International Journal of Veterinary Sciences and Animal Husbandry 2024; 9(4): 764-768

ISSN: 2456-2912
VET 2024; 9(4): 764-768

www.veterinarypaper.com
Received: 05-07-2024
Accepted: 11-08-2024

N Kowsalya
M.Tech Scholar, Department of Poultry Technology, College of Poultry Production and Management, Hosur, Tamil Nadu, India

Dr. M Anandhi
Assistant Professor, Department of Poultry Technology, College of Poultry Production and Management, Hosur, Tamil Nadu, India

Dr. D Jayanthi
Professor and Head, Department of Poultry Technology, College of Poultry Production and Management, Hosur, Tamil Nadu, India

Dr. P Shamsudeen
Professor and Head, Department of Poultry Management, College of Poultry Production and Management, Hosur, Tamil Nadu, India

Corresponding Author:
Dr. M Anandhi
Assistant Professor, Department of Poultry Technology, College of Poultry Production and Management, Hosur, Tamil Nadu, India

Effect of short periods of incubation during egg storage on hatchery performances of broiler chicken

N Kowsalya, Dr. M Anandhi, Dr. D Jayanthi and Dr. P Shamsudeen

Abstract
An experiment was conducted to evaluate the effect short periods of incubation during egg storage (SPIDES) with or without turning on hatchery performances of long term stored eggs. A total of 750 broiler hatching eggs from 33.5 weeks old parent stock were divided into five groups: T_1 (Control without SPIDES), T_2 (3 SPIDES without turning), T_3 (3 SPIDES and 3 turning during each SPIDES), T_4 (4 SPIDES without turning), and T_5 (4 SPIDES and 3 turning during each SPIDES). Eggs were stored at 17 °C with 75% relative humidity and SPIDES treated eggs were periodically exposed to 37.7 °C for 3 hours at 5 days interval. The SPIDES with turning treatment group eggs were turned by 45º angle on either side of an hourly interval. All eggs were stored for 21 days and incubated at 22nd day. The results showed significant differences between treatment groups in storage loss, moisture loss, hatchability of total egg set and fertile egg set, hatch time, hatch window, early, mid, late and total embryonic mortality as well as dead-in-shell. SPIDES effectively mitigated the negative impacts of prolonged storage, suggesting its potential for improving hatchability of commercial broiler hatching eggs stored for long period. In conclusion, SPIDES treatment, particularly with 3 SPIDES and 3 turning during each SPIDES at every 5 days interval significantly ($p<0.01$) enhanced hatchability and reduced embryonic mortality in long term stored eggs.

Keywords: SPIDES, hatchability, hatch time, hatch window, break open study

Introduction

The poultry industry plays a critical role in Indian meat industry by producing over half of the country's total meat production. The Basic Animal Husbandry Statistics for the year 2022-23 [3] highlighted the significant growth of the poultry sector in India. The sector has achieved an impressive total meat production of 9.77 million tones, with poultry meat alone 4.995 million tones. This growth is largely supported by the increasing demand for poultry products, especially chicken meat, because of its cost-effectiveness when compared to other meats. Meeting this rising demand has been largely supported by innovations and efficiency improvements in hatcheries.

The hatchability is more important for achieving optimal number of chicks. Several factors affect hatchability, including incubator condition, incubation environment, egg storage condition, storage duration, etc. Normally, the hatching eggs are stored for more than 7 days in commercial hatcheries during adverse conditions like market demand fluctuations, disease outbreaks, etc. which impacts various quality parameters such as decrease hatchability (Fasenko *et al*., 2001) [9] and increase early and late embryonic mortality (Tona *et al.*, 2003) [18]. Many trials have been conducted to overcome the prolonged storage associated low hatchability. Some researchers increased the stage of embryonic development by using short period of incubation during egg storage (SPIDES) (Nicholson *et al*., 2011 [13] and Dymond *et al*., 2013) [6].

