



EFFECT OF BREED AND DURATION OF EGG-STORAGE ON HATCHING AND SEVENTH-DAY PRODUCTION PERFORMANCE OF CHICKS

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ABSTRACT

Research was conducted to evaluate the effect of breed, pre-incubation storage duration and their interaction on day-old quality and 7th-day growth parameters of broiler chicks of Arbor acre and Ross 308 origins. A total number of 1200 eggs were collected in three (3) batches, and within each batch, eggs were randomly grouped and stored for 4, 7, and 10 days respectively before incubation. After hatching, birds within each batch/group were placed on a starter diet for seven days. The experiment design was factorial arrangement of breed (2) by storage days (3) in a completely randomized design (CRD). Data on chick quality and growth performance were collected from day-old to 7 days of life, and subjected to factorial ANOVA. Interaction of breed and egg-storage duration revealed the best navel quality and 7-day production efficiency in Arbor acre and Ross at 7- and 10-day pre-incubation egg-storage duration ($P < 0.050-0.001$) respectively. Due to breed, Arbor acre presented better day-old chick activity and 7-day production efficiency than Ross 308 breed ($P < 0.050-0.001$). The 7-day pre-incubation storage interval for hatching eggs produced the best day-old navel quality and 7-day production efficiency ($P < 0.050-0.001$). Arbor acre and Ross eggs could be stored for 7 to 10-days pre-incubation, for best production performance at 7 days of age.

Keywords: Cost, Gain, Feed, Conversion, Quality, Egg.

INTRODUCTION

Poultry production has gained popularity over the years in developing countries because of its role in bridging protein malnutrition gap, economic empowerment of the resource-poor segment of society and fitting into farming systems being practiced (Attia *et al.*, 2022). However, despite its economic importance, certain factors still limit the growth of the industry such as breeder and chick quality. The quality of breeding stock is an important consideration in poultry production as this contributes significantly to the success of the enterprise. The quality of chicks in a flock, to a large extent, dictates how well the flock performs; as chicks of poor quality tend to yield poorly. Chick quality can be affected by a combination of genetic, environmental and management factors, especially the duration, period or time-interval of the pre-incubation storage of the hatchable-eggs. Tona *et al.* (2003) reported a depressed effect in the quality of chicks obtained from eggs stored for 18 days before incubation as compared to eggs stored for 3 days prior to incubation. This is an indication that the longer the duration of storage of eggs pre-incubation, the lower the quality of chicks produced. The quality of chicks also depends on management factors and their interactions such as pre-storage conditions, hatchery sanitation and management, embryo temperature during incubation, rate of water loss from eggs, parent stock quality, egg quality, incubator temperature, humidity and ventilation etc. Performance during rearing is highly dependent on the quality of the day-old chicks. This ensures greater survivability and better growth potential during early-life.

Various parameters have been evaluated on chicks to quantify their overall performance (Goliomytis *et al.*, 2015; Hougbo *et al.*, 2025). Gaps still exist on the quality and performance of day-old chicks from broiler breeder eggs stored for different durations interacting with parental breed type. Hence, this study was designed to provide information on the interaction of breed and egg pre-incubation storage-period on the quality and performance of broiler breeder day-old chicks. The research hypothesis was that the interaction of both factors shall have important, positive and increasing effects on chick productivity.



MATERIALS AND METHODS

Experimental Site

The hatched chicks were reared at the Teaching and Research Farm of the Department of Animal Production and Health, Federal University, Oye-Ekiti, Ikole-Ekiti campus, Ekiti State. Ikole Ekiti is in the Rainforest Zone of South-west Nigeria. It is located on Latitude 7.783° North and Longitude 5.517° East (Bolarinwa *et al.*, 2017).

Experimental Chicks and Management

A total of 1200 eggs of both Ross 308 and Arbor acre breeds were sourced from a reputable farm at Ibadan, Nigeria. Four hundred (400) hatch-able eggs were collected in three batches. Each batch consisted of 200 eggs of Ross 308 and 200 eggs of Arbor Acre. First batch of eggs were collected on day 1 and stored for 10 days, second batch of eggs were collected on day 4 and stored for 7 days and the last batch of 400 eggs were collected on day 7 and stored for 4 days. Each treatment (pre-incubation storage-duration: 10, 7, 4 days) had 4 replicates consisting of 50 eggs per replicate. Hatchable eggs for each Treatment and Replicate were labeled for proper identification with different letters and colors. All eggs were stored in the hatchery at 18°C and 75% Relative Humidity (RH) in the cold-room before setting into the incubator on day 11. Due to reductions from cracked eggs, only 1116 (93%) hatching eggs were set into the incubator as designed on Table 1. The eggs were placed in the setter at 37°C and 75% RH. Egg candling was conducted on 18th day, and fertile eggs were transferred from the setter to the hatcher compartment of the incubator. A minimum of 46 chicks were incubated per breed by egg-storage duration within replicate.

