Abstract
This study was carried out to investigate the hatchability results of broiler breeder eggs with hairline cracks (HE), hairline cracks covered by nail polish (CE) and intact shells (IE). A total of 1800 eggs was collected from four 48-53 weekly Ross-308 flocks. The eggs with hairline cracks were covered by nail polish over the cracked area of the shell under lamp control in the CE group. All of the eggs in three groups were ensured the same storing, disinfection (fumigation), hatcher and setter department conditions. Fertility rates of the IE, HE and CE groups were 93.50, 85.15 and 87.16% (P<0.01), hatchability rates were 86.15, 25.84 and 64.67% (P<0.001), hatchability of fertile eggs rates were 92.14, 30.17 and 74.24% (P<0.001), respectively. Covering treatment of hairline cracks in the CE group reduced embryonic mortalities, contaminated eggs rate and egg weight loss (P<0.01), but cull chicks rate was found to be similar among the groups (P>0.05). The results of the CE group indicated that this simple and unexpensive method can improve hatchability results of eggs with hairline cracks and provide significant economic contributions to the poultry industry.

Keywords: Broiler, shell quality, fertility, hatchability performance

Introduction
Losses from cracked eggs can be a significant problem in the broiler chicken industry. Shell damage can be classified as either a complete crack or as a hairline crack. A hairline crack occurs when the shell is broken, yet the shell membranes remain intact. A complete crack occurs when both the shell and shell membranes are broken (Narahari et al., 2000). Cracked eggs are not placed in commercial hatcheries, because enhanced water loss increases mortality and subsequent dehydration of embryo, thus decreases hatching success (Kirikci et al., 2004). Furthermore, cracked eggs have a higher risk of bacterial contamination and by this may increase the likelihood of contamination of the incubator due to putrefaction, leading to embryonic death and enhanced chick mortality (Barnett et al., 2004). Sometimes the number of hatching eggs is limited, thus eggs with minor shell defects e.g. as hairline cracks may be set in commercial hatcheries. If a suitable method is developed to hatch these hairline-cracked eggs, several million additional chicks will be produced annually throughout the globe, which will boost the overall economy of chick hatcheries (Narahari et al., 2000). The present study was performed to determine hatchability results of broiler breeder eggs with hairline cracks on the shell, hairline cracks covered by nail polish and eggs with intact shell.

Materials and Methods
This study was carried out at a commercial broiler hatchery. A total of 1800 eggs was collected from four 48-53 weekly Ross-308 flocks. After all of the eggs were fumigated with formaldehyde gas for 20 min, they were brought to the hatchery. Hairline cracked eggs were determined by candling in a darkened egg storage room and these cracks were covered by the nail polish in treated hairline-cracked eggs (CE) group. All of the eggs were put on incubator tray (flat), contained up to 100 eggs. These eggs were stored 18 °C, with 65-70% relative humidity for 3-5 days. Before transferring incubator, these eggs were weighed. Soon the eggs were fumigated again with formaldehyde gas for 20 min, set in a incubator (Petersime, Belgium) at 37.5°C, with 86°F wet bulb thermometer value. Temperature was reduced 36°C at setter department, with 94°F wet bulb thermometer value. All of the eggs was weighed again and examined at 18th day of incubation. Infertile and early embryonic deaths were discarded. These eggs were broken open to assess status. The rest of the eggs were transfered to setter department.
Three days later, live chicks and late embryonic mortalities were recorded. Each treatment group was further subdivided into 6 regular replicates, independent from each other. After tests of normality, the data were subjected to analysis of variance by using SPSS for Windows (SPSS Inc., 1999), significant differences were further subjected to Duncan’s multiple range test. The results were considered as significant when P values were less than 0.05.

**Results**

Hatching results of normal intact (IE), untreated hairline-cracked eggs (HE) and covered hairline-cracked eggs (CE) were presented in Table 1. The IE group exhibited normal fertility and hatchability characteristics. Differently, HE group showed poorer hatchability, while hatchability performance improved in covered eggs by nail polish in the CE group (P<0.001).

According to Table 2, the HE group showed a higher rate of embryonic mortality (P<0.001) and contaminated egg rate (P<0.05). Relative egg weight loss increased (P<0.01) in this group than the other groups. Covering treatment of hairline cracks decreased the embryonic mortalities, contamination rate and egg weight loss in the CE group. Cull chicks rate was found to be similar among the groups (P>0.05).

