BREEDING PRACTICES AND TRAITS OF PREFERENCE FOR SELECTION OF PIGS BY MALE AND FEMALE SMALLHOLDER FARMERS IN NIGERIA †

[PRÁCTICAS DE CRÍA Y RASGOS DE PREFERENCIA PARA LA SELECCIÓN DE CERDOS POR PEQUEÑOS PRODUCTORES Y PRODUCTORAS EN NIGERIA]

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SUMMARY

Background. Pig farming is one of the most important livestock raised in Nigeria by smallholder farmers. **Objective.** To determine the breeding practices and breeding traits of preference by pig farmers in Nasarawa State, Nigeria. **Methodology.** A total of 120 pig rearers (62 males and 58 females) were randomly sampled. Primary data were collected through individual structured questionnaire administration. Chi square ($\chi 2$) statistics was used to compare categorical variables. Arithmetic means and their standard errors of continuous variables between gender were tested using T- Test. Ranking of the eight traits of preference (body size, body conformation, mothering ability, survival, heat tolerance, disease resistance, fertility and temperament) was carried out using the non-parametric Friedman Test (Wilcoxon Signed-rank test for post hoc analysis) as well as Kruskal–Wallis H Test (with Mann–Whitney U Test for means separation). Multivariate Clustering Analysis was also explored to group the farmers on gender basis. **Results.** The source as well as the number of foundation stock varied between the sexes (P= 0.048 and 0.028, respectively). Average flock size was higher (20.31±2.21 versus 14.78±1.53; P<0.05) where the pigs were under the management of male farmers. This reflected more in pigs of mixed genotypes compared to the indigenous ones. The number of piglets/sow/annum (14.77±0.77 versus 12.29±0.54; 16.36±0.76 versus 14.02±0.58; $P \leq 0.05$) was also higher in flocks of male farmers for both indigenous pigs and those of mixed blood. Between-gender, all the preference traits were ranked similarly (P>0.05) apart from temperament which was more highly rated by the males. However, the multivariate analysis revealed that body size and body conformation were more associated with the female farmers while survival, disease resistance, heat tolerance, mothering ability and temperament were more preferred by their male counterparts. **Implication.** The traits of economic importance obtained in this study may guide future community-based pig genetic improvement programmes in a tropical environment. **Conclusion.** The present study revealed the importance of body size, body conformation, mothering ability, survival, heat tolerance, disease resistance and fertility in the selection of breeding pigs. However, these traits were differentially rated by male and female farmers.

Keywords: improvement; preference; ranking; swine; tropics

RESUMEN

Antecedentes. La cría de cerdos es una de las actividades más importantes de los pequeños productores de Nigeria. **Objetivo.** Determinar las prácticas de cría y preferencia de selección de los criadores de cerdos en el estado de Nasarawa, Nigeria. **Metodología.** Se muestrearon al azar un total de 120 criadores de cerdos (61 machos y 59 hembras). Los datos primarios se recopilaron mediante la administración de cuestionarios estructurados individuales. Se utilizó estadística de chi cuadrado ($\chi 2$) para comparar variables categóricas. Las medias aritméticas y sus errores estándar de variables continuas entre géneros se probaron usando la prueba T. La clasificación de ocho rasgos de preferencia (tamaño corporal, conformación corporal, capacidad de maternidad, supervivencia, tolerancia al calor, resistencia a enfermedades, fertilidad y temperamento) se llevó a cabo utilizando la prueba no paramétrica de Friedman (prueba de rango de Wilcoxon para análisis post hoc) así como la prueba Kruskal – Wallis H (con la prueba U de Mann – Whitney para la separación de medias). El análisis de agrupamiento multivariado también se

† *Submitted October 12, 2018 – Accepted September 27, 2019.*
ISSN: 1870-0462.

