EFFECT OF BATTERY CAGE AND PASTURE SYSTEMS ON EGG PRODUCTION AND QUALITY PARAMETERS OF LAYING HENS

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ABSTRACT
The study was conducted to investigate the effect of production systems (battery cage, pasture) on egg production and egg quality parameters. 100 Isa Brown laying hens at 50 weeks of age and 80% hen day production were assigned to treatment 1 (battery cage) at 9 birds per replicate, and to treatment 2 (pasture) at 11 birds per replicate. Treatment 1 birds were given 120g/d while treatment 2 birds were given 100g/d of proprietary feed for an experimental period of 7 weeks. Percent hen day egg production, feed intake per dozen eggs, egg weight, and yolk weight were all higher in treatment 1 than in treatment 2. Yolk colour and shell thickness were higher in treatment 2 than in treatment 1.There was no significant difference in the albumen weight, yolk width, yolk height, yolk index and shell weight. It was concluded that egg production of commercial hybrid hens was significantly lower on the pasture than in the battery cage while feed intake per dozen eggs, yolk colour and shell thickness were improved on the pasture.
Keywords: Battery cage, pasture, scavenging, laying hen.

INTRODUCTION
The three poultry management systems (intensive, semi-intensive and extensive) are differentiated on the basis of flock size and input and output relationship (Sonaiya, 1990). The quality of poultry products is mostly influenced by housing system, nutrition and health condition of poultry (Pavlovski *et al.*, 2010). In response to the challenges of the battery cage (barren environment and quality of the products) and scavenging systems (low output and predators), innovations, developments and interventions have been produced (Sonaiya, 2012). Therefore, the aim of this present study was to determine and compare the production performance and egg quality parameters of hens kept in battery cage (intensive system), pasture (semi-intensive system) and on the free-range (extensive system).

MATERIALS AND METHODS
The study was conducted at the Poultry Unit of the Teaching and Research Farm and the Poultry Meat Laboratory. For the pasture treatment, a 30m x 30m plot was mowed prior to fencing with aluminium pole and fencing wire of 1.2m high. The pasture plot was partitioned into 5 sub-plots each with dimension of 6m x 30m. A roofed wooden shelter of 1.9m x 1.2m was constructed for each sub-plot to cover the feeder, waterer and nest box. For the battery cage treatment, a 15 cell battery cage with automatic drinkers was used. The plant species in the fenced area were identified to be *Panicum maximum* and *Ipomoea involucrate* (Table 1).
A total of 100, 50-weeks old Isa Brown laying hens (80% hen day production) was allotted in a completely randomized design into two treatments: battery cage (treatment 1) and pasture (treatment 2) systems. In treatment 1; fifteen battery cage cells of 0.6×0.6m were stocked with 3 birds per cell at 3 cells per replicate making a total of 45 hens which were fed commercial layer mash (Table 2) at 125g/bird/day while water was provided *ad libitum*. For Treatment 2, five pasture sub-plots were stocked with 11 birds per sub-plot making a total of 55 hens which were fed commercial layer mash at 100g/bird/day in addition to access to pasture while water was provided *ad libitum*. Birds were accustomed to study conditions for 7 days before data for percent hen day production (HDP), feed intake per dozen eggs and body weight changes were taken every two weeks. For egg quality analysis, fifteen eggs were collected at two weeks interval for a total of 45 eggs from

each treatment. For comparison, 3 eggs per flock were also collected from scavenging hens of unknown age from five flocks in villages around Ikire, a town 50km south-west of Ile-Ife. Data were collected for weight, shell thickness, yolk colour and yolk index. Data from live performance in battery cages and pasture were analyzed using student t- test. Data on egg quality were analyzed using analysis of variance (ANOVA) while the means were separated by Duncan's multiple range test.

