Research Article

Influence of Fumigation Strength on Hatchery Parameters and Later Life of Chicks

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Abstract |The experiment was carried out to determine the use of double strength fumigation with formaldehyde gas on broiler breeder's eggs hatchability, candling, blasting/putrification, dead in shell, quality of chicks and later life mortality. The broiler breeders eggs were divided into two groups each (n=134640 eggs). The fumigation of both groups was performed through automatic fumigation system provided by chick master. The hatchability and candling of flocks SSR1AIC, SSR2AIB, SSR3AID and SSF5 were significantly (P<0.05) better for double strength fumigation compared to single strength fumigation. The dead in shell were insignificant for the treatment. The putrification/blasting and low quality chicks were significantly (P<0.05) better for double strength fumigation for SSR2AIB, SSR3AID and SSF5, while remaining flocks were insignificant regarding quality of chicks and putrification due to fumigation strength. The chicks each (n=30,000) were shifted to poultry houses from both groups to know the effects of fumigation strength on later life of chicks. The weight gain, feed intake and FCR were insignificant for both groups while mortality was significantly better for double strength fumigation compare to single strength fumigation. In short double strength fumigation is safe can be used to improve the hatchery parameters and later life of chicks,

Keywords: Chicks mortality, Candling, Dead in Shell, Fumigation strength, Hatchability

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INTRODUCTION

Formaldehyde gas is commonly use as disinfectant for fertile eggs to avoid contamination on eggs surface. Formaldehyde (H_2CO, formalin, formol) is a gas which is readily soluble at room temperature commonly used for fumigation of eggs due to non-corrosive and cheap. The formaldehyde is more effective in vapor phase because the gas particles are carried by water vapors. So, biocidal activity will be much higher in warm humid atmosphere as compare to cooler environment. The recommended humidity for fumigation is 75% or more and temperature should not exceed 25^{0}C. During high temperature the gaseous phase is able to keep the vapors in high concentrations. The biocidal efficiency of formaldehyde is due to its ability to act on the protein and nucleic acid basis of microorganisms. By attaching itself to the primary amide and amino groups of proteins, formaldehyde forms stable methylene bridges and hence intermolecular cross-linkages (Cadirci et al., 2009). The scientists used different technique to reduce bacterial load on eggs surface (Chung et al., 2018) used different concentrations of ClO_2 and compared with different UV methods. Application of 40 ppm ClO_2 to table and hatch able eggs reduces the aerobic plate count (APC) with no statistical difference with conventional fumigation with formalin and UV. No, statistical difference was found for in albumin height, Haugh unit and yolk color. The hatchability of fertile eggs was statistically different when compared with 80ppm ClO_2 and values were decreased when compared with treatment 160ppm ClO2 gas. Hence they found that ClO2 gas can be used for disinfection of eggs. (Upadhyaya et al., 2015)

used plant derived antimicrobial (PDAs), transcinnameldehyde and eugenol as fumigation treatment applied on the surface of embryonated eggs to reduce salmonella enteric (SE). The embryonated eggs which were fumigated with (PDAs) were more effective to reducing SE on eggs surface. (Baylan et al., 2018) worked on garlic extract (Allium sativum) as an alternate of formaldehyde to fumigate the quail eggs to determine the hatching traits and growth parameters. Two dilutions of garlic extract (Garlic-1) 2.5% and (Garlic-2) 5% was used for disinfection along formaldehyde as positive control and eggs not submitted to disinfection were used as negative control. The hatching eggs were immersed into garlic solution for one minute the left to dry for one minte at room temperature. The highest early embryonic mortality was found with formaldehyde and lowest with garlic-2. Mid-term, late embryonic mortality and culling chicks were insignificant. Growth parameters were also found better with Garlic-2 compare to garlic-1. The feed intake and feed conversion ratio were not influenced by the treatments. (Karrar et al., 2015) investigate the effectiveness of ultra violet light (UV) (262 nm, 10 mW cm–2) as disinfectant for chicken eggs and found that the eggs disinfected with UV were in hatchability and total mortality. Further investigation he found that UV is as safe as formaldehyde for disinfection of chicken eggs without any adverse effects. Formalin is also used along potassium permanganate to increase its efficacy. Normally 20gram $KMNO_4$ 40 ml (40% aqueous) formalin along 40 ml water for $100ft^3$ for 20 minutes, for single strength we can use following formula L*W*H*20/$100ft^3$ for double strength 20 will be replaced by 40 and 40 will be replaced by 60 for triple strength respectively (Jabbar et al., 2017). Formaldehyde is an effective procedure for reducing microbial contamination on eggs shell surface before incubation.

MATERIALS AND METHODS

Ethical Approval

The experiment was performed regarding all rules and regulation of animal rights and considering the adverse effects of formaldehyde gas.

Experimental Site

The experiment was performed at one of the biggest chicken hatchery of south Asia SS hatchery Chakri Pakistan facilitated with latest HVAC system , having ISO (International standard organization) 1900-2000 certified. This hatchery is producing 650000 to 700000 chicks/month through single stage incubator (Avida G4) provided by chick Master USA.

