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Phenotypic, Physiological and Blood Profile Characterization of Muscovy Ducks (Cairina moschata) In North Central Nigeria

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Abstract

Animal genetic resources (AnGR) are important to all future developments and adaptations. The concept has an international obligation to conserve certain characteristics of domestic animals for sustainable and future use. Characterization of indigenous Muscovy duck (Cairina moschata) would provide information for AnGR and also aid in conservation of ducks for future use. Two hundred (200) Muscovy ducks obtained from five (5) geographical locations in North central Nigeria were characterised using qualitative traits, physiological parameters, blood profile and quantitative traits. The results showed that 52.50, 54.00, 51.50, 50.00, 45.00 and 35.50% of the Muscovy ducks in the study area had black colour with respect to their general body plumage, shank, bill, web, eye, and bean, respectively. 50.00% were of horizontal body carriage, 90.50% had palmate web type, and 95.00% had no crest while 62.50% had caruncles. Sexual dimorphism existed between male and female with drakes having significantly ($p<0.05$) higher values compared to ducks in all the quantitative traits measured. Physiological parameters were not significantly ($p>0.05$) different according to sex and origin of the Muscovy duck studied. Comparison of the ducks by origin showed significant ($p>0.05$) differences in body weight, shank diameter, keel and wing length, and also in white blood cells, lymphocytes, red blood cells and mean corpuscular haemoglobin concentration, platelets and glucose. The information obtained here can serve as a guide on decisions concerning the conservation and development of selective breeding strategies for improvement of Muscovy ducks in the studied area.

Keywords: Characterization, Muscovy Ducks, Traits, Physiological parameters, Blood Profile

Introduction

In Nigeria, many households and resource poor farmers depend on poultry as a major source of meat and eggs because locally adapted poultry are readily available, these poultry type are productive with little inputs and easier to keep with minimum disease control inputs (Halima et al., 2007). Unfortunately, little or no attention has been given to local poultry species for commercial production of meat and eggs in Nigeria. Of these poultry species, Muscovy ducks (Cairina moschata) is one (Duru et al. (2006) and it is the most common genus. Ducks are an essential part of many human societies around the world and supplement local chicken in egg and meat supply especially among the resource poor farmer. Muscovy ducks are easily recognized by the red-coloured fleshy outgrowths (caruncles) round the bills and eyes, and are found mostly along the coastal areas of southern Nigeria (Ugbomeh, 2002; Ikani, 2003). Since Muscovy ducks have high potential for meat and egg production more scientific effort must be exerted towards their genetic improvement and enhancement of their innate potential as

sources of food and income.

Muscovy ducks make up 74% of the ducks in Nigeria, and its meat is lower in fat and hence considered to be healthier (Adesope and Nodu, 2002). Muscovy ducks are known for hardiness, resistance to environmental stress, prolificacy, resistance to common poultry diseases and can tolerate feed of low quality (Yakubu et al., 2011). Ducks need less care or management, they can adapt to almost all types of environmental conditions. They also have the natural tendency of foraging on aquatic weeds, algae, green legumes, fungi, earthworms, maggots, snails, various types of insects, etc. which directly reduces their feeding cost. Ducks have less mortality rate and usually, they live longer than chickens. In the case of egg production, ducks lay eggs for a long period and its products such as eggs and meat have a great demand as they are a good source of protein and iron (Tai and Tai, 2001).

Genetic variation in duck populations is essential for the development of appropriate breeding programmes and actualisation of breeding goals for each agro-ecological zone of a country (Yakubu et al., 2011). Thus, characterization of Muscovy duck population is very important for the development of appropriate breeding goals and optimal duck production in every agro-ecological zone where they are found. Few empirical studies to date have reported the variation and its extent in Nigerian local duck; also such studies have been limited in coverage as well as efforts to improve ducks for meat and egg production (Ogah and Ari, 2012). Renewed efforts to characterise local animal genetic resources including the Muscovy duck will enhance their conservation threatened by large scale transformation of the agricultural systems and indiscriminate introduction of exotic genetic resources. Fundamental knowledge of their genetic attributes, variation, unique genetic identity and agro-ecological/environmental adaptation, will also inform judgement of their potential for improvement and appropriateness of competing strategies for their general improvement. This study was therefore designed to characterize the qualitative and quantitative traits, physiological parameters and blood profile of Adult Muscovy ducks found in some areas of the North Central Nigeria.

