

Egg fertility and hatchability in *Avians* broiler-breeder hens under humid tropical conditions

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Abstract

Impact of temperature and humidity in different month of lay was evaluated on fertility and hatchability in broiler breeder hens reared in Sapele, Nigeria. Six million, six hundred and nineteen thousand, seven hundred and forty six eggs from flocks of Avians broiler-breeder hens reared between 2005 and 2006 in a farm located in Sapele were used. Egg fertility and hatchability ($P < 0.001$) were significantly affected by month of lay. The month of June recorded the highest egg fertility were the highest in hatchability of set eggs and fertile eggs was in May. However, fertility and hatchability for all months between May and October were not different from each other but significantly higher than the values obtained in January-April and November-December. Months of May-October were the rainy season in Sapele while dry spell covers November to April. Temperature had significant ($P < 0.05$) but negative correlation with egg fertility ($r = -0.31$), hatchability of set eggs ($r = -0.26$) and fertile eggs ($r = -0.12$) respectively. Correlation of amount of rainfall with egg fertility ($r = 0.29$), hatchability of set eggs ($r = 0.22$) and of fertile eggs ($r = 0.06$) was positive ($P < 0.05$). Relative humidity had positive ($P < 0.05$) correlation with egg fertility ($r = 0.25$), hatchability of set eggs ($r = 0.17$) and fertile eggs ($r = 0.48$). Correlation of number of rainy day with egg fertility ($r = 0.40$), hatchability of set eggs ($r = 0.34$) and fertile eggs ($r = 0.71$) was positive and strong ($P < 0.05$). It can be concluded that high pen temperature especially during dry season does adversely affect egg fertility and hatchability in Avians broiler-breeder hens under humid tropical conditions.

Keywords: season, egg fertility, hatchability, broiler-breeder, Sapele

Introduction

High temperature has detrimental effects on productivity of poultry species (Abioja 2010), especially in regions where environmental and/or pen temperature approaches or exceeds body temperature. It leads to reduction in egg fertility and hatchability (Karaca *et al.* 2002c). Fertility and hatchability are important determinants of the productivity in broiler breeder flocks. Lowered fertility may results from poor quality semen from heat-stressed cocks

used in natural or artificial insemination, or hen's inability to release viable ovum and effectively store spermatozoa in the semen storage tubules (SSTs) in the reproductive tract (McDaniel *et al.* 1995; Karaca *et al.* 2002a). Some other factors that can affect fertility and hatchability of breeder eggs include age of hens (Gumulka and Kapkowska 2005; Fassenko *et al.* 2009), the use of natural mating or artificial insemination (Brillard 2004) and mating ratio (Hazary *et al.* 2001). Lucas and

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Marcos (2013) in a review, postulated that there are several potential pathways are still under investigation, including changes of reproductive hormones levels which do affect the success or otherwise of reproduction in chickens. All these are results of heat stress in breeder farms in Nigeria. The effects of heat stress on egg fertility and hatchability differ from season to season and for different locations in various species of poultry (Ipek and Sahan 2004; González-Redondo 2006; Ozceilik et al. 2006). Sapele, a city in the Nigeria Delta located on latitude 05° 31'N, longitude 05° 48'E and elevation of 2.44 m above sea level has warm humid climate. The higher humidity coupled with hotness during dry season usually aggravates the effects of heat stress (Adeyinka et al. 2004). Understanding of the extent to which egg fertility and hatchability are affected by temperature and humidity in each month will bridge the gap of knowledge in this area of animal production. Therefore, the present study is to determine the monthly variations in egg fertility and hatchability in Sapele, Nigeria.

Materials and methods

Experimental location: The birds were reared in Sapele located on latitude 05°31'N, longitude 05°48'E and elevation of 2.44 m above sea level.