Table 1: Experimental Treatment Design for the Study

Breed	Egg pre-storage duration (days)		
	10	7	4
Arbor acre breed	46, 46, 48, 46	48, 46, 46, 46	47, 47, 46, 46
Ross 308 breed	48, 46, 46, 46	46, 47, 46, 47	46, 46, 48, 46

Note: Each factor had 4 replicates with minimum of 46 chicks at egg-setting.

Of the eggs set, 69-82% were hatched-out to chicks. All hatched day-old chicks were placed randomly in 4 replicates in brooding cages under standard conditions based on 2x3 (breed by storage duration) factorial treatment arrangement in completely randomized design. Both breeds of broiler breeder chicks were reared on the same farm under same management practices. The commercial nutritional and feeding standard in Nigeria were adopted. The chicks were placed on a standard broiler starter diet of 3000 kcal ME/kg and 24% CP during the first week of life. (Table 2).

Table 2: Ingredient Composition of Experimental Diets

Ingredient	Starter (kg/100kg)
Maize	45.00
Wheat Offal	13.30
Fish meal	3.00
Soybean meal	35.00
Methionine	0.20
ZAGRO mineral-vitamin Premix	0.25
Salt	0.25
Bone meal	2.00
Oyster shell	1.00
Total	100.00
Crude Protein (%)	24.00
Energy (Kcal ME/kg)	3000.00

Premix composition/kg: copper 15g, iodine 350mg, iron 130g, manganese 45g, selenium 300mg and zinc 125g.



Data Collection

Chick Quality Assessment

Immediately after the hatching operation, quality assessment was performed for chick reflex/activity and navel condition based on Tona *et al* (2003) standards. Chick activity was determined by placing each chick on its back to determine how quickly it returned to its feet. A good, active, ability to right self immediately and spring back onto its feet was regarded as 'Good = 6', a slow return was termed as "average = 3" and a slow trailing back or very poor and lethargic return onto both feet was assessed as 'weak = 1', while a chick remaining on its back was scored = 0'. Navel condition was assessed by counting and recording the number of chicks with deformed and unhealed navels per breed and batch. Navel and surrounding areas were examined for closure of the navel. Completely closed and clean was scored = **12 points**, open and/or black crusts (mild) = 6 points, and open and/or black crusts (severe) was scored = 0, following the standard description by Tona, *et al.* (2003).

Performance and Productivity Assessment

Assessment of traits monitored was done at 7-day old namely: total weekly feed intake (TFI, g), total weight gain (TWG, g), average body weight (ABW, g), average daily gain (ADG, g/day), feed conversion efficiency (FCE, %), feed consumption cost per day (FCC, ₦/day) and cost per unit weight gain (CWG, ₦/kg). The day-old weight was done by weighing all chicks and determining the average weight within each factor and replicate levels. The 7-day body weight for factors and replicates were done and recorded at the end of the first week. The TWG was computed as 7-day weight minus the day-old weight, while the ADG was calculated as TWG divided by 7. The DFI was estimated as feed offered minus feed left-over (g/day). The total feed intake for each breed, storage duration and replicates was obtained by summing-up daily records for the week. The FCE was determined as ratio of average feed consumed to average weight gain multiplied by 100. Cost of feed consumed (CFC) was determined by multiplying total feed consumed by price/kg, while cost per kg weight gain (CPG) was determined as total cost of feed consumed divided by total weight gain.

Experimental Design, Model and Statistical Analysis

The experimental design was a factorial arrangement of 2 breeds by 3 storage durations in completely randomized design. The model was of the form: $Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{ijk}$

Where:

i = Number of breeds ($i = 1, 2$)

j = Number of pre-hatching storage duration ($j = 1, 2, 3$)

k = number of replicates ($k = 4$)

Y_{ijk} = general observation in the i^{th} breed, j^{th} storage duration and k^{th} replicate

μ = universal constant

α_i = effect of i^{th} breed (i =Ross 308, Arbor Acre)

β_j = effect of j^{th} pre-hatching storage duration (i =4, 7 and 10 days)

$\alpha\beta_{ij}$ = interaction effects of the i^{th} breed and j^{th} storage duration

e_{ijk} = random error term, committed $\text{nid} \sim (0, \delta^2)$

Data generated were subjected to ANOVA procedures of the General Linear Model of SAS, version 9.4 (2013). Means were separated by Tukey's Honestly Significant Difference (HSD) procedure ($\alpha=0.05$).

