



Effect of short periods of incubation during egg storage (SPIDES) on hatchability of broiler breeder eggs

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ABSTRACT

An experiment was conducted to evaluate the effect of Short Periods of Incubation During Egg Storage (SPIDES) on the hatchability of broiler breeder eggs. Broiler hatching eggs (500) were divided into five groups (A to E) containing 100 eggs in each and further subdivided into five replicates of 20 each. These groups were subjected to SPIDES treatment at temperature 37.5°C and 55-60% relative humidity (RH) viz. control A (7 days egg storage without SPIDES and incubated on 8th day), B (10 days storage with 1 h SPIDES on 5th day and incubated on 11th day), C (10 days storage with 2 h SPIDES on 5th day and incubated on 11th day), D (15 days storage with 1 h SPIDES on 5th and 10th day and incubated on 16th day), E (15 days storage with 2 h SPIDES on 5th and 10th day and incubated on 16th day). All eggs were stored at 16-18°C temperature and 65-70% RH. Egg weight loss, fertility, hatchability, embryonic mortality, hatch window, chick quality and healthy chick production were studied. SPIDES treatment in Group E restored hatchability and healthy chick production, reduced late embryonic mortality and improved day-old chick length. In conclusion, SPIDES treatment at 37.5°C and 55-60% RH for 2 h on 5th and 10th day during 15 days egg storage restored the hatchability; and improved embryonic survivability, healthy chick production and chick quality.

Keywords: Chick quality, Embryonic mortality, Hatchability, SPIDES

Egg storage is a practical method in breeder farms and hatcheries. Before incubation, hatching eggs are kept at a temperature below physiological zero (21°C) (Edwards 1902). Bakst *et al.* (2012) reported the death of more than half of the cells present at the time of oviposition after ten to twelve days of storage. Long-term egg storage results in decreased embryonic metabolism, leading to an increase in necrotic and apoptotic cell death, and developmental delays. This results in irreversible damage to the embryo, as well as an increase in embryonic mortality (Fasenko 2007, Hamidu *et al.* 2010). Storage of hatching eggs for more than seven days, results in poor hatchability (Fasenko 2007) and chick quality (Reijrink *et al.* 2009) as well as delay in hatch time (Meir and Ar 1998, Dymond *et al.* 2013). The short periods of incubation during egg storage (SPIDES) theory is based on natural phenomena. A hen lays one egg in the nest every day until her clutch is complete, during this the eggs laid on earlier days will also be warmed by the hen still she lays an egg each day. The SPIDES technique was introduced by Meir and Ar (1998), which is the temporary

exposure of hatching eggs to incubation temperature and humidity to mimic the natural conditions in which birds incubate their eggs. Improvement in hatchability was reported by Fasenko *et al.* (2001), Dymond *et al.* (2013), Reijrink *et al.* (2009) and Reijrink *et al.* (2010) in long-term storage of eggs with SPIDES techniques. Though the commercial hatcheries are in large number in India, very rare studies have been found about SPIDES techniques; hence, the experiment was conducted to know the effect of SPIDES on the hatchability of broiler breeder eggs.

MATERIALS AND METHODS

Location of study: The present experiment was conducted at the Department of Poultry Science, KNP College of Veterinary Science, Shirwal, Dist. Satara (18.13°N 73.98°E) and Central Hatchery, Khadki, Pune, Maharashtra, India during 2021-22.

Experimental design: Total 500 broiler hatching eggs were randomly assigned to five groups viz., A, B, C, D and E containing 100 eggs in each group. Each group was further subdivided into five replicates of 20 eggs in each. To prevent mixing-up eggs during treatment, all the eggs were serially numbered from 1 to 500. These groups were subjected to SPIDES treatment as indicated below:

Group A: Eggs were stored for 7 days without

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SPIDES treatment and set for incubation on 8th day(Control).

Group B: Eggs were stored for 10 days and exposed to 1 h on 5th day, and set for incubation on 11th day.

Group C: Eggs were stored for 10 days and exposed to 2 h SPIDES on 5th day, and eggs were set for incubation on the 11th day.

Group D: Eggs were stored for 15 days and exposed to 1 h SPIDES on the 5th and 10th days, and eggs were set for incubation on the 16th day.

Group E: Eggs were stored for 15 days and exposed to 2 h SPIDES on the 5th and 10th days, and eggs were set for incubation on the 16th day.

The eggs were stored at 16-18^oC and 65-70% relative humidity (RH) during storage, and eggs from Groups B, C, D and E were exposed to SPIDES treatment at 37.5^oC and 55-60% relative humidity in a hatchery incubator.

Statistical analysis: The data obtained from the experiment was tabulated by using MS Excel and subjected to descriptive analysis including percentage, means, SE, etc. Analysis of Variance (ANOVA) was employed with post-hoc Duncan’s multiple range test by using Statistical Package for the Social Sciences (SPSS) version 20 developed by IBM, Chicago, USA. Probabilities (p<0.05) were considered significant.