Meteorological observations: The data on monthly minimum, maximum and mean ambient temperatures, relative humidity and rainfall for Sapele covering years 2005 and 2006 were collected from the Nigerian Meteorological Agency (NIMET) Office, Oshodi, Lagos. The data were actually the mean for collected at 09.00 h daily throughout the month.

Management of the birds: Data collected from flocks of broiler-breeder hens (strain *Avians*) of Zartech Farms Nigeria Limited in Sapele were used. The birds were raised on the wood-shaving floors in open-sided housing units on the same farm location and artificially inseminated weekly with semen collected fresh on the farm. Hatchable eggs from the breeder hens of strain *Avians* were collected twice daily, arranged in crates, labelled and transported straight to the setting room where they were sorted to remove cracked and non-settable eggs under 26°C before setting. The eggs were fumigated and kept in cold room for not more than 2 to 3 days before setting. Set eggs stayed in the setter (N. V. Petersime® EV1/EN2 Setter, Belgium; capacity 57600) at 37.5 - 37.6°C and 85% RH for 18 days before candling. Fertile eggs were thereafter transferred into the hatcher (N. V. Petersime® B-9870 Hatcher Zulte, Belgium; capacity 19200) at 36.9°C and 88 - 92.5% RH for 3 days.

Data collection: Records of egg collected, egg set, fertile eggs, egg hatched, percentage fertility and percentage hatchability were kept each month over the years 2005 and 2006. The eggs were collected from pens in a single farm location in Sapele.

Statistical analyses: The data were subjected to analyses of variance using the general linear model procedures of SYSTAT statistical computer package (SYSTAT, 1992). The model is $Y_{ij} = \mu + M_i + \Sigma_{ij}$; where Y_{ij} = yield; μ = population mean, $M_i = i^{\text{th}}$ effect due to month ($i = 1, 2, \dots, 12$); and Σ_{ij} = residual error. The egg fertility, hatchability and climatic data were subjected to Pearson correlation analysis to determine the relationships between them.

Results

Sapele had her hottest months in March and April (29.3°C) and the coldest in August (26.4°C). The temperature decreased gradually from the peak (29.3°C) in March to 26.4°C in August, before a gradual increase in dry months. It rained throughout the year in Sapele, though the amount was low in January, February, November and December. Rain started in March and increased in amount till a peak was reached in July. There was a reduction in amount of rainfall in August before another peak was obtained in September. The characteristic bimodal pattern of rainfall in the southern Nigeria was observed in Sapele. Relative humidity ranged between 80.8 and 88.2%.

Monthly egg fertility and hatchability of set eggs and of fertile eggs of broiler-breeder hens are shown in Figures 1-3 respectively. The mean egg fertility and hatchability of

set eggs and of fertile eggs were 82.04%, 69.93% and 84.91% respectively. Month had significant ($P < 0.001$) effect on egg fertility, hatchability of set eggs and of fertile eggs. The highest fertility (88.0%) was recorded in June. Egg fertility however was not significantly ($P > 0.05$) different in the months of May to October. The lowest (75.3%) fertility was observed in February. Egg fertility in January, February and December was not different from each other. The value increased steadily from February through March, April and May to reach the peak in June. A plateau was formed from June to October before the value decreased in November and December. Hatchability of set eggs and fertile eggs followed similar pattern but the highest were in May. The percentage runt was less than 1% of the total egg set for each of the month.

Table 2 shows the Pearson pair-wise

Table 1. Summary of climatic data of Sapele (Delta State) during year 2005 and 2006

Parameter	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean temp. (°C)	27.1	28.8	29.3	29.3	28.3	27.4	26.5	26.4	26.5	27.7	28.8	27.8
Relative hum. (%)	80.8	81.4	82.0	81.4	82.8	84.6	88.2	87.0	87.4	83.2	81.6	81.6
Rainfall (mm)	45.5	66.5	130.3	192.2	309.9	359.9	525.5	364.6	425.0	369.8	58.5	13.6
No of rainy day	6.0	6.4	12.2	14.7	23.8	20.2	22.4	17.6	18.4	22.4	6.8	2.0

