SEASONAL VARIATION ON EGG QUALITIES OF LAYING CHICKENS FED VARYING LEVELS OF PROCESSED TANNIA COCOYAM MEAL (*Xanthosoma sagittifolium*)

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ABSTRACT

The study was conducted to evaluate the effect of seasonal changes on egg quality characteristics of laying chickens fed cocoyam-based diet. A total of 140 day old commercial chicks (Shika Brown) were allotted to seven dietary treatments (n=20 birds) in a factorial arrangement 2×3+1; 2 factors (raw and boiled cocoyam), 3 levels (25%, 50% and 75%) and 1 control 0% in a completely randomized design, 80 chicks for raw sun dried (RS) cocoyam and 80 chicks for boiled sun dried (BS) cocoyam. The rate of cocoyam inclusion comprises 4 diets from RS and another 4 from BS cocoyam, each replaced maize 0%, 25%, 50%, and 75% as T_1, T_2, T_3 and T_4 respectively. During the 12 months experimental period, the birds were given feed and water ad libitum and routine vaccinations/medications were administered appropriately. Data collected were subjected to analysis of variance and significant differences among treatments means were compared using Tukey test. Result on the effect of season on egg qualities were found to increase ($p<0.05$) at dry season than at rainy season for both RS and BS cocoyam. Similar interaction was observed in egg abnormalities and egg qualities parameters at both rainy and dry season except with shelless egg and yolk index as both increased ($p<0.05$) with increase in level of cocoyam in the diet. Conclusively, the study underscores the vulnerability of egg quality parameters to seasonal climate changes in tropical climates and underscores the need for adaptive strategies to sustainably enhance poultry farming under such conditions.

Keywords: Season, Egg quality, Cocoyam, Shika Brown, Raw cocoyam, Boiled cocoyam

INTRODUCTION

The rising demand for livestock products is primarily driven by urbanization and growth in income and population (Ade *et al*., 2024). Increased temperatures, shifts in precipitation patterns, an upsurge in the periodicity of extreme events, and growing carbon dioxide concentrations are all consequences of climate change that are exerting growing pressure on the production of livestock (Cheng *et al*., 2022). Apart from the inherent fluctuation of the climate seen the UNFCCC (2014) while on comparable periods defined climate change as a change in climate that is attributed, either directly or indirectly, to human activity that modifies the atmosphere's structure globally (Falloon and Betts 2010, Fatoki *et al.,* 2020). Variability in climate is the term used to describe variations in the average condition of the weather as well as other statistics (such as standard deviations, the frequency of extremes, etc.) over all temporal and spatial scales that go beyond individual weather occurrences (Ade *et al*., 2024). Climate change can affect livestock production directly through increased heat stress and indirectly through effects on the quantity and quality of forage and crop-based feeds, as well as land and water availability (Ade *et al*., 2024). It has been observed that such changes have an impact on livestock performance across many tropical regions (FAO, 2021). Environmental factors are generally recognized to have a major impact on the production of meat and eggs from poultry. These include temperature, humidity, light (length of day and intensity), altitude (air pressure and partial pressure of oxygen and carbon dioxide), wind velocity (air movement), solar energy, quality of air and water, and density population (Abdullahi *et al*., 2021). The current study was designedto investigate the results of seasonal variations on the egg quality parameters of laying pullets in a monsoon climate in Northern Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out at the Poultry Research Program Section of the National Animal Production Research Institute, Shika, Zaria Nigeria.

Experimental Animals and Management

A total of 160 day-old layer chicks (Shika Brown) were used in this study. Animals were procured from hatchery section at artificial insemination unit of National Animal Production Research Institute, Shika (NAPRI), Zaria. The birds were raised on litter (wood shavings) of good absorbent quality. Birds were brooded for the period of two weeks at mean temperature of 35ºC. The chicks were vaccinated with intraocular vaccines against Newcastle Disease (ND) and to induce cross-reactive serum and mucosal antibody responses. Feed was given based on the

nutritional requirement of the bird as starter, grower or layer. All vaccination schedules and management procedures were followed. Feed and water were provided *ad-libitum*.

