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Impact of SPIDES on slaughter characteristics of broiler chickens from long-term stored eggs

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Abstract
This experiment assessed the effects of Short Periods of Incubation During Egg Storage (SPIDES), applied with or without egg turning, on the slaughter traits of broilers hatched from eggs stored for an extended period. A total of 750 hatching eggs obtained from 33.5-week-old breeder hens were randomly distributed into five treatment groups: T_1 (control, no SPIDES), T_2 (three SPIDES without turning), T_3 (three SPIDES with turning), T_4 (four SPIDES without turning), and T_5 (four SPIDES with turning). Eggs were maintained at a temperature of 17 °C and 75% relative humidity, while those subjected to SPIDES were periodically heated to 37.7 °C for three hours at five-day intervals. All eggs were stored for 21 days and transferred for incubation on the 22nd day. Among the treatments, T_5 exhibited the highest New York dressing yield (90.45%), dressed weight percentage (74.19%), ready-to-cook weight (79.78%) and liver weight percentage (2.91%). No significant differences were observed in the small intestine, gizzard, heart, breast, neck, ribs and back, thigh and drumstick weight percentage among the groups. However, T_2 (3 SPIDES without turning) had the highest wing weight percentage (12%) ($p<0.05$). These findings suggest that SPIDES, particularly with turning, enhances carcass yield parameters in broilers.

Keywords: SPIDES, hatching eggs, broiler slaughter traits, carcass yield

Introduction
The duration and environmental conditions under which hatching eggs are stored have a considerable effect on embryonic development, hatchability, and subsequent broiler growth performance. Extended storage periods often result in higher embryonic mortality, lower hatchability rates, and diminished post-hatch growth and carcass quality. The Short Periods of Incubation During Egg Storage (SPIDES) technique offers an effective strategy to sustain embryo viability by intermittently warming eggs during prolonged storage (Nicholson *et al*., 2013; Dymond *et al*., 2013) [5, 3]. This method has been shown to enhance hatchability and chick quality by minimizing cellular deterioration in stored eggs. Nevertheless, information regarding the long-term influence of SPIDES on post-hatch growth and slaughter characteristics remains limited. Therefore, the present study was conducted to assess the effects of SPIDES, with or without egg turning, on the slaughter traits of broilers hatched from eggs subjected to extended storage.

Materials and Methods
A total of 750 hatching eggs from Vencobb 430Y broiler breeders aged 33.5 weeks were used to examine the effects of Short Periods of Incubation During Egg Storage (SPIDES) on hatchability and production performance. The eggs were fumigated at three times the standard concentration for 20 minutes, placed with the broad end upward, and stored for 21 days before incubation on the 22nd day. The eggs were randomly distributed into five treatment groups of 150 eggs each: T_1 (Control), T_2 (three SPIDES without turning), T_3 (three SPIDES with three turns during each SPIDES), T_4 (four SPIDES without turning), and T_5 (four SPIDES with three turns during each SPIDES). Each treatment was further divided into three replicates of 50 eggs.

All eggs were stored under controlled conditions of 17 °C temperature and 75% relative humidity. Eggs in SPIDES treatments (T_2-T_5) were subjected to heat exposure every five days. Specifically, T_2 and T_3 underwent heating on the 5th, 10th, and 15th days, while T_4 and T_5 were heated on the 5^{th}, 10^{th}, 15^{th}, and 20^{th} days of storage.

During each SPIDES cycle, eggs were maintained at 100°F±3°F and 55% relative humidity for three hours. In turning treatments (T_3 and T_5), eggs were rotated 45° on either side at hourly intervals during heating. After 21 days of storage, all eggs were transferred to a forced-draught incubator set at 99.8°F and 55% relative humidity from day 1 to day 18. On the 10th day, eggs were candled, and infertile and early-dead embryos were removed. On the 18th day, the eggs were weighed and transferred to the hatcher, maintained at 98.9°F and 75% relative humidity. Standard incubation conditions of temperature and humidity were consistently maintained throughout the 21-day incubation period.

Chicks were removed from the hatcher once 95% were completely dry. From each treatment, 36 healthy chicks (six males and six females per replicate) were selected, weighed, sexed, and transferred to the brooding shed for subsequent growth performance evaluation. The experimental layout is shown in Table 1.