Experimental Eggs

The experimental eggs were collected from different breeder farms each (n=134640 eggs). Salman Sadiq farm (SS) ross (R) 1, 2 and 3 (house no.) Artificial insemination team (AI) A, B, C and D. SSR1AIC, SSR2AIA, SSR2AIB, SSR3AID, SSF5 and SSF6AI

Experimental Groups

The eggs from each flock were divided into two groups with equal number of eggs. Group A was fumigated with single strength while group B was fumigated with double strength.

Eggs Fumigation

The fumigation of both groups was performed by automatic fumigating system provided by chick master (Jabbar et al., 2017). The eggs from group A were fumigated with 20gram $KMNO_4$ 40 ml (40% aqueous) formalin along 40 ml water for $100ft^3$ for 20 minutes according to formula L*W*H*20/$100ft^3$ (for single strength), while eggs from group B were fumigated L*W*H*40/$100ft^3$ (double strength) for 20 minutes. After fumigation both groups were immediately shifted to incubation.

Fumigation Process

The software base fumigation provided by chick master is designed to avoid the carcinogenic effects of formalin. The specially design system works according to following steps.
Step-1 (OFF Condition)
Inlet Damper MD1 position close
Extract Damper MD2 close
Door Open
Circulation Fans OFF
Extract Fan OFF
Step-2 (Locking Doors)
Step-3 (15-20 Minutes) Required Fumigation process turned on (Circulation Fans ON) automatically within 30 seconds after Door Lock
Inlet Damper MD1 position close
Extract Damper MD2 close
Door Close
Circulation Fans ON
Exhaust Fan OFF
Heat Room 22 DEG C
Step-4 (15-20 Minutes) Required Extraction after Fumigation process
Inlet Damper MD1 position open
Extract Damper MD2 open
Door Close
Circulation Fans ON (ON only for first 10-15 Minutes)
Exhaust Fan ON
Step-5
Finished - Clear to enter
By using this system the carcinogenic effects of formalin can be avoided.

Eggs Transfer and Blasting/Putrification Detection

The fertile eggs from both groups were incubated in single stage incubator for 456 hours then transfer to Hatcher for next 48 hours. During transfer from setter to Hatcher the number to contaminated and blasted eggs were counted for both groups.

Hatch Pull and Chicks Grading

The single hatch pulling and chicks grading were performed after 506 hours according to (Jabbar et al., 2017). The chicks were graded as A grade having shining legs and nose without any physical abnormalities, while B grade having any kind of physical abnormality especially omphalitis due to contaminations.

Chicks Transfer to Poultry House

The Chicks (n=30,000) from each group were transferred to poultry house through environmental control vehicles (25^0C and 65 humidity) to access the outcome from single and double dose fumigation. The poultry house conditions were kept same for the chicks of both groups Table 1.

Table 1: Poultry house conditions

Parameters	1st week	2nd week	3rd week	4th week	5th week
Temperature^{0}F	95-86	86-83	83-77	77-75	75
Humidity%	65	65	65	65	65
Ventilation m^3/ hour/bird	0.07	0.25	0.4	0.59	0.87

Statistical Analyses

All data were analyzed by using Statistical Analysis Sys tem package software (SAS version 9.2, SAS Institute Inc., Cary, NC, USA). All means were compared using t-test and results were presented as mean ± SEM (standard error of mean). Results were considered significant if P<0.05.

RESULT AND DISCUSSION

Fumigation with formaldehyde is a widespread and effective tool in the battle against contamination by viruses' bacteria and mould in the hatcheries. In this experiment the eggs were fumigated with double strength using formalin and potassium per magnate. We found positive results when compared with single strength fumigation in term of hatchability. The hatch abilities of flocks SSR1AIC, SSR2AIB, SSR3AID and SSF5 were significantly (P<0.05) better for double strength fumigation compared to single strength fumigation.

The hatchability results were also supported by (van den Brand et al., 2016) eggs incubated with disinfection provides more fertility and hatchability. The hatch abilities of these flocks were increased due to decline in candling percentage, while dead in shell was insignificant for the fumigation treatment for all flocks Table 2. Our results were similar as who conducted experiment with different chemicals like ozone, formaldehyde, hydrogen peroxide and per acetic acid to know the best antimicrobial resistant on eggs surface. The UV radiation and formaldehyde were effective in reducing aerobic mesophilic bacterial count on eggs shell surface.

In modern incubation practice, the ventilation process during early incubation is vastly reduced. This significantly improves the hatchability, uniformity and post hatch performance. However it causes some of the formaldehyde to remain on eggs surface enter into egg and adversely affects the hatchability. The blastoderm, the layer of cells from which embryo develops, is positioned on upper surface of yolk which is held in central position by a combination of chalazae and viscous nature of the albumin (Banwell, 2013). Toward the end of incubation about three days before hatching the incubating eggs are shifted from setter to hatchers. During this transfer process the blasting/putrification can be easily observed. The infection to embryos may start from the surface of eggs penetrate deep through egg shell and shell membrane causes unable to gaseous exchange becomes source of infection for surrounding eggs as well as incubator due to blasting deteriorate chicks quality (Jabbar et al., 2017). The flocks SSR2AIB, SSR3AID and SSF5 were presented significantly (P<0.005) low blasting of eggs due to double strength fumigation while the eggs blasting of flocks SSR1AIC, SSR2AIBI and SSF6AI were insignificant for blasting Table 3.