RESULTS AND DISCUSSION

Egg weight loss: Non-significant differences were recorded between the groups for percent egg weight loss (Table 1). These results correlated with Abdel-Halim *et al.* (2015), Silva *et al.* (2008) and Fassenkoet *et al.* (2001).

Percent fertility and hatchability: The percent fertility observed in different groups (Table 1) did not differ significantly which indicated that SPIDES treatment did not have any deleterious effect on fertility. These results correlated with Elibol *et al.* (2002) and Gharib (2013). In contrast to this, Petek *et al.*(2003) and Petek and Dikmen (2004) observed decreased apparent fertility in longer periods of egg storage.

The percent hatchability on a total egg set basis (TES) was significantly (p<0.05) higher in Group E than Groups B, C and D but it was comparable with Group A, clearly indicating that exposing long term storage (15-days)

hatching eggs to SPIDES of 2 h on 5th and 10th day of storage helps to restore the hatchability of eggs without affecting the fertility. It was also observed that eggs exposed to SPIDES at once (1 or 2 h on the 5th day) did not help to restore percent hatchability. The percent hatchability on fertile egg set basis (FES) did not differ significantly. The percent hatchability on TES and FES basis observed for Group E was 6 and 7.33% higher than the control. The present result correlates with findings of Dymond *et al.* (2013). They suggested that broiler hatching eggs exposed to multiple small pre-incubation periods than a single pre-incubation period restore the hatchability of eggs stored for 21 days. Similarly, eggs stored for a longer period without any heat treatment significantly reduced hatchability (Senbeta 2016). Reijrink *et al.* (2009) and Reijrink *et al.* (2010) also reported no improvement in the hatchability of eggs stored for a longer period (8-13days) without any pre-incubation but the provision of pre-incubation in long term storage of eggs improved hatchability. On the other hand, Gharib (2013) reported that egg storage of more than 4 days along with 6 h pre-heating increased hatchability, while 9 h pre-heating of eggs stored less than 4 days decreased hatchability from which it is understood that pre-heating or pre-warming is applicable only when eggs are stored for more than 4 days. Nicholson *et al.* (2013) also suggested that for obtaining the best results on hatchability, the eggs should be repeatedly treated with SPIDES every week and Abdel-Halim *et al.* (2015) suggested that heating eggs for 2 h period every 3-day interval during storage is an effective method of negating the detrimental effect of a long period of egg storage. All the above-mentioned reports of various authors support the results of the present findings.

Percent healthy chicks: Group A and E significantly (p<0.05) produced higher healthy chicks on TES basis than Group C, while Groups A, B, D and E were comparable (Table 1). A similar trend was observed for healthy chicks on FES basis but non-significant. During long-term storage of eggs for 15 days, exposing the eggs for a short period of incubation for 2 h on the 5th and 10th day of storage helps to restore healthy chick production. Previously, Tona *et al.* (2003) reported that a longer storage period had a detrimental effect on chick quality i.e. healthy chick rate and found the occurrence of greater anomalies in day-old chicks.

Table 1. Effect of egg storage along with SPIDES on egg weight loss, percent fertility, percent hatchability, percent healthy chicks and hatch window

Group	Egg weight loss (%)	Fertility (%)	Hatchability on TES (%)	Hatchability on FES (%)	Healthy chicks on TES (%)	Healthy chicks on FES (%)	Hatch window (h)
A	1.69±0.53	98.00±2.00	85.00 ^{ab} ±3.87	86.56±2.40	84.00 ^b ±3.67	85.56±2.24	20.80 ^a ±0.49
B	1.72±0.05	95.00±2.74	75.00 ^a ±3.16	79.35±4.74	73.00 ^{ab} ±3.39	77.17±4.50	17.20 ^a ±0.49
C	1.78±0.05	94.00±6.52	76.00 ^a ±4.85	80.70±3.84	71.00 ^a ±4.85	75.36±3.90	19.20 ^b ±0.49
D	1.88±0.06	93.00±1.22	78.00 ^a ±2.00	83.92±2.29	73.00 ^{ab} ±2.00	78.54±2.27	19.60 ^b ±0.40
E	1.79±0.04	97.00±2.00	91.00 ^b ±3.67	93.89±3.67	84.00 ^b ±2.92	86.73±3.32	22.40 ^d ±0.40
p value	0.093	0.514	0.025*	0.060	0.028*	0.091	0.000*
SEM	0.022	0.996	1.936	1.778	1.848	1.663	0.398

Means bearing different superscripts within the column differed significantly. *Significant at p<0.05

Table 2. Effect of egg storage along with SPIDES on percent embryonic mortality, chick weight and chick length

