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Effects of source of hatchable egg on egg external characteristics, fertility, embryo characteristics, mortality, and hatchability of guinea fowl keets

Idowu, O. P. A. [1,2*], [2]Egbeyale, L. T., [2]Odutayo, O. J., [2]Idowu, K. R., [2]Iyanda, A. I., [2]Sogunle, O. M.

[1] *Agricultural Media Resource and Extension Center, Federal University of Agriculture Abeokuta, P.M.B. 2240, Abeokuta Ogun State, Nigeria.*

[2] *Department of Animal Production and Health, College of Animal Science and Livestock Production, Federal University of Agriculture Abeokuta, P.M.B. 2240, Abeokuta Ogun State, Nigeria.*

[*] **Corresponding author:** idowuopa@funaab.edu.ng

Abstract

The study was design to identify effect of Guinea fowl hatchable egg source on fertility and hatchability and egg physical characteristics. Hatching eggs are primarily subject to assessment of external characteristics. The most important characteristics determining whether eggs are suitable for incubation are their weight, shape, and eggshell condition. Six hundred Guinea fowl eggs were purchased from two reputable breeder farms in Northern Nigeria BirninKebbi and Southern Nigeria Saki consisting of 300 eggs from each source. The eggs collected were stored for seven days at temperature between 16°C-20°C and selected for incubation in an automated incubator to determine the percentage overall keet hatched, dead in shell, dead in germs, infertile, fertile but not hatched and weak in shell. The results showed that, the hatching rate of the eggs was mostly found to be in the range of 60% for Saki and 68% for BirninKebbi. From the measurements of egg weight, egg length, egg width and egg shape index, egg length and egg shape index (ESI) were significantly ($p<0.05$) influenced by the egg source. Eggs sourced from Saki had significantly ($p<0.05$) higher egg length (44.12 mm) and lower egg shape index (0.70) values compared with those got from BirninKebbi. Incubated eggs sourced from BirninKebbi had higher dead in shell (17%), infertile eggs (7%) and keets hatched (68%) compared to ones from Saki, while hatchable eggs from Saki had higher dead in germ (28%) and weak in shell (4%) embryos compared to values obtained for BirninKebbi eggs. Data on incubated guinea fowl eggs were obtained from the hatchery units records and the results showed that, the hatching rate of the eggs was mostly found to be in the range of 60% for Saki and 68% for BirninKebbi. The experiment was laid out on studentized - t test at 95% confidence limit.It was concluded that hatchable Guinea fowl eggs sourced from BirninKebbi in the hot northern region of Nigeria are better than those obtained from the cooler Saki area of the south-west due to high keets hatched (68%) and low dead in germ and weak in shell embryo. The hot weather conditions at Kebbi appear to have adverse effect on Guinea fowl egg fertility and hatchability. The egg fertility of guinea fowl during hot periods needs further investigation to enable better conclusion to be drawn.

Keywords: *Numidameleagris*, hatchability, incubation, egg fertility

Effets de la source d'œuf à l'ascenseur sur les caractéristiques extérieures des œufs, de la fertilité, des caractéristiques d'embryon, de la mortalité et de l'achoupriabilité des villes de la guignade

