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The Effects of Different Formaldehyde Fumigation for Broiler Hatching Eggs on Hatching Results

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ABSTRACT

In this study, different concentrations of formaldehyde fumigation to broiler hatching eggs effects on hatching results were investigated. In the experiment, 1000 broiler hatching eggs were used. Formaldehyde fumigation treatments for the disinfection of hatching eggs in the study 1. for formaldehyde group; 3x: 42 ml formalin (40%) + 21 g potassium permanganate for 1m3, 2. for the formaldehyde group; 4x: It has been planned as 56 ml formalin (40%) + 28 g potassium permanganate for 1 m3. At the end of the study, increasing the formaldehyde fumigation level decreased the hatching performance and increased the late period mortality rate.

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1. Introduction

Formaldehyde is a chemical substance that has a wide usage area due to its chemical properties and is naturally found in the organism too. It is used industrially in many areas. Formaldehyde is used as a disinfectant for the preservation and embalming of biological samples, as well as for its killing effect on many microorganisms and insects, as it enables the proteins in the structure of foods to harden and prevent their deterioration (Blair et al., 1990; Smith, 1992; Usanmaz et al., 2002).

Hatching eggs are disinfected with various disinfectants in order to eliminate the effects of harmful microorganisms on the egg surface before incubation. Formaldehyde is one of the most common disinfectants used in hatching eggs. However, due to the damages caused by the carcinogenic effect of formaldehyde to human health, studies have been carried out on it and alternative substances and applications have been investigated and these studies are still ongoing. Although it has reached an important point as a result of the studies, formaldehyde is still used as a disinfection material in the world and in our country for the disinfection of hatching eggs due to reasons such as cheap, effective and easy applicability (Altan et al., 1996; Yıldırım and Yetişir, 1999; Sheldon and J. Brake, 1991). The breeders reported that the hatching results was negatively affected as they sometimes could not show the necessary care in terms of time and amount while performing this application.

Studies have been conducted to determine the optimal pre-incubation fumigation time. As stated before, it has been reported that fumigation should take at least 20 minutes to eliminate harmful microorganisms in the shell (Lancaster and Crabb, 1953). Studies have shown that incubation results are poor in case of excessive duration and amount (Elibol et al., 2003). In this study, it was aimed to investigated different concentrations of formaldehyde fumigation to broiler hatching eggs before incubation effects on hatching results.

2. Material and Methods

In the incubation part of the experiment "ÇİMUKA" brand incubators belonging to the Department of Animal Science of Uşak University Faculty of Agriculture were used. The 1000 broiler hatching eggs required for the experiment were obtained from commercial enterprises. 1 dose formaldehyde gas concentration (1x) is obtained by mixing 14 ml formalin (40%) + 7 g potassium permanganate for 1 m^3. In the study, formaldehyde fumigation treatments to be applied in disinfection of hatching eggs for 20 minutes before incubation; for 1. formaldehyde group (F3x) 3x: 42 ml formalin (40%) + 21 g potassium permanganate for 1m^3, 4x for the 2nd formaldehyde group (F4x); It has been planned as 56 ml formalin (40%) + 28 g potassium permanganate for 1 m^3. During the incubation period for both experimental groups; While applying 37.5 ^{o}C temperature and 55-60% NR humidity values in the pre-development machine (first 18 days), the change of values in the outlet section is given in Table 1.

Table 1: Humidity and temperature values (18^{th}-21^{th} days of hatching)

Hatching period (day:hour)	Temperature (^{o}C)	Humidity (%)
18:00	37.4	67.3
18:06	37.3	67.5
18:12	37.2	67.5
19:00	37.1	68
19:06	37	68
19:12	37	68
20:00	37	68
20:06	36.9	68
20:12	36.8	67
20:23	36.8	65

In the pre-development phase of the incubation, the eggs are automatically turned every 2 hours at an angle of ^{o}45 as, the embryo was prevented adhering to the eggshell. Egg weight losses were determined by measuring the weight of the eggs before they were placed in the hatcher. After the end of hatching process, all the eggs that were not hatched were broken and the fertility rate (FR), early period mortality (EPM), late period mortality (LPM), internal pip (IPR) and external pip (EPR) rates were determined. All chick weights obtained after hatching were measured.

