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COMPARATIVE STUDY OF THE EFFECT OF SOME DISINFECTANTS ON EMBRYONIC MORTALITY, HATCHABILITY, AND SOME BLOOD COMPONENTS

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ABSTRACT: The present study was carried out to investigate the effect of some different chemical egg disinfectants against bacteria and to study its effect on embryonic mortality, hatchability and some blood biochemicals parameters.

A total of 525 hatching eggs (38-wk-old Golden Montazah) were randomly distributed to seven equal groups. The first group was disinfected by formaldehyde. The second, third and fourth groups were sprayed by 3, 5 and 7% Hydrogen peroxide. While, the fifth, sixth and seventh groups were sprayed by 0.1, 0.5 and 0.7% TH4 (DDAG). Total bacterial counts on hatching eggshell surface and chicks' caeca salmonella counts, embryonic mortality, hatching percentage, hatched chicks' weight, and relative weights of liver and spleen were measured. Serum total protein, albumin, globulin, glucose, uric acid, creatinine, alanine transaminase, aspartate transaminase, and triiodothyronine concentrations were determined. Results indicated that the total number of bacterial counts were significantly higher at pre-disinfection than post-disinfection. The lowest number of bacteria detected was that of the 7% of Hydrogen peroxide and 0.7% TH4 groups. Total embryonic mortality was significantly lower, while, hatchability percentage was higher in the formaldehyde group than the other disinfectants groups. Also, hatchability traits were significantly better while, embryonic mortality were significantly lower in the 5% Hydrogen peroxide group.

In addition, protein profiles, glucose, and triiodothyronine concentrations were significantly lowered, while, kidney and liver functions were significantly higher in the formaldehyde group. While, its values improved in the 5% Hydrogen peroxide group. In conclusion, our results recommended using 5% Hydrogen peroxide as egg disinfectants against bacteria due to its effectiveness and ease of application

Key words: Chemical disinfections-hatchability-embryonic mortality-blood biochemistry

INTRODUCTION

Maximizing hatchability and chick quality are a crucial step in optimizing poultry production efficiency. Reducing microbial contamination of eggshells may help to decrease the incidence of bacterial infections in developing embryos and newly hatched chicks. Microorganisms can penetrate the eggshell through shell pores or cracks (Bailey et al., 2001) and can kill the developing embryo, reduce hatchability, and negatively affect the chick post-hatching (Bialka et al., 2004). Hatched chicks can also be infected through contact with contaminated eggshells and hatchery equipment (Fasenko et al., 2000), with infected chicks then transmitting bacteria such as Salmonella serovar Salmonella Enteritidis, pathogenic Escherichia coli, and Listeria monocytogenes to other chicks in the growing flock (Messens et al., 2007).

There are many disinfectants to choose based on their mode of action, they are grouped with alkylating agents (formaldehyde, ethylene oxide, propylene oxide, betapropionolactone), oxidizing agents (hydrogen peroxide, peracetic acid, chlorine peroxide, ozone) and combination of quaternary ammonium compounds and gluteraldhyde (TH4) (Block, 2001). Formalin is an aqueous solution (37%) of formaldehyde, which is an excellent antimicrobial agent, and its efficiency is not affected in the presence of organic matter. In the poultry industry, formaldehyde is used as a disinfectant for poultry houses (Bialka et al., 2004)**,** poultry litter, and fumigation of hatching eggs (Fabrizio et al., 2002). Formaldehyde, a gaseous chemical, is released from formalin as fumes in hatchers to disinfect the environment and prevent the spread of infections (Cadirci, 2009).

Formaldehyde has been the recommended fumigant used in hatcheries due to its effectiveness and ease of application (Fabrizio et al., 2002). However, the United States Environmental Protection Agency has recently moved toward regulating the use of formaldehyde under the Toxic Substances Control Act (Anonymous, 1984). Moreover, formaldehyde fumigation is an irritant for the eyes and the nose and has a lingering noxious odor, venting of its vapors is difficult (Cadirci, 2009). Most importantly, recent actions by the environmental protection agency to regulate the use of formaldehyde fumigation under the toxic substances control act due to its suspected carcinogenicity (Chmelnicna, 2000). Thus, effective alternatives disinfectants such as hydrogen peroxide and TH4 are needed to replace formaldehyde fumigation in the event that the environmental protection agency bans its use (Fichet et al., 2007).