Résumé

L'étude a été conçue pour identifier l'effet de la source d'œufs à l'éruption à l'églance de la guidé sur la fertilité et les caractéristiques physiques d'élevabilité et d'œuf. Les œufs d'éclosion sont principalement soumis à l'évaluation des caractéristiques externes. Les caractéristiques les plus importantes déterminant si les œufs conviennent à l'incubation sont leur poids, leur forme et leur état d'œufs. Six cents œufs de picottes de Guinée ont été achetés dans deux fermes d'éleveur réputées dans le nord du Nigéria Birninkebbi et le sud du Nigeria Saki composé de 300 œufs de chaque source. Les œufs recueillis ont été stockés pendant sept jours de température entre 16^{o}C-20^{o}C et sélectionnés pour une incubation dans un incubateur automatisé pour déterminer le pourcentage de keet global éclos, morts en coquille, morts dans des germes, stériles, fertiles mais non éclos et faibles en coquille. Les résultats ont montré que, le taux d'éclosion des œufs était principalement reconnu dans la fourchette de 60% pour Saki et 68% pour Birninkebbi. Des mesures de poids d'œuf, de longueur des œufs, de largeur d'œufs et d'index de forme d'œuf, de longueur d'œufs et d'index de forme d'œufs (ESI) ont été significativement ($p <0,05$) influencées par la source d'œufs. Les œufs provenant de Saki avaient de manière significative ($p <0,05$) la longueur d'œuf supérieure (44,12 mm) et les valeurs inférieures de la forme d'œufs (0,70) sont comparées à celles de Birninkebbi. Les œufs incubés provenant de Birninkebbi avaient des morts plus élevés dans la coquille (17%), des œufs stériles (7%) et des attelles éclos (68%) par rapport à ceux de Saki, tandis que les œufs de Saki étaient plus élevés de Saki (28%) et faibles En coquille (4%) embryons par rapport aux valeurs obtenues pour les œufs Birninkebbi. Les données sur les œufs d'œufs d'tinctouche incubées ont été obtenues à partir des enregistrements d'unités d'écloserie et les résultats ont montré que le taux d'éclosion des œufs était principalement constaté partie de 60% pour Saki et 68% pour Birninkebbi. L'expérience a été définie sur un test étudié à 95% de la confiance. Il a été conclu que les œufs d'œufs d'orgueille à l'ascellable provenant de Birninkebbi dans la région du nord du Nigéria chaude sont meilleurs que ceux obtenus à partir de la zone froide Saki du Sud-Ouest en raison de hautes clés éclos (68%) et de morts peu élevés dans les germes Embryo Shell. Les conditions météorologiques chaudes de Kebbi semblent avoir des effets néfastes sur la fertilité des œufs d'œufs et l'éclosibilité des œufs de poule. La fertilité des œufs de la volaille de Guinée pendant les périodes chaudes nécessite une enquête plus approfondie pour permettre une meilleure conclusion à tirer.

Mots-clés: Numida Méléagre, happée, incubation, fertilité des œufs

Introduction

Guinea fowl production in Nigeria is still in its vestigial stage even though these birds originated from Africa (Moreki and Radikara, 2013). There are ready markets for Guinea fowl in Africa (Nahashon *et al*., 2006). These birds are still raised with minimal input by subsistent farmer with the low productivity (Oke *et al.,* 2012). The rearing of guinea fowl has a greater potential to bridge the demand supply gap in animal protein intake. This indigenous species makes significant contributions to animal protein availability in Nigeria through cheap meat and eggs which serve as buffer to shortage of other poultry products. Ayorinde (2004) stated that guinea fowl is second to the domestic fowl in terms of number and supply of poultry protein in Nigeria. However, as with other indigenous species little or no attention has been paid to their conservation and improvement which according to Drucker *et al*. (2001) leads to gradual loss of indigenous animal genetic resources, being native to Africa, Guinea fowl possess valuable adaptive genetic potentials and yield valuable products under low-input agriculture typical of rural Nigeria. With regards to number, a larger population of guinea fowl is found mostly in the northern region of Nigeria, which calls for systemic effort to conserve, sustainably manage and improve these birds in other regions, like the rain-forest zone owing to their economic importance. Guinea fowl takes six months to reach slaughter weight of 1.5 to 2kg depending on geographical location and management (Koney, 2004; Ikani and Dafwang, 2004). Despite importance and advantages of guinea fowls over other poultry species in Nigeria there is still a paucity of scientific research on the management problems of local guinea fowl production, in contrast to indigenous chickens (Awotwi, 1987). These problems include poor hatchability of eggs, male infertility, high keet mortality, difficulty in sexing keets, slow growth rate and a dearth of knowledge on the genetic improvement (Oke *et al.*, 2012), nutrient requirements and prophylactic health management practices. The quality of eggs, pre-incubation handling and incubation management accounts for the variable hatchability rates (Avornyo *et al.,*2007 and Gueye, 2007) and eggs are often not readily available for hatching, incubation of guinea fowl eggs last for 26 to 28 days with 68 to 80% hatchability or more (Dei and Karbo, 2004; Karbo *et al.,*2002). In this regard, evaluation of egg characteristics, fertility and hatchability of the guinea fowl will not only be useful as a selection criterion but will also enhance economic decisions for intending backyard and/or commercial guinea fowl producers in Nigeria. This indicates that there is potential to improve guinea fowl hatching and post-hatching performance to increase household protein supply, combat rural protein-energy malnutrition and increase family income. This study is therefore undertaken to obtain basic information on the effects of egg sources on physical characteristics, fertility, and hatchability of guinea fowl eggs from different sources.

