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EFFECT OF QUALITATIVE CHARACTERISTICS ON ECOMETRIC TRAITS OF NIGERIAN INDIGENOUS CHICKENS REARED EXTENSIVELY IN MAIDUGURI, BORNO STATE

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ABSTRACT: This research was conducted in Borno State to assess the influence of qualitative characteristics on the quantitative traits in six hundred (600) adult indigenous chickens randomly sourced from central and southern parts of the state. Nine (9) quantitative (body weight, ornithological measurement, wing span, neck length, back length, keel length, tail length, thigh length and shank length); and six (6) qualitative traits (shank colour, plumage colour, comb type, earlobe colour, eye colour and crestedness) were measured. Data were analyzed using General Linear Model of SPSS, version 20. Chickens with green shank had best keel length (11.93 cm) while those of black shank demonstrated longest tail (22.01 cm). 'White with Black Strips' and brown plumage chickens had longest keel. Rose combed had longest thigh (13.29 cm) and shank (9.22 cm). Best ornithological measurements (68.67, 23.33cm) and wing span (72.33 cm) were attributed to blue white earlobe chickens. Pearl eyed chickens had widest wing (67.16 cm). Crestless chickens performed better for all the traits except tail length. The results suggest the potentiality of the chickens for improvement and could be prerequisites to their selection for improvement.

Keyword: Influence, qualitative, quantitative, characters, indigenous chickens

INTRODUCTION

Farm animal production especially chicken farming plays a vital socio-economic role for people living in low-income countries. In Nigeria, domestic fowls are the most widespread poultry species as they are seen under the care of almost every rural family. These chickens provide a valuable source of family protein and income. They are being used as simple farming and are recognized as side farm business (Permadi *et al*., 2020). Eggs of indigenous chicken are widely sought as consumers believe this to boost stamina and vitality when used in herbal medication (Hendriyanto, 2019). Their multipurpose use also extended to production of decorative feathers, recreational role in ritual practices and fulfillment of social obligations (Desta, 2020). Thus, the significant role of indigenous chicken sector in poverty alleviation, food security and economic empowerments for vulnerable groups of the society could not be over emphasized.

In term of their body conformation, plumage colour and a host of other morphological traits such as shank colour, ear-lobe colour and comb types, these chickens are known for large variations. The colour of the shank and skin are an essential characteristic of native chickens and is significantly related to consumer preference (Suyatno *et al*., 2023). Shen *et al.* (2019) stated that shank colour in local chicken plays an essential role in market competition.

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However, due to their low genetic potentials, the economic contribution of indigenous chicken is not proportional to their huge number. Increasing the productivity of local chickens requires careful attention to nutrition, health and breeding (Manyelo *et al*., 2020). Attempts have been made by several authors to improve the productivity of indigenous chickens (Widodo *et al.,*2019, 2021; Tonda *et al.,* 2022; 2023). Characterization of traits in native chickens can be carried out through morphometric identification of quantitative traits that can be used as selection criteria to increase productivity. More so, associating different marker genotypes (peculiar traits) to morphological traits is advantageous as individual animal (chicken) could be chosen based on its selected advantages (Abdulraheem *et al.*, 2021).

Although some previous authors revealed that morphology contributes very little to quantitative and production characteristics (Shuaibu *et al.*, 2020), it is essential to assess the influence of morphology on the morphometric traits. This is because, knowledge and understanding of association between the two traits are crucial in designing and implementation of indigenous chicken-based improvement programmes. Therefore, this study was designed to assess the influence of qualitative characters on the quantitative traits of indigenous chickens in Borno State.

MATERIALS AND METHODS

Experimental Environment

The work was carried out in Borno State. Borno State lies between Latitudes 10^0-13^0 N and Longitudes 12^0 – 15^0 E. The climate of Borno State is tropical with defined wet and dry seasons. The intensity and duration of wet season decrease south-north ward, thus making the state a semi-arid characterized by long dry season (October to May) and a short rainy season (June to September). Annual rainfall ranges from 500 to 600 mm with a mean temperature of 38^0 C (25 - 41^0 C) and with relative humidity range of 5 – 45% (Abdulraheem, 2021; Abdulraheem *et al.,* 2023).

Data Collection

A total of 600 adult indigenous chickens were randomly collected from six local government areas (LGAs); three each (LGAs) from Central (300) and Southern (300) parts of Borno State for the study. One hundred chickens (100) each were collected from Jere, Maiduguri and Konduga (Central part); and one hundred chickens (100) each were collected from Damboa, Biu and Chibok (Southern part). This was done across thirty (30) villages/communities with twenty (20) chickens collected from each of the villages/communities. Figure 1 presents the map of Borno State showing the three (3) administrative districts (parts) of the state and the selected Local Government Areas.