Hassan et al. (2011) reported that hydrogen peroxide (H_2O_2) has been used as a disinfectant, particularly as a surface decontaminant, for years. Unlike formaldehyde, H_2O_2 is easily evaporated or decomposed, has no lingering unpleasant odour, and poses minimal safety problems for workers. However, H_2O_2 is a strong oxidizing agent and can irritate the skin, eyes, and mucous membranes if care is not taken in handling it, formaldehyde results in a very violent reaction in the presence of H_2O_2. Thus, extreme care should be taken if both compounds are present on the same premises. H_2O_2 concentrations much higher than 0.003% (30ppm) can be used in drinking water for poultry without any adverse effects on performance (Hassan et al., 2011). Fichet et al. (2007) demonstrated the effectiveness of a 5% H_2O_2 solution, as a substitute for formaldehyde, in sanitizing broiler breeder hatching eggs does not interfere or reduce hatch of fertile eggs for young or old flocks. The authors conclude that H_2O_2 is as good if not slightly superior to formaldehyde as a hatching egg sanitizer.

Also, Essam et al., (2009) used TH4 as a disinfectant against four bacterial isolates (Staphylococcus aureus, Escherchia coli, Klebsiella oxytoca and Pseudomonas aureuginosa). They concluded that quaternary ammonium compounds eliminated all the microorganisms.

Therefore, the present study was carried out to investigate the effect of some different chemical egg disinfections against bacteria and to study its effect on embryonic development, hatchability and some blood biochemicals parameters.

MATERIALS AND METHODS

The present work was carried out at El-Takamoly Poultry Project, El-Fayoum, to study the effect of some disinfectants on embryonic mortality and hatching traits. A total of 525 hatching eggs with an average weight (50 ± 2 g) were collected from Golden Montazah strain at 38-wk-old. Pre-incubation, eggs were randomly distributed to seven equal groups with three replicates for each group (25 hatching eggs for each replicate). The first group was disinfected by formaldehyde (formaldehyde, obtained from 60 mL formalin, 30 mL water and 48 g potassium permanganate at a temperature of 37°C, air humidity 80% and exposure time 30 minutes). The second, third and fourth groups were disinfected by spraying of 3, 5 and 7% Hydrogen peroxide (H_2O_2). While, the fifth, sixth and seventh groups were disinfected by spraying 0.1, 0.5 and 0.7% TH4. Active ingredients of TH4 are: Didecyl dimethyl ammonium chloride, 18.75g; Dioctyl dimethyl ammonium chloride, 18.75g; Octyl decyldimethyl ammonium chloride, 37.50g; Alkyl dimethyl ammonium chloride, 50.00g and Glutardialdehyde, 62.50g. Before and after 20 minutes of disinfectants, five eggs were selected randomly from each group. Each egg was cleaned by a swab to determine the total number of bacteria (TBC). The total no. of bacteria counts were enumerated on plate count agar medium (PCA) according to Fardiaz (1993). While, after hatch caeca Salmonella counts were enumerated on Salmonella Shigella agar medium (SSA) also according to Fardiaz (1993).

Eggs were individually weighed then incubated at 37.5°C and 60% RH, air sac upside (vertically) and turned 12 times daily at a 45 degree angle during the first 18 days of incubation. At the 10^{th} day of incubation, eggs were candled by light to remove the infertile eggs and the early embryonic death. At the 18^{th} d of incubation, all eggs were candled to remove the middle embryonic death, then, all remaining eggs were individually weighed to calculate moisture loss using the following equation:

Water loss (percentage) = [(EW before incubation – EW at transfer)/EW before incubation] × 100.

Where, EW = Egg weight.

At the 18^{th} d of incubation eggs from each group were transferred into the hatcher at 36.5°C and 65% RH until hatch. After hatch, late and total embryonic mortality were recorded.

Total embryonic mortality rate was calculated using the equation:

Embryonic mortality (percentage) = [(number of incubated fertile eggs –

number of hatched chicks)/number of incubated fertile eggs] × 100.

At hatch, hatching percentage was calculated as follows:

Hatching of fertile eggs percentage = (number of hatched eggs/number of fertile eggs) × 100.

Hatchability percentage = (number of hatched eggs/number of set eggs) × 100.