Procurement and Processing of Cocoyam (*Xanthosoma sagittifolium*)

Cocoyam (*Xanthosoma sagittifolium*) corms were purchased at Dal market, Sumaila local government, Kano state. The cocoyam was clean from sand and external fibers manually using hand followed by chopping using knife. The chopped cocoyam corms were subjected to two different processing methods as a means of improving its nutritive value i.e raw & sundried (RS) and boiled & sundried (BS). The method of Uchegbu *et al.* (2010) was used in preparing the sundried cocoyam meal. Cleaned cocoyam corms were sliced and spread on an even surface to sundry. Sun drying was done for five consecutive days until crisp textured. Chopped cocoyam corms were immersed in 75 liters of boiling water at 100ºC inside aluminum pot and allowed to boil continuously for fifteen minutes, cooled, drained and dehydrated. This method was previously described by (Olajide *et al*., 2013).

Experimental Diets and Design

A total of one hundred and fourty-old layer chicks were sourced from incubation section at artificial insemination unit of National Animal Production Research Institute, Shika, Zaria and allocated into seven dietary treatments (n=20 birds) in a factorial arrangement 2×3+1; 2 factors (raw and boiled cocoyam), 3 levels (25%, 50% and 75%) and 1 control 0% in a completely randomized design 80 for raw cocoyam and 80 for boiled cocoyam. Seven experimental diets were formulated, comprising 3 diets from raw sundried and another 3 from boiled sundried form and control, each replaced maize 0%, 25%, 50%, and 75% as treatment 1 (T_1), treatment 2 (T_2), treatment 3 (T_3) and treatment 4 (T_4) respectively.

Egg Quality Parameters

Egg quality parameters were calculated using the following formulas and methods as summarized by Yoruk*et al.* (2004), egg shape index (%) = (egg width, cm/egg length, cm) × 100; The egg length (L) and width (W) were measured using Vernier calipers with the least count of 0.01 mm; shell thickness (mm) was determined in 3 different parts with a micrometer; albumen index (%) = (albumen height, mm/average of albumen length, mm and albumen width, mm) × 100; yolk index (%) = (yolk height, mm/yolk diameter, mm) × 100; yolk colour was determined with a commercially available "yolk colour fan" according to the CIE standard colorimetric system (Yolk Colour Fan, the CIE standard colorimetric system, F. Hoffman-La Roche Ltd., Basel, Switzerland), and Haugh unit = $100 \times \log(AH + 7.57 - 1.7 \times EW^{0.37})$, where AH = albumen height (mm) and EW = egg weight (g) (Haugh, 1937).

Egg weight was measured by placing an unbroken egg on a scale and recording the value. The individual eggs were weighed on a digital balance (Ohaus EX45 Explorer) to the nearest of 0.01 g accuracy. According to USDA (2000), egg weights were divided into six size categories. The minimum weight requirements for these categories are jumbo (68.6 g), extra-large (61.5 g), large (54.4 g), medium (47.3 g), small (40.3 g) and peewee (no minimum requirement), eggs were graded based on the category fallen. Albumen weight was calculated by subtracting yolk weight and shell weight from egg weight. Eggshell weight was determined after drying and weighing on digital scale. Albumen and yolk height were evaluated with Vernier calliper. Yolk length and albumen length was evaluated using Vernier calliper. Egg shell colour will be obtain using a scale of 1-5 range with 1; been excellent in brown shell colour, 2; very good, 3; good, 4; poor and 5; been very poor in brown egg shell colour.

Statistical Analysis and Model

The data were analysed by 2×3+1 factorial in completely randomize design (CRD) by a general linear model (GLM) procedure in SAS (2009) software 9.4 Version (SAS Institute Inc., Cary, NC, USA). Means were separated using Tukey test at 5% level of significance.