2.1. Calculations

Fertility Rate: (Number of fertilized eggs in hatching / Number of eggs in hatcher) * 100
Hatching performance: (Number of newly hatched chicks / Number of eggs in hatcher) * 100
Fertile hatchability: (Number of newly hatched chicks / Number of fertilized eggs in hatcher) * 100
Early Period Mortality: (Number of early period mortality chicks / Number of fertilized eggs in hatcher) * 100
Middle Period Mortality: (Number of middle period mortality chicks / Number of fertilized eggs in hatcher) * 100
Lately Period Mortality: (Number of lately period mortality chicks / Number of fertilized eggs in hatcher) * 100
Under the Shell Mortality: (Number of chicks mortality under the shell / Number of fertilized eggs in hatcher) * 100

SPSS 23 program package was used for the descriptive analysis of the data; the differences between F3x and F4x formaldehyt fumigation groups were compared through an independent samples t-test. Differences between the means were considered significant at P<0.05.

3. Results and Discussions

In this study, the effect of different formaldehyde fumigation levels before incubation, on hatching performance was found to be statistically significant. In the experiment, the hatching performance of eggs in the groups with F3x and F4x formaldehyde fumigation levels, was determined as 69.73% and 65.77%, respectively. (P <0.05). It was found no statistically significant difference between F3x and F4x formaldehyde fumigation levels in terms of fertility rate, fertile hatchability and newly hatched chick weight (P> 0.05) (Table 1). Proudfoot and Stewart (1970) obtained similar findings in their study. The researchers reported that a concentration of 2 and 3 times the standard level negatively affected the hatching performance compared to the 1.5 cc formalin + 1 g potassium permanganate (standard) level for 0.02832 m^3.

Table 1. Different formaldehyde fumigation on broiler hatching eggs effects on newly hatched chick weight and hatching characteristics.

Characteristics	FR (%) $\bar{x} \pm S\bar{x}$	FH (%) $\bar{x} \pm S\bar{x}$	NHCW (g) $\bar{x} \pm S\bar{x}$	HP $\bar{x} \pm S\bar{x}$
F3x	85,30±0,61489	81,77±1,333	44.80±0.240	69,73±1,143a
F4x	83,91±0,99517	78,39±0,916	44,97±0,229	65,77±1,049b
P Value	0,229	0,063	0,603	0,010

a,b:The difference between average values carrying different letters in the same order is statistically significant.(p<0.05).
FR: Fertility Rate
FH:Fertile Hatchability
NHCW:Newly Hatched Chick Weight
HP: Hatching Performance

In this study, the effect of different formaldehyde fumigation levels before hatching on late period embryo mortality was found to be statistically significant. In the groups F3x and F4x formaldehyde fumigation levels, late period embryo mortality in eggs were determined as 14.79% and 11.82%, respectively (P <0.05) in the research. It was not found any statistically significant difference between F3x and F4x formaldehyde fumigation levels in early, middle period and pip mortality measurements (P> 0.05) (Table 2).

In this study, results similar to those obtained by Okan et al., (2003) were obtained. Okan et al., (2003) found that two different fumigation concentrations (3x and 4x) were significant in late period embryo mortality (P <0.05). These results show us that the negative effect of high fumigation (F3x) concentration occurs more in the last period when the embryo starts lung respiration compared to the early period. Many researchers (Çadırcı, 1997; Yıldırım et al., 2003) reported that exposure to formaldehyde in pre-incubation storage causes embryonic mortality during incubation.

Table 2. Different formaldehyde fumigation on broiler hatching eggs effects on under shell mortality

Characteristics	EPM (%) $\bar{x} \pm S\bar{x}$	MPM (%) $\bar{x} \pm S\bar{x}$	LPM (%) $\bar{x} \pm S\bar{x}$	PIPM (%) $\bar{x} \pm S\bar{x}$
F3x	1,33±0,569	2,03±0,612	11,82±0,592b	3,04±0,530
F4x	1,70±0,605	2,72±0,581	14,79±0,808a	2,41±0,613
P Value	0,689	0,480	0,016	0,454

a,b:The difference between average values carrying different letters in the same order is statistically significant.($p<0.05$).
EPM: Early period mortality
MPM: Middle period mortality
LPM: Lately period mortality
PIPM: Pip mortality

4. Conclusions

In the present incubation practices, ventilation levels are reduced in the early periods of incubation. This, significantly improves hatching ability, chick quality, homogeneity and post hatching performance. If hatcheries overdo it at optimum fumigation doses, it will cause some of the formaldehyde to remain in the eggshell and enter the egg. This situation can negatively affect the incubation results. As a result of this study, formaldehyde fumigation to be applied in the disinfection of hatching eggs for 20 minutes before incubation can be recommended as F3x (3x; 42 ml formalin (40%) + 21 g potassium permanganate for 1 m^3.

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