exploró para agrupar a los agricultores por género. **Resultados**. La fuente y el número de animales de cria variaron entre los sexos (P = 0.048 y 0.028, respectivamente). El tamaño promedio del hato fue mayor (20.31 ± 2.21 versus 14.78 ± 1.53; P <0.05) cuando los cerdos estaban bajo el manejo de hombres. Esto se reflejó más en cerdos de genotipos mixtos en comparación con los indígenas. El número de lechones / cerda / año (14.77 ± 0.77 versus 12.29 ± 0.54; 16.36 ± 0.76 versus 14.02 ± 0.58; P ≤ 0.05) también fue mayor en los hatos de granjeros hombres tanto para cerdos indígenas como de raza mixta. Entre los géneros, todos los rasgos de preferencia se clasificaron de manera similar (P > 0.05), aparte del temperamento, que fue mejor calificado por los hombres. Sin embargo, el análisis multivariado reveló que el tamaño corporal y la conformación corporal eran mejor calificados por las mujeres agricultoras, mientras que sus contrapartes masculinas preferían más la supervivencia, la resistencia a las enfermedades, la tolerancia al calor, la capacidad maternal y el temperamento. **Implicación.** Los rasgos de importancia económica obtenidos en este estudio pueden guiar futuros programas apoyados en comunidad para mejora genética de cerdos en un ambiente tropical. **Conclusión.** El presente estudio reveló la importancia del tamaño corporal, la conformación corporal, la capacidad de maternidad, la supervivencia, la tolerancia al calor, la resistencia a las enfermedades y la fertilidad en la selección de cerdos reproductores. Sin embargo, estos rasgos fueron clasificados diferencialmente por hombres y mujeres agricultores.
Palabras clave: mejora; preferencia; clasificación; cerdos; trópicos

INTRODUCTION

Agriculture plays an essential role as a source of economy and employment in Nigeria. Pig farming is one of the most important livestock raised in Nigeria by smallholder farmers because pigs require small space for farming (Iyiola-Tunji, 2011). It plays essential functions in smallholders, as an investment, emergency cash, home consumption (protein/ meat), manure for fertilizing the soil for growing crops (Ocampo *et al*., 2005; Phengsavanh *et al*., 2011; Kambashi *et al*., 2014) and they are important assets of the household. In addition, pig produces large number of offspring in a short gestation period compared to other small stock, and as the agriculture world changes, so does the perceived value of a pig breed's qualities (Best, 2012; Carter *et al*., 2013). Pigs have a gestation of hundred and fourteen days which means it can get pregnant two and half in one year compared to cattle. Smallholder pig farming is the most practiced system among rural farmers due to lack of land for subsistence farmers (Chikwanha *et al.*, 2007). Pigs commonly found in Nigeria include exotic and local breeds of pigs.

The majority of rural pig farmers practice backyard pig farming while those in the peri-urban areas rear pigs semi-intensively with pig sty usually located around the garbage sites. Such practices are unsafe because raising pigs in the garbage dumping zones come with risks of disease outbreaks (Randolph, 2002; Normile, 2005). Effective rearing of livestock allows farmers not only to 'hang in' but it also provides opportunity to 'step up' and 'step out' of poverty. However, smallholder pig farming is faced with a lot of challenges which limits farmers from emerging to commercial status, and, in addition, they are viewed negatively and referred to as non-productive (Borges *et al*., 2005; Mutua *et al*., 2010; Tekle *et al*., 2013).

Programmes on genetic improvement of pigs in Nasarawa State can be executed using within breed selection based on the level of performance of the animals. It has been postulated that increased gender equality benefits society through better decision-making as well as increasing overall productivity and quality of life in countless ways (Sadedin, 2017). Due to the role of gender relations in poverty alleviation, various studies have reiterated the need for further studies on the implications of dynamic livestock production system on gender relations among pastoral and agro-pastoral communities (Nedessa *et al*., 2005; Said *et al*., 2014). This sex differences may also be exploited in the aspect of genetic improvement of livestock especially Nigerian indigenous pigs to understand the pattern of trait preferences and selection of breeding animals by male and female keepers. Marshall *et al*. (2016) reported that traits of key importance to the pastoralists varied by species and gender.

There is inadequate understanding of the genetic potentialities and capabilities of pigs in Nasarawa State, Nigeria as well as the associated productive factors at the village level. This knowledge based on gender perception is needed to design appropriate breeding schemes for the smallholder pig farmers. The possible outcome includes the production of more vigorous animals with better meat yields. The main objective of this study was to assess the breeding practices being carried out by pig farmers in Nasarawa State on the basis of gender to gain a lot of insight about the production system and identify the traits that are preferred for selection and breeding based on the sex of the farmers.