Table 2. Correlation matrix of climatic factors and egg fertility

	Temperature	Relative humidity	Rainfall amount	Number of rainy day	Fertility	Hatchability of set eggs	Hatchability of fertile eggs
Temperature	1.00						
Relative humidity	ND	1.00					
Rainfall amount	ND	ND	1.00				
Number of rainy day	ND	ND	ND	1.00			
Fertility	-0.31*	0.25*	0.29*	0.40*	1.00		
Hatchability of set eggs	-0.26*	0.17*	0.22*	0.34*	ND	1.00	
Hatchability of fertile eggs	-0.12*	0.48	0.06*	0.71*	ND	ND	1.00

ND- Not determined; * $P < 0.05$

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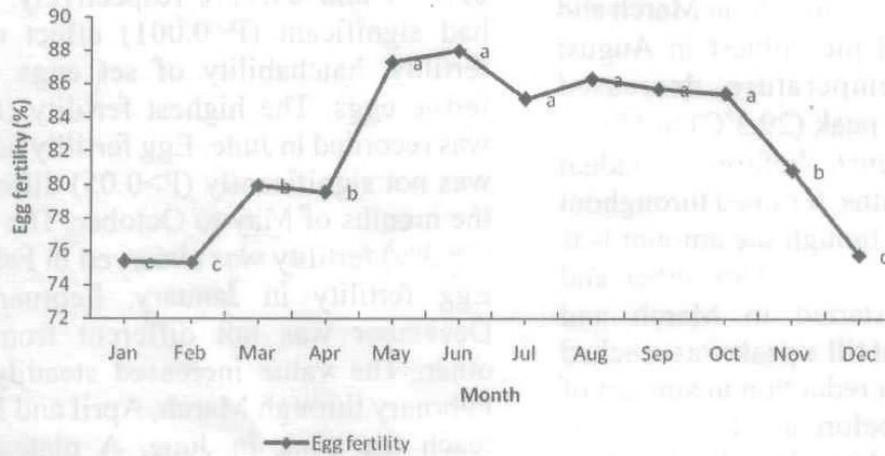


Figure 1. Effect of month of lay on egg fertility of broiler-breeder hens in Sapele

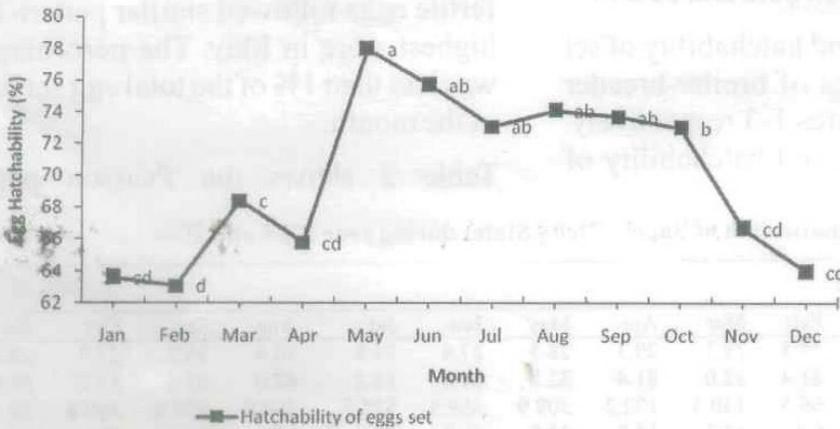
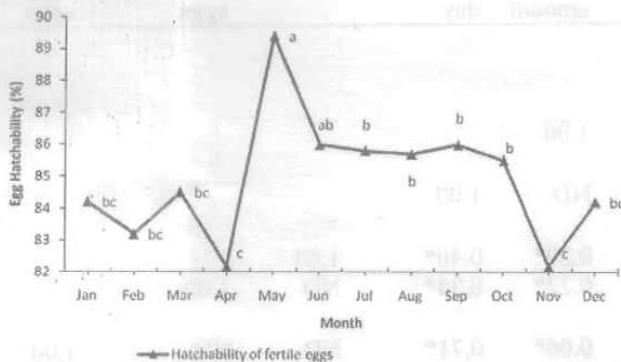


