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RELATIONSHIP AMONG EXTERNAL MORPHOMETRIC TRAITS AND SEMEN QUALITY IN BREEDER COCKS AND EGG CHARACTERISTICS IN LAYING HENS

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ABSTRACT

The relationship between external morphometric traits and semen quality in Lohman breeder cocks and egg characteristics in laying hens were evaluated. A total of twelve (12) breeder cocks and sixty–nine (69) hens were assessed in a completely randomized design. External morphometric traits such as comb height, wattle length, earlobe width, ear colour, comb colour were measured using measuring tape. Egg length and egg breadth were measured using Vernier caliper while egg weight was measured using a sensitive weighing scale. Semen was collected weekly for four weeks and evaluated for semen quality such as semen colour, sperm concentration, sperm motility, mass activity and percentage livability. Hen day production was also determined. All data obtained were subjected to correlation analysis. The result showed that a positive non – significant correlation exists between egg weight and wattle length, egg length and comb length, egg length and comb height, egg length and wattle length. Also, a negative correlation which was also not significant was observed between Hen day production and comb length. The relationship between the morphometric traits and semen quality in breeder cocks showed that only the correlation between sperm concentration and comb length was positively significant at $P<0.05$. It was observed that positive correlation existed between semen volume and comb length, comb height, wattle width, ear lobe width, ear colour, wattle colour and comb colour, while it was negatively correlated with wattle length, body weight, ear lobe height and vent diameter. There was a high correlation between ear lobe height and percentage live sperm cells. This study suggests that external morphometric traits in cocks and hen can be used to predict semen quality and egg laying performance characteristics, respectively.

Keywords: Chicken morphology, Lohman breeder cocks, Egg laying chickens, Semen quality.

INTRODUCTION

Reproduction is a vital aspect of poultry production that ensures the continuity of poultry species. Semen evaluation is required to predict fertility in natural mating and artificial insemination (Udeh, 2012). So far, in studying reproductive life cycle of animals, puberty, pregnancy and parturition in mammalian species in which the offspring develop inside the body of the dam and, after birth, are provided nourishment in the form of milk produced by the dam. In the avian species, the hen produces an egg in which, if fertilized, the offspring will undergo growth and development outside the body of the hen. Thus, fertility of the egg is male and female dependent.

The fertilizing ability of the breeder cock is dependent upon several semen quality characteristics which includes semen volume, semen colour, mass activity, sperm motility, sperm concentration, percentage live sperm cells, percentage dead sperm cells and percentage abnormalities (Udeh, 2012). Accurate and reliable prediction equations for estimating semen characters from *in vivo* measurements are required by poultry breeders.

The most accurate method for evaluating the semen characteristics are collection of semen followed by microscopic examination. However, this method is stressful for the bird, time consuming and costly (Galal, 2007). Thus, simple, reliable and indirect methods for in vivo estimation of semen attributes based on the correlation between some morphometric traits and semen parameters are needed. Several studies reported similar conclusions where it was found that ornamental traits (comb and wattle) were good indicators of semen quality (Galal *et al*., 2002; El-Sahn, 2007; Galal, 2007; Gebriel *et al*., 2009).

Semen evaluation in the developing world is a stressful, time consuming and expensive exercise which necessitate the need to develop an alternative means of evaluating semen qualities of breeder males that are used in poultry breeding and also to assist the rural dwellers who do not have access to the laboratory for semen evaluation. As it is known that a successful breeding programme in poultry requires the availability of sexually matured cock and hen, thus this study aims to examine some external morphometric traits of hens and cock, in relation with their egg laying and semen qualities, respectively.

MATERIALS AND METHODS

Experimental Location

The study was carried out at the Poultry Unit of the Teaching and Research Farm, and the Animal Physiology Laboratory, Department of Animal Science, University of Ibadan, Oyo State, Nigeria. The farm is situated in the derived savanna vegetation zone of Nigeria.

Experimental Animals and Management

A total of twelve (12) breeder cocks and sixty-nine (69) hens (Lohman breed) were used for the study. The birds (hens and cocks) were 50 weeks old. The cocks were allotted randomly and housed individually while the hens were allotted randomly (three per group) both in a battery cage system. Feed containing 16.5% crude protein and 2500kcal/kg Metabolisable energy was provided for the hens and cocks *ad libitum* throughout the experiment. Clean water was made available to the birds as well. All the cages were kept clean and adequate management practices were carried out. Medications were administered as at when due. The experiment lasted for four weeks.