Chicks were weighed, after hatching, using a digital balance (accuracy ± 0.01 g) within 24 h from hatch, after it becomes dried. Chicks were slaughtered then liver and spleen weights were obtained and calculated as a percentage of body weight.

Blood samples were collected in tubes, without anticoagulant, then left to clot. They were centrifuged at 1600 × g for 15 min and the resulting serum Samples were stored at −20°C until analysis. Serum total protein, albumin, glucose, uric acid, creatinine, alanine transaminase (ALT), and aspartate transaminase (AST) concentrations were determined colorimetrically using colorimetric kits (Stanbio Laboratory LP, Boerne, USA) and measured using scanning spectrophotometer Spectronic 1201 (Milton Roy, Ivyland, USA). Serum globulin values were calculated by subtracting albumin values from their corresponding total protein values of the same sample. While triiodothyronine (T_3) concentration was determined using radioimmunoassay kit (Institute of Isotopes Co., Ltd., Budapest, Hungary) and samples were counted on a Packard Cobra Gamma Counter, Model 5002 (PerkinElmer, Waltham, USA).

Statistical methods:

Data were statistically analyzed by one-way analysis of variance using the General Linear Models procedure of the SAS software (Statistical Analysis System, Version 8.2, 2002). Significance level was set at $P < 0.05$. Mean values were separated, if significance exists, using Duncan's Multiple Range Test (Duncan 1955).

The model used was:

$X_{ij} = \mu + T_i + e_{ij}$

Where:

X_{ij} = any value from the overall population

μ = overall mean

T_i = effect of the i^{th} disinfection treatment

e_{ij} = random error associated with the ij^{th} individual.

RESULTS

The effects of some disinfectants on the total bacterial counts on hatching eggshell surface and chicks' caeca salmonella counts are presented in Table (1). Here the highest total number of bacteria counts was significantly higher at pre-disinfectant than post-disinfectant in all disinfectants groups. While, the total bacterial count present in formaldehyde group was greater than the other disinfected groups. Total bacterial count gradually decreased as the hydrogen peroxide or the TH4 concentrations increased. The lowest bacterial count was that of in the 7% of H_2O_2 and in the 0.7% TH4 groups. While, the caeca Salmonella counts were only present in the 3% and 7% H_2O_2 group.

Table 2 shows the effects of some disinfectants on embryonic mortalities. Early embryonic mortality was only present in the 5% hydrogen peroxide group and in the 0.7% TH4 group. The highest numbers of embryonic mortality at the mid and late stages were detected in the 7% hydrogen peroxide and in the 0.7% TH4 groups. While, the lowest numbers of embryonic mortality at the mid and late stages were observed in the 5% of hydrogen peroxide group and in the 0.5% TH4 groups (Table 2). However, total number of embryonic mortality was significantly lower in the formaldehyde group than, the other two disinfectants groups.

Effects of some disinfectants on the egg weights loss percentages are present in Table (3). Here, there were no significantly differences in the egg weights loss percentages between all the disinfectants groups.

The highest hatchability of total eggs set and hatchability of fertile eggs were that of the formaldehyde treated (Table 4). However, hatchability was significantly decreased with the increase in hydrogen peroxide or TH4 levels. The lowest hatchability was that of the 7% hydrogen peroxide or the 0.1 and 0.7% TH4 groups.

The effects of the some disinfectants on the hatched chicks' weights and the relative weights of their liver and spleen are presented in Table (5). The highest hatched chicks' weight was that of in the 5% hydrogen peroxide group. However, there were no significant differences in the hatched chicks' weight between all the other disinfectants groups. The highest relative weights of liver were that of the formaldehyde group. The lowest relatives' weight of liver were that of the 5% hydrogen peroxide group followed by 0.7% TH4 group. The highest relative spleen weights were that of the 5% hydrogen peroxide group. However, the significantly lowest relative spleen weights were those of the formaldehyde group (Table 5).

Table (6) represents the effects of some disinfectants on some blood components. Here, total protein, globulin, glucose, and T_3 concentrations were significantly higher in the 5% hydrogen peroxide group than any of the other groups. While, the lowest total protein, globulin, glucose, and T_3 concentrations were those of the formaldehyde group and in the 0.7% TH4 group. There were no significant differences between the 3% hydrogen peroxide and the 0.1% TH4 groups in their albumin concentration, and both of them had albumin concentration greater than the other disinfectants groups (Table 6). However, the lowest albumin value was that of the formaldehyde group.