Morphological Measurements

The following linear measurements were obtained:

- Body weight: live weight of the birds determined using an electronic scale (0.0g sensitive) on the same day by the same operator.
- The ornithological measurement: measuring from the tip of the beak to the end of the tail when the bird is laid down on its back.
- Wing span: distance between the ends of the longest primaries with wings stretched. On the work table/board, maintain the joints of the wings as stretched as possible.
- Neck length: the birds were immobilized on its left hand side on the work table/board by an operator stretching legs with one hand and the neck with the other hand, another operator took the measurement of the distance between the nape and the insertion of the neck into the body.
- Back length:- length from the insertion of the neck in to the body to the saddle.
- Keel length:- distance between both vertical of the sternum (Processus carnine and processus xiphoideus) laying the birds on its back.
- Tail length:- length from the tip of a central rectrix to the point where it emerges from the skin.
- Thigh length:- length from the notch of the shin bone-femur joint, to shin bone tarsus joint.
- Shank length: tarsus length (Abdulraheem, 2021).

Measuring Instruments

A tailor measuring tape (± 1 mm) was used to measure ornithological measurement, wing span, neck, back, keel, tail length and extremities. The body weight of the birds was taken using a digital measuring scale (5 kg x 1g (SF – 400)). Birds were measured on a wooden-board improvised by the researcher for measuring chickens.

Qualitative Characteristics

Effects of the following qualitative traits on quantitative traits were studied:

- Five (5) Shank colour: (Grey blue, Black, Green, White, Yellow);
- Eleven (11) plumage colours (Brown red, Red, Ash, White with Black Stripes, Black, Black with White Stripes, Yellow, Brown, Multicolour, others, White);
- Four (4) comb types (Pea, Rose, Single, V/shape);
- Twelve (7) ear lobe colours (black, blue, blue/black, red, blue/white, red/white, white);
- Four (4) eye colour (brown, orange, pearl, red); and
- Crestedness (normal/crestless, crested).

All qualitative traits were identified by visual observation.

Statistical Analysis

Data collected on the seven (7) quantitative traits were subjected to Analysis of Variance using General Linear Model (GLM) with shank, plumage, comb type, earlobe colours and crestedness as fixed factors. Significant means were separated using Duncan's Multiple Range Test. All statistical analyses were performed using SPSS version 20.0 (SPSS, 2011).

- The following model was adopted for the GLM:
- $Y_{ijklmno} = \mu_o + B_i + C_j + D_k + E_l + F_m + G_n + e_{ijklmno}$
- Where $Y_{ijklmno}$ = observation belonging to $_{ijklmn}$ classification
  μ_0 = Overall mean
- B_i = effect of ith shank colour (i =1, 2,…5)
- C_j= effect of jth plumage colour (j =1, 2, …11)
- D_k = effect of kth comb type (k =1, 2, … 4)
- E_l = effect of l^{th} earlobe colour (k =1, 2, … 7)
- F_m = effect of m^{th} eye colour
- G_n = effect of n^{th} crestedness (k =1, 2)
- $e_{ijklmno}$ = random error

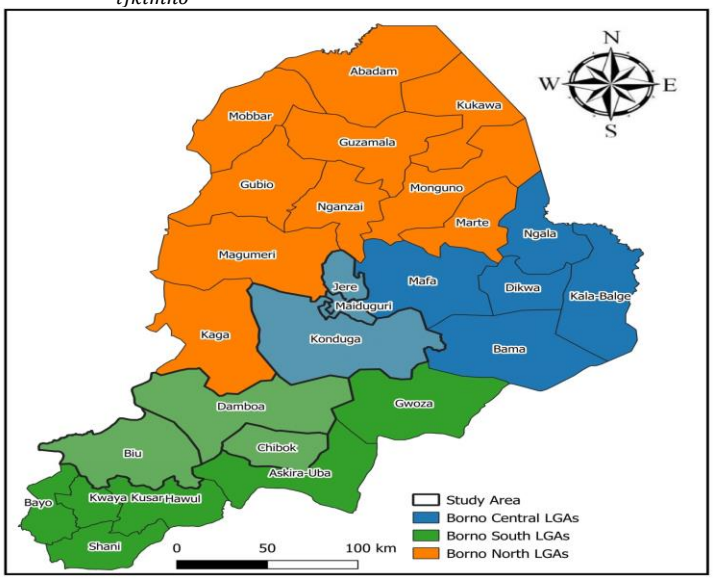


Figure 1: Map of Borno State showing the study areas

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RESULTS AND DISCUSSION

Effect of shank colour on body weight and morphological traits of indigenous chickens

Table 1 shows the results of effect of shank colour on body weight and morphological measurements of indigenous chickens. The study revealed significant effect (P<0.05) of shank colour on three traits (keel length, tail length and shank length) out of the nine examined. Chickens with green shank had the longest keel (11.93 cm). However, the keel length was not significantly different from those of white and yellow shank, while the shank length was not significantly (P<0.05) different from those of other colours except grey blue that had the least (8.50 cm). The least keel length of grey blue shank chickens was not equally different from those of other colours except green. Chickens with longest tail had black coloured shank. The least tail length (20.79 cm) of chickens with green shank differed from only those of black shank. Like the previous traits, these did not significantly differ from those with white, yellow and grey blue shank. Consequently, chickens with green shank had best keel length while chickens with black shank had best tail length. This result may suggest their potentiality for better improvement than other birds. Considering the significance of keel in poultry meat production, these findings could be used to develop effective breeding index to improve the genetic resources of these chickens.