The SPIDES introduces a novel approach by periodical warming of hatching eggs during storage which are stored for longer period that stimulates the embryos and helps them to maintain the viability. After each warming period, the eggs are returned to cold storage to preserve their freshness and to improve their chances of successful hatching. The optimal time and frequency for SPIDES are crucial for achieving high hatchability. The best results are obtained when eggs are treated weekly, with the cumulative pre-incubation time not exceeding

15 hours at temperatures above 32 °C (Nicholson *et al*. 2011) [13]. If the eggs are stored for longer days with SPIDES techniques had improved the hatchability, reduced hatch time (Dymond *et al*. 2013) [6] and reduced early embryonic mortality (Dhotre *et al*. 2023 [4] and Abdel-Halim *et al*. 2015 [1]). The objective of the present study was to investigate the effect of short periods of incubation during egg storage (SPIDES) with or without turning on hatchery performance of long term stored eggs.

Materials and Methods

A total of 750 hatching eggs from Vencobb 430Y were collected from 33.5 weeks old parent stock and were used to study the effects of Short Periods of Incubation During Egg Storage (SPIDES) on hatchery performance. The eggs were fumigated with 3X concentration for 20 minutes and stored for 21 days with broad end up position and incubated at 22nd day. The eggs were divided into five treatment groups of 150 eggs each. The treatment groups are: T_1 (Control-without SPIDES), T_2 (3 SPIDES without turning), T_3 (3 SPIDES and 3 turning during each SPIDES), T_4 (4 SPIDES without turning), and T_5 (4 SPIDES and 3 turning during each SPIDES). Each treatment group was further divided into three replicates of 50 eggs each. The eggs were stored at 17 °C with 75% relative humidity and T_2 to T_5 eggs were subjected to heat treatment for every 5 days. T_2 and T_3 eggs were subjected to heat treatment on 5th, 10th and 15th day of storage and T_4 and T_5 eggs were subjected to heat treatment on 5th, 10th, 15th and 20th day of storage. During SPIDES, the eggs were exposed to 100°F±3°F and 55% relative humidity for 3 hours. The SPIDES with turning treatment group eggs (T_3 &T_5 were turned by 45˚ angle on either side of an hourly interval (Table 1).

Table 1: Experimental design

S. No.	Treatment groups	Treatment	No. of broiler hatching eggs per treatment
1.	T_1	Control - Eggs storage without SPIDES	150
2.	T_2	3 SPIDES without turning	150
3.	T_3	3 SPIDES with turning	150
4.	T_4	4 SPIDES without turning	150
5	T_5	4 SPIDES with turning	150
Total			750

After 21 days of storage, all the eggs were incubated in a forced draught setter at 99.8°F and 55% relative humidity from day 1 to 18. On 10th day of incubation, the eggs were candled to remove the infertile eggs and early embryonic mortality. On day 18, the eggs were weighed and moved to the hatcher. Throughout the 21 days of incubation period, standard temperature and humidity conditions were maintained for all treatment group eggs. On 21st day, chicks were removed from the hatcher once 95% of chicks had dried.

Storage loss

The bulk egg weights of each replicate were recorded before storage and weekly interval upto 21 days of storage. Weekly storage loss was calculated by using the following formula.

Candling study during 10th day of incubation

At 10th days of incubation all eggs were candled and all infertile and early embryonic mortality was removed from the trays in order to determine the no. of fertile eggs and per cent of early embryonic mortality.

Moisture loss during incubation

The bulk egg weights of each replicate were recorded before setting and during the transfer from the setter to the hatcher. The per cent moisture loss throughout the incubation period was determined by using the following formula.

Hatch window

After 460 hours of incubation, hatching eggs were checked in each treatment frequently for hatching. Hatched chicks were collected and determined the hatch window.
Hatch window = the time duration between the first hatched chicks and last hatched chicks.

Hatchability

After hatching, the chicks were pulled out of the hatchery once 95% of them had dried. The number of hatched chicks was counted and recorded. Hatchability was then calculated in terms of total number of eggs (TES) and the number of fertile eggs (FES), based on the following formula.

Hatch time

After 460 hours of incubation, hatching eggs were checked in each treatment frequently for hatching. Hatched chicks were collected and determined the hatch time.
Hatch time = Time between setting of eggs and hatching of chicks.