Material and Methods

Description of the Study area

Kwara and Niger states are located in the North Central Geo-political zone of Nigeria; Kwara State is located in 8.4799 ^{o}N, 4.5418^{o}E (KWSG, 2017) while Niger is located in 10.2155^{o} N, 5.3940^{o}. Five areas (Four in Kwara and one in Niger States of Nigeria) that are known for Muscovy duck farming were purposively selected for the study. The five areas were: (i) Oke-Oyi (8.5791^{o} N,4.7148^{o} E), (ii) Bode-Saadu (9.0491^{o} N 4.7071^{o} E), (iii) Yenbeleku (9.3493^{o} N, 3.5813^{o} E), (iii) Patigi (8.7211^{o} N, 5.7563^{o} E) of Ilorin East, Mooro, Baruten and Patigi Local Government areas, respectively, and (v) New Bussa (9.8829^{o} N, 4.5109^{o} E) of Borgu local government area of Niger State.

Experimental Birds

Two hundred adult Muscovy ducks (79 drakes and 121 ducks) were purchased from five locations. {Oke-Oyi (KEY), Yenbeleku (YBK), Bode Saadu (BDS), Patigi (PTG) and New Bussa (NBS)}. The total numbers of ducks obtained per locations were 40, 39, 39, 40 and 42 from KEY, YBK, BDS, PTG, and NBS, respectively. Each location was regarded as the Origin the Muscovy ducks accordingly. The Muscovy ducks were wing tagged according to their origin at the point of purchased. They were taken to a private farm (Fair and Firm Limited, Tanke, Oke-Odo, Ilorin, Kwara State) and kept intensively for data collection. On arrival at the farm, the Muscovy ducks were given anti stress, broad spectrum antibiotics and quarantined for five days; they were fed commercial layers diets and provided with watered troughs.

Data Collection

Qualitative Parameters

The qualitative traits measured on individual duck were body carriage (BDC), shank colour (SKC), general plumage colour (GPLC), beak structure (BKS), bill colour (BLLC), web type (WTY), presence of crest (CRT), caruncles colour (CRCL), presence or absence of caruncles (CRC), web colour (WCL), eye colour (EYC), and bean colour (BNCL) as described by Manuel (2008).

Physiological Parameters

The physiological parameters were taken in the morning between the hours of 7:30 to 9:30 am at an atmospheric temperature of 25-27 ^{0}C and relative humidity of 66 to 70%. The rectal temperature (RT) and respiratory rate (RR) were taken for each duck and recorded according to their sex and origin. The rectal temperature (RT) was measured using a digital thermometer with accuracy to ± 0.10 ^{o}C by inserting the thermometer into the cloaca of the duck to a depth of 2-3cm and held until the thermometer beeped. Pulse rate (PR) of each duck was monitored with the use of a clinical stethoscope with assistant of a trained handler; the handler carried the duck with two hands and allowed it to calm, then lifted the duck left wing and carefully placed the stethoscope chest piece at its breasts region after which the duck's heart beat is counted through the sound heard from the stethoscope earpiece for 15 seconds; the number obtained for 15 seconds was multiplied by 4 to get the Pulse Rate per minutes (PRPM) as described by Machini et al. (2007).

Blood Profiles of the Muscovy Duck

Four ducks (2 Males and 2 females) were randomly selected per location / origin; 5ml of blood samples were collected from each duck through brachial venipuncture. Blood collected were carefully let into blood sample collections tube with EDTA for haematological assay, and bottles meant for determination of blood glucose and serum. The blood sample tubes were immediately transported to the Central Research Laboratory, Ilorin Kwara State Nigeria and a Veterinary Analyser (Veterinary Analyzer, DR-3125 plus Model, Diatek, India) was used to determine haematological parameters, while the procedures of Randox^R were used for Serum and Glucose determination.

Quantitative Parameters

Eleven (11) quantitative parameters taken from the Muscovy ducks were: body weight (BW), body length (BDL), keel length (KL), shank length (SL), body height (BH), drumstick length (DL), thigh length (TL), wing length (WL), shank Diameter (SC), body girth (BG) and bill length (BLL). Body weight of individual bird was determined by placing each duck on the loading pan of the Mettler Toledo® top loading scale to the nearest kg, while the linear body measurements were done as described by Sola-Ojo and Ayorinde (2009) using a measuring tape (cm).