Figure 2. Effect of month of lay on hatchability of set eggs of broiler-breeder hens in Sapele



Means with different letters on the same curve differ significantly ($P < 0.05$)

Figure 3. Effect of month of lay on hatchability of fertile eggs of broiler-breeder hens in Sapele

correlation matrix for egg fertility, hatchability and climatic variables. Temperature had significant ($P < 0.05$) but negative correlation with egg fertility ($r = -0.31$), hatchability of set eggs ($r = -0.26$) and fertile eggs ($r = -0.12$) respectively. Correlation of amount of rainfall with egg fertility ($r = 0.29$), hatchability of set eggs ($r = 0.22$) and of fertile eggs ($r = 0.06$) was positive. Relative humidity had positive correlation with egg fertility ($r = 0.25$), hatchability of set eggs ($r = 0.17$) and fertile eggs ($r = 0.48$). Correlation of number of rainy day with egg fertility ($r = 0.40$), hatchability of set eggs ($r = 0.34$) and fertile eggs ($r = 0.71$) was positive and strong.

Discussion

In broiler-breeder production, the main goal is production of fertile eggs (McDaniel, *undated internet material*). These eggs at the same time must hatch out to become healthy chicks. According to Sastry *et al.* (1996) temperature was the most critical factor for incubation and the temperature affected both quantity and quality of hatch. The finding in the present study is in agreement with the report of Keirs (1982) in broiler breeder hens that the reduction in egg fertility during summer month can be as much as 15% compared with the value during cooler month. In the same vein, Ipek and Sahan (2004) reported negative effect of dry season on egg fertility and hatchability. Lower egg fertility and hatchability are recorded in breeder chickens during hot seasons (Bird *et al.*, 2000; Morris, 2004). Chowdhury *et al.* (2004) found high hatchability in fall and winter and lower hatchability in the summer in Belgium. Heat stress in male chickens caused a lowered sperm concentration, semen volume and reduction in the fertilizing capacity of spermatozoa in cocks (Karaca *et al.*, 2002b). In contrast,

Yassin *et al.* (2008) reported that higher hatchability was obtained in summer month in broiler-breeder hens in Netherland. Most poultry in developed countries use temperature controlled close pen system. Ayo *et al.* (2011) reviewed on the effects of heat stress on the well-being, fertility and hatchability of chickens in the northern Guinea Savannah zone of Nigeria and concluded that there exists complex interplay between environment and reproductive efficiency of domestic chickens.

The results of correlation analysis revealed that higher the temperature, the lower the egg fertility and hatchability. This is in consonance with the findings of Karaca *et al.* (2002b) and Abioja (2010). High environmental temperature had been implicated in poor semen quality in cocks, sperm capacitation in the female reproductive tract and storage in semen storage tubules (SSTs) in the reproductive tract (McDaniel *et al.*, 1995; Karaca *et al.*, 2002a). Amount of rainfall and relative humidity tend to ameliorate the effects of high environmental and pen temperature on the hens. Therefore, as precipitation increases, so does the egg fertility and hatchability. Reduction in nutrients that supposed to be diverted to thermoregulatory activities such as panting may be the reason for increased egg fertility and hatchability. Subjecting breeder hens to heat stress leads to infertile eggs laid (Karaca *et al.* 2002b).

Conclusion

High temperature coupled with high relative humidity lowers egg fertility and hatchability in broiler breeder hens. Therefore, strategies to ameliorate the micro-climate of birds during dry season should be put in place if the productivity

must be maintained throughout the year.

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