The effects of some disinfectants on some kidney and liver functions are presented in Table 7. It was found that the highest uric acid, creatinine, AST and ALT concentrations were those of in the formaldehyde group than the other disinfectants groups. However, the lowest values were those of the 5% hydrogen peroxide and the 0.5% TH4 group.

DISCUSSION

It has been demonstrated that if hatching eggs are not sanitized prior to incubation, excessive bacterial contamination and subsequent growth can lead to decreased hatchability, poor chick quality, growth and performance and increased mortality (Bialka et al., 2004). Disinfectants reduced bacterial contamination of the eggshell and they affect the functional properties of the eggshell with respect to egg water loss and gas exchange during incubation. These results complicate the situation regarding application of any new egg disinfectants. Therefore, eggshell permeability should be taken in our account in choosing any method of egg disinfection (Bouchra et al., 2003).

Our results indicated that, the number of total bacteria present on the egg surface of the formaldehyde group was greater than the other disinfected groups. The lowest bacterial count was that of the 7% of H_2O_2 and the 0.7% TH4 groups. Our data are in agreement with Fabrizio et al., (2002) who observed that formaldehyde fumigation eliminated some of bacteria of the eggshell microorganism population.

In addition, the data of our experiment are in agreement with those reported by Wells et al. (2010) who stated that hydrogen peroxide and TH4 reduced eggshell bacterial counts and it is possible that hatchability and chick quality of breeder eggs will be improved by treatment as compared with control. While, Wells et al. (2011) stated the same conclusion of bacterial count reduction on eggshell surface due to using 1.5% hydrogen peroxide with no effect on hatchability. Sander and Wilson (1999) demonstrated that fogging eggs with 3% H_2O_2 significantly reduced bacterial counts on broiler hatching eggs.

Additionally, our results are in agreement with Sigwarth and Stark (2003) who reported that no significant differences in egg water loss were detected between all different disinfectants treatments. The avian eggshell is both a conduit through which diffusive water vapor, oxygen, and CO_2 are permitted to pass. The $CaCo_3$ portion of the shell and, to a lesser extent the shell membranes and cuticle affects this free exchange.

The porosity of the eggshell to water vapor and vital gases during incubation influences hatchability, embryonic growth, and chick weight at hatch. Thus, any alteration or removal of the cuticle by sanitizers, bacterial growth, abrasion, storage, washing, or improper handling may have a significant impact on the hatchability and livability of the chick. Under the conditions of this study, H_2O_2 did not significantly affect eggshell permeability. However, due to the oxidation potential of H_2O_2, some modification of the proteinaceous cuticle would be expected (Quanten and Koenen, 2011). While, Sander and Wilson (1999) evaluated hydrogen peroxide (H_2O_2) with contaminated eggs and reported that eggs exposed to H_2O_2 lost a significantly greater amount of moisture during incubation but hatchability was not affected.

Our data were in agreement with Zeweil et al. (2015) who reported that, although total embryonic mortality was significantly lower in the formaldehyde group than the other disinfectants groups, mortality rate was also significantly lower in the 5% H_2O_2 group and in the 0.5% TH4 group. They reported that, formaldehyde, unlike TH4 or H_2O_2, produces teratogenic and toxic chick's performance after hatching effects in the developing chicken and may cause malformations on some embryos such as swelling at the part below the lower jaw of the beak (Zeweil et al., 2015).

Hatchability of fertile eggs was significantly higher in the formaldehyde group than the other disinfectants groups. Fasenko et al. (2000) attributed the increases in hatchability to a significant reduction in embryonic mortality. In addition, our results indicated that hatchability values were significantly higher in the 5% hydrogen peroxide and in the 0.5% of TH4 groups. Fichet et al. (2007) reported that the utilization of a hydrogen peroxide solution, as a sanitizer for hatching eggs, is a safe and effective means for inhibiting the growth of microorganisms that may adversely affect the quality of the fowl after hatching. It also reduces the number of chick deaths occurring within a few days after hatching. The use of hydrogen peroxide does not require the handling of hazardous chemicals and does not require venting of unpleasant fumes from the hatchery facility. The method of the invention additionally results in less interior contamination within the shell among the percentage of eggs that do not hatch (Hassan et al., 2011). The use of 0.5% hydrogen peroxide in lieu of formaldehyde not only very effectively combats surface microbial contaminants but also, surprisingly, very significantly increases the hatchability of the eggs treated (Hassan et al., 2011).

