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Effect of Storage Period on the Health of Selected Eggs of Domestic

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Abstract

The marketing of eggs must follow a standard that will check production and storage against the expiration date. There is a need to evaluate the storage period and the healthy nature of the eggs of domestic birds from different poultry farms. A total of 135 eggs were collected aseptically, three each from five domestic birds on three different poultry farms. These eggs were collected on different storage days (1–7, 8–14, and 15–21) and weighed to ensure their healthy nature. The weight of the different eggs was weighed with an electronic weighing balance and compared among storage days. The result showed that the weight of eggs collected from days 1–7 recorded a mean value, ranging from 54.5±1.0–70.6±0.7g for a whole egg, 27.0±0.6–37.5±0.9g for albumin, 20.1±1.2–24.7±0.3g for egg York, and 5.4±0.3–11.2±0.9g for eggshell. For days 8–14, the weight ranged from 48.8±0.4–64.1±0.4g for a whole egg, 24.4±0.1–33.0±1.1g for albumin, 18.2±0.5–24.3±0.3g for egg York, and 6.0±0.2–9.5±0.4g for eggshell. The weight of eggs recorded for days 15–21 ranges from 43.5±0.6–60.6±0.9g for a whole egg, 20.8±0.6–30.5±0.8g for albumin, 16.3±0.6–23.6±0.7g for egg yolk, and 5.3±0.1–8.9±0.1g for eggshell. The effects of egg weight and quality do not significantly decrease within days 1–7 but dramatically decrease from days 8–14 and days 15–21 of storage. The weight of eggs increases with egg size and decreases with an increase in storage period.

Keywords: Effect of Storage Period, Selected Eggs, Bayelsa, Nigeria.

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Introduction

Laying birds are kept to produce eggs and meat for man and his household (Musgrove et *al*., 2005). These birds are poultry birds, native, domestic, or local birds, quail birds, etc. These birds produce different eggs with different morphological outlooks, respectively. Some are spherical in shape, round in shape, or ovoid in shape. Some are whitish in color, brownish in color, or whitish or brownish with black spots. McNamara (2015) explains that an egg has all the nutrition an embryo needs to grow and establish until it hatches. Eggs have been thrust into the spotlight as a primary source of nutrition for humans as a result of their great digestibility, ideal balance of a variety of nutrients, high cost-effectiveness, and low environmental impact (Musgrove et *al*., 2005). Eggs continue to be widely consumed across the globe because they are a food product with good nutritional quality for humans of all ages, including old people and children (McNamara, 2015; Ali et al., 2022).

Few meals can match the value of eggs when it comes to maintaining a balanced diet and lifestyle (Zaheer, 2015; Saleh, 2016). By 2050, it is anticipated that there will be 9 billion people on the planet living in poverty due to food shortages (Zaheer, 2015; Daluma & Saleh, 2017). The global goal of FAO (2012) is to promote an autonomous and resilient supply of food so that people can meet their own food needs both now and, in the future, (Miranda et al., 2015). The number of eggs eaten around the world has tripled in the last 40 years, and with that increase has come a corresponding rise in the quality standards consumers hold producers to (Windhorst, 2011; Saleh, 2017).

Eggs have several uses beyond human eating, making them a valuable raw material in the pharmaceutical and cosmetic sectors (Narahari et al., 2004). These uses depend on the egg's interior and outer qualities, which are reflected in its quality and size. Egg quality includes management, climate, nutrition, breed, and post-lay handling practices that affect egg quality, as described by (Zemková et al., 2007; Saleh, 2017; King'ori, 2012). Depending on the shell and the contents, eggs might lose a lot of their quality while being stored (Adeogun & Amole, 2004; Saleh & Daluma, 2017). Storage period has a relationship with the weight and quality of eggs, as does the microbial contamination of eggs (Musgrove et *al*., 2005). Despite the nutraceutical, there are potential health-challenging issues resulting from individual allergies arising from egg quality during production processes and storage (Musgrove et *al*., 2005; Daluma & Saleh, 2017).