MATERIALS AND METHODS

Description of study area

This study was undertaken in the three Senatorial Zones (Nasarawa South, Nasarawa North and Nasarawa West) of Nasarawa State, north central Nigeria. The State is located within the guinea savannah agro-ecological zone and is found between latitudes 7° 52′ N and 8° 56′ N and longitudes 7° 25′ E and 9° 37′ E, respectively (Lyam, 2007).

Sampling procedure

Preliminary information was sought to identify areas where pig farmers were located. A total of 120 pig farmers (58 Females and 62 males) were randomly sampled in the selected villages of the study area.

Data collection procedure

The participatory rural appraisal tool (Questionnaires and face-to-face discussions) comprised assessment activities around three key issues for pigs. These issues were: (i) farmers socio-economic characteristics (ii) flock structure and management (iii) the criteria used by the farmers for selecting male and female breeding animals. Male and female pig farmers were asked separately to list the selection and culling criteria for breeding pigs and rank them from the most important (1), more important (2), important (3) to the least important (4).

Statistical analysis

The categorical variables within and between gender were compared using Chi square ($\chi 2$) statistics. T-Test was used to separate the arithmetic means of continuous variables of both sexes (gender). Rank means were also calculated for between-gender comparisons of the continuous variables. Friedman test was carried out to ascertain whether there were significant differences within-sex ranking of the traits of preference at $P<0.05$. Significant rank means were then separated using the non-parametric Wilcoxon Signed-rank test with Bonferroni's adjustments. The non-parametric Kruskal–Wallis test followed by the Mann–Whitney U test for post hoc separation of mean ranks was used for comparison between gender following the description of Dossa *et al*. (2015). Cluster analysis, a multivariate technique was used to determine hidden patterns of breeding trait preferences. This was to permit appropriate grouping of the male and female pig farmers. The K-means clustering algorithm was used. The maximum iteration was set at 10.0 while the convergence was zero. SPSS (2015) statistical package was used in all analyses.

RESULTS

Among the categorical traits, only primary occupation and type of landholding were significantly influenced by gender ($P \leq 0.05$; $P \leq 0.01$) (Table 1). The female farmers appeared to be more into trading compared to their male counterparts. With regard to continuous variables, male farmers had higher average farm size (hectares) than the opposite sex (1.59 versus 1.10; $P \leq 0.05$). Men were also more experienced in pig keeping (years) than women (6.54 versus 4.74; $P \leq 0.05$).

The size of pigs kept by male farmers was higher than that kept by female farmers (20.31±2.21 versus 14.78±1.53; $P \leq 0.05$) (Table 2). This was more reflected in mixed breeds (12.08±1.69) than the indigenous pigs (6.81±1.16). The composition of the mixed breeds indicated that the number of male piglets, boars and milking sows were significantly higher in male-owned flocks compared to those being managed by females (2.74±0.45 versus 1.60±0.30; 1.02±0.21 versus 0.37±0.11 and .02±0.19 versus 0.46±0.11; $P \leq 0.05$ and $P \leq 0.01$, respectively).

Source of foundation stock significantly ($P<0.05$) varied between male and female farmers (Table 3). However, management system, feed supplementation, breeding control and access to veterinary services were not significantly ($P>0.05$) affected. Number of foundation stock was significantly higher in flocks owned by male farmers (2.22±0.17 versus 1.78±0.10; $P<0.05$).

Number of piglets/sow/annum (14.77±0.77 versus 12.29±0.54; 16.36±0.76 versus 14.02±0.58) was higher ($P \leq 0.05$) in indigenous pigs' flocks and those of mixed genotypes of male farmers (Table 4). However, there were no significant ($P>0.05$) differences in average farrowing interval in both types of pigs.

Within each sex, the pattern of ranking of the traits followed similar pattern with the exception of temperament which was rated lower ($P \leq 0.006$) than fertility by the female farmers (Table 5).

The two sexes varied in the ranking of temperament, where male farmers rated it higher compared to their female counterparts (53.86 versus 66.46; $P \leq 0.05$) (Table 6). Other traits such as body size, body conformation, mothering ability, survival, heat tolerance, disease resistance and fertility were not significantly ($P > 0.05$) influenced.

In the multivariate analysis, four clusters were formed (Table 7). The female farmers were more associated with clusters 1 and 3. The respective preference traits were body size and body conformation. However, clusters 2 (disease resistance and survivability) and 4 (temperament, fertility, heat tolerance and mothering ability) were characterized by traits preferred by male farmers.