Our results were in agreement with Abdul Rashid et al. (2011) who investigated the effect of different disinfectants (Sanisquad, Beloran and TH4) on chick body weight and hatchability traits in Fayoumi and crossbred (Rhode Island Red male X Fayoumi female) chickens. They found that none of the disinfectants solutions affected egg weight and chicks' body weight. In addition, Abdul Rashid et al. (2011) reported that the lowest hatchability was observed in the untreated eggs as control group. The hatchability of eggs treated with TH4 was higher than untreated control eggs. The other traits of hatchability (early dead, mid dead and late dead embryo) were found to be significantly lower in the TH4 than all the other treatments. Our study indicated that treatment of hatching eggs with TH4 significantly improved hatchability.

Khan et al., (2006) reported that formalin administration resulted in behavioral alterations, included depression, dullness, staggering, somnolence, anorexia, and decreased frequency of crowing. Decreasing and increasing trends in concentrations of serum proteins and enzymes, respectively, were observed with the formalin treatment. Significantly lower blood glucose and triiodothyronine levels and significantly higher blood urea and creatinin concentrations were observed in higher formalin levels.

A decrease in the serum proteins was observed in the hatched chicks of the formaldehyde group than the other hatched chicks from the other disinfectants groups. This indicates that formaldehyde might have suppressed the synthesis of plasma proteins (Babar et al., 2001). Serum proteins are mainly synthesized in the liver, and a decrease in their level is indicative of a disturbance in the function of this organ (Babar et al., 2001). Our results are in agreement with Khan et al. (2006) who reported that a decrease in serum proteins in the formaldehyde group might have occurred due to its hepatotoxic effect that lead to the liver hepatomegaly. Also decreased glucose concentration in the formaldehyde groups could also be related to the hepatotoxic effects of formaldehyde that might have an inhibitory effect on glycogenesis in the liver.

Regardless of formaldehyde group, our results indicated that using 5% H_2O_2 as a disinfectant solution increased hatchability, which attributed to a significant reduction in total embryonic mortality. In addition, our study indicated that using 5% H_2O_2 improved embryonic development that lead to increase in hatched chicks' weight. This might be attributed to increased serum glucose, triiodothyronine and proteins synthesis in the liver (Tobe et al. 1989).

Significantly, higher levels of serum urea and creatinine that was observed in the hatched chicks of the formaldehyde group could be due to decreased fluid intake and urine production and, consequently, the retention of urea and creatinine in the blood, ultimately resulting in increased concentration of these parameters in the blood. Thus, an elevated concentration of urea and creatinine in the blood could be associated with impaired renal function (Khan et al., 2006). While, in our study the reduction in serum uric acid and creatinine in the 5% H_2O_2 and in 0.5% TH4 than the other treatment groups may be attributed to improving kidney functions and to the positive effects of using hydrogen peroxide or TH4 as disinfectant solutions than formaldehyde treatment.

A significant increase in concentrations of ALT and AST in the hatched chicks of the formaldehyde group as compared with the other groups in the present study was indicative of liver hepatomegaly. The ALT is a cytoplasmic enzyme, and AST is a cytoplasmic and mitochondrial enzyme in hepatic cells. An increased activity of these enzymes is a very sensitive index of hepatic damage (Khan et al., 2003). Irrespective of the magnitude of alteration in serum enzymes, these changes reflect adverse effects of the formaldehyde on the function of hepatic cells. Unlike, using 5% H_2O_2 or 0.5% TH4 significantly reduced these enzymes.

In conclusion, the results of this study demonstrated that using 5% H_2O_2 as disinfectant solution slightly improved hatchability and increased blood glucose and triiodothyronine, which was reflected on increased hatched chicks weights. In addition, 5% H_2O_2 reduced embryonic mortality and improved liver and kidney functions. Therefore, using 5% H_2O_2 as a disinfectant solution appears to be better than formaldehyde or TH4. Therefore, our study recommended using H_2O_2 by 5% in hatcheries as disinfectant due to its effectiveness and ease of application.