Experimental Design

The experimental design was Complete Randomized Design (CRD).

Traits Measured

The physical morphometric traits measured in the breeder cocks and hens using measuring tape (cm) were comb length, comb height, wattle length, wattle width, body weight, ear lobe height, ear lobe width and vent diameter, while ear colour, wattle colour, comb colour were measured by visual appraisal using colour chart. These measurements were repeated after four weeks to minimize error.

Semen Collection and Evaluation

Semen collection was done by abdominal massage method. Semen was obtained by gently massaging (stroking) the back with the palm and the abdomen was massaged from the vent towards the legs with the other hand as described by Burrows and Quinn (1937). Semen was collected into Eppendorf tubes and were labeled accordingly. Immediately after collection, each ejaculate was evaluated for colour, volume, mass activity, motility, concentration, live-dead ratio and sperm abnormalities as described in Ewuola and Egbunike, (2010). The semen evaluation was done once in a week over a period of four weeks using the same procedure.

Semen Colour

Semen colour is done by visual appraisal, the semen collected had either a milky or cream colour and some were transparent which indicate absence of sperm cells.

Semen Volume
The semen volume was measured in the graduated collecting tube. The values obtained were recorded in millitres.

Sperm Motility
This is the collective movement (progressive) of spermatozoa. Sperm motility, a sample of semen was dropped on a microscope slide covered with a slide cover and placed under a light microscope under x40 objective lens to estimate the fraction of the population that was moving in a progressive manner.

Sperm Concentration
The semen is diluted at the ratio 1 to 20 of semen to formal saline, 0.1ml of the semen was mixed with 2ml of formal saline. A drop of the mixture was dropped on the hemocytometer and placed under the light microscope to estimate the number of sperm cells.

Percentage Livability
A drop of the fresh semen sample was placed on a glass slide and stained with eosin nigrosine stain and a glass smear was prepared and air dried after which it was placed under a light microscope. The sperm cells that absorb the stain were counted as dead cells while those that did not were counted as live sperm cells. The dead sperm were counted and placed as a fraction of the total number of sperm cells that are present.

Abnormal Sperm Cells
To estimate the fraction of the semen samples that are abnormal, a drop of the fresh semen sample was placed on a glass slide and stained with eosin nigrosine stain and a glass smear was prepared and air dried after which it was placed under a light microscope and viewed at x40 magnification, some abnormal sperm cells, such as, sperm cells with no head or no tail or curved tail were also visible under the light microscope and they were counted and placed as a fraction of the total number of sperm cells that are present in that particular field.

Egg Collection and Evaluation
Eggs were collected daily from the cage and well labeled accordingly for easy identification. The following parameters were taken from the eggs daily: Hen day production, egg shell colour, egg weight, egg breadth, egg length, percentage egg production per bird per week.

Egg Weight
The egg weight was determined using an electric sensitive scale. The egg was placed at the center of the weighing scale plate and the weight was recorded for each egg in gram (g).

Egg Length and Breadth:
Egg length and breadth was determined using a digital venial caliper. The egg was placed vertically, and the longest length of the egg was taken this was recorded as the length while the breadth was taken by measuring the fattest area of the egg and is recorded. All measurements were recorded in centimeter (cm).

Egg Shell Colour
Egg shell colour was determined using an egg shell colour chat. The colour of the shell was compared with the colours on the colour chat and it is given number from one to nine (1 – 9) indicating white, tinted, red, extra red, extra dark to exceptional or accidental colour as the case may be.

Hen Day Production (HDP)
The hen day production is determined by dividing the total number of eggs laid per day by the total number of birds per group multiplied by hundred. This

can be expressed mathematically as

$$\text{HDP} = \frac{\text{total number of eggs in a box per day}}{\text{total nuber of birds in each box}} \text{ X } 100$$

Percentage Egg Production per Bird per week
The average of the number of eggs collected per group per day was then used to calculate the percentage egg production per bird per week.

Percentage egg production per bird per week = $\frac{\text{Total number of eggs produced per bird per week}}{7} \text{ x } \frac{100}{1}$

Statistical Analysis

Data collected were subjected to Pearson correlation analysis of SAS (2003) to determine the relationship between the morphometric external features of the cock and the semen qualities and also to determine the relationship between the morphometric external features of the hen and the egg laying ability.

