day in commercial hatcheries. The results obtained in our research in terms of turning frequency support this finding. Baspınar et al. (1997) reported a positive correlation (r = 0.809) between embryonic mortality and shape index in their study where the incubation characteristics of Japanese quail eggs depend on the egg weight and shape index. However, there was no significant difference in embryo mortality rates in terms of shape index. They determined that the effect was insignificant. Esen & Ozcelik (2002), Turkyılmaz et al. (2005), Yılmaz & Cağlayan (2008) and Sari et al. (2010) reported that the effect of shape index on incubation characteristics was insignificant in their studies in quails. It is observed that the results obtained for the shape index in the present study are in line with these findings. Ascı & Durmus (2015) reported that the egg shape index has a significant effect on the late embryo mortality rate, hatchability of fertile eggs, hatchability and malposition, and eggs with normal shape index have a better outcome than others. Durmus (2014), Narushin & Ramanov (2002) reported that the hatchability of fertile eggs is much lower in the round shaped eggs than the pointed ones. However, while the effect of the shape index discussed on the hatching results was found to be insignificant, it was determined that the effect of the turning frequency on the hatchability of fertile eggs and late-stage embryo mortality rate was important. Considering these findings it is concluded that the outcomes of the study differ. Further work is essential to clearly define these discrepancies.

According to the results obtained from the present study, it was determined that the 30 and 120 minute turning frequency of hatching eggs with different shape indexes had a negative effect on the hatchability of fertile eggs and late embryo mortality. It was concluded that even if the shape index of the hatching eggs were different, the optimum turning frequency should be every 60 minutes.

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