Group	Early mortality (%)	Mid mortality (%)	Late mortality (%)	Total embryonic mortality (%)	Contaminated eggs (%)	Chick weight (g)	Chick length (cm)
A	5.00±3.87	0.00±0.00	8.00 ^{ab} ±2.55	13.00±2.00	1.00±1.00	46.14±0.34	19.20 ^{ab} ±0.06
B	7.00±2.55	1.00±1.00	12.00 ^b ±3.39	20.00±4.74	0.00±0.00	46.78±0.43	19.30 ^{bc} ±0.08
C	2.00±1.22	2.00±1.22	14.00 ^c ±2.92	18.00±3.39	1.00±1.00	45.98±0.42	19.30 ^{bc} ±0.07
D	4.00±1.87	2.00±1.22	9.00 ^{ab} ±1.87	15.00±2.24	0.00±0.00	46.11±0.40	19.08 ^a ±0.08
E	4.00±2.92	0.00±0.00	2.00 ^a ±1.22	6.00±3.67	0.00±0.00	46.36±0.40	19.42 ^c ±0.06
p value	0.756	0.322	0.030*	0.068	0.570	0.680	0.014*
SEM	1.129	0.408	1.322	1.69	0.276	0.178	0.032

Means bearing different superscripts within the column differ significantly. *Significant at $p < 0.05$

Hatch window: The results indicated a significant ($p < 0.05$) effect of egg storage periods and SPIDES on hatch window (Table 1). It was observed that the hatch window was higher as the egg storage period increased. Hatch window was the highest for Group E. The results are in agreement with Tag El-Din *et al.* (2017). They found that the one-time SPIDES (2.5 and 5 h) to the eggs stored for 7 days showed a lower hatch window as compared to twice SPIDES to the eggs stored for 14 days. In the present experiment, hatch windows of SPIDES treated Groups B, C and D were lower than control Group A.

Embryonic mortality: It was found that storage of eggs for different periods (7, 10 and 15 days) along with SPIDES at once (1 or 2 h on 5th day) and at twice (1 or 2 h on 5th and 10th day) did not influence early and mid-embryonic mortality (Table 2). However, the late embryonic mortality was influenced by the SPIDES treatment. It was found that when the eggs were stored for 10 days and exposed to SPIDES for 2 h on the 5th day of storage (Group C) had a significantly ($p < 0.05$) higher percentage of late embryonic mortality (14%) than the eggs exposed to SPIDES for 1 h on 5th day (12%) from Group B. The eggs stored for 15 days and exposed to SPIDES twice (1 h on 5th and 10th day) from Group D had a similar percentage of late embryonic mortality as that of control A. However, when the eggs were stored for a similar period i.e. 15 days but exposed twice with 2 h SPIDES on similar days i.e. 5th and 10th day (Group E), the percentage of late embryonic mortality was drastically reduced to 2% which is lowered than that of the control Group A.

The lowest total embryonic mortality was recorded in Group E while Group B recorded the highest total embryonic mortality. The result indicates that exposing eggs for a short period of incubation for 2 h on the 5th and 10th day increases the survivability of the embryo. Contaminated eggs were recorded only in Groups A and D (1%). This indicates better hygienic practices at the farm, storage and handling of eggs.

Tag EL-Din *et al.* (2017) recommended pre-warming of eggs for 2.5 h for every 5-day interval for eggs stored more than 7 days to minimize the harmful impact of storage. In line with the present findings, Abdel-Halim *et al.* (2015) reported that frequent pre-incubation heating of eggs for 2 h every 3-day interval significantly lowered early and total embryonic mortality. Nicholson *et al.* (2013) and

Hamza *et al.* (2020) reported that frequent use of SPIDES treatment for eggs stored for a longer period significantly decreased early, late and total embryonic mortality.

Chick quality: The data on chick weight (g) at day-old and chick length (cm) are presented in Table 2. All day-old chicks were collected after hatched out and subjected to chick quality measurements such as day-old chick weight and chick length according to Tona *et al.* (2003). It was observed that the different duration of storage and SPIDES treatment did not affect day-old chick weight. The highest chick length was recorded in Group E while the lowest in Group D. A significantly ($p < 0.05$) highest chick length was recorded in Group E exposed to 2 h SPIDES on 5th and 10th day of storage than Group A and D, while Groups B and C were comparable.

Rejirink *et al.* (2009) and Rejirink *et al.* (2010) reported that pre-storage heat treatment improved the chick quality on the day of a hatch in terms of chick length. Tag El-Din *et al.* (2017) found that two times SPIDES (2.5 and 5 h) to hatching eggs gave better results for eggs stored for 14 days.

Overall results of the experiment concluded that SPIDES treatment at 37.5°C temperature and 55-60% relative humidity for 2 h on 5th and 10th day during 15 days egg storage period helps to restore the hatchability, embryonic survivability, healthy chick production and chick quality. The SPIDES treatment to hatching eggs will help the farmers as well as the breeders for improving hatchability in case the eggs need to be stored for a couple of weeks.

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