Marketing of eggs must follow a standard that will check production as against the expiring date, as stipulated and regulated by the Commission Regulation Standard (EC, 2052/2003; EFSA, 2009; USDA, 2018; 2013; USEPA, 2012; USDAFSIS, 2000), for marketing standard eggs. This commission stated that foods like eggs and meat from birds are potential sources of infection. Developed nations like Canada and Japan frequently re-examine chicken eggs before selling them to consumers. Eggs kept for consumption are supposed to have an expiration date. Three to four (3–4 weeks) weeks is the storage time, and it is not more than 30 days after packaging (Braun, 2000). The flotation test proves that fresh viable eggs sink, while bad or older eggs float as weight is lost as eggs stay longer (Musgrove et *al*., 2005; Daluma & Saleh, 2017). This is not the practice in Africa, and Nigeria in particular. Therefore, there is a need to evaluate the effect of the storage period on the health of selected eggs of domestic birds in Bayelsa State, Nigeria.

Research Methodology

Sample collection

A total of 135 eggs sample were collected aseptically, 3 each from 5 domestic birds in 3 different poultry farms located in Ogbia, sagbama and Yenagoa LGA at latitude *5°9'8.06"N*/longitude *6°11'32.92"E*, latitude 4° 55' 36.30" N/longitude 6° 16' 3.50" E and *Latitude 4° 38' 59.99" N/Longitude 6° 15' 60.00" E* respectively. These poultry and livestock farms were represented as A, B, and C, respectively, to protect the anonymity of the involved farms. Three (3) sample treatments and five (5) different egg types—local egg, layers egg, quail egg, duck fowl egg, and turkey egg—were used. The samples of eggs were aseptically collected with sterile hand gloves and transported in an ice bag to the Medical Laboratory Centre, Niger Delta University, Wilberforce Island, Bayelsa State. These eggs were collected on different storage days (days 1–7, 8–14, and 15–21). The avian species present in the vicinity, including the local fowl, quail, duck, and turkey, were provided with the opportunity to roam outdoors. Their diet consisted of a combination of grains, grass, clover, crops, and green crops. The layer chickens ate balanced, incomplete cereal-based mixed fodder with several additives.

Assessment of the weight of eggs

One hundred and thirty-five (135) eggs were used to assess the relationship between the weight and storage days (1-7days, 8-14days, 15-21days) of the eggs sample collected from the study location A, B and C (Ogbia, Sagbama and Yenagoa) respectively, in other to envisage their healthy nature. The eggs sample were collected from the farms at different days. The eggs were conveyed to the testing facility, and the weight of the different eggs was weighed with an electronic weighing balance and compared among days of storage.

Extraction and weighing of egg York and albumin

The eggs albumin and the yolk were aseptically extraction using a sterilized 50ml syringe. Using sterile forceps, the shells were punctured aseptically from the egg's blunt end. The weight of the empty sterilized 10ml syringe was determined. The albumen and the yolk were collected with a 10ml sterile sample collector syringe, weighed and label according. The remaining egg shells were weighed directly on an electronic weighing balance. The weight of the albumin and the yolk were determined by subtracting the weight of the empty sterilized 10ml syringe from the weight of the syringe containing the albumin or the yolk. Weight of albumin = weight of 10ml syringe containing the albumin – weight of empty sterilized 10ml syringe. The same was done for the yolk.

Results and Discussion

Result presented in table 4.1 – 4.3, shows the relationship between storage period and weight of eggs compartment. The weight of egg collected from Ogbia L.G.A recorded a mean value, ranging from 45.7±0.6-70.6±0.7g for whole egg, 22.8±0.1-37.5±0.9g for Albumin, 17.5±0.6-24.7±0.3g for egg York and 5.4±0.3-11.2±0.9g for egg shell. The weight of egg collected from Sagbama L.G.A recorded a weight ranging from 43.5±0.6-69.2±1.0g for whole egg, 20.8±0.6-35.4±0.8g for Albumin, 17.3±0.6-26.7±1.3g for egg York and 5.4±0.5-10.2±0.4g for egg shell. The weight of egg collected from Yenagoa L.G.A ranges from 44.3±1.1- 69.8±0.2g for whole egg, 21.7±0.6-37.0±0.6g for Albumin, 6.3±0.6-25.1±2.1g for egg yolk and 5.3±0.1-9.9±0.9g for egg shell.