RESULTS AND DISCUSSION

Effect of season on egg quality parameters in laying hens fed processed cocoyam (*Xanthosoma sagittifolium*) based diet.

Albumen height one of the important indicators of freshness in egg was better during rainy season when the environmental temperature is higher than dry season. This could due to positive effect of selenium in enhancing the egg quality (Muhammad *et al*., 2021). Length and width of the albumen were also higher at dry season affirm previous statement on freshness of the egg. Higher albumen length and width could also be attributed to the size of the egg, as egg/s that is bigger in size might have higher albumen length and width. Higher albumen length and width might also indicate lower freshness in egg. Albumen indexanother important measure that indicates freshness of egg was found to be better in birds during rainy season than dry season. However, yolk height, yolk length and yolk weight were found to be better during dry season. This could be due increase in size of egg due to increase in feed intake as a result of decrease in environmental temperature at dry season. When the ambient

temperature is higher than normal, the poultry skin is covered by feathers and without sweating glands; their regulating is disordered and affect feed intake and dietary energy concentration (Liu, 2019). This is also in line with the report of Mack (2013), who said birds subjected to low temperature conditions spend more time eating and less time drinking water and panting, as well as less time with their wing elevated, more time moving and less time resting. Yolk colour was also better at dry season when compared to rainy season. This could also be due high plain of nutrition at dry season than rainy season when the ambient temperature is higher. Egg length, egg width, and egg weight were found to be higher during dry season when compared to rainy season. This could due to advancement in age couple with decrease in ambient temperature which enhances feed intake to meet the demand required for excellent egg formation and lay. This also in accordance with report of Mack (2013), who said birds subjected to low temperature conditions spend more time eating and less time drinking water and panting. This is contrary with the work of Yakubu *et al*. (2007), who reported that egg production, egg weight and feed intake were higher in the wet season when compared with the hot-dry season.

Table 1: Effect of season on egg quality parameters in laying hens fed processed cocoyam (*Xanthosoma sagittifolium*) based diet.

	Season			
Parameters	**Rainy**	**Dry**	**SEM**	**P value**
Albumen Height (cm)	0.79[a]	0.75[b]	0.005	0.0004
Albumen Length (cm)	7.47[b]	8.45[a]	0.026	0.0001
Albumen Weight (g)	30.06[b]	32.42[a]	0.116	0.0001
Albumen Width cm	6.80	6.80	0.019	1.0000
Albumen Index (%)	20.59[a]	18.50[b]	0.122	0.0001
Yolk Height (cm)	1.73[b]	1.84[a]	0.005	0.0001
Yolk Length (cm)	3.84[b]	4.06[a]	0.008	0.0001
Yolk Weight (g)	14.07[b]	16.24[a]	0.064	0.0001
Yolk Color	3.06[b]	4.84[a]	0.057	0.0001
Yolk Index (%)	45.11	45.41	0.123	0.1390
Haugh unit (Hu)	64.50	63.50	0.832	0.6330
External				
Egg Length (cm)	5.47[b]	5.67[a]	0.009	0.0001
Egg Width (cm)	4.12[b]	4.24[a]	0.006	0.0001
Shell Thickness (mm)	0.48	0.49	0.002	0.1010
Shell Weight (g)	5.17	5.24	0.023	0.1983
Egg shape index (%)	75.40	74.88	0.135	0.0677
Shell Color	2.13	2.13	0.029	1.0000
Egg Weight (g)	51.41[b]	57.06[a]	0.171	0.0001

[a,b]Means within the rows with different superscripts are significantly different (p<0.05)
SEM=standard error of mean; P =probability value; g= gram; cm= centimeter; mm= millimeter

CONCLUSION

In conclusion, the result of this study reveals that cocoyam processing either by boiling or sun drying has a great potential to improved egg quality parameters. The study also underscores the vulnerability of egg quality parameters to seasonal climate changes in tropical monsoon climates and underscores the need for adaptive strategies to sustainably enhance poultry farming under such conditions.

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