RESULTS

The external morphometric traits of breeder cocks and laying hens

The external morphometric traits of cocks and hens are presented in Table 1. The Live body weight, comb length, comb width, wattle length, wattle width, earlobe length, earlobe width and vent diameter were significantly ($P<0.05$) influenced by sex. All the variables were higher ($P<0.05$) in cocks than hens except vent diameter which was lower in the former. Earlobe colour was light red in hens and red in cocks while the hen comb colour was pinkish red, the cock was brick red. The wattle colour in hen and cocks were brick red and dark red, respectively.

Table 1: Live body weight, qualitative and quantitative external morphometric traits of breeder cocks and laying hens (n=69)

Parameters	Sex	Mean	Standard Deviation	Range	
				Minimum	Maximum
Live Body Weight (kg)	Hens	1.74[b]	0.12	1.57	2.15
	Cocks	2.71[a]	0.24	2.4	3.2
Comb Length (cm)	Hens	6.66[b]	0.56	5.20	7.73
	Cocks	14.14[a]	1.78	9.5	17.1
Comb Height (cm)	Hens	3.64[b]	0.45	2.83	4.77
	Cocks	8.03[a]	0.73	6.9	9.3
Wattle length (cm)	Hens	3.21[b]	0.43	2.27	4.05
	Cocks	6.05[a]	0.71	4.5	7.4
Wattle width (cm)	Hens	2.71 [b]	0.40	1.70	3.75
	Cocks	5.06[a]	0.85	3.7	6.8
Earlobe height (cm)	Hens	2.97 [b]	0.36	2.00	3.67
	Cocks	5.06[a]	0.85	3.7	6.8
Earlobe width (cm)	Hens	2.20 [b]	0.37	1.50	3.17
	Cocks	3.88[a]	0.74	2.7	5.3
Vent Diameter (cm)	Hens	2.08[a]	0.19	1.50	2.40
	Cocks	1.58[b]	0.24	1.0	2.0
Ear lobe colour	Hens	Light Red			
	Cocks	Red			
Comb colour	Hens	Pinkish Red			
	Cocks	Brick Red			
Wattle colour	Hens	Brick Red			
	Cocks	Dark red			

ab: Means along the same column with different superscripts are significantly ($P<0.05$) different

The Morphometric traits of Eggs from Laying hens

The external morphometric traits of eggs from laying hens are presented in Table 2. The egg weight, egg length and egg width ranged from 41.21 to 68.75g, 4.25 to 6.15 and 2.31 to 4.91cm, respectively. The egg shell colour score was 2.78± 0.63, while the weekly egg production per bird was 81.83±16.72

Semen characteristics of the breeder cocks

The semen characteristics in breeder cocks is as shown in Table 3. Semen volume, mass activity, sperm motility and sperm concentration ranged from 0.20 to 1.65ml, 1.00 to 4.00, 50.00 to 95.00, and 0.19 to 2.49x10^9/ml. the sperm livability and abnormality were 91.16±10.27 and 10.74±6.29, respectively.

Table 2: Morphometric traits of Eggs from Laying hens (n=479)

Parameters	Mean	Standard Deviation	Range	
			Minimum	Maximum
Egg Weight (g)	57.48	3.99	41.21	68.75
Egg Length (cm)	5.59	0.21	4.25	6.15
Egg Breadth (cm)	4.27	0.16	2.31	4.91
Egg Shell Colour score	2.78	0.62	1.0	4.0
Weekly Egg Production per bird (%)	81.83	16.72	28.57	100.00

Table 3: Semen characteristics of the breeder cocks

Parameters	Mean	Standard Deviation	Range	
			Minimum	Maximum
Semen volume (ml)	0.59	0.28	0.20	1.65
Mass activity	3.64	0.72	1.00	4.00
Sperm motility (%)	86.59	16.66	50.00	95.00
Sperm concentration (x10^9/ml)	1.28	0.12	0.19	2.49
Sperm Livability (%)	91.16	10.27	50.00	100.00
Abnormality (%)	10.74	6.27	3.45	33.33