Break open analysis

The unhatched eggs were subjected to a break open analysis on the 22nd day to determine the reasons for non-hatching. The following categories were identified and recorded as a percentage of the total eggs set: early embryonic mortality (embryos that died between 0-7 days of incubation), mid embryonic mortality (embryos that died between 8-14 days), late embryonic mortality (embryos that died between 15-18 days), dead in shell (died between 18-21 days), live in shell (chicks alive but unable to break through the shell), pipped (chicks pipped the shell but could not hatch), contaminated eggs and infertile eggs were also determined.
The data collected on various parameters were subjected to statistical analysis in Completely Randomized Design (CRD) as per the methods suggested by Snedecor and Cochran (1989) [17] and the means of different treatment groups were tested for statistical significance by Duncan's multiple range test (Duncan, 1955) [5].

Result and Discussion

Storage loss and moisture loss

The result of SPIDES with or without turning on storage loss and moisture loss per cent is presented in Table 2. The result showed highly significant (p<0.01) difference in per cent storage loss on first, second and third week between treatment groups. The first week storage loss per cent is significantly (p<0.01) lower in T_1 (1.14%) followed by T_5, T_3, T_4 and T_2. In second week, T_1 had significantly (p<0.01) lowest storage loss per cent (1.77%) and T_2 and T_4 had significantly (p<0.01) highest storage loss per cent (2.23%) each. During third week storage loss per cent is significantly (p<0.01) influenced by range of 3.11 % (T_1) to 3.58 % (T_4). The SPIDES with turning groups (T_3 and T_5) had significantly (p<0.01) lower storage loss per cent than SPIDES without turning groups (T_2 and T_4) during first and second weeks of storage. During 3rd week of storage, the per cent storage loss was significantly lower in 3 SPIDES groups (T_2 and T_3) than 4 SPIDES groups (T_4 and T_5).

The moisture loss per cent of eggs till 18th day of incubation had highly significant difference (p<0.01) between treatments. The T_1 (10.05%) had significantly (p<0.01) lower moisture loss per cent on 18 days of incubation than rest of the treatment groups. There was no significant difference between SPIDES with turning groups (T_3 and T_5) but they were significantly (p<0.01) lower than T_2 and T_4 (SPIDES without turning groups). Further significant difference was noticed between T_2 and T_4 treatment groups.

The present result is in accordance with earlier findings of Fasenko *et al.* (2001) [9], Abdel-Halim *et al.* (2015) [1] and Ebeid *et al.* (2017) [7], who reported that short period of incubation during egg storage significantly increase the storage loss of hatching eggs than non-SPIDES treatment. Gharib *et al.* (2013) [10] and Elkhaiat *et al.* (2024) [11] also stated that longer storage period with SPIDES treatment increase both storage and moisture loss. Melo *et al.* (2020) [12] also had significantly (p<0.05) higher egg weight loss during extended storage period.

However, Fasenko *et al.* (2001) [9], Abdel-Halim *et al.* (2015) [1] and Ebeid *et al.* (2017) [7] were not in accordance with this present result. They found no significant difference in moisture loss due to longer storage period and SPIDES treatment. The findings of Dhotre *et al.* (2023) [4] and Ansah *et al.* (2023) [2] stated that SPIDES treatment did not have significant impact on both storage loss and moisture loss.

The short periods of incubation during egg storage of 21 days have recorded higher storage and moisture loss per cent than non-SPIDES (control). These shows prolonged storage and heat treatment increase the water evaporation from the eggs.

Table 2: Mean (±SE) storage loss (%) and moisture loss (%) as influenced by SPIDES with or without turning

Treatment	Storage loss (%)			Moisture loss (%)
	1st week	2nd week	3rd week	
T_1 (Control without SPIDES)	1.14^a±0.02	1.77^a±0.02	3.11^a±0.03	10.05^a±0.009
T_2 (3SPIDES without turning)	1.29^c±0.004	2.23^c±0.005	3.44^b±0.009	10.67^c±0.03
T_3 (3 SPIDES with Turning)	1.21^b±0.009	2.05^b±0.01	3.37^b±0.002	10.23^b±0.04
T_4 (4 SPIDES without turning)	1.28^c±0.005	2.23^c±0.004	3.58^c±0.01	10.98^d±0.01
T_5 (4 SPIDES with Turning)	1.20^b±0.005	2.07^b±0.01	3.55^c±0.03	10.22^b±0.04

Mean within a column bearing different superscripts differ significantly (p<0.01)

Hatchability, Hatch window and Hatch time

The result of SPIDES with or without turning on per cent hatchability (%), hatch window (hr) and hatch time (hr) are presented in Table 3.