Statistical Analysis

Qualitative traits data collected were subjected to descriptive statistics to obtain the percentage of occurrences of the parameters among the population studied. The physiological, quantitative and biochemical data were subjected to General Linear Model (GLM) procedure of variance analysis (ANOVA) using the model: $Yij= \mu+ ai +bi +eij$. Where: Yij= Overall observations; μ = Overall mean; ai = sex effects; bj = location/ origin effect; eij = random experimental error.

Significant differences among means were compared ($p<0.05$) using Duncan's Multiple Range Test procedure (Duncan, 1955). All statistical analyses were done using the SPSS (2017) Version 7.

Results

Table 1 shows the distribution of qualitative traits in the adult Muscovy ducks obtained from the five locations of the North Central Nigeria. The general plumage colour (GPLC) of the Muscovy ducks studied were mostly black (52.50%), 31.50% of the Muscovy ducks had a mixture of black and white, 10.50% had brown plumage, 4.50% were of pure white plumage, while those with light blue mixed with white plumage

colour were the least (1.00%) among the population studied. Majority of Muscovy duck studied had black shank (54.00%), 33.00% had slate grey shank colour, while 13.00% had yellow shank colour. Bill colour distributions were 51.50, 33.50 and 15.00% with respect to black, slate grey and yellow. Caruncles colours were distributed at the rate of 40.00, 25.00 and 35.00% among red, black and pink, while web colours were 50.00, 35.00 and 15.55% for black, slate grey and yellow. The eye colour distribution among the Muscovy duck studied showed that 45.00% had black, 41.00% had grey, while 14.00% had orange colour. It was also observed that, 35.50% of Muscovy ducks studied had black bean, 34.00% had slate grey bean while 30.50% had yellow bean colour. 50% of Muscovy duck studied had horizontal body carriage, majority of the Muscovy ducks had palmate web type (90.50%), and were not crested (95.00%), while 62.50% had caruncles.

Table 1. Descriptive statistics of qualitative traits in Muscovy Duck obtained from five locations of the North Central Nigeria.

Parameters	Description	Number Observed	Percentages (%)
General Plumage Colour	Black	105	52.50
	Black and White	63	31.50
	Brown	21	10.50
	White	09	4.50
	Light Blue and White	02	1.00
Shank Colour	Black	108	54.00
	Slate Grey	66	33.00
	Yellow	26	13.00
Bill Colour	Black	103	51.50
	Slate Grey	67	33.50
	Yellow	30	15.00
Caruncles Colour	Red	80	40.00
	Black	50	25.00
	Pink	70	35.00
Web Colour	Black	100	50.00
	Slate Grey	70	35.00
	Yellow	30	15.00
Eye Colour	Black	90	45.00
	Grey	82	41.00
	Orange	28	14.00
Bean Colour	Black	71	35.50
	Slate Grey	68	34.00
	Yellow	61	30.50
Body Carriage	Slightly Upright	78	39.00
	Upright	22	11.00
	Horizontal	100	50.00
Bill Structure	Smooth	162	81.00
	Saddle	38	19.00
Web Type	Palmate	181	90.50
	One Feet Palmate	12	6.00
	Non Palmate	7	3.50
Crest	Crested	10	5.00
	Non Crested	190	95.00
Caruncles	Absent	75	37.50
	Present	125	62.50

Table 2 shows the results of the quantitative traits and physiological parameters of the ducks sampled across the five locations separated by sex. These results indicated significant ($p<0.05$) variations between the two sexes with drakes having significantly ($p<0.05$) higher BW (2.33 vs. 1.49kg) and longer ($p<0.05$) BDL (54.59 vs. 49.02cm), BG (37.46 vs. 30.40cm), KL (16.37 vs. 14.63cm), BH (28.22 vs. 21.95cm), TL (8.63 vs. 6.84cm), WL (23.65 vs.19.24cm), and DL (10.22 vs. 9.07 cm) than ducks. There were no significant ($p>0.05$) differences in the physiological parameters of drakes and ducks with RT of 38.54ºC and 38.78 ºC and PRPM of 158.15 vs. 161.75, respectively.