Materials and methods

Study area

A total of 600 Guinea fowl eggs were purchased from two reputable breeder farms in Northern Nigeria (BirninKebbi) and Southern Nigeria (Saki) consisting of three hundred from each source. Northern Nigeria (BirninKebbi) is located on latitude $12^0 27^' 14^o$N, longitude 4^0 $19^'$ 56^oE and at a height of 234m above sea level. It has a uni-modal rainfall pattern that begin in April and ends October. The average monthly and annual rainfalls are 112.21±25.31 mm and 787.53±24.03mm respectively. The average annual temperature is 37^oc. The area experienced dry for 305 days in a year with an average humidity of 33% and an ultra-violent index of 8. While Saki in Southern Nigeria on latitude 8.67^0 N and longitude 3.39^0E and at a height of 472 m above sea level. It has a unimodal rainfall pattern that begin in February and ends November. The mean annual rainfall is 1043mm. The average annual temperature is16.8^oC. The mean annual day time relative humidity is 83%.

Egg collection and management

The eggs were purchased in August which was coincide with the peak of the rainy season in the tropical zone and the peak of the guinea fowl egg production occurred between August and October. It was ensured that the eggs were selected based on egg quality, size, and void of physical defects. **Egg** physical characteristics such as egg weight (EWT), egg length (ELT), egg width (EW) and egg shape Index (ESI) were measured before incubation. The weight of each egg sample was measured with a sensitive weighing scale (Mettler –Toledo ® PB 3002 electronic balance) to the nearest 0.01g prior to incubation. The length of the egg was taken as the longitudinal distance between the narrow and the broad ends. A vernier calliper with an accuracy of 0.1mm was used to determine the egg length. The diameter of the widest cross-sectional region was taken as the egg breadth using a vernier calliper to the nearest 0.1mm. From the measurements of egg length and egg width for individual egg sample, egg shape index was calculated as the ratio of egg breadth to its length. The eggs were stored for seven days at temperature between 16°C-20°C prior to setting in the incubator. The eggs were incubated at Foresight Agro-Allied Industries Limited, Ibadan, Oyo State. The eggs were numbered according to sources for identification and were set in the same incubator. The eggs were positioned in the setting crates with broad end up to ensure ease of gas exchange between the eggs and the environment. Temperature and relative humidity were maintained at 37.5± 0.5°C and 74-85% at setting and 36.5± 0.05°C and 66-75% at hatching. Eggs were candled on the 25th day of incubation for the detection of dead embryo, and clear eggs. After candling, the fertile eggs were transferred into the hatching tray and thereafter into the hatcher for three days. After the keets were hatched at 28 days, the numbers of hatched keets were recorded and others were classified as weak, abnormal, and dead keets. On the 29th day of incubation period, all unhatched eggs were broken open to identify infertile eggs and embryonic deaths. Fertility and Hatchability percentage for each egg was evaluated to determine the fertility status of eggs and the followings calculations were done:

$$\%\text{Fertility} = \frac{\text{No. of fertile eggs x 100}}{\text{No of eggs set}}$$

$$\%\text{Hatchability of fertile egg was} = \frac{\text{No. of keets hatched x 100}}{\text{No. of fertile eggs}}$$

$$\%\text{Dead in Shell} = \frac{\text{Number of dead in Shell x 100}}{\text{Number of fertile eggs}}$$

$$\%\text{ Dead in Germ} = \frac{\text{Number of dead in germ x 100}}{\text{Number of fertile eggs}}$$

$$\%\text{ Weak Shell} = \frac{\text{Number of weak in shell x 100}}{\text{Number of fertile eggs}}$$

The experiment was laid out on studentized - t test at 95% confidence limit

Results

Effect of source on egg physical characteristics of Guinea fowl eggs

The effect of egg source on Guinea fowl egg physical qualities are presented in Table 1. Egg length and egg shape index (ESI) were significantly ($p<0.05$) influenced by the egg source. Eggs sourced from Saki had significantly ($p<0.05$) higher egg length (44.12 mm) and lower egg shape index (0.70) values compared with those got from BirninKebbi. Egg weight (37.47g) and egg breadth (34.74mm) of eggs from BirninKebbi were higher ($p>0.05$) than 37.26g and 34.65mm respectively obtained in eggs from Saki.