Sample eggs collected from Ogbia L.G.A recorded higher values in weight for all the egg compartment than Sagbama and Yanegoa. Turkey bird eggs (T.B.E) has the highest values in weight from 1-7days for whole egg, egg albumin and egg shell, followed by Duck fowl eggs (D.F.E), local fowl eggs (L.F.E) or poultry layers' eggs (P.L.E) and quail bird eggs (Q.B.E). The recorded weight in whole egg, egg albumin and egg shell of Turkey rangesd from 60.6±0.9-70.6±0.7g, 30.5±0.8- 37.5±0.9g and 7.4±0.5- 11.2±0.9g respectively in Ogbia L.G.A, 59.6±0.5-69.2±1.0g, 26.9±1.3-35.4±0.8g and 8.8±0.6-10.2±0.4g in Sagbama L.G.A and 58.1±0.4-69.8±0.2g, 28.7±0.5-37.0±0.6g and 8.9±0.6-9.9±0.9g in Yenagoa L.G.A. Duck fowl eggs have the highest weight in yolk, followed by turkey fowl eggs, poultry layers' eggs, local fowl eggs than quail bird eggs. Duck fowl eggs recorded the values in weight for egg yolk ranging from 23.6±0.3-24.7±0.6g, 23.5±0.7-26.7±1.3g and 22.5±0.7-25.1±2.1g in Ogbia, Sagbama and Yenagoa L.G.A respectively from 1-7days of storage compared to others sample bird eggs.

Results (Table 4.1 – 4.3) shows that eggs have more weight within 1-7days than 8-14days (1-2 weeks), and loss a significant weight from 15-21days (week 3). The effects of egg weight and qualities do not significantly decrease within days 1-7, but dramatically decreased from day 8-14 and days 15-21 of storage. It was observed that the weight of egg decreases with increase in storage period. There was no significant ($p>0.05$) decreased in the weight of quail bird eggs recorded as days of storage increased, but a significant decrease was recorded with turkey bird eggs, duck fowl eggs, local fowl eggs and poultry layers' eggs.

Table 1. Effect of storage period and weight (Mn±S.D) of eggs collected from Ogbia L.G.A

Farm/ storage period	Egg type	Whole egg (g)	Albumin (g)	Egg Yolk (g)	Egg shell (g)	WHO (g)
A	L.F.E	63.2±1.0^{b}	33.2±1.2^{b}	21.2±1.1^{a}	8.7±1.1^{ab}	
1-7days	P.L.E	63.0±0.8^{b}	32.4±0.8^{b}	23.3±0.4^{a}	8.1±0.2^{ab}	WE
	Q.B.E	55.6±1.1^{a}	27.5±0.9^{a}	21.1±0.9^{a}	6.9±1.1^{a}	53-73
	D.F.E	69.4±0.7^{c}	35.6±0.6^{b}	24.7±0.3^{a}	9.6±0.3^{ab}	
	T.B.E	70.6±0.7^{c}	37.5±0.9^{b}	21.8±0.8^{a}	11.2±0.9^{b}	
B	L.F.E	60.3±0.7^{b}	32.8±0.3^{b}	20.3±0.4^{a}	7.2±0.8^{ab}	ALB
8-14days	P.L.E	59.9±0.7^{b}	30.1±1.2^{b}	22.2±0.8^{a}	6.1±0.3^{a}	-
	Q.B.E	51.2±0.1^{a}	25.8±0.2^{a}	19.4±0.5^{a}	6.1±0.5^{a}	
	D.F.E	61.9±0.6^{b}	31.1±0.6^{b}	24.4±0.7^{b}	6.5±0.6^{a}	
	T.B.E	63.1±0.5^{b}	32.7±1.2^{b}	23.8±0.9^{ab}	7.8±0.1^{a}	EY
C	L.F.E	53.5±0.4^{a}	28.7±0.3^{bc}	19.1±0.4^{a}	5.7±0.9^{a}	-
15-21days	P.L.E	50.9±0.7^{a}	25.4±0.4^{ac}	20.0±0.7^{a}	5.5±0.3^{a}	
	Q.B.E	45.7±0.6^{d}	22.8±0.1^{a}	17.5±0.6^{a}	5.4±0.3^{a}	
	D.F.E	58.7±0.7^{a}	28.7±0.6^{bc}	23.6±0.7^{ab}	6.3±0.5^{a}	ES
	T.B.E	60.6±0.9^{b}	30.5±0.8^{b}	22.7±0.6^{a}	7.4±0.5^{ab}	-

L.F.E = local fowl egg, P.L.E= poultry layers eggs, Q.B.E= quail bird eggs, D.F.E= duct fowl eggs and T.B.E= turkey bird eggs. Different superscript along column indicates a significant difference among sample values at p<0.05, while the same alphabet indicates no significant variation among sample value at p>0.05. WHO standard for healthy eggs weight ranges from 53-73g.