Table 2. Mean and Coefficient of Variation of physiological parameter, body weight (kg), linear body measurements (cm) of the Muscovy Ducks Sampled

	Male (n=79)			Female (n=121)		
Parameters	Mean	SD	CV	Mean	SD	CV
PRPM	158.15	35.21	22.26	161.75	39.32	24.31
BW	2.33[a]	0.87	37.34	1.49[b]	0.50	33.56
SD	5.19[a]	1.09	21.00	2.84[b]	0.89	31.33
SL	7.69[a]	1.80	23.41	5.68[b]	1.09	19.19
BLL	4.57[a]	1.02	22.32	3.38[b]	0.45	13.31
BDL	54.59[a]	6.97	12.81	49.02[b]	3.57	7.28
BG	37.46[a]	6.78	18.03	30.40[b]	4.54	14.93
KL	16.37[a]	5.65	34.51	14.63[b]	4.98	34.04
BH	28.22[a]	4.42	15.66	21.95[b]	4.18	19.04
TL	8.63[a]	2.18	25.26	6.84[b]	1.42	20.76
WL	23.65[a]	4.17	17.63	19.24[b]	3.67	19.07
DL	10.22[a]	1.80	17.61	9.07[b]	1.21	13.34

Mean with different superscripts (a-b) are not similar ($p<0.05$); SD: Standard deviation; CV : Coefficient of Variation; RT: Rectal Temperature; PRPM: Pulse rate per minute; BW: Body Weight; SD: Shank Diameter; SL: Shank Length; BLL: Bill Length; BDL: Body length; BG: Body Girth; KL: Keel Length; BH: Body Height; TL: Thigh Length; WL: Wing Length; DL: Drumstick Length.

Table 3 showed the mean value of the quantitative traits of the Muscovy ducks with respect to their locations or origin and it varied significantly ($p<0.05$). The results showed that significant ($p<0.05$) differences existed in BW, SD, KL and WL between locations, with PTG Muscovy ducks having significantly ($p<0.05$) higher values for each traits (1.99kg, 4.70cm, 17.11cm, 23.56cm, respectively) when compared to ducks from other locations. NBS, PTG, and YBK had significantly ($p<0.05$) higher value for BH (25.79, 26.25 and 27.05, respectively) and SL (7.87, 7.99 and 8.10) than KEY and BDS. No significant ($p<0.05$)differences were observed in BLL (4.15 to 4.77), BDL (48.55 to 51.73), BG (32.21 to 35.19), DL (10.02 to 10.25cm) and TL (7.96 to 8.87 cm), RT (38.45 to 39.01 ºC) and PRPM (153.14 to 165.95) when the location of the Muscovy ducks were considered.

Table 3: Means of the physiological parameters, Body weight (Kg), linear body measurement (cm) of the Muscovy ducks according to their locations/Origin in the North Central Nigeria

Parameters	KEY	BDS	YBK	PTG	NBS	SEM
RT ºC	38.45	38.78	38.78	39.01	38.48	0.135

PRPM	160.30	161.23	165.95	163.00	153.14	2.685
BW	1.73^{bc}	1.75^{b}	1.71^{c}	1.99^{a}	1.85^{b}	0.050
SD	3.06^{c}	3.39^{bc}	3.75^{b}	4.70^{a}	3.44^{bc}	0.017
SL	6.61^{b}	6.33^{b}	8.10^{a}	7.99^{a}	7.87^{a}	0.014
BLL	4.15	4.43	4.41	4.77	4.22	0.065
BDL	50.75	48.55	50.98	51.73	50.88	0.410
BG	34.11	32.21	34.85	35.19	34.98	0.443
KL	12.99^{c}	12.84^{c}	16.06^{b}	17.11^{a}	17.02^{b}	0.037
BH	24.64^{b}	26.58^{ab}	27.05^{a}	26.25^{ab}	25.79^{ab}	0.030
WL	20.36^{b}	20.44^{b}	19.35^{b}	23.56^{a}	20.37^{b}	0.027
DL	10.23	10.02	10.10	10.25	10.11	0.122
TL	8.75	7.96	8.53	8.85	8.87	0.167

Means with different superscripts (a-c) are not similar ($p<0.05$); SEM: Standard Error of the Mean; RT: Rectal Temperature; PRPM: Pulse rate per minute; BW: Body Weight; SD: Shank Diameter; SL: Shank Length; BLL: Bill Length; BDL: Body length; BG: Body Girth; KL: Keel Length; BH: Body Height; TL: Thigh Length; WL: Wing Length; DL: Drumstick Length.