Table 1.Socio economic characteristics of pig farmers in Nasarawa State.

	Gender			
	Male	Female		
Characteristics	No (%)		Chi-square	P-value
Categorical variables				
Age of Respondent				
20-30	15 (24.6)	16 (27.6)		
31-40	16 (26.2)	16 (27.6)		
41-50	11 (18.0)	8 (13.8)		
51 above	19 (31.1)	18 (31.0)	0.458	0. 928^{ns}
Marital Status				
Single	15 (24.6)	15 (25.9)		
Married	46 (75.4)	42 (72.4)		
Wid**owed**	0 (0.0)	1 (1.7)	1.107	0.575^{ns}
Education				
None	9 (14.8)	5 (8.6)		
Primary	9 (14.8)	16 (27.6)		
Secondary	19 (31.1)	23 (39.7)		
Tertiary	24 (39.3)	14 (24.1)	6.044	0.110^{ns}
Primary Occupation				
Crop farming	23 (37.7%)	21 (36.2)		
Trading	14 (23.0)	28 (48.3)		
Artisan	9 (14.8)	5 (8.6)		
Civil Service	13 (21.3)	4 (6.9)		
Others	2 (3.3)	0 (0.0)	12.598	0.013*
Access to Credit				
No	39 (63.9)	39 (67.2)		
Yes	22 (36.1)	19 (32.8)	0.144	0.704
Personal savings				
No	28 (45.9)	26 (44.8)		
Yes	33 (54.1)	32 (55.2)	0.014	0.906
Type of landholding				
Individual ownership	29 (47.5)	12 (20.7)		
Communal farming system	11 (18.0)	7 (12.1)		
Rent	3 (4.9)	6 (10.3)		
Free occupation	18 (29.5)	33 (56.9)	13.282	0.004**
Continuous variables				
	Mean	**Mean**	**T- value**	**P-value**
Farm size (hectares)	1.59	1.10	2.201	0.030*
Experience in pig keeping (years)	6.54	4.74	2.094	0.038*

*, ** Significant at $P \leq 0.05$ and $P \leq 0.01$, respectively

^{ns}Not significant

Table 2. Flock structure (Mean±S.E.) of pigs reared in Nasarawa State.

	Gender			
Parameters	Male	Female	T-value	P-value
Flock size	20.31±2.21	14.78±1.53	2.040	0.044*
Indigenous pigs	8.39±1.66	7.71±1.55	0.301	0.764^{ns}
Male piglets	1.93±0.54	1.72±0.38	0.313	0.755^{ns}
Female piglets	1.70±0.34	1.63±0.32	0.133	0.895^{ns}
Male growers	1.00±0.22	1.70±0.44	-1.463	0.146^{ns}
Female growers	1.08±0.26	1.03±0.34	0.112	0.911^{ns}
Boars	0.79±0.19	0.44±0.12	1.470	0.144^{ns}
Milking sows	0.95±0.26	0.60±0.18	1.094	0.276^{ns}
Non-milking sows	0.87±0.20	0.90±0.28	-0.081	0.936^{ns}
Mixed breeds	12.08±1.69	6.81±1.16	2.548	0.012*
Male piglets	2.74±0.45	1.60±0.30	2.067	0.041*
Female piglets	2.43±0.39	1.50±0.34	1.787	0.077^{ns}
Male growers	2.19±0.40	1.46±0.36	1.362	0.176^{ns}
Female growers	1.42±0.30	0.81±0.20	1.672	0.097^{ns}
Boars	1.02±0.21	0.37±0.11	2.614	0.01**
Milking sows	1.02±0.19	0.46±0.11	2.453	0.016*
Non-milking sows	1.30±0.25	1.19±0.37	0.235	0.815^{ns}

S.E. = standard error

*, ** Significant at $P \leq 0.05$ and $P \leq 0.01$, respectively

^{ns}Not significant

Table 3. Management systems of pigs kept in Nasarawa State.