Table (1): Total bacterial count of eggshell and caeca Salmonella counts isolates from different disinfection groups.

Treatments	**Total Bacterial Counts(x 10^4)**	**Salmonella Counts / Caeca**
Pre-disinfection	*5.7 ± 0.02[a]	0
Formaldehyde	3.1 ± 0.02[b]	0
H_2O_2 (3%)	2.5 ± 0.02[c]	> 300x10^2
H_2O_2 (5%)	1.8 ± 0.02[d]	0
H_2O_2 (7%)	0.34 ± 0.02[g]	8x10^2
TH4 (0.1%)	0.75 ± 0.02[e]	0
TH4 (0.5%)	0.47 ± 0.02[f]	0
TH4 (0.7%)	0.24 ± 0.02[h]	0

*Values are means ± SE. n = 5 per group.

[a, c] Means with different superscripts, in the same column, are significantly different ($P < 0.05$).

Table (2): Effects of the some disinfectants on embryonic mortalities.

Treatments	Early dead (%)	Mid dead (%)	Late dead (%)	Total embryonic mortality (%)
Formaldehyde	0	0	*2.74 ± 0.06[c]	2.75± 0.01[f]
H_2O_2 (3%)	0	1.37 ± 0.02[d]	4.10 ± 0.06[b]	5.48± 0.01[c]
H_2O_2 (5%)	*1.34 ± 0.02	1.40 ± 0.02[d]	1.38 ± 0.06[e]	4.17± 0.01[e]
H_2O_2 (7%)	0	2.90 ± 0.02[a]	8.53 ± 0.06[a]	11.4± 0.01[a]
TH4 (0.1%)	0	2.60 ± 0.02[c]	2.63 ± 0.06[c]	5.39± 0.01[c]
TH4 (0.5%)	0	1.36 ± 0.02[d]	2.33 ± 0.06[d]	4.69± 0.01[d]
TH4 (0.7%)	1.35 ± 0.02	2.86 ± 0.02[b]	3.86 ± 0.06[b]	7.99± 0.01[b]

*Values are means ± SE.

[a, c] Means with different superscripts, in the same column, are significantly different ($P< 0.05$)

Table (3): Effects of the some disinfectants on the egg weight loss percentages.

Treatments	Initial egg weight (g)	Transfer egg weight (g)	Egg weights loss (%)
Formaldehyde	*50.31 ± 0.27	44.27 ± 0.29[a]	12.02 ± 0.28
H_2O_2 (3%)	49.90 ± 0.27	43.51 ± 0.29[ab]	12.84 ± 0.28
H_2O_2 (5%)	49.54 ± 0.27	43.20 ± 0.29[ab]	12.70 ± 0.28
H_2O_2 (7%)	49.81 ± 0.27	43.50 ± 0.29[ab]	12.70 ± 0.28
TH4 (0.1%)	49.60 ± 0.27	43.30 ± 0.29[b]	12.70 ± 0.28
TH4 (0.5%)	49.70 ± 0.27	43.6 ± 0.29[ab]	12.30 ± 0.28
TH4 (0.7%)	50.11 ± 0.27	43.9 ± 0.29[ab]	12.20 ± 0.28

*Values are means ± SE.

[a, c] Means with different superscripts, in the same column, are significantly different ($P< 0.05$).

Table (4): Effects of the some disinfectants on the fertility and hatchability traits.

Treatments	Fertility (%)	Hatchability of total eggs set (%)	Hatchability of fertile eggs (%)
Formaldehyde	*97.3 ± 2.4	94.66 ± 4.7[a]	97.22 ± 4.3[a]
H_2O_2 (3%)	97.3 ± 2.4	92.02 ± 4.7[bc]	94.73 ± 4.3[c]
H_2O_2 (5%)	96.8 ± 2.4	93.71 ± 4.7[b]	96.01 ± 4.3[b]
H_2O_2 (7%)	97.6 ± 2.4	91.31 ± 4.7[c]	94.02 ± 4.3[c]
TH4 (0.1%)	97.6 ± 2.4	91.71 ± 4.7[c]	93.16 ± 4.3[cd]
TH4 (0.5%)	97.3 ± 2.4	92.96 ± 4.7[b]	95.72 ± 4.3[b]
TH4 (0.7%)	97.3 ± 2.4	90.71 ± 4.7[c]	92.12 ± 4.3[d]

[1]Values are means ± SE.