The null hypothesis tested was that interaction of breed by storage interval shall not be significant ($P > 0.05$)

RESULTS

Interaction of Breed and Egg-storage Duration on Chick Quality and Production Efficiency

Table 3 shows that interaction effect of breed and egg-storage duration was significant on navel quality ($P < 0.0500$), average day-old body weight (DBW, $P < 0.0001$), average daily gain (ADG g/d; $P < 0.0500$) feed conversion efficiency (FCE, $P < 0.0111$), feed consumption cost (FCC, ₦/day, $P < 0.0111$) and cost per unit weight gain (CWG, ₦/g, $P < 0.0500$) of chicks at 7-days old. Total weekly feed intake was marginal among factor levels ($P = 0.0720$). Arbor acre (AA) eggs stored for 4 days recorded better day-old weight of 36.40g. But AA eggs stored for 7-days had the best navel quality



score of 2.00, highest ADG and FCE (11.29g/d and 36.71%), and the lowest FCC and CWG (₦10.26/day and ₦0.91/g) at 7 days of age. Ross breed eggs pre-stored for 7 days before incubation recorded the best chick activity and navel quality score (4.00 and 1.92). Ross eggs stored for 10 days prior to incubation had the best DBW (32.80g), highest ADG and FCE (10.48g/d, 34.38%) and lowest FCC and CWG (₦10.36/d and ₦0.99/g) respectively.

Table 3: Interaction of Breed and Storage Duration (days) on Chick Quality at Day-old and Production Efficiency at 1 Week of Age

Breed Storage duration	Arbor acre broiler			Ross broiler			SEM	P
	4-d	7-d	10-d	4-d	7-d	10-d		
Day-old								
Chick activity	4.29	4.29	3.92	3.63	4.00	3.39	0.23	0.7453
Navel quality	1.92 ^a	2.00 ^a	1.67 ^b	1.58 ^b	1.92 ^a	1.57 ^b	0.24	0.0500
DBW	36.40 ^a	35.20 ^c	35.80 ^b	31.50 ^e	32.50 ^d	32.80 ^d	0.60	0.0001
7 days								
ABW (g)	111.50	114.29	109.80	101.00	102.40	106.14	2.46	0.2233
TWG (g)	75.10	79.09	74.00	69.50	70.00	73.34	2.46	0.2497
TFI (g)	251.17	215.47	236.82	254.50	230.04	213.30	7.46	0.0720
ADG (g/d)	10.73 ^b	11.29 ^a	10.57 ^b	9.93 ^c	10.00 ^c	10.48 ^b	0.23	0.0500
FCE (%)	29.90 ^c	36.71 ^a	31.25 ^c	27.31 ^d	30.26 ^c	34.38 ^b	1.43	0.0111
FCC (₦/day)	12.19 ^b	10.26 ^e	11.50 ^c	12.36 ^a	11.17 ^d	10.36 ^e	0.16	0.0111
CWG (₦/g)	1.89 ^a	0.91 ^c	1.09 ^b	1.27 ^b	1.12 ^b	0.99 ^{bc}	0.34	0.0500

Note: DBW: day-old body weight, ABW: average body weight, TWG: total weekly weight gain, TFI: total weekly feed intake, ADG: average daily gain, FCE: feed conversion efficiency to body weight, FCC: feed consumption cost, CWG: cost per unit weight gain, ^{a, b, c}: figures across rows with different superscripts are significantly different.

Effect of Breed on Chick Quality and Production Efficiency

In Table 4, breed caused significant effect on chick activity ($P < 0.0214$), DBW ($P < 0.0001$), ABW ($P < 0.0002$), TWG ($P < 0.0168$) and ADG ($P < 0.0500$), with Arbor acre breed having higher values on all traits than Ross breed. The effect of breed was similar ($P = 0.1430-0.7866$) on navel quality, TFI, FCE, FCC and CWG.