Table 4 showed the blood profiles of Muscovy duck separated by their origin. The results showed significant ($p<0.05$) differences in White Blood Cell (WBC: 21.39 to 32.56 $x10^6/mm^3$), Lymphocytes (71.40 to 88.04%), Red Blood Cell (RBC:3.69 to 5.03 $x10^6/mm^3$), Mean Corpuscular Haemoglobin Concentration (MCHC: 26.90 to 40.30%), Platelet (0.13 to 0.54) and Glucose (156.92 to 186.37 mg/dL) across the five locations or origin of the ducks with PTG Muscovy duck having higher ($p>0.05$) value for WBC and it was similar to that of NBS, also it had a higher value for blood glucose that were not different from the blood glucose of NBS, YBK and BDS. No significant ($p>0.05$) differences were observed in Packed Cell Volume (PCV) which ranged from 40.26 to 43.02%, Haemoglobin (HGB) (13.59 to 14.79%), Total Cholesterol (157.98 to 169.34 mg/Dl), Triglyceride (351.19 to 355.28 mg/Dl), High Density lipoprotein–cholesterol ranged from 28.12 to 32.88, while the Low density lipoprotein-cholesterol ranged from 34.72 to 42.51 in the Muscovy ducks obtained from the five locations of study.

Table 4. Blood Profiles of the Muscovy Ducks based on their Location /Origin in the North Central Nigeria

Parameters	KEY	BDS	YBK	PTG	NBS	SEM
WBC x 10^6 /mm^3	32.56^{a}	21.54^{bc}	22.09^{b}	21.39^{c}	22.44^{b}	0.012
P.C.V (%)	43.02	41.23	41.45	40.26	42.34	0.868
LYM (%)	71.40^{d}	81.75^{c}	85.26^{b}	88.04^{a}	86.49^{b}	0.003
RBCx10^6 / mm^3	3.69^{b}	4.16^{ab}	4.96^{ab}	5.03^{a}	4.57^{ab}	0.001
HGB (%)	13.59	13.79	14.04	14.79	14.75	0.240
MCHC (%)	26.90^{c}	29.65^{c}	30.10^{b}	40.30^{a}	33.18^{b}	0.014
Platelet	0.13^{d}	0.25^{c}	0.30^{b}	0.54^{a}	0.42^{b}	0.035
Glucose (mg/dL)	156.92^{b}	177.39^{ab}	177.50^{ab}	186.37^{a}	179.72^{ab}	0.020
Total cholesterol mg/dL	157.98	158.72	159.08	169.34	163.08	0.786
Triglyceride (mg/dL)	351.24	351.19	351.19	355.28	352.12	2.835
HDL-C	28.12	32.54	30.96	32.88	31.24	1.067
LDL-C	34.72	35.70	41.72	42.51	37.51	1.015

Means with different superscripts (a-c) are not similar ($p<0.05$); SEM: Standard Error of the Mean.

WBC: White Blood Cell; PCV: Packed Cell Volume; LYM: Lymphocytes; RBC: Red Blood Cells; HGB: Haemoglobin; MCHC: Mean Corpuscular Haemoglobin Concentration; HDL-C; High Density Lipoprotein-Cholesterol; LDL-C: Low Density Lipoprotein- Cholesterol.