[a, c] Means with different superscripts, in the same column, are significantly different ($P< 0.05$).

Table (5): Effects of some disinfectants on the hatched chicks' weights and the relative weights of their livers and spleens at hatch.

Treatments	Chicks Weight (g)	Liver Weight (%)	Spleen Weight (%)
Formaldehyde	*31.11 ± 0.29 ^{b}	2.86 ± 0.27^{a}	0.63 ± 0.01^{e}
H_2O_2 (3%)	31.29 ± 0.29^{b}	2.26 ± 0.27^{d}	1.41 ± 0.01^{c}
H_2O_2 (5%)	34.96 ± 0.29^{a}	2.15 ± 0.27^{e}	1.69 ± 0.01^{a}
H_2O_2 (7%)	32.13 ± 0.29^{b}	2.38 ± 0.27^{c}	1.21 ± 0.01^{d}
TH4 (0.1%)	31.71 ± 0.29^{b}	2.35 ± 0.27^{c}	1.37 ± 0.01^{c}
TH4 (0.5%)	33.05 ± 0.29^{b}	2.24 ± 0.27^{d}	1.54 ± 0.01^{b}
TH4 (0.7%)	31.15 ± 0.29^{b}	2.68 ± 0.27^{b}	1.17 ± 0.01^{d}

*Values are means ± SE. n = 5 per group

$^{a, c}$ Means with different superscripts, in the same column, are significantly different ($P< 0.05$).

Table (6): Effects of some disinfectants on some blood components.

Treatments	T. Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Glucose (mg/dl)	T3 (ng/ml)
Formaldehyde	*2.99 ± 0.05^{e}	1.35 ± 0.009^{c}	1.64 ± 0.05^{d}	65.9 ± 0.06^{d}	2.33 ± 0.04^{c}
H_2O_2 (3%)	3.49 ± 0.05^{b}	1.57 ± 0.009^{a}	1.92 ± 0.05^{b}	73.1 ± 0.06^{c}	2.52 ± 0.04^{b}
H_2O_2 (5%)	3.65 ± 0.05^{a}	1.47 ± 0.009^{b}	2.18 ± 0.05^{a}	94.9 ± 0.06^{a}	2.63 ± 0.04^{a}
H_2O_2 (7%)	3.19 ± 0.05^{d}	1.48 ± 0.009^{b}	1.71 ± 0.05^{c}	88.2 ± 0.06^{b}	2.48 ± 0.04^{b}
TH4 (0.1%)	3.38 ± 0.05^{c}	1.60 ± 0.009^{a}	1.78 ± 0.05^{c}	89.3 ± 0.06^{b}	2.55 ± 0.04^{b}
TH4 (0.5%)	3.39 ± 0.05^{c}	1.44 ± 0.009^{b}	1.95 ± 0.05^{b}	75.9 ± 0.06^{c}	2.59±0.04^{ab}
TH4 (0.7%)	2.93 ± 0.05^{e}	1.46 ± 0.009^{b}	1.47 ± 0.05^{e}	68.2 ± 0.06^{d}	2.32 ± 0.04^{c}

*Values are means ± SE. n = 5 per group.

$^{a, c}$ Means with different superscripts, in the same column, are significantly different ($P< 0.05$).

Table (7): Effects of some disinfectants on some blood components.

Treatments	Uric Acid (mg/dl)	Creatinin (mg/dl)	AST (IU/L)	ALT (IU/L)
Formaldehyde	*6.77±0.15^{a}	0.63±0.02^{a}	49.4 ± 0.4^{a}	65.4 ± 0.5^{a}
H_2O_2 (3%)	5.68±0.15^{b}	0.49±0.02^{bc}	41.5 ± 0.4^{d}	57.3 ± 0.5^{b}
H_2O_2 (5%)	5.19±0.15^{e}	0.43±0.02^{c}	37.9 ± 0.4^{e}	51.0 ± 0.5^{c}
H_2O_2 (7%)	5.36±0.15^{d}	0.56±0.02^{b}	43.1 ± 0.4^{c}	59.4 ± 0.5^{b}
TH4 (0.1%)	5.55±0.15^{c}	0.51±0.02^{b}	47.8 ± 0.4^{ab}	53.1 ± 0.5^{c}
TH4 (0.5%)	5.02±0.15^{f}	0.43±0.02^{c}	44.5 ± 0.4^{c}	49.6 ± 0.5^{c}
TH4 (0.7%)	5.78±0.15^{b}	0.53±0.02^{b}	46.8 ± 0.4^{b}	58.6 ± 0.5^{b}

*Values are means ± SE. n = 5 per group.