Table 1: Effect of source of on egg physical characteristics of Guinea fowl eggs

Parameters	Egg Source	
	Saki	BirninKebbi
Egg weight (g)	37.26±0.15	37.47±0.15
Egg length (mm)	44.12±0.1^a	43.43±0.1^b
Egg breadth (mm)	34.65±0.09	34.74±0.1
Egg Shape Index	0.70±0.002^b	0.80±0.002^a

$^{a, b}$Means in the same row not sharing common superscripts are significantly different ($p<0.05$)

Effect of egg source on egg fertility, embryo characteristics, mortality, and hatchability ofGguinea fowl eggs

Figure 1 shows the graphical illustration of the effect of egg source on egg fertility, embryo characteristics, mortality, and hatchability of guinea fowl eggs. There were differences in the numbers of fertile eggs, embryo characteristics, embryo mortality and percentage hatchability of guinea fowl eggs incubated across the two egg sources. The graph showed that incubated eggs sourced from BirninKebbi had higher dead in shell (17%), infertile eggs (7%) and keets hatched (68%) compared to those from Saki, while hatchable eggs from Saki had higher dead in germ (28%) and weak in shell (4%) embryos compared to values obtained in BirninKebbi eggs.

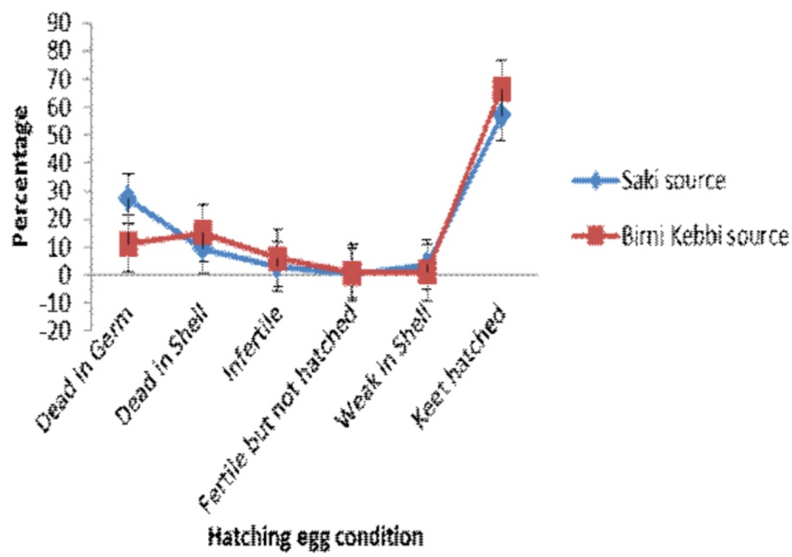

Figure 1: Effect of sources of hatching eggs on hatchability

Discussion

Guinea fowl eggs sourced from BirninKebbi in the hot northern region of Nigeria were shorter in length and had higher egg shape index (ESI) when compared with those obtained from the Saki area of the south-west (Ahaotu *et al.,* 2013). The value for egg shape index reported in this study (0.70±0.02 for Saki and 0.80±) was within the range reported by Dudusola (2010) for guinea fowl in Nigeria. The value for egg shape index observed in this study suggests that eggs are less prone to breakage and can make good for hatchability. Egg size is usually related with body weight of laying hens. In this study, mean egg weight for Kebbi was highest with 37.47g the value was lower than the mean weight of 55.3g for French broiler guinea fowl and 40.7g for domestic polish guinea fowl raised in temperate region. Ayorinde *et al.* (1989) reported similar values of 37.6±0.2 and 37.91±0.39 for pearl and black strains of guinea fowl respectively Ayorinde *et al.*(1989) also reported similar range of between 38g to 45g for indigenous guinea fowls in Nigeria. The difference observed in this study may be due to variation in environmental factors such as uncontrolled mating system which have resulted in the loss of hybrid vigour of the guinea fowl as well as variation in storage time as eggs collected from BirninKebbi took extra two days before its arrival. Moreki and Ditshupo (2012) reported lower (17.94%) and higher (22.26%) egg weight differences for eggs stored for 0 and 14 days, respectively. No reason could be given for this finding as it was expected that eggs weight would decline with lengthened storage. The reduction in egg weight in this study is consistent with Tilki and Saatchi (2004) who reported a greater egg weight reduction as storage time increased. Similar results were reported by Petek and Dikmen (2006) in broiler breeder eggs. The authors stated that exposure of eggs to long time storage and heat treatment would increase the opportunity for water vapour to escape from the egg. It has been established that the interval between lay and incubation has a negative effect on the survivability of embryos. Romao *et al.