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Influence of Production Seasons on Egg Quality Characteristics of Layers in Semi-arid Sokoto, North-Western Nigeria

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ABSTRACT

An experiment was conducted to assess the influence of production seasons (Rainy and Cold Seasons) on the egg quality performance of laying pullets in semi-arid Sokoto environment. Using Completely Randomised Design (CRD), a total of 240 day-old chicks were raised to point of lay (POL) both in battery cage (BC) and on deep litter (DL) housing systems under the rainy and the cold seasons serving as treatments. For each of the seasons, 240 POL birds were divided into 6 replications with 20 birds per replicate and allocated to the battery cage (BC) and deep litter (DL) houses, under the same roof for each season. All management recommendations were observed. At 20 weeks in lay, 72 egg samples were randomly collected, 36 from each housing system and 6 eggs from each of the 6 replications for each season. The sampled eggs were studied for external and internal egg quality traits. From these records, other egg indices were calculated. Reported values are therefore, composite means of the two housing systems under each season. Instruments used were ssensitive electronic balance, Vernier calliper, Micrometer screw gauge, meter rule, flat trays, tissue paper etc, for egg analysis. Results showed that environmental factors that constitute the production seasons have varied effects on external (egg weight (EW)(g), egg length (EL)(cm), egg width (EWd)(cm), egg shell surface (ESS)(cm) and egg surface index (ESI)) and internal egg quality traits (Albumen height (AH)(cm), Albumen width (AW)(cm), Albumen weight (AWt)(g), Albumen index (AI), Yolk height (YH)(cm), Yolk width (YW)(cm), Yolk weight (YWt)(g), Yolk index (YI), Yolk colour (YC), Shell weight (SW)(g), Shell thickness (ST)(mm) and the Haugh Unit (HU) (%)) of eggs produced by commercial layers. These traits were more significantly (P>0.05) favoured during the cold season production than in the rainy season. HU, being the overall score of EQ was significant under the seasons in favour of the cold season. It was thus concluded that the cold season is the best production season when EQ is attained at its best, thus recommended to farmers in the study area to obtain the highest EQ and price for their table eggs.

Keywords: *Egg quality, table eggs, production season, poultry farmers*

INTRODUCTION

Poultry plays an important role in human nutrition, employment and income generation. Poultry is by far the largest livestock group and has been estimated to be about 252.3 million consisting of chickens, ducks and pigeons (BBS 2009). Poultry products constitute 30% of animal protein and will increase to 40% before 2015 (IFPRI 2000) (Talukder *et al.*, 2010). It has been noted that quality of table eggs worldwide, costs the egg industry many millions of dollars annually. Thus, the production of good egg shell quality is important to the economic viability of the global egg industry (Ahmad and Rahimi, 2011). The hen's egg consists of the yolk (30-33%), albumen (approximately 60%) and the shell (9-12%) (Stadelman, 1995). It is sold commercially as shell egg, egg product or as components derived from eggs.

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 pressures of oxygen and carbon dioxide), wind velocity (air movement), solar energy, quality of air and water, and density of population. During the last decade, the influence of environmental factors on poultry have received greater attention so that more reliable baseline values are available. Most studies have dealt with only one environmental factor—with other factors presumably held constant. Yet, it is recognized that in husbandry practices, indoors or outdoors, poultry are subjected to a multiple of factors, none held completely constant, and all interrelated (NAS, (2015).

Thus, climatic conditions have also been known to affect the production behaviour of the laying hens (Smith and Leclecq, 1990; Oluyemi and Roberts, 2000). In areas where climate is hot and humid, commercial hybrids produce an average of 180-200 eggs per year, while in more temperate climate, birds can produce between 250 and 300 eggs per year. The production cycle of eggs may also be influenced by many other factors such as breed, mortality rate, body weight, laying house lighting schedule, feed and culling (North and Bell, 1990).

Above 27°C feed consumption gradually decreases. Oarad *et al.*, (1981) stated that higher temperature reduce the productive performance of layer hens. At 35°C there is a remarkable decrease of feed consumption. Moreover, high temperature is related to egg shell thickness. In high temperature the shell thickness is decreased while Sloan and Harms (1984) reported that there is no effect of low temperature on egg shell thickness. Merat and Bordas (1982) found that body weight did not differ significantly but feed consumption was lower at the higher temperature. A negative correlation between daily feed consumption and temperature in poultry was detected. As the temperature of poultry house increased, feed consumption reduced. In addition, feed conversion ratio also decreased. The reverse trend was observed in lower temperature.

If environmental temperature is allowed to exceed normal ranges, then egg production, egg size and growth will be negatively affected. These factors along with others affect the birds' metabolism which in turn is responsible for the output of eggs, meat, and body heat to maintain normal physiological processes and functions. Environmental stressors such as hot temperatures, high air humidity, etc., may affect the bird in an additive manner if these stressors are imposed concurrently. These stressors can negatively affect hen's growth performance, feed intake and efficiency, and physiological status (Talukder *et al.*, 2010). All these have direct relationship on the quality characteristics of shell eggs produced by laying birds.