Discussions

These findings showed that variations existed in the qualitative traits of the Muscovy ducks studied. The quantitative traits and some biochemical indices among the Muscovy duck studied also varied with respects to sex and locations, while the physiological parameters measured were similar in drakes and ducks and in the duck population across the five locations. Variations in qualitative and quantitative traits observed in this study is in accordance with earlier studies by some authors on Nigeria Muscovy ducks across various agro-ecological zones (Etuk et al.,2006; Mallick et al., 2009; Ogah et al., 2009; Raji et al., 2009; Yakubu et al., 2011; Bati et al., 2014; Ogah and Kabir, 2014; Oguntunji and Ayorinde, 2015). Variations in plumage colour recorded in this study agrees with the report of Raji *et al*.(2009) where the authors reported four plumage colours (Multicolour, black, black and white and white) as prominent colour in Muscovy ducks from Northern Nigeria. Furthermore, the highest number of black plumage recorded in this study is in line with the report of Bati et al. (2014) where black plumage was reported to be higher in ducks of Congo Brazzavile origin and also that of Marahani et al. (2019), where it was reported that Muscovy duck reared in highland area of Indonesia has predominantly black plumage colour against those reared in other agroecological zones of the study area. Though the number of colour types recorded in this region was lower than those reported Marahani et al., 2019, it was in line with those reported for Nigeria ducks by Raji et al. (2009). Observed highest frequency of black bill colour in this study is in agreement with the report of Baghel (2007), Oguntunji and Ayorinde (2015) on Nigerian duck and also with the report of Maharani et al.(2019) on Indonesia duck. Wide variations in plumage colour and other qualitative traits observed in the present study is an indication that the studied duck populations have not been purified through selection and this could be a starting point in selection of Muscovy ducks for improvement as asserted by Yakubu (2013). These variations in colour and interspecific variations has also been reported as an indication of adaptive response to variation in light environments across an habitat (Mc Naught and Owen, 2012) while Gaelotti et al. (2003) stated that habitat and climate differences in selective pressures may be responsible for production of colour variation with broad ecological niches that involves visual and physiological effects of colour pigmentation, while Evans and Sheldan (2012) stated that genetic factor affects plumage colour variation mediated by multiple loci. Predominance of black plumage colour in Muscovy ducks here could also be associated with adaptation of the Muscovy ducks with black plumage to the prevailing environmental conditions and ability to survive predators at younger age.

Sexual dimorphism in ducks had earlier been reported by Yakubu et al. (2011) and Huang et al. (2012) and this was observed among the Muscovy duck population sampled in this study. Sex associated differences observed in this study corresponds with that of Yakubu (2013), where drakes had significantly higher body weight, body length, breast circumference, thigh circumferences, bill length and other parameters measured than their female counterparts.

Body weight obtained for the ducks in this study was higher than the range of 1.51 to 1.70kg reported by Mallick et al. (2009) but was within 1.73 and 2.51kg reported by Etuk et al.(2006) and lower than 2.0 to 2.2 kg reported by Yakubu et al. (2011) for rainforest and guinea savannah Nigerian ducks, respectively. SL value obtained was higher that 4.3 to 5.5cm reported for ducks by the same author probably due to agro ecological differences of the study area and nature of the area where the ducks were reared as Yakubu et al. (2011) reported that some of these morphological traits are sensitive to the nature of the environment and nutrition. This is to show that there is room for genetic improvement of ducks for better production due to the observed variations, because they differ in quantitative traits from one location to the other based on

environmental and management practices they are subjected to. Higher values reported for body weight and some morphometric traits observed in PTG and NBS ducks could be due to the fact that those areas have larger populations of their Muscovy ducks on lowland and the ducks are raised in flood plain regions, this is in line with the assertion of Oguntunji and Ayorinde (2015) where the authors described ducks as water loving in nature and scavenger of flora and fauna in water bodies such as swamps, rivers, lakes streams and ponds.

Study of physiological and blood parameters are very useful in determining the health status of an animal. This can provide baseline information for clinical evaluation and improvement of an animal for better production as healthy animals will be favoured as parent of next generation. The rectal temperature (38.45 to 39.01 ^{o}C) obtained for Muscovy duck in this study were slightly lower than a range of 40.48 to 41.05^{o}C reported for Muscovy duck by Oguntunji et al. (2019), this might be due to the varying time of measurement as the former RT were taken only in the morning. Variations are observed in some blood profiles with respect to locations. The PCV, HGB and MCHC obtained for Muscovy ducks in this study fell within the range of 41.17 to 46.00, 14.17 to 15.67 and 34.07 to 34.42, respectively reported for duck and drake by Okeudo et al. (2013), the lymphocytes counts obtained for ducks in this study was between 71.40 and 88.04 and fell within a range reported for duck and drakes by Okeudo (2013), was higher than 61.37 reported for duck but comparable to 72.75 reported for drakes by Sulaiman et al. (2010). The RBC obtained for ducks in this study was higher than a range of 3.13 to 3.31 reported by Sulaiman et al. (2010). The blood cholesterol was lower than a range of 173.17 to 186.33 reported for local ducks by Ismoyowati and Juni Sumarmono (2011) and 203.33 reported for hybrid ducks by Kurniawan et al. (2015) while the triglyceride was also higher than those reported for hybrid ducks, HDL and LDL values obtained in this study were lower than those reported for hybrid ducks fed normal diet as reported by Kurniawan et al.(2015).