Hatchability

The result showed highly significant (p<0.01) difference in hatchability per cent on total egg set and fertile egg set between treatment groups. There was no significant difference noticed in per cent hatchability between SPIDES without turning groups (T_2 and T_4), SPIDES with turning groups (T_3 and T_5) and also between T_2 and T_5 treatment groups. But, significant (p<0.01) difference were observed between 3 SPIDES with and without turning groups (T_2 and T_3), 4 SPIDES with and without turning groups (T_4 and T_5) and also 3 SPIDES with turning (T_3) and 4 SPIDES without turning (T_4) groups. All the treatment groups (T_2, T_3, T_4 and T_5) had significantly (p<0.01) higher hatchability on both total egg set and fertile egg set than control group (T_1).

The present result is in accordance with previous findings of Fasenko *et al.* (2001) [9], Reijrink *et al.* (2010) [16], Dymond *et al.* (2013) [6], Gharib (2013) [10], Nicholson *et al.* (2013) [13], Abdel-Halim *et al.* (2015) [1], Ebeid *et al.* (2017) [7], Elmenawey (2019) [8], Ozlu *et al.* (2020) [15], Dhotre *et al.* (2023) [4], Okasha *et al.* (2023) [14] and Ansah *et al.* (2023) [2] as they reported that heat treatment during egg storage significantly improved hatchability of hatching eggs stored for longer days over the non-heated hatching eggs.

The prolonged storage of hatching eggs might cause embryonic mortality and in turn reduce the hatchability. Short periods of incubation during egg storage may increases the proportion of viable cells of embryos and alleviate the negative effect of storage induced cell death of embryos and which result in improved hatchability than non-SPIDES groups

Hatch window

The hatch window was lower in T_5 (15.67 hours) followed by T_4 (16.67 hours), T_3 (18.33 hours) and T_2 (20.00 hours). T_1 had significantly (p<0.01) higher hatch window (27.67 hours) than rest of the treatment groups.

The present result is in accordance with Dhotre *et al.* (2023) [4] as they reported that short period of incubation during egg storage groups had significantly (p<0.05) reduced hatch window than untreated hatching eggs.

Hatch time

The result showed highly significant (p<0.01) difference in hatch time between treatment groups. The hatch time was lower in 4 SPIDES treatment groups (T_4 and T_5) than 3 SPIDES groups (T_2 and T_3) and control (T_1). No significant difference noticed between 3 SPIDES groups (T_2 and T_3). T_1 had significantly (p<0.01) highest hatch time (515 hours).

The present result is in accordance with earlier findings of Reijrink *et al.* (2010) [16] and Dymond *et al.* (2013) [6]. They reported that short period of incubation during egg storage reduce hatch time of long term stored hatching eggs than non-heated eggs. Tona *et al.* (2003) [18] stated that long term stored hatching eggs increase the hatch time than the short term stored hatching eggs.

Table 3: Mean (±SE) hatchability (%), hatch window (hours), hatch time (hours) as influenced by SPIDES with or without turning

Treatment	Per cent hatchability		Hatch window (hours)	Hatch time (hours)
	Total egg set (%)	Fertile egg set (%)		
T_1 (Control without SPIDES)	$63.33^d±2.34$	$64.25^d±2.61$	$27.67^e±0.21$	$515.00^c±1.09$
T_2 (3SPIDES without turning)	$83.33^{bc}±0.42$	$85.61^{bc}±0.06$	$20.00^d±0.36$	$490.67^b±0.55$
T_3 (3 SPIDES with Turning)	$92.00^a±1.26$	$93.86^a±0.77$	$18.33^c±0.21$	$489.00^b±0.36$
T_4 (4 SPIDES without turning)	$78.66^c±2.23$	$80.99^c±3.17$	$16.67^b±0.21$	$481.67^a±0.42$
T_5 (4 SPIDES with Turning)	$86.66^{ab}±1.11$	$89.70^{ab}±1.41$	$15.67^a±0.21$	$481.67^a±0.21$

Mean within a column bearing different superscripts differ significantly (p<0.01)