	Gender			
	Male	Female		
Characteristics	No (%)	No (%)	Chi-square	P-value
Categorical variables				
Source of Foundation Stock				
Inherited	15 (24.6)	6 (10.3)		
Purchase from market	18 (29.5)	14 (24.1)		
Purchase from neighbor	19 (31.1)	17 (29.3)		
Borrowed	9 (14.8)	20 (34.5)		
Others	0 (0.0)	1 (1.7)	9.571	0.048*
Management system				
Semi-intensive	55 (90.2)	52 (89.7)		
Intensive	4 (6.6)	6 (10.3)		
Extensive	2 (3.3)	0 (0.0)	2.41	0.300^{ns}
Feed supplementation				
Yes	53 (86.9)	49 (84.5)		
No	8 (13.1)	9 (15.5)	0.140	0.708^{ns}
Breeding Control				
No	48 (78.7)	48 (82.8)		
Yes	13 (21.3)	10 (17.2)	0.316	0.574^{ns}
Access to Vet				
Yes	47 (77.0)	45 (77.6)		
No	14 (23.0)	13 (22.4)	0.005	0.944^{ns}
Continuous variables				
	Mean ±S.E.	Mean ±S.E.	T-value	P-value
No of foundation stock	2.22±0.17	1.78±0.10	2.223	0.028*

*, ** = significant at P<0.05 and P<0.01, respectively

^{ns} = not significant

S.E.= standard error

Table 4. Reproductive performance of pigs.

	Gender	
	Male	Female
Traits	Mean±S.E.	Mean±S.E.
Indigenous pigs		
Number of piglets/sow/annum	14.77±0.77[a]	12.29±0.54[b]
Average farrowing interval (days)	194.15±2.07[a]	192.83±2.17[a]
Mixed breeds		
Number of piglets/sow/annum	16.36±0.76[a]	14.02±0.58[b]
Average farrowing interval (days)	189.49±1.67[a]	186.70±1.39[a]

S.E.= Standard error

Means in rows with different letters are significantly different at $P \leq 0.05$

Table 5. Mean ranks of traits preferred for breeding of pigs according to Friedman test.

	Gender	
	Male	Female
Traits	Mean rank*	Mean rank*
Body size	3.65[a]	3.46[a]
Body conformation	4.06[a]	3.53[a]
Mothering ability	3.92[a]	3.84[a]
Survivability	3.83[a]	4.09[a]
Heat tolerance	3.90[a]	3.82[a]
Disease resistance	4.39[a]	4.43[a]
Fertility	5.97[b]	5.97[b]
Temperament	6.29[b]	6.86[c]
Friedman test (chi-square)	85.59	115.59
Asymptotic Significance	P<0.05	P<0.05

Means in columns followed by different lower case letters are different at the Bonferroni-adjusted significance level of $P \leq 0.006$

*The lower the mean rank, the more important the trait.

Table 6. Mean ranks of factors preferred in the choice of breeding stock of pigs and their significance level according to Kruskall-Wallis test[z].

	Gender			
	Male	Female		
Traits	Mean rank	Mean rank	Kruskall-Wallis test	Asymptotic significance
Body size	60.89	59.07	0.107	0.743[ns]
Body conformation	62.82	57.03	0.968	0.325[ns]
Mothering ability	58.75	61.31	0.184	0.668[ns]
Survival	57.45	62.68	0.775	0.379[ns]
Heat tolerance	59.60	60.42	0.020	0.889[ns]
Disease resistance	59.82	60.19	0.004	0.951[ns]
Fertility	57.67	62.45	0.634	0.426[ns]
Temperament	53.86[a]	66.46[b]	5.726	0.017*

Means followed by different superscripts in rows are different at $P \leq 0.05$.

[z]The lower the mean rank, the more important the trait

*, Significance at $P \leq 0.05$

[ns]Not significant

DISCUSSION

Females were more into trading, had lower farm size and less experienced in pig keeping in the present study. These may have negatively affected production. Gender influences the nature or type of work/tasks that men or women perform, and those roles may vary per country, group or generation. Those defined roles may thus confer specific opportunities, challenges, and status for individuals (Blackstone, 2003).

Table 7. The clusters of farmers based on traits of preference.