**Discussion**

Embryonic mortality affects inversely to the hatchability (Jassim et al., 1996; Barnett et al., 2004; Fasenko, 2007). Egg shell quality has a significant role on embryonic death throughout incubation (Bennett, 1992; Yoshizaki and Saito, 2002). Differences among the groups of the present study in hatchability performance could be related to variety of the fertility rates and embryonic deaths. Higher embryonic mortality in hairline-cracked eggs, especially in the HE group might be due to embryonic dehydration and/or microbial contamination (Barnett et al., 2004). Covering treatment of hairline cracks in the CE group improved hatchability success, perhaps by minimizing evaporative loss and contamination. Moreover, hatchability results of this group indicated that the nail polish was not toxic to the embryo. Christensen (2001) noted that the embryos were resistant to a wide range of dessication in early development than late. During the late period, dramatic physiological and metabolc changes occur, and any disturbances during this period may markedly affect embryonic survival (De Oliveira et al., 2008). However, embryonic mortalities in both early and late period were significant in the hairline-cracked groups. Furthermore, embryonic deaths increased in wide hairline cracks of shell. Garibaldi and Stokes (1958) reported that increasing the time and concentration of bacterial exposure to the membrane increased the digestion of the membrane by proteolitic enzymes secreted by the bacteria, then contamination and embryonic death rate were higher. In the present study, bacterial contamination increased in hairline-cracked eggs and this caused increasing rate of contaminated eggs and embryonic deaths, thus reduced hatchability success. Similar findings were reported by Barnett et al. (2004). Additionally, these researchers found that percentages of fertility were 91.89 and 90.42%, percentages of hatchability were 74.37 and 50.52%, percentages of hatchability of fertile eggs were 80.92 and 56.43% of intact shell and hairline-cracked eggs, respectively. Narahari et al. (2000) observed the hatchability of checked chicken eggs by using three different methods. In the first treatment, the checked area of shell up to 0.5 cm on all sides was smearsed with a synthetic adhesive resin ‘Fevicol’. In the second treatment, adhesive cellophane tape was fixed over the checked area up to 0.5 cm on all sides. In the third treatment, electric insulation tape was pasted over the checked area. Researchers argued that the all shell treatments improved the hatchability compared to untreated group and the first treatment improved hatchability most. The hatchability results of the present study were better than the previous studies. This may be related to protection of egg permeability with the existing metod by covering the only cracked region.

All of these findings indicated that the method of present study was effective. This simple, easy to perform and low coast method can be comfortably used in broiler chick production.

**References**


**Effects Of Covering Broiler Breeder Eggs With Hairline Cracks By Nail Polish On Hatchability Results**


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### Table 1. Hatchability results of broiler breeder hatching eggs with normal intact shell, untreated hairline-cracked shell and covered hairline-cracked shell

<table>
<thead>
<tr>
<th>Properties</th>
<th>Fertility (n/100 eggs set)</th>
<th>Hatchability (chicks/100 eggs set)</th>
<th>Hatchability (chicks/100 fertile eggs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact shell egg</td>
<td>93.50±0.7a</td>
<td>86.16±1.0a</td>
<td>92.14±0.6a</td>
</tr>
<tr>
<td>Hairline cracked-egg</td>
<td>85.15±1.5b</td>
<td>25.84±2.4c</td>
<td>30.17±2.3c</td>
</tr>
<tr>
<td>Covered egg</td>
<td>87.16±1.0b</td>
<td>64.67±1.5b</td>
<td>74.24±2.0b</td>
</tr>
</tbody>
</table>

Significance (P) ** *** ***

**: P<0.01,***P<0.001, a-c: Mean values with different superscripts within a line differ significantly.
Mean ± S.E.

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### Table 2. Hatching performance of broiler breeder hatching eggs with normal intact shell, untreated hairline-cracked shell and covered hairline-cracked shell

<table>
<thead>
<tr>
<th>Properties</th>
<th>Embryonic mortalities (n/100 fertile eggs)</th>
<th>Contaminated egg rate (n/100 eggs set)</th>
<th>Egg weight loss (% of fresh egg weight)</th>
<th>Cull chicks rate (n/100 of living chicks)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early (0-18 d)</td>
<td>Late (18-21 d)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intact shell egg</td>
<td>2.32±0.6b</td>
<td>5.53±0.7c</td>
<td>0.50±0.1b</td>
<td>10.63±1.2c</td>
</tr>
<tr>
<td>Hairline cracked-egg</td>
<td>19.66±2.9b</td>
<td>50.15±2.3a</td>
<td>2.84±0.7a</td>
<td>21.28±2.0a</td>
</tr>
<tr>
<td>Covered egg</td>
<td>7.77±1.4b</td>
<td>17.98±1.8b</td>
<td>1.22±0.5ab</td>
<td>14.41±1.7b</td>
</tr>
</tbody>
</table>

Significance (P) *** *** *** ***

NS: P>0.05, *: P<0.05, **: P<0.01, ***P<0.001, a-c: Mean values with different superscripts within a line differ significantly.
Mean ± S.E.