Break open study

The result of SPIDES with or without turning on embryonic mortality per cent is depicted in Table 3. The early embryonic mortality per cent was significantly (p<0.01) lowest in T_3 (2.66) and no significant difference was observed between SPIDES with turning groups (T_3 and T_5) and also between SPIDES without turning groups (T_2 and T_4). T_1 had significantly (p<0.01) highest early embryonic mortality per cent (24.00). T_2 had significantly (p<0.05) highest mid embryonic mortality per cent (3.33). No significant difference observed in mid embryonic mortality between SPIDES with turning groups (T_3 and T_5) and also between SPIDES without turning groups and control (T_2, T_4 and T_1). The late embryonic mortality per cent is significantly (p<0.01) highest in T_4 (7.33). No significant difference observed in late embryonic mortality between SPIDES with turning groups (T_3 and T_5) and also between SPIDES without turning groups and control (T_2, T_4 and T_1). T_3 had significantly (p<0.01) lowest late embryonic mortality per cent (1.33). The dead in shell per cent is significantly (p<0.01) higher in T_1 (2.00). No dead in shell noticed in T_2, T_4 and T_5. There was no significant difference noticed in live in shell per cent between treatment groups. Contamination was noticed in T_1 and T_4 groups. The hatching eggs stored for 21 days without SPIDES (T_1) had significantly (p<0.01) higher total embryonic mortality (35.33) per cent than remaining treatment groups. No significant difference observed in total embryonic mortality between with turning groups (T_3 and T_5) and also between without turning groups (T_2 and T_4). T_3 had significantly (p<0.01) the lowest total embryonic mortality per cent (6.00).

The early and total-embryonic mortality results of this study were in agreement with the report of Gharib (2013) [10], Abdel-Halim *et al.* (2015) [1] and Ebeid *et al.* (2017) [7]. They concluded that heat treatment significantly (p<0.05) reduce the early and total embryonic mortality than the non-heated eggs. This might indicate that eggs stored for longer days with short periods of incubation during storage enhance the survive of the embryos which reduces embryonic mortality compared to non-SPIDES.

In contrary, the result of the early and mid embryonic mortality of this study were not in agreement with the findings of Dhotre *et al.* (2023) [4]. They found that SPIDES had no significant difference on early and mid embryonic mortality. The results of Dymond *et al.* (2013) [6] and Dhotre *et al.* (2023) [4] also not in accordance with our results, as they found SPIDES treatment had significantly (p<0.05) lowest late embryonic mortality.

Table 3: Mean (±SE) break open study per cent influenced by SPIDES with or without turning

Treatment	Embryonic mortality (%)			Dead in shell (%)	Live in shell (%)	Contamination (%)	Total embryonic mortality (%)
	Early	Mid	Late				
T_1 (Control without SPIDES)	$24.00^c±1.46$	$2.67^{ab}±1.11$	$5.33^{ab}±1.11$	$2.00^b±0.73$	0.67±0.42	0.67±0.42	$35.33^c±2.76$
T_2 (3SPIDES without turning)	$6.00^{ab}±1.26$	$3.33^b±0.84$	$4.67^{ab}±0.42$	-	-	-	$14.00^{ab}±0.00$
T_3 (3 SPIDES with Turning)	$2.66^a±0.42$	$0.67^a±0.42$	$1.33^a±0.42$	$0.67^{ab}±0.42$	0.67±0.42	-	$6.00^a±0.73$
T_4 (4 SPIDES without turning)	$8.66^b±0.42$	$2.00^{ab}±0.73$	$7.33^b±1.83$	-	-	0.67±0.42	$18.66^b±3.29$
T_5 (4 SPIDES with Turning)	$5.33^{ab}±0.84$	$1.33^{ab}±0.843$	$2.67^{ab}±1.11$	-	0.67±0.42	-	$10.00^a±1.46$
Significance	**	*	**	**	NS	NS	**

Mean within a column bearing different superscripts differ significantly.

NS-Non significant, *- significant (p<0.05), **-Highly significant (p<0.01)

Conclusion

From this result it is concluded that hatching eggs with 3 hours SPIDES for every five days interval with 3 turning during each SPIDES during 21 days of storage was an effective method for reducing embryonic mortality, increasing hatchability percentages and reducing hatch time and hatch window. This method helps to minimize the harmful effects of long-term storage of hatching eggs.