Parameters	Cluster			
	1	2	3	4
Body size	3.82	1.63	1.23	1.29
Body conformation	1.64	1.79	2.53	1.39
Mothering ability	1.41	1.74	1.88	2.45
Survivability	1.41	2.47	1.58	2.37
Heat tolerance	1.41	1.95	1.45	2.63
Disease resistance	1.95	2.63	1.75	2.37
Fertility	3.09	2.42	3.05	3.16
Temperament	3.45	1.53	3.73	3.84
Gender	Female	Male	Female	Male

In developing countries, the gender differences in livestock production activities mainly arise from customary or traditional roles that view certain activities as more suitable for males or females (Walugembe, 2017). Hence, there is need for re-orientation towards an explicit gender-equality focus (Chanamuto and Hall, 2015) to guarantee sustainable pig production. The years of experience in pig keeping of the present study is less than the 10.86 ± 6.42 years reported by Kouam and Moussala (2018). The mean piglet number recorded for mixed breeds in the present study appears lower than the 12.2 ± 7.3 and 7.8 ± 1.0 reported for pigs in Kenya (Roessler *et al*., 2008). The differences may however be due to varying production objectives, breeds of animals, environment and the available resources. According to Abiola *et al*. (2015) the management practices are still largely manual, labour intensive and mostly on small scale basis. There is need for government and stakeholder's intervention in swine husbandry and management in Nigeria. The numbers of piglets per sow values obtained in the present study under productivity are comparable to the estimate of 13.84 reported by Ye *et al*. (2018). However, Phengsavanh *et al*. (2010) gave a value of 6.8 piglets/litter while Huyen *et al*. (2017) reported a range of 6-12 piglets/litter for indigenous/local pigs and 3-14 piglets/litter for crossbred pigs.

In the current study, considering the outcome of the Friedman Test and that of Kruskal–Wallis, both sexes perceived body size, body conformation, mothering ability, survivability, heat tolerance and disease resistance as being of utmost importance. This might not be unconnected with the direct and indirect relationship of these traits with the market value and profitability of the pig enterprise. The appearance of animals in terms of size and conformation; proper nurturing and their ability to withstand environmental hazards and diseases may influence the amount of revenue generated by the farmers. Body size in pigs has been proposed as signature for selection (Reimer *et al*., 2018). It has been suggested that selection for disease resistance and tolerance might improve the health and welfare of pigs with concomitant increase in pork production (Guy *et al*., 2012). Quite unexpectedly, within gender rating of fertility was low in both male and female flocks. This could be as a result of the traditional belief that pigs are naturally prolific, as they have the ability to conceive and deliver many offspring at a time. Therefore, farmers may be interested in prioritizing and developing other traits which to them appeared more complex. This assertion, however, needs to be corrected through farmers' orientations and re-orientations considering the accrued benefits in the improvement of reproductive traits. According to Ek-Mex *et al*. (2014) and Małopolska *et al*. (2018), reproductive performance is an economically important factor in a pig enterprise to improve efficiency.

Between-gender higher rating of temperament by male farmers might be attributed to their knowledge of the merits and demerits of this trait more than the opposite sex. Perhaps, the female sex laid less emphasis on temperament because it has little direct relationship with market value. In a study on traits preference in pigs, Mbuthia *et al*. (2015) rated temperament low in both semi-intensive and extensive system. The clustering analysis agrees with those of Friedman and Kruskal–Wallis Tests in assigning temperament to male farmers. However, the differential ratings of other traits of preference may be due to varying sensitivity of each algorithm. Different animal trait preferences are influenced by various factors, including the production system, infrastructural and environmental constraints and availability of feed resources (Roessler *et al*., 2008). Gender dimension of criteria used to select livestock has been reported (Marshall *et al*., 2008).

CONCLUSION

The present study revealed the importance of body size, body conformation, mothering ability, survival, heat tolerance, disease resistance and fertility in the selection of breeding pigs. However, these traits were differentially rated by male and female farmers. Considering the specific roles and responsibilities of men and women in relation to livestock keeping, the present findings have implications for future breeding programs geared towards increased pig production and productivity. Promotional strategies will bridge the gap between male and female farmers thereby enhancing pig research/breeding programmes at the rural level in the study area.

Acknowledgement
The authors are extremely grateful to all the farmers that were involved in this research for their time and patience.

Funding. No funding support was received from any organization to carry out this research.

Conflict of interest statement. The authors declared no conflict of interest.

Compliance with ethical standards. There was strict adherence to the Global code of conduct for research in resource-poor settings following the Convention on Biological Diversity and Declaration of Helsinki.

Data availability. Data are available with the corresponding author (abdulkubu@nsuk.edu.ng) upon reasonable request**.**

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