Materials and Methods

The research was conducted at the Poultry Production Unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto located at the Sokoto Veterinary Center, Aliyu Jedo road, in Sokoto metropolis.

In a completely randomised design (CRD), a total of 240 point of lay (POL) pullets were allocated to 2 housing systems, namely the battery cage (BC) and the deep litter (DL) systems and each housing system was replicated 6 times with 20 birds per replicate, and raised in the rainy and cold seasons, serving as treatment groups.

At the end of 20^{th} week in lay, 6 eggs per replicate, in 6 replications, making a total of 36 eggs per housing system and 72 eggs per season, were collected and studied for external and internal egg quality characteristics in the Agric. Physical Laboratory. External egg quality characteristics studied were egg weight (EW)(g), egg length (EL)(cm), egg width (EWd)(cm), egg shell surface (ESS)(cm) and egg surface index (ESI). Internal egg quality parameters studied include Albumen height (AH)(cm), Albumen width (AW)(cm), Albumen weight (AWt)(g), Albumen index (AI), Yolk height (YH)(cm), Yolk width (YW)(cm), Yolk weight (YWt)(g), Yolk index (YI), Yolk colour (YC), Shell weight (SW)(g), Shell thickness (ST)(mm) and the Haugh Unit (HU) (%).

Parametric values are therefore composite means of values from the two housing types in the seasons. Instruments used were sensitive electronic balance, Vernier calliper, Micrometer screw gauge, meter rule, flat trays, tissue paper, centimeter rule, petri dishes and Roche Colour Fan etc, for egg analysis. All data on egg quality characteristics were analysed using analysis of variance (ANOVA) and significant means were separated using Least Significant Difference (LSD) using Stat-View Statistical Analysis System (GLM of SAS, 2004).

Results and Discussion

External Egg Quality Characteristics

Results on the external egg quality characteristics of the sampled eggs at 20 weeks in lay under the different seasons is presented in Table 1.

Table1. *External egg quality performance of experimental birds under the two production seasons*

Parameter	Production Season		SEM
	Rainy Season	Cold Season	
Egg weight (g)	53.08[b]	58.92[a]	0.49
Egg length (cm)	5.33[b]	5.63[a]	0.03
Egg width (cm)	4.36	4.38	0.02
Shell weight (g)	6.34[b]	6.75[a]	0.13
Shell thickness (mm)	0.43[a]	0.38[b]	0.01
Egg shell surface (cm)	65.40[b]	71.42[a]	0.99
Egg shape index	0.81[a]	0.78[b]	0.01

Means with different superscripts along the same row are statistically significant (P<0.005).

Significant (P<00.5) effect of the production seasons was reported on EW performance, being higher during the cold season than the rainy season. This is in line with the reports of Talukder *et al.*, (2010) who reported positive effect of low temperature on EW performance of laying birds. High temperatures have been known to affect EW negatively (Star *et al.*, 2008). EW of up to 50-70g have been reported by Nys *et al.*, 2008; Gerzilov *et al.*, 2012, Lolli *et al.*, 2013). There is a dearth of research information on the influence of the seasons on egg weight performance in the study area to compare this performance with. EL was significant (P<0.05), being higher (5.63) in the cold season against a lower value of 5.33 recorded in the rainy season. Thus, lower temperature of the cold season in the study area has a marked effect on EL in this study. EL of up to 5.84-6.00 has been reported by Ojedapo (2013) under similar tropical conditions.

SW performance was significant (P<0.05) and was better at 6.75 in the cold season against the value of 6.34 determined during the rainy season. ST was significant (P<0.05) and surprisingly better under the rainy season (0.43) than under the cold season production (0.38). Thus, ST was higher in eggs produced during the rainy season with characteristic high temperature, than during the cold season when temperatures were milder ad in favour of good shell formation. Many authors reported contrasting effect of temperature or season on ST performance of birds. According to Talukder *et al.*, (2010), high temperature is related to egg shell thickness because at high temperature, ST is decreased. However, Sloan and Harms (1984) reported no effect of low temperature on egg shell thickness. ST range of 0.38 and 0.43 recorded in this experiment is in line with 0.39 – 0.41 reported by Kucukyilmaz *et al.*, (2012).

ESS was significant (P<0.05) under the seasons, being lowest during the rainy season at 65.40 and was best at 71.42 for eggs laid in the cold season. This shows that lower temperatures of the cold season had marked effect on ESS of eggs laid by birds. ESS is a function of egg size and weight and these factors are affected by temperature at which birds are raised as reported by Balnave, (1998). This is supported by the fact that EW under the seasons was also significant (P<0.05) and in favour of the cold season, a time when temperatures are moderately low and in favour of higher EW. ESS values obtained in this research are lower than the ESS value range of 73.50-75.81 as reported by Englmaierova and Tumova *et al.*, (2009) and Lolli *et al.*, (2013).