References

1. Abdel Halim AA, Mohamed FR, Desoky AA, Elmenawey MA, Gharib H. Effect of heating hatching eggs before or during storage on the alleviation of the negative effect of prolonged storage periods on hatchability. Egypt Journal Poultry Sciences. 2015;35:703-717.
2. Ansah SA, Ackah EM, Boateng M, Nurudeen L, Nyarko F, Acheampong KA, *et al.* Impact of storage duration and short periods of incubation during egg storage on embryonic development and hatching traits of hybrid chicken strain. Animal. Biotechnology. 2023;34(8):4081-4093.
3. Basic Animal Husbandry Statistics. Department of Animal Husbandry and Dairying. New Delhi: Government of India. c2023
4. Dhotre B, Kadam A, Lonkar V, Patodkar V, Tumlam U, Mote C, *et al.* Effect of short periods of incubation during egg storage (SPIDES) on hatchability of broiler breeder eggs. Indian Journal Animal Sciences. 2023;93(5):534-537.
5. Duncan DB. Multiple range and multiple F-tests. Biometrics. 1955;11(1):1-42.
6. Dymond J, Vinyard B, Nicholson AD, French NA, Bakst MR. Short periods of incubation during egg storage increase hatchability and chick quality in long-stored broiler eggs. Poultry Sciences. 2013;92:2977-2987.

7. Ebeid TA, Twfeek FA, Assar MH, Bealish AM, Abd El-Karim RE, Ragab M. Influence of prestorage incubation on hatchability traits, thyroid hormones, antioxidative status and immunity of newly hatched chicks at two chicken breeder flock ages. Animal. 2017;11:1966-1974.
8. Elmenawey MA. Effect of heat treatments during hatching egg storage on hatchability traits and chick quality. Egypt Journal Poultry Sciences. 2019;39(4):791-808.
9. Fasenko GM, Robinson FE, Whelan AI, Kremeniuk KM, Walker JA. Pre-storage incubation of long-term stored broiler breeder eggs: Effects on hatchability. Poultry Sciences. 2001;80(10):1406-1411.
10. Gharib H. Effect of pre-storage heating of broiler breeder eggs, stored for long periods, on hatchability and chick quality. Egypt Journnal Animal Production. 2013;50(3):174-184.
11. Elkhaiat IA, El-Kassas S, Ebied MA, Eid YZ, Younis HA, Ragab MM, *et al*. Breed of chicken and frequent short periods of incubation during different egg storage periods (spides) differentially modify the hatchability %, chick’s quality and post-hatching bird’s performance. Egypt Journal Veterinary Sciences. 2024;55:835-850.
12. Melo E, Araújo I, Triginelli M, Castro F, Baiao N, Lara L. Effect of egg storage duration and egg turning during storage on egg quality and hatching of broiler hatching eggs. Journal Animal, 2020;15(2):100111.
13. Nicholson D, French N, Kretzchmar V, Goyne D, Hogg A. Hatch benefits of short periods of incubation during egg storage. Avian Biology Research. 2011;4:145.
14. Okasha HM, El Gendi GM, Eid KM. The effect of storage periods and spides on embryonic mortality, hatching characteristics and quality of newly hatched chicks in broiler eggs. Animal. 2023;55:133.
15. Ozlu S, Ucar A, Erkus T, Yasun S, Nicholson AD, Elibol O. Effects of flock age, storage temperature and short period of incubation during egg storage, on the albumen quality, embryonic development and hatchability of long stored eggs, British Poultry Science. 2020;62(4):611-619.
16. Reijrink IAM, Berghmans D, Meijerhof R, Kemp B, Van Den Brand H. Influence of egg storage time and pre-incubation warming profile on embryonic development, hatchability, and chick quality. Poultry Sciences. 2010;89(6):1225-1238.
17. Snedecor GW, Cochran WG. Statistical Methods. 8th ed. Ames, IA: Iowa State University Press, c1989.
18. Tona K, Bamelis F, De Ketelaere B, Bruggeman V, Moraes VMB, Buyse J, *et al*. Effect of egg storage on spread of hatch, chick quality and chick juvenile growth. Poultry Sciences. 2003;82:736-741.

How to Cite This Article
Kowsalya N, Anandhi M, Jayanthi D, Shamsudeen P. Effect of short periods of incubation during egg storage on hatchery performances of broiler chicken. International Journal of Veterinary Sciences and Animal Husbandry. 2024;9(4):764-768.