Table 2. Effect of storage period and weight (Mn±S.D) of eggs collected from Sagbama L.G.A

Farm/ storage period	Egg type	Whole egg (g)	Albumin (g)	Egg Yolk (g)	Egg shell (g)	WHO (g)
A	L.F.E	64.2±1.0^{b}	34.8±1.7^{b}	20.8±0.6^{a}	9.5±0.4^{ab}	
1-7days	P.L.E	64.3±0.9^{b}	33.9±0.7^{b}	22.4±0.4^{ab}	9.7±0.7^{ab}	WE
	Q.B.E	56.4±0.8^{a}	28.2±0.9^{ac}	20.2±0.4^{a}	7.3±0.3^{ab}	53-73
	D.F.E	68.7±0.5^{b}	33.1±0.2^{b}	26.7±1.3^{b}	9.1±0.4^{ab}	
	T.B.E	69.2±1.0^{b}	35.4±0.8^{b}	23.2±0.6^{ab}	10.2±0.4^{b}	
B	L.F.E	58.4±0.3^{a}	30.9±0.6^{bc}	19.9±0.6^{a}	7.6±0.2^{ab}	ALB
8-14days	P.L.E	59.7±0.1^{ac}	29.9±0.6^{bc}	21.9±0.5^{ab}	8.8±0.9^{ab}	-
	Q.B.E	50.9±0.5^{a}	25.3±0.2^{a}	18.9±0.4^{a}	6.7±0.4^{ab}	
	D.F.E	63.2±0.8^{bc}	30.7±0.5^{bc}	24.3±0.3^{b}	7.9±0.2^{ab}	
	T.B.E	65.5±0.8^{b}	31.8±0.6^{bc}	22.7±1.0^{ab}	9.5±0.2^{ab}	EY
C	L.F.E	50.8±0.8^{a}	26.1±0.7^{a}	18.5±1.0^{a}	6.2±0.4^{ab}	-
15-21days	P.L.E	48.9±0.4^{a}	23.4±0.3^{a}	19.2±0.5^{a}	6.2±0.2^{ab}	
	Q.B.E	43.5±0.6^{d}	20.8±0.6^{d}	17.3±0.6^{a}	5.4±0.5^{a}	
	D.F.E	57.8±1.4^{a}	26.9±0.9^{a}	23.5±0.7^{ab}	7.4±0.3^{ab}	ES
	T.B.E	59.6±0.5^{ac}	28.9±1.3^{ac}	21.8±0.3^{ab}	8.8±0.6^{ab}	-

L.F.E = local fowl egg, P.L. E= poultry layers' eggs, Q.B. E= quail bird eggs, D.F. E= duct fowl eggs and T.B. E= turkey bird eggs. Different superscript along column indicates a significant difference among sample values at p<0.05 among treated value.

Table 4.3. Effect of storage period and weight (Mn±S.D) of eggs collected from Yenagoa L.G.A

Farm/ storage period	Egg type	Whole egg (g)	Albumin (g)	Egg Yolk (g)	Egg shell (g)	WHO (g)
A	L.F.E	61.1±0.6^{b}	33.0±1.5^{ab}	20.1±1.2^{a}	8.0±0.2^{a}	
1-7days	P.L.E	62.8±1.1^{b}	33.7±1.1^{ab}	23.0±0.3^{ab}	7.2±0.5^{a}	WE