ESI performance was significant (P<0.05) and best at 0.81 for eggs laid during the rainy season in contrast to lower value of 0.78 recorded on eggs laid during the cold season. Thus, seasonal factors have effect on ESI of eggs laid by laying hens at different seasons. ESI values recorded in this experiment seasons were similar to the values (0.77 to 0.78) reported by Kucukyilmaz *et al.*, (2012).

Internal Egg Quality Characteristics

Table 2 shows the internal egg quality (EQ) characteristics of eggs laid at 20 weeks in lay by the experimental birds under the production seasons.

Table2. *Internal egg quality performance of experimental birds under the two production seasons*

Parameter	Production Season		SEM
	Rainy Season	Cold Season	
Albumen height (cm)	1.17	1.12	0.02
Albumen width (cm)	5.83[a]	5.21[b]	0.07
Albumen weight (g)	34.20b	40.19a	0.62
Albumen index	0.65a	0.45b	0.05
Yolk height (cm)	1.90	1.77	0.08
Yolk width (cm)	3.91a	3.43b	0.03

Yolk weight (g)	12.51 [a]	11.60 [b]	0.24
Yolk index	0.49	0.47	0.01
Haugh Unit (HU) (%)	94.82b	96.04a	0.44

Means with different superscripts along the same row are statistically significant (P<0.005).

AH, YH and YI were not significant (P>0.05) in this study, thus the production seasons have no influence on these egg parameters. AW showed a significant (P<0.05) difference between the production seasons. AW was high during the rainy season at 5.83, higher than 5.21 attained by birds during the cold season.

AWt performance in lay showed AWt was better (40.19) during the cold season than the record of 34.20 attained in the rainy season.

Significant (P<0.05) difference was reported on AI in this research under the production seasons. AI was significant (P<0.05) in favour of the rainy season. There is a dearth of research literature to compare AI performance of birds in this experiment in similar setting in the study area or the tropics.

Yolk Quality

According to Jacob *et al.,* (2000), yolk quality of eggs is determined by the yolk colour, texture, firmness and smell of the yolk. The yolk of a freshly laid egg is round and firm. However, as the egg ages and the vitelline membrane degenerates, water from the albumen moves into the yolk and gives the yolk a flattened shape. Rubbery yolks may be caused by severe chilling or freezing of intact eggs, the consumption of crude cottonseed oil or the seeds of some weeds.

Performance of birds on YW was similarly significant (P<0.05). YW was 3.91, higher in the rainy season and was 3.43, lowest for birds managed during the cold season. This implies that seasons have effect on YW performance of birds on eggs laid and studied by commercial hens in this study. YW mean value in the cold season when ambient temperature was cooler, was lower than that for the rainy season when temperature was higher. This suggests that ambient temperature is likely a factor affecting yolk quality of laid eggs in hot periods. Storage temperature is one of the many factors believed to influence yolk quality of eggs especially yolk firmness, viscosity and stability of yolk vitelline membrane. There is dearth of research literature for comparing performance in this egg quality parameter in a similar experimental setting comparing the seasons in the study area or the tropical environment.

Significant (P<0.05) difference existed on YWt values recorded. Mean YWt value of 12.51 was the highest in the rainy season, better than 11.60 attained during the cold season. YWt values of 20.05 – 21.05 have been recorded by Stanley et al (2013). There is a high lack of research data comparing YWt performance of eggs from layers raised under different seasons, especially in the tropical region.

Haugh Unit/Quality

HU is a measure of egg quality, particularly albumen quality. It signifies the freshness of an egg. HU is calculated from the height of the albumen and the weight of the egg (Coutts and Wilson, 1990, Sekeroglu *et al.*, 2008). A minimum measurement in HU for eggs reaching the consumer is 60. However, most eggs leaving the farm should be between 75 and 85 HU (Coutts and Wilson, 1990; Gerber, (2011).

In this study, HU was significant (P<0.05) with the cold season having a higher HU value of 96.04, than the value of 94.82 recorded during the rainy season. Thus, the production seasons have influence on HU performance of eggs produced by laying hens in the seasons in the area of production. HU values reported in this trial, are higher than the values of 85.0 - 87.2 recorded by Englmaierova and Tumova (2009) from table eggs from birds studied under the season.

Conclusion

HU was reported to be significant (P<0.05) under cold season. Since HU is the overall score of EQ and was best and significant (P<0.05) under the cold season study, internal EQ traits could be said to be better in the cold season, in spite of significant (P<0.05) difference in some individual external and internal parameters in favour of the rainy season. Hence, the cold season is concluded to be the best season for attaining better EQ from eggs produced by commercial layer hens.

Recommendations

Going by the outcomes of this experimental study, it is hereby recommended that:

- The cold season period gives the best overall performance in terms of EQ traits.

- Another research in this set up, should be conducted again in the study area, to include the hot season, which this research failed to capture. If done, it will paint an all-year-round picture of the seasons in EQ performance in the study area. This will avail local layer bird farmers with the best season to target high EQ for optimal and profitable egg production.

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