* (2008) found out that increased storage time increases embryo mortality rate during incubation. This can be responsible for the higher percentage of dead in shell (DIS) obtained with eggs sourced from Kebbi because additional time of 2 days was required for collection and transportation to the site of hatching at Ibadan in the south-west of Nigeria. The eggs sourced from Saki had shorter time lag in the period between collection and actual incubation and thus had lower number of dead in shell. The dead in shell rate were similar to the 16.40-25.30% reported by Kyere *et al.* (2017. However, it was higher than 8.7% reported by Dzungwe *et al.*(2018) and 15% by Khairunnesa *et al.* (2016). Fertile but not hatched did not follow any particular trend, however, variation occurred in both source for dead in germ, in Kebbi dead in germ was lower than 28% of Saki. The fertility obtained during this study was higher than 16.2-61.9% fertility reported by Ayomide *et al.* (1986), in the dry/hot season and in rainy season. They attributed the poor fertility occurring in the dry hot season to sexual rest or poor libido while the highest fertility was favoured by active spermatogenesis observed in the rainy season. The higher fertility found in this study could be explained by the production system adopted by the farmers where a higher number of males were kept at the beginning of the breeding season. Many females could be mated during this period before males had been removed from the flock. The hatchability rate of guinea fowls eggs in this study (68% and 60%) for Birnin Kebbi and Saki respectively were in line with 68% reported by Karbo *et al*. (2002) but fall within the range reported by Ebegbulem *et al.* (2017). On the contrary, hatchability was lower than 88% (Saina *et al*., 2005) and 91.40% (Dzungwe *et al.,* 2018). This difference in hatchability rates may be due to egg storage time and handling of eggs before incubation and the efficient of incubator management during the setting and hatchling processes. The eggs used for hatching in this current research can be classified as small (Moreki and Mothei, 2013), and the hatchability values are comparable to those obtained by Naandam and Issah (2012) who reported values that ranged from 72.8% and 73.6%. *A* study conducted by Mbajiorgu (2011) in South Africa to determine the effect of hatching egg size on hatchability and hatch-weight of indigenous Venda chickens (*Gallus gallus domesticus*) showed that large-sized eggs (60-69g) had higher hatchability than medium (<50-59g) and small-sized eggs (<49g). The study reported lower hatchability (20.0%) for small eggs (<39g) when compared to this current research and the Ghanian study of Naandam and Issah (2012) which used eggs that are as low as 31.6g in average weight. No explanation was given for this very low hatchability. However, the results of percent hatchability obtained from the two egg sources in this study is much lower than the near 100%

reported for the Nigerian local chickens (Atteh, 1990). Several factors have been identified to affect hatchability of eggs in poultry and these include the age of flock (Rogue and Soares, 1994) species used, experimental conditions and storage conditions (Brah and Sandhu, 1989), incubation relative humidity and egg turning angle (Permsak, 1996).

Conclusion

The study showed that hatchability and fertility was high in egg collected at Kebbi 68% compared to Saki. Low hatchability in Saki from incubation to hatching could be attributed to improper handling before hatching, prolong storage resulting to low hatchability.

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