In hatchers the process of pipping start during which the newly hatch chicks can easily infected. The fumigation of eggs immediately transfer to hatcher minimize the risk of infection because the embryo becomes direct breathing animals (Cadirci et al., 2009). Both pre-incubation fumigation and fumigation just after transfer to hatchers helps to avoid low quality (B grade chicks) chicks. The low quality chicks with poor or without eggs fumigation may include blood withdrawn from chorioallontoic membrane, bruised naval, infected naval and omphilitis (King'ori, 2011).The B grade chicks of flocks SSR2AIB, SSR2AID and SSF5 were significantly (P<0.005) decreased, while flocks SSR1AIC, SSR2AIA and SSF6AI were insignificant for low quality chicks Table 3.

The chicks (n=30,000) from both groups were shifted to poultry houses to observe the effects of fumigation on later life of chicks. The poultry house conditions were kept same for the chicks of both groups. We did not find significant difference (P<0.05) for weight gain (g), feed intake (g) and feed conversion ratio of chicks from both groups, although

Table 2: Effect of Fumigation strength on Hatchability, Candling and DIS

	Hatchability %		Candling %		DIS %	
Flock	Single strength Fumigation	Double strength Fumigation	Single strength Fumigation.	Double strength Fumigation	Single strength Fumigation.	Double strength Fumigation.
SSR1AIC	74.83±0.01[a]	76.42±0.2[b]	10.72±0.3[a]	9.67±0.21[b]	14.45±0.31[a]	13.91±0.34[a]
SSR2AIA	71.39±0.02[a]	71.45±0.03[a]	14.54±0.2[a]	14.41±0.34[a]	14.07±0.61[a]	14.14±0.51[a]
SSR2AIB	71.48±0.06[a]	72.99±0.04[b]	14.55±0.2[a]	13.06±0.16[b]	13.97±0.64[a]	13.95±0.31[a]
SSR3AID	73.17±0.04[a]	75.77±0.01[b]	12.25±0.14[a]	10.28±0.41[b]	14.58±0.21[a]	13.95±0.51[a]
SSF5	78±0.02[a]	81.78±0.04[b]	10.08±0.41[a]	8.38±0.51[b]	11.92±0.23[a]	11.84±0.61[a]
SSF6AI	84.64±0.01[a]	85.58±0.01[a]	6.07±0.01[a]	5.92±0.24[a]	9.29±0.91[a]	8.5±0.51[a]

a-b denote difference in rows ($p<0.05$)

Table 3: Effect of Fumigation strength on Blasting/Putrification and B grade chicks

	Blasting/Putrification %		B Grade chicks %	
Flock	Single strength Fumigation.	Double strength Fumigation.	Single strength Fumigation.	Double strength Fumigation.
SSR1AIC	1.55±0.31[a]	1.9±0.95[a]	1.57±0.17[a]	1.47±0.38[a]
SSR2AIA	2.8±0.51[a]	2.7±0.34[a]	1.4±0.65[a]	1.31±0.61[a]
SSR2AIB	2.1±0.24[a]	1.4±0.14[b]	1.53±0.94[a]	1.03±0.39[b]
SSR3AID	2.3±0.34[a]	1.9±0.34[b]	2.18±0.34[a]	0.9±0.24[b]
SSF5	3.1±0.67[a]	0.8±0.39[b]	1.82±0.71[a]	1.19±0.41[b]
SSF6AI	0.4±0.16[a]	0.3±0.61[a]	1.64±0.66[a]	1.12±0.65[a]

a-b denote difference in rows ($p<0.05$).

the mortality percentage especially early mortality was significantly ($P<0.05$) better for the double dose fumigation group Table 4.

Table 4: Effect of Fumigation strength on Mortality%, Weight gain, Feed intake and FCR

Parameters	Single strength Fumigation	Double strength Fumigation
Mortality %	1.96±0.06[a]	1.65±0.31[b]
Weight gain (g)	2100±0.14[a]	2200±0.071[a]
Feed Intake (g)	3355±.021[a]	3310±0.091[a]
FCR %	1.82±0.038[a]	1.80±0.048[a]

a-b denote difference in rows ($p<0.05$)

CONCLUSION

Double strength fumigation is safe and can be used to avoid contamination on eggs surface, blasting/putrification during transfer, low quality chicks and early mortality in later life of chicks.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest with respect to the research, authorship and/or publication to this research.

AUTHOR'S CONTRIBUTION

Dr.Adnan Jabbar and Dr. Abdul Hameed were main authors responsible for tabulation of experimental data and article writing under supervision of Dr. Amjad Riaz and Dr.Yasir Allah Ditta.

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