Effect of Pre-incubation Egg-storage Duration on Chick Quality and Production Efficiency

There were statistically significant differences due to egg-storage duration (days) on navel quality, DBW, TFI, ADG, FCE, FCC and CWG ($P < 0.0025-0.0500$). Hatchable eggs stored for 7-days prior to incubation produced day-old chicks with best navel quality score, lowest TFI, highest ADG and FCE, least FCC and CWG (1.96, 222.76g, 10.75g/d, 33.80%, ₦10.82/day and ₦1.01/g) than other egg-storage durations

Table 4: Effect of Breed and Storage Duration on Chick Quality at Day-old and Production Efficiency at 1 Week of Age

SOV	Breed		SEM	P	Storage duration			SEM	P
	AA	Ross			4-d	7-d	10-d		
Day-old									
Chick activity	4.16 ^a	3.67 ^b	0.14	0.0214	3.96	4.15	3.65	0.18	0.1512
Navel quality	1.86	1.69	0.08	0.1314	1.75 ^{ab}	1.96 ^a	1.62 ^b	0.09	0.0500
DBW (g)	35.8 ^a	32.23 ^b	0.13	0.0001	33.95 ^c	33.80 ^b	34.30 ^a	0.53	0.0001
7 days									
ABW (g)	112.11 ^a	103.39 ^b	1.40	0.0002	106.25	109.33	107.67	2.14	0.6663
TWG (g)	76.34 ^a	71.13 ^b	1.40	0.0168	72.30	75.30	73.62	1.87	0.6602
TFI (g)	234.49	232.61	5.97	0.7866	252.83 ^b	222.76 ^a	225.06 ^a	5.66	0.0025
ADG (g/d)	10.91 ^a	10.16 ^b	0.38	0.0500	10.33 ^c	10.75 ^a	10.52 ^b	0.12	0.0500
FCE (%)	32.76	30.58	1.16	0.1430	28.60 ^b	33.80 ^a	32.71 ^a	1.23	0.0067
FCC (₦/day)	11.39	11.30	0.06	0.1430	12.28 ^b	10.82 ^a	10.93 ^a	0.16	0.0067
CWG (₦/g)	1.04	1.11	0.13	0.6758	1.18 ^b	1.01 ^a	1.04 ^a	0.05	0.0061

Note: DBW: day-old body weight, ABW: average body weight, TWG: total weekly weight gain, TFI: total weekly feed intake, ADG: average daily gain, FCE: feed conversion efficiency to body weight, FCC: feed consumption cost, CWG: cost per unit weight gain ^{a, b, c}: figures across rows with different superscripts are significantly different.

DISCUSSION

Interaction of Breed and Egg-storage Duration on Chick Quality and Production Efficiency

The quality of a day-old chick is determined by a combination of factors centered around visual observations such as presence or absence of abnormalities or defects on chicks. Chick quality could be determined by combination of quantitative and qualitative scoring criteria in commercial hatcheries (Narinc 2022). This assessment is conducted based on subjective traits such as chick feather colour, body development, navel appearance and chick vitality. The standard quality day-old chick could be defined as clean, dry, uncontaminated, undeformed, bright- clear- and opened eyed, completely sealed navel (Ipek and Sözcü, 2013). Chick activity is measured by how quickly a chick returns to its feet when it is laid on its back (Tona *et al.*, 2003). Interaction of breed and storage-days revealed similarity in chick activity, but the best navel quality (2.00, 1.92) was obtained in chicks whose eggs were pre-stored for 7-days. The highest day-old chick weight for Arbor acre (36.40 g/bird) and Ross 308 (32.80 g/bird) hatching eggs were obtained from eggs stored for 4 and 10 days respectively. This higher DBW of chicks from eggs stored for 4 days could be due to lower water loss from the eggs, which maintained albumen and embryo moisture content, better egg nutrient preservation through less degradation of the yolk and albumen nutrients and reduced embryonic stress.

At 7 days of age, the highest ADG, FCE (11.29 d/day, 36.71 %) and lowest (best) FCC and CWG (10.26 ₦/day, 0.91 ₦/g) obtained by AAx7-day egg storage period could be that AA performs better with shorter storage days due to breed specific storage tolerance, thereby retaining optimum moisture and nutrient better at 7 days, while its growth pattern may align better with the 7-day pre-incubation storage effect. Conversely, the highest DBW, ADG, FCE, FCC and CWG (32.80 g/bird, 10.48 g/d, 34.38 %, 10.36 ₦/day, 0.99 ₦/g) by RSSx10-day egg storage interval could be due to higher and better tolerance to longer pre-incubation storage of eggs.