Table 1: Experimental design

S. No.	Treatment groups	Treatment	No. of broiler hatching eggs per treatment	No of birds per treatment
1.	T_1	Control-Egg storage without SPIDES	150	36
2.	T_2	Egg storage with 3 SPIDES without turning (5th, 10th and 15th day of storage)	150	36
3.	T_3	Egg storage with 3 SPIDES with turning (5th, 10th and 15th day of storage)	150	36
4.	T_4	Egg storage with 4 SPIDES without turning (5th, 10th, 15th and 20th day of storage)	150	36
5	T_5	Egg storage with 4 SPIDES with turning (5th, 10th, 15th and 20th day of storage)	150	36
Total			750	180

At the end of the experiment (35th day), one male and one female from each replicate (six birds from each treatment) were randomly selected and slaughtered as per the method of Arumugam and Panda (1970) [1]. Data on pre-slaughter weight, defeathered weight, dressed weight and ready to cook carcass weight were recorded.

Carcass yields

a) Pre-slaughter live weight (g)

Body weight of individual birds as recorded before slaughter.

b) New York dressing percentage

$$\text{New York dressing (\%)} = \frac{\text{New York dressed weight (g)}}{\text{Live weight (g)}} \times 100$$

Where, New York dressed weight is live weight-blood and feather weight

c) Dressing yield percentage

$$\text{Dressing Yield (\%)} = \frac{\text{Dressed weight (g)}}{\text{Pre slaughter live weight (g)}} \times 100$$

Where, dressed weight = New York dressed weight-weight of viscera, head, legs, others offals and giblet.

d) Ready to cook yield percentage

$$\text{Ready to cook (\%)} = \frac{\text{Ready to cook weight (g)}}{\text{Pre slaughter live weight (g)}} \times 100$$

Where, Ready to cook weight = dressed carcass weight + giblet weight

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) [6] and the means of different treatment groups were tested for statistical significance by Duncan's multiple range test (Duncan, 1955) [2].

Results and Discussion

Slaughter characteristics

The result of SPIDES with or without turning on slaughter characteristics of broilers is presented in Table 2. T_5 had significantly (p<0.01) higher percent of New York dressing yield (90.45%) than other treatment groups and there was no significant difference noticed in New York dressing yield (%) between 4 SPIDES without turning (T_4), 3 SPIDES groups (T_2 and T_3) and Control (T_1). T_2 to T_5 had no significant difference in dressed weight (%) which ranges from (70.83 to 74.19%) but there were significantly (p<0.01) higher than the control group (T_1). The same trend was followed in ready to cook weight percent also. There was no significant difference between treatments in giblets weight percent and abdominal fat weight percent. Giblets weight and abdominal fat weight percent ranged from 5.35 (T_1) to 5.58 (T_5) and 0.84 (T_3) to 1.32 (T_4), respectively.

The (T_5) 4 SPIDES with turning during each SPIDES treated birds had better feed intake and improved body weight with better FCR that may the reason for higher New York dressing yield, dressed weight and ready to cook weight percent. The result of present trial is in disagreement with Mohamed *et al.* (2021 [4]). They reported no significant difference in carcass weight between the broilers from SPIDES treated groups.

Table 2: Mean (±S.E.) slaughter characteristics (% of live weight) of broilers as influenced by SPIDES with or without turning

Treatment	New York Dressing yield (%)	Dressed weight (%)	Ready to cook weight (%)	Giblet weight (%)	Abdominal fat weight (%)
T_1 (Control)	84.26^{b}±0.92	67.03^{b}±0.79	72.38^{b}±0.87	5.35±0.31	1.30±0.09
T_2 (3 SPIDES without turning)	86.23^{b}±0.89	70.83^{a}±1.26	76.40^{a}±1.20	5.57±0.17	0.95±0.20
T_3 (3 SPIDES with Turning)	87.27^{b}±0.48	70.90^{a}±0.21	76.35^{a}±0.16	5.44±0.10	0.84±0.15
T_4 (4 SPIDES without turning)	87.09^{b}±0.30	71.84^{a}±0.44	77.27^{a}±0.44	5.43±0.05	1.32±0.21
T_5 (4 SPIDES with Turning)	90.45^{a}±1.00	74.19^{a}±0.95	79.78^{a}±0.91	5.58±0.20	1.09±0.14
Significance	**	**	**	NS	NS
F Value	8.39	9.82	10.79	0.81	1.55

Value given in each cell is the mean of 6 observations
Mean within a column bearing different superscripts differ significantly
NS-Non significant, **Highly significant (p<0.01)

Conclusion

This study concluded that T_5 exhibited superior New York dressing yield, dressed weight percentage, ready-to-cook weight and liver weight percentage. No significant differences were observed in the weight percentages of the small intestine, gizzard, heart, breast, neck, ribs and back, thigh and drumstick among the treatment groups. However, the 3 SPIDES without turning (T_2) resulted in the highest wing weight percentage. SPIDES treatment effectively enhanced carcass traits without negatively affecting major cut-up parts of long term stored eggs.

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