Pearson correlation between external morphometric traits and egg characteristics

The result of correlation between external morphometric traits and egg laying characteristics in breeder hens is shown in Table 4. It was observed that all the correlation coefficients obtained were not significant. A positive correlation existed between hen-day production and comb height, body weight, ear lobe height, ear colour and comb colour while it had a negative correlation with comb length, wattle length, wattle width, ear lobe width, vent

diameter and wattle colour. The egg shell colour positively correlated with comb length, comb height, wattle width, body weight, ear lobe width, vent diameter and ear colour. But it had a negative correlation with comb length, comb height, wattle length, wattle width, body weight, ear lobe height and wattle colour. A positive correlation also exists between egg length and comb length, comb height, wattle width, wattle length, ear lobe height, ear lobe width, vent diameter, ear colour, comb colour and wattle colour while it negatively correlated with body weight. Egg breadth was observed to positively correlate with comb length, wattle width, body weight, ear lobe width, vent diameter and comb colour while it negatively correlated with comb height, wattle length, ear lobe height, ear colour and wattle colour. It was observed that percentage egg production per bird per week positively correlated with body weight, ear lobe height, earlobe width, vent diameter and ear colour but negatively correlated with comb length, comb height, wattle length, wattle width and wattle colour.

The result on correlation between external morphometric traits and semen quality parameters in breeder cocks is presented on Table 5. Among all the correlation coefficients obtained, only the correlation between sperm concentration and comb length showed positive high significance at $P<0.05$. All other correlation coefficients recorded either positive or negative where not significant. It was observed that a positive correlation existed between semen volume and comb length, comb height, wattle width, ear lobe width, ear colour, wattle colour and comb colour while a negative correlation was recorded with wattle length, body weight, ear lobe height and vent diameter. The correlation coefficient obtained for semen colour showed a positive correlation with ear colour, comb colour, and vent diameter but a negative correlation existed with comb length, comb height, wattle length, wattle width and body weight. There existed a positive correlation between Mass activity and comb length, wattle length, wattle width, ear lobe height, ear lobe width, ear colour, comb colour, wattle colour and vent diameter while it has a negative correlation with comb height and body weight. It was also observed that a positive correlation was observed between motility and comb length, wattle length, wattle width, ear lobe height, ear lobe width, ear colour, wattle colour, comb colour and vent diameter while a negative correlation was observed with comb and body weight. The correlation coefficient for concentration showed a positive correlation with comb height, wattle length, ear lobe height, ear lobe width, ear colour, wattle colour and vent diameter while a negative correlation was observed with body weight and comb colour. The correlation coefficient for percentage live sperm cells was observed to have a positive correlation with comb length, wattle length, wattle width, ear lobe width, ear lobe height, ear colour, wattle colour, comb colour and vent diameter while it has a negative correlation with cob height and body weight. Percentage dead sperm cells was observed to be positively correlated with comb length, comb height, ear lobe width, vent diameter while its negatively correlated with wattle length, wattle width, body weight, ear lobe height, ear colour, wattle colour and comb colour. It was also observed that percentage abnormal sperm cells had a positive correlation with comb length, comb height, ear lobe width, wattle colour, comb colour, vent diameter while it has a negative correlation with wattle length, wattle width, body weight and ear colour.

Table 4: Correlation between morphometric external traits and egg characteristics in laying hens

Parameters	Comb length	Comb height	Wattle length	Wattle width	Body weight	Ear lobe height	Ear lobe width	Vent diameter	Ear colour	Comb colour	Wattle colour
HDP	-0.1633	0.1536	-0.0487	-0.0570	0.0703	0.0703	-0.2734	-0.2098	0.1390	0.1290	-0.2396
ESC	0.1938	0.0465	0.1221	0.1792	0.0259	-0.2675	0.2007	0.0346	-0.1727	-0.2600	-0.0358
EW	-0.0116	-0.1520	-0.0262	-0.0287	-0.0287	-0.0619	0.2276	0.0276	0.1559	0.1126	-0.3081
EL	0.0281	0.0211	0.1381	0.0437	-0.0430	0.2919	0.0724	0.0679	0.1562	0.0506	0.0342
EB	0.0057	-0.1124	-0.0964	0.0122	0.1343	-0.0904	0.0662	0.0232	-0.0564	0.2041	-0.1257
WEP	-0.5727	-0.7320	-0.6528	-0.3846	0.0551	0.0808	0.1291	0.0362	0.3978	-0.3189	-0.9078

HDP - Hen Day Production, ESC - Egg Shell Colour, EW - Egg Weight, EL - Egg Length, EB - Egg Breadth
%WEP – Weekly egg production per Bird per Weeks