In conclusion, the variations in traits obtained for the Muscovy ducks found in this study with respect to the qualitative traits, body weight, linear body measurements and blood parameters will be useful in making strategic planning for Nigerian Muscovy ducks improvement. The body parameters measured in this study could be an indicator for describing the Muscovy ducks as a breed or population along with any specific traits of interest and agro ecological conditions in which the breed are habited. Higher phenotypic variations observed in this study could also guarantee a sufficient selection response and provide direct opportunity for future genetic improvement among and within Muscovy duck populations.

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Availability of data and materials

The authors declare that data collected and materials are available for use.

Authors' contributions

- Adeniyi, Sola-Ojo and Yusuf conceived and designed the experiment
- Sola-Ojo, Yusuf and Joe-Alabi performed the experiment and involved in data collection
- Sola-Ojo analyzed the data
- Sola-Ojo and Adeniyi interpret the data and wrote the manuscript

All authors revised and approved the final manuscript.

Ethics approval and consent to participate

This work was carried out under the ethical approval of the University of Ilorin, Kwara State Nigeria and all the authors agreed to participate in the research.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

Adesope OM and Nodu MB. 2002. A note on acceptance of duck as table-meat among inhabitants of selected communities in the Niger Delta zone, Nigeria. Livestock Research for Rural Development **14**: http://www.lrrd.org/lrrd14/6/ades146.htm. Accessed September 9, 2012.

Baghel IK. 2007. Phenotypic characterization and production of Muscovy ducks (Nag –hans) matured under intensive and free range production system of Chattigarh. Master's thesis: Raipur; Indira Ghandi Agricultural University. Pp 75 124.

Bati JB. BizaKoukaba CCK. Banga-Mboko H. MfoukousNtsakala A. Bakoutana D. Adzona PP. Hornik JL and Leroy PL. 2014. Phenotypic characterization according to the feathercolourof indigenous Muscovy ducks bred in the backyard in Brazzavile the Congo. Animal Production. 16 (3): 140-145.

Duncan BD. 1955. Multiple Range and multiple F-test, *Biometrics*. 11: 1-42.

Duru S. Akpa GN. Saidu L. Olugbemi T S. Jokthan GE. 2006. A preliminary study on duck management under peri-urban system. Livestock Research for Rural Development: 18 (3) http://www.lrrd.org/lrrd18/3/duru18036.htm, retrieved on April 7, 2014.

Evans SR and Sheldan BC. 2012. Quantitative genetics of a carotenoid based colour, heritability and persistent natal environment effects in the great tit. The American Naturalist. 79: 79-94.

Etuk IF. Abasiekong GF. Ojewola GS and Akomas SC. 2006. Carcass and Organ characteristics of Muscovy ducks reared under three management systems in south eastern.*Nigeria International Journal of poultry science*. 5: 474-476.

Galeotti P. Rubohi D and Dum PO. 2003. Colour polymorphism in birds: causes and function. Journal of evolutionary biology. 16: 635-646.

Halima H. Neser FWC. Van Marle-Koster E and De Kock A. 2007. Village-based indigenous Chicken production systems in north-west Ethiopia. Tropical Animal Health and Production.39, 3, 189-198.

Ikani I. 2003. Duck production in Nigeria. Poultry Series No.7. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria, Nigeria, Pp. 31.

Ismoyowati I and Juni Sumarmono, 2011. Fat and Cholesterol contents of Local duck *Anas Platyrhynchos Platyrhnchos* meat fed mash, paste and crumble feed. Asian journal of Poultry Sciences. 54:150-154. DOI.10.3923/ajSaj.2011.150.154.