	Q.B.E	54.5 ± 1.0^{a}	27.0 ± 0.6^{ac}	20.2 ± 1.1^{a}	6.6 ± 1.5^{a}	53-73
	D.F.E	67.5 ± 0.6^{c}	35.1 ± 0.7^{b}	25.1 ± 2.1^{b}	8.5 ± 1.0^{a}	
	T.B.E	69.8 ± 0.2^{c}	37.0 ± 0.6^{b}	23.0 ± 0.6^{ab}	9.9 ± 0.9^{a}	
B	L.F.E	57.7 ± 0.6^{ab}	31.5 ± 0.5^{a}	19.6 ± 0.1^{a}	6.6 ± 0.8^{a}	ALB
8-14days	P.L.E	58.7 ± 1.1^{ab}	27.6 ± 0.6^{ac}	22.7 ± 1.4^{abc}	6.0 ± 0.2^{a}	-
	Q.B.E	48.8 ± 0.4^{d}	24.4 ± 0.1^{cd}	18.2 ± 0.5^{a}	6.2 ± 0.3^{a}	
	D.F.E	61.7 ± 0.6^{b}	30.9 ± 1.0^{a}	23.5 ± 0.7^{ab}	7.3 ± 1.1^{a}	
	T.B.E	64.1 ± 0.4^{b}	33.0 ± 1.1^{ab}	21.3 ± 0.3^{ab}	9.5 ± 1.5^{a}	EY
C	L.F.E	51.4 ± 0.8^{a}	27.2 ± 0.2^{ac}	17.4 ± 1.1^{c}	5.7 ± 0.6^{a}	-
15-21days	P.L.E	48.0 ± 0.6^{d}	24.1 ± 0.6^{cd}	20.0 ± 0.7^{ac}	5.6 ± 0.3^{a}	
	Q.B.E	44.3 ± 1.1^{d}	21.7 ± 0.6^{d}	16.3 ± 0.6^{c}	5.3 ± 0.1^{a}	
	D.F.E	56.2 ± 1.9^{a}	26.7 ± 1.5^{ac}	22.5 ± 0.7^{abc}	7.0 ± 0.6^{a}	ES
	T.B.E	58.1 ± 0.4^{ab}	28.7 ± 0.5^{ac}	20.4 ± 0.7^{ac}	8.9 ± 0.1^{a}	-

L.F.E = local fowl egg, P.L. E= poultry layers' eggs, Q.B. E= quail bird eggs, D.F. E= duct fowl eggs and T.B. E= turkey bird eggs. Different superscript along column indicates a significant difference among sample value at $p<0.05$.

Birds of different species exhibit the biological phenomenon of oviparity, wherein females produce and lay eggs. Poultry eggs are well recognized as an essential component of diet globally, owing to their significant nutraceutical content and feasibility of digestion (Zhang et al., 2022 & 2011). It comprises lipids, vital fatty acids, proteins, and carbs. Eggs are also a great source of micronutrients, particularly fat-soluble vitamins. The dependency on eggs by humans and other living things for protein is higher that the reevaluation of their microbial contamination became necessary. The higher choice of eggs to the populace is mostly broiler eggs. Quail, duck fowl, turkey and local fowl eggs are also rich, and highly demanded by consumers. Egg formulations compared to conventional domestic species have certain similarities, but they also differ significantly from one another (Huang & Lin, 2011 & 2012; Taylor et al., 2014; Sardin et al., 2023), which is primarily attributed to the shifting ratio of egg yolk to egg white.

There is a relationship between storage days, weight of eggs and healthy nature of eggs. The result recorded showed that the weight of eggs was higher at days 1-7, followed by 8-14days compared to 15-21days of storage. The weight of eggs and their quality were found to be considerably influenced by both storage period and temperature, as observed in the present investigation. The weight of eggs decreases with an increase in storage period. There was a variation at $p<0.05$ in the weight of the egg samples. The progressive increase in air cell area and volume was associated with the loss of water through evaporation from the egg and a subsequent decrease in egg weight (Akyurek & Okur, 2009). The air cell volume increases with storage time, which causes the internal content of the egg to shrink. The air space in eggs increases with the storage period. This resulted in older eggs weighing less than newly laid eggs. Consequently, this makes newly laid eggs sink in water and older eggs float in water. The weight of an egg increases with size and the loss of weight increases with egg size and storage period. Larger eggs lose weight faster than smaller eggs due to larger surface area exposure and air space. The degradation and elongation of the vitelline membrane, elevation in pH levels, and augmentation in water content inside the egg yolk are all consequences of the deterioration in egg quality associated with storage. This discovery is in line with reports by Huang et al. (2012), Hidalgo et al. (2006), and Silversides and Budgell (2004).

Conclusion

Chicken eggs are widely consumed because of their nutritional value. In the worldwide egg market, a key conundrum is how to increase production of eggs to fulfill demand from a growing global population. The management factors encompassing hygiene, feeding practices, and housing conditions exert a significant influence on the content and quality, hence affecting consumer perception. The present study provided evidence of an effect on the weight of the eggs as storage increases, thereby affect the healthy nature of eggs to consumers. Eggs kept for consumption are supposed to bear expiring date and should not stay more than three to four (3-4wk) weeks is the storage time after packaging.

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