$^{a, c}$ Means with different superscripts, in the same column, are significantly different ($P< 0.05$).

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الملخص العربي

دراسة مقارنة لتأثير بعض المطهرات علي نفوق الأجنة و الفقس وبعض مكونات الدم

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اجريت هذه التجربة لدراسة تأثير بعض المطهرات على الفقس و نمو الأجنة و ايجاد طرق بديلة عن الفورمالدهيد لتطهير البيض من الملوثات الميكروبية التي تؤثر بالسلب على الفقس و نمو الأجنة و جودة الكتاكيت الناتجة. استخدمت في التجربة 525 بيضة تفريخ من بيض سلالة المنتزه الذهبي (عمر 38 اسبوع) و تم تقسيم البيض عشوائيا الي سبعة مجموعات متساوية. تم تطهير المجموعة الاولي بغاز الفورمالدهيد بينما تم معاملة المجموعات الثانية و الثالثة و الرابعة ب H_2O_2 بتركيزات 3 و 5 و 7% علي التوالي. اما المجموعة الخامسة و السادسة و السابعة فتم تطهيرها بمحلول TH4 بتركيزات 0.1 و 0.5 و 0.7% علي التوالي. تم قياس العد البكتيري الكلي و السالمونيلا قبل و بعد التطهير بعشرين دقيقة لعدد خمسة بيضات من كل معاملة. كما تم تقدير النفوق الجنيني في مراحله المختلفة المبكر و الاوسط و المتأخر. و كذلك تم تقدير الفقد في وزن البيض و نسبة الفقس و وزن الكتاكيت الناتجة و وزن الكبد و الطحال كنسبة من وزن الجسم. كما تم تقدير محتوي سيرم الدم من كل من بروتينات الدم و الجلوكوز و بعض وظائف الكلية و الكبد كما تم تقدير مستوي هرمون الدرقية بعد الفقس.

و قد دلت النتائج علي ارتفاع مستوي التلوث البكتيري الكلي قبل التطهير عن المجموعات التي تم تطهيرها. و انخفض العد البكتيري بدرجة معنوية بالتطهير باستخدام H_2O_2 بمستوي 7% و استخدام محلول ال TH4بمستوي 0.7%. بينما انخفض النفوق الكلي للأجنة و ارتفعت نسب الفقس معنويا في مجموعة الفورمالدهيد مقارنه بالمجموعات الأخرى. بينما اظهر التطهير بمستوى 5% من H_2O_2 تحسن في مستوي الفقس و انخفاض نسبة النفوق.

كما اظهرت النتائج تدهور مستوي بروتينات الدم و مستوي الجلوكوز و هرمون الدرقية و ارتفعت وظائف الكلية و الكبد في مجموعة الفورمادهيد مقارنه بالمجموعات الأخرى. كما تسبب استخدام الفورمالدهيد في حدوث تضخم في الكبد و انخفاض في وزن الطحال مما يدل علي حدوث خلل في وظائف الكبد و انخفاض مناعة الطيور مما كان له دلاله واضحة علي الاثار السلبية للمعاملة بالفورمالدهيد علي الكتاكيت الناتجة. بينما اظهرت النتائج حدوث تحسن في وظائف الكلية و الكبد وارتفاع مستوي بروتينات الدم و مستوي الجلوكوز و هرمون الدرقية في المجموعة المعاملة بالH_2O_2 بمستوي 5% مما انعكس علي حدوث تحسن في وزن الكتاكيت الناتجة.

و لذلك اوصت الدراسة باستخدام ال H_2O_2 بتركيز 5 % في تطهير بيض التفريخ لما له من تحسن في نسب الفقس و انخفاض نسب نفوق الأجنة و تحسن وظائف الكبد و الكلية علاوة علي سهولة استخدامه و انخفاض الاثار الضارة الناتجة منه علي العاملين.