Kurniawann D. Widodo E and Djunaidi IH. 2015. Lipid profiles of blood serum and fatty acid composition of meat of hybrid duck fed diet supplanted with Noni *Morindacitrifolia* fruit meal. JITC (20) 2: 200-206.

KWSG (Kwara State Government) (2017). Geography of Kwara State available at https://kwarastate.gov.ng.

Marchini CFP. Silva PL. Nascimento MRB.2007. Frequência respiratóriae temperatura cloacalemfrangos de cortesubmetidos à temperatura ambient ecíclicaelevada. Archives of Veterinary Science. (12) 1: 41-46.

Maharani D Hariyuho DNH. Putra DDI. Lee JH. Sidadolog JHP. 2019. Phenotypic characterization of local female ducks population in Indonesia. Journal of Asia Pacific Biodiversity:https:// doi.org//10.1016.japb 2019.07.004.

Mallick PK. Padhi MK. Prasad SM. 2009. Performance evaluation of Deshi ducks of Orisaa and Deshi x Khaki Campbell cross in extensive system of rearing. Proceedings of the 4th Waterfowl conference, November 11-13, 2009. Karala, India Pp 93-95.

Manuel LC. 2008. Pictorial guidance for phenotypic characterization of chickens and ducks. FAO, GCO/RAS/ 228.IGER.Working paper No 15. Rome.

Mc Naught NK and Owens IPF. 2002. Interspecific variation in plumage colour among birds, species recognition or light environment. Journal of Evolutionary Biology. 15: 505-514.

Ogah DM. Alaga AA. Momoh. A. 2009. Principal Components factors analysis of the Morphostructural traits of Muscovy Duck. *International Journal of poultry science* 8: 1100-1103.

Ogah DM and Ari MM. 2012. Evaluating inbreeding rate in population of local Muscovy duck Egyptian Poultry Science Journal. 32 (1): 217-220.

Ogah DM and Kabir M. 2014.Variability in size and shape in Muscovy duck with Age, Principal component Analysis. ***Biotechnology in Animal husbandry***, 30: 125-136.

Oguntunji AO and Ayorinde KL. 2015. Phenotypic characterization of the Nigeria Muscovy ducks (*Cairianamoschata) AGR*. 56: 37-45.

Oguntunji AO. Oladejo OA. Ayoola MO. Oluwatomini I. Oriye LO. Egunjobi IM (2019). Genetic variation in physiological adaptation of local, exotic and crossbred ducks to heat stress in a tropical environment. Genetics and Biodiversity Journal 3. 1 39-49.

Okeudo NJ. Okoli IC. Igwe GOF. 2003, Haematological characteristics of ducks (*CairinaMoschata*) of South Eastern Nigeria. Tropicultura 21: 61-65

Raji AO. Igwebuike JU and Usman MT. 2009. Zoometrical body measurements and their relation with live weight in matured local Muscovy ducks in Borno State, Nigeria. ARPN Journal of Agriculture and Biological Science 4: 58-62.

Sulaiman MHC. Aduta DM and Salami SO. 2010. The comparative study of blood cellular composition in Muscovy ducks in Nigeria. International Journal of poultry science 9:836-841.

Sola-Ojo FE and Ayorinde KL. 2009. Characterization of growth potential of the Fulani Ecotype chicken. World Journal of Applied Science and Technology. 1 (1), 37-44.

SPSS 2017. Statistical Package for Social Sciences 2017 Version 7.0 IBM Inc. 444 Michigan Avenue, Chicago, IL60611, USA.

Tai C and Tai JJL 2001. Future Prospects of Duck Production in Asia. Journal of Poultry Science 38: 99-112.

Ugbomeh GMM.2002. Socio-economic characteristics of duck farmers in Ughelli North and South Local government areas of Delta State of Nigeria: Implication for food security. Ghana Journal of Science. 42: 49-60.

Yakubu A. Kaankula FG and Ugho SB. 2011. Morphometric traits OF Muscovy ducks for two agro-ecological zones Nigeria. Tropicultura, 29: 121-124.

Yakubu A. 2013. Discriminant analysis of sexual dimorphism in morphological traits of Africa Muscovy duck (*CairinaMoschata*), Archivos de Zootechnica 60: 1115-1123.