Table 5: Correlation between external morphometric traits and semen quality parameters in breeder cocks

Parameters	Comb length	Comb height	Wattle length	Wattle width	Body weight	Ear lobe height	Ear lobe width	Ear colour	Wattle colour	Comb colour	Vent diameter
Semen volume	0.4557	0.0556	-0.0902	0.0947	-0.4685	-0.0667	0.3233	0.3292	0.2837	0.3309	-0.1366
Semen colour	-0.4004	-0.2104	-0.2202	-0.3479	-0.2498	-0.1077	-0.0292	0.2075	-0.0916	0.2209	0.3382
Mass Activity	0.4393	-0.0813	0.1614	0.1124	-0.3088	0.1699	0.0551	0.2982	0.2147	0.1988	0.1787
Motility	0.3878	-0.0874	0.1614	0.1216	-0.2898	0.0937	0.0234	0.3060	0.2329	0.1752	0.2116
Concentration	0.5938**	0.1802	0.0608	0.1498	-0.0227	0.0687	0.1933	0.2445	0.2549	-0.2638	0.1967
% Live	0.3619	-0.1362	0.1589	0.0796	-0.3629	0.0859	0.1026	0.2719	0.1466	0.2668	0.2405
% Dead	0.1357	0.0932	-0.1653	-0.2807	-0.1163	-0.0005	0.0608	-0.1422	-0.2299	-0.1888	0.0293
% Abnormal	0.1377	0.1839	-0.2523	-0.3289	-0.0604	0.1567	0.1091	-0.0042	0.2384	0.0819	0.0185

** There is high significant correlation at $P < 0.05$. * There is significant correlation at $P < 0.01$

DISCUSSION

According to the report by Oluyemi and Roberts (2000), some external morphometric traits can be used to predict birds that are out of lay and those that are just coming into the laying phase. The success of selection of breeder cocks and hens using external morphometric traits will be of great advantage to poultry production at large. The observed significantly increase in value for all the quantitative external morphometric traits measured in cocks than the hens except vent diameter could be attributed to the higher weight and size of the cock than the hen. Besides, the presence of testosterone, the male reproductive hormone, in abundant in cocks do promote vegetative growth of those traits most especially comb length and height, wattle length than their female counterpart. Vent diameter which was significantly higher in hens than cocks may be probably due to egg laying activity since the single vent plays dual role of oviposition and excretion which would have widen the vent than that of the cocks. It has been reported that external morphometric traits such as comb and wattle significantly correlate with ejaculate volume, sperm concentration, percentage live sperm cells and sperm motility (Galal *et. al.,* 2002). Also, Udeh *et al.* (2012) reported that comb size can be used to predict semen traits of cock, similarly larger combs may indicate rosters with more semen production compared with rosters with smaller combs (Burrows and Titus, 1939). Wattle length and height correlated with semen volume as reported by Bakst *et al*. (1994). There was a positive correlation between comb height and sperm concentration (Kathleen, 2008) but a negative correlation was established between wattle width and sperm motility which was at variance with the report from this study because a positive correlation was observed between wattle width and sperm motility.

Hang (2008) reported that body weight has no impact on sperm quality but from this study, body weight was negatively correlated with all the semen quality parameters such as semen volume, semen colour, sperm concentration, sperm motility, mass activity, percentage abnormal sperm cells, percentage live sperm cells and percentage dead sperm cells. This implies that heavier cocks may likely suffer depressed semen quality than light weight cocks. This suggests that excessive feeding which induces increase in the rate of fat deposition that leads to increase in weight will reduce the reproductive efficiency in breeding cocks

Ear lobe height and ear lobe width was found to be positively correlated with mass activity, concentration, percentage live sperm cells and motility and this corroborates with the report of Benedetti *et al.* (2011).

Reddy *et al.* (2004) reported that egg characteristics of some laying birds can be assessed using some external morphometric traits such as comb length, comb height, wattle width, wattle length, body weight, ear lobe width and vent diameter are positively correlated with egg shell colour. This finding also corroborates the report of Obioha (1992) who also recorded a positive correlation between egg colour and the above-mentioned morphometric traits.

CONCLUSION

The findings from this study revealed that external morphometric traits such as comb length, comb height, wattle length and body weight can be used to predict the egg characteristics in laying hens, while comb length, comb height, wattle length, vent diameter positively correlated with semen quality attributes in breeder cocks.

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