Effect of Breed on Chick Quality and Production Efficiency

Gharahveysi and Kenari (2018) submitted that the day-old chick should be alert, active and interested in its environment by responding to sounds. Chick activity score between breeds presently (3.6 - 4.1) is lower than 4.5-6.0 observed in day-old chicks of naked chicken breed (Abioja *et al.*, 2022). Iqbal *et al.* (2017) clarified that egg weight is a dominant factor affecting chick weight at hatch, and a source of the difference observed between breeds. Sozcu *et al.* (2021) reported similar day-old weight for Cobb and Ross 308 (45.6, 45.5, g/chick) breeder chicks. Present results are similar to 35.01-36.1 reported for naked-neck chicken, and 32.7-37.5 for Transylvanian naked neck (Addo *et al.* 2018; Abioja *et al.* 2022) chicks. The day-old weight of chicks in present study is lower than above reported weights.



The genetic difference in day-old weight of chicks of breeds could also be influenced by variation in albumen pH, yolk nutrient mobilization and embryonic metabolism rates (Gyawali and Goto, 2025). At 7 days old, there was a clear superiority of AA over Ross in ABW, TWG and ADG, which could be due to higher genetic potential on growth, maternal effect, better responses to incubation conditions, and the slightly better feed conversion efficiency of AA compared to RSS (32.76, 30.58, %) at this age (Helal, *et al.*, 2025).

Effect of Pre-incubation Egg-storage Duration on Chick Quality and Production Efficiency

The 10-day egg storage had advantage of producing the highest DBW, although this did not translate to best parametric values in the experiment. Nowaczewski *et al.* (2022) reported increased weight of day-old chicks with increase in storage duration, as eggs stored for 21 days had heavier chicks than those stored for 14, 7 and 3 days. This result was attributed to slower absorption rate of the yolk sac content by developing embryos of eggs stored for longer period. Addo *et al.* (2018) however reported similarity in effect of different storage duration (1, 3, 7, 10, 14) on the day-old weight of chicks.

The better navel quality, least TFI, highest ADG and FCE; high FCC and CWG, of chicks from 7- and 10-day egg storage intervals revealed an optimum pre-incubation storage period of 7-10 days for expression of the genetic potential for growth during the first week of life in chicks hatched. Navel quality is an important quality control point due to its susceptibility to bacterial infection when poorly closed. This trait could also be affected by genetics (Dawkins and Layton, 2023), pre-hatch factors such as breeder flock health status, age, nutrition, embryo development (Molenaar *et al.*, 2023, Alo *et al.*, 2024, Poultry-care, 2024); incubation and hatching factors such as turning frequency and angle, incubator, eggshell and cloaca temperature, humidity and incubator sanitation (Vantress, 2021); and navel characteristics such as length, diameter, infection and wetness (Mitchell, 2016, Kolarczyk, 2019). Abioja *et al.* (2022) reported poorer chick activity score for eggs stored for 16 days compared to those stored for 0, 4, 8 and 12 days. Storage duration improved navel quality positively to 7-day maximum storage interval. Eggs stored for 18-days were reported with reduced-day-old chick quality scores compared to shorter storage periods (Zhang *et al.*, 2025).

At 7- to 10-day egg storage period the mean values for TFI, ADG, FCE, FCC and CWG were similar, indicating that hatchery managers could employ either storage durations to produce the similar results. The observed decrease in TFI of chicks from eggs stored to 7-day period could be due to slower absorption rate of the yolk sac content in chicks (Nowaczewski *et al.*, 2022), thus decreasing satiety and lowering total feed consumption in the first 7-days of life. Contrary to present result, Alsobayel and AL-Miman (2010) observed that chicks from eggs stored for 14 days pre-incubation period consumed more feed than those from eggs stored for 1 and 7 days; and that storage duration was significant on performance traits monitored in broiler chicks. Similarly, they reported that eggs stored for 1-day pre-incubation period had lower feed intake, higher weight gain and improved FCR compared to those from eggs stored for 7- and 14-days. Petek and Dikmen (2006) observed similarity in the performance of broiler chicks due to either 5-day or 15-day pre-incubation storage duration, except for feed conversion.

CONCLUSION AND RECOMMENDATIONS

Arbore acre and Ross 308 eggs could be stored for 7- and 10-days pre-incubation for optimum 7th day (age) chick performance respectively. Arbor acre had better genetic potential for growth from day-old to 7 days old than Ross308. Eggs can be stored for 7 days without adverse effects on navel quality and growth performance within breed.

Arbor Acre and Ross308 eggs could be stored for 7 and 10 days respectively - pre-incubation - when navel quality, chick activity and early first week performance is desired. Research should be furthered on the joint effects of storage interval and seasonal variations on parameters monitored in present study.

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