RESULT AND DISCUSSION

Table 3 shows that HDP and feed intake per dozen eggs were significantly higher ($P<0.05$) for hens in the battery cage hens compared to hens on pasture. This could be due to the low concentrate feed intake of birds on pasture because of the high fibre content of the plants on the plot. Glatz *et al.* (2005) reported that the egg production of B-Hyline layers in a free-range system was lower than the standard performance expected in a cage system. The hens on pasture had better feed intake per dozen eggs which agrees with the observation of Olusegun *et al.*, (2012) that hens on pasture improve profitability via reduction in concentrate feed intake and better feed conversion efficiency. The significant loss in body weight of hens on pasture could be related to the use of feed energy for physical activities on the pasture. Glatz and Ru (2002) reported that egg weight and body weight were lower in free range hens than in caged hens. Table 4 shows that the hens in battery cages laid heavier eggs in correlation with their heavier body weights as compared with the hens on pasture or scavenging. The thicker shell of the eggs from scavenging and pasture hens could be due to ingestion of grits on the pasture and also due to higher synthesis of vitamin D_3as a result of the increased exposure to sunlight. The hens on pasture produced eggs with deeper coloured yolk than hens in the battery cage and in the scavenging system. This agrees with the findings of Pavlovski *et al* (2004) that hens on free range produced eggs with deeper coloured yolk.

CONCLUSION

Commercial hybrid hens kept in battery cage were superior to hens on pasture in feed intake, egg production, egg weight and body weight. Hens on pasture had better feed intake per dozen eggs than hens in battery cage. The deepest yolk colour was found in eggs laid by hens on pasture when compared with eggs laid by hens in the battery cage and scavenging. Eggs laid by scavenging local hens had thicker shells than eggs laid by hybrid hens on pasture and in battery cage.

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Table 1: Proximate Composition of *P. maximum* and *I. involucrate*

Content (%)	*P. maximum*	*I. involucrate*
Moisture	14.1±0.57	9.4±1.46
Crude protein	8.8±0.46	10.7±0.14
Crude fibre	24.4±0.49	18.4±4.16
Ether extract	5.9±0.37	6.9±0.40
Ash content	10.2±1.07	11.0±0.23
N free extracts	36.6+0.59	43.6+1.28

Table 2: Percentage composition of the commercial diet

Ingredients	**Quantity(kg)**
Maize	53.00
Soybeans meal	21.00
Wheat offal	15.00
Bone meal	2.20
Oyster shell	8.00
Salt	0.30
Layer Premix	0.25
Lysine	0.10
Methionine	0.15
Calculated analysis	**100**
Metabolizable energy(kcal/kg)	2700
Crude protein (%)	17.60
Crude fibre (%)	3.70
Ether extract (%)	3.29
Calcium (%)	3.92
Phosphorous (%)	0.57

Table 3. Production Characteristics of Battery Cage and Pasture-based systems.

Parameters	Production systems	
	Battery cage	Pasture system
Concentrate feed intake (g/d)	123±1.25[a]	99.6±0.16[b]
Hen-day egg production (%)	77±1.08[a]	66±3.07[b]
Feed intake per dozen egg laid (kg)	1.95±0.03[a]	1.83±0.08[b]
Average daily weight change (g)	-2.06±2.83	-3.02±1.40

[ab]Means in the same rows with different superscripts differ significantly (P<0.05).

Table 4: Egg quality characteristics of three production systems

Qualities	Production systems		
	Battery cage	Pasture	Scavenging
Egg weight (g)	61±6.0[a]	59.2±6.7[b]	34.2±3.5[c]
Albumen weight (g)	35.6±4.2[a]	35.6±4.0[a]	15.6±1.5[b]
Yolk width(mm)	46.7±2.1[a]	46.7±1.9[a]	45.8±2.1[b]
Yolk height(mm)	15.9±1.0[a]	16.3±1.4[a]	11.1±1.5[b]
Yolk weight (g)	15.1±1.5[a]	14.1±1.2[b]	13.3±2.2[c]
Yolk colour*	6±1.8[c]	10±1.5[a]	8±1.7[b]
Shell thickness(mm)	0.30±0.02[c]	0.36±0.01[b]	0.38±0.03[b]
Shell weight (g)	6.8±0.8[a]	6.4±0.7[a]	3.6±0.4[b]
Yolk index	34.7±2.6[a]	34.2±2.6[a]	24.3±2.9[b]

[abc]Means in the same rows with different superscripts differ significantly (P<0.05)