The effect of shank colour on morphological traits of indigenous chickens in this study is in line with the work of Apuno *et al.* (2011) who reported significant effect (P<0.001) of shank colour on body measurements of indigenous chickens of Adamawa State. The authors also reported significant effect of milky colour on the body girth of indigenous chickens. This is contrary to the outcome of this study that chickens with green shank had the longest keel length. Variations in the reports may be associated with geographical locations, colour variants and genetic constitution of the birds.

Effect of plumage colour on body weight and morphological measurements of indigenous chickens

Significant effect (P<0.05) of plumage colour on keel and thigh lengths was observed (Table 2). The effect was observed for chickens with 'White with Black Strips' and brown. On the other hand, plumage colour had effect on thigh length but had no effect on body weight. Chickens having 'White with Black Strips' and brown plumage colour had longest keel than any other while all the birds had longer thigh except those of brown red plumage colour. This is an indication of better improvement of keel for chickens having 'White with Black Strips' plumage over others when selection is applied.

Table 1: Effect of shank colour on morphological measurements (cm) of indigenous chickens

Shank colour	Morphological traits								
	Body weight (kg)	Ornitho-logical measure-ment	Wing span	Neck length	Back length	Keel length	Tail length	Thigh length	Shank length
Grey blue	1414.55^{a}	64.99^{a}	64.29^{a}	13.47^{a}	22.06^{a}	11.38^{b}	21.79^{ab}	12.79^{a}	8.50^{b}
Black	1439.84^{a}	64.22^{a}	64.76^{a}	13.35^{a}	21.87^{a}	11.42^{b}	22.01^{a}	12.89^{a}	8.91^{a}
Green	1456.79^{a}	63.14^{a}	63.23^{a}	13.17^{a}	21.85^{a}	11.93^{a}	20.79^{b}	13.04^{a}	8.99^{a}
White	1465.59^{a}	62.48^{a}	64.09^{a}	13.34^{a}	21.73^{a}	11.81^{ab}	21.27^{ab}	13.02^{a}	9.17^{a}
Yellow	1468.68^{a}	65.14^{a}	65.12^{a}	13.32^{a}	22.07^{a}	11.80^{ab}	21.65^{ab}	12.84^{a}	8.94^{a}

Means with different superscript (a,b,c) in the same column differ significantly (P<0.05)

The result of this study that revealed no significant effect of plumage colour on body weight is in accordance with the report of Shuaibu *et al.* (2020). Similar findings were reported by of Apuno *et al.* (2011) who found no significant difference of plumage colour on body weight of Nigerian indigenous chickens of Adamawa State. In line with this, Tabassum *et al.* (2014) reported same for indigenous chickens of Bangladesh.

Meanwhile, a contradictory observation was observed by Onasanya *et al.* (2018) as they reported barrel pigmented plumage chickens to express superior performance across ecometric traits. However, these authors equally observed significant effect (P<0.05) of plumage colour on breast length (keel length), a concordance with the report of the present study. Although the authors recorded the highest breast length among mottled birds as against brown chickens

reported in this study, the variations in the result of this study and those of other authors could be related to the variations in the chicken-types, varieties of plumage colours as well as the morphological traits investigated in the studies.

Table 2: Effect of plumage colours on morphological measurements of indigenous chickens

Plumage colour	Morphological traits								
	Body weight (kg)	**Ornitho-logical measure-ment (cm)**	**Wing span (cm)**	**Neck length (cm)**	**Back length (cm)**	**Keel length (cm)**	**Tail length (cm)**	**Thigh length (cm)**	**Shank length (cm)**
Brown red	1400.00^{a}	66.35^{a}	63.53^{a}	12.90^{a}	22.22^{a}	11.50^{b}	22.38^{a}	12.11^{b}	8.51^{a}
Red	11403.85^{a}	59.85^{a}	63.00^{a}	13.00^{a}	20.54^{a}	11.65^{b}	19.23^{a}	13.08^{a}	9.18^{a}
Ash	1404.00^{a}	65.38^{a}	64.40^{a}	13.28^{a}	21.98^{a}	11.53^{b}	22.50^{a}	12.76^{a}	8.76^{a}
WBS	1410.53^{a}	63.45^{a}	60.87^{a}	13.05^{a}	21.79^{a}	12.11^{a}	20.81^{a}	12.57^{a}	9.09^{a}
Black	1410.63^{a}	62.94^{a}	63.21^{a}	13.56^{a}	21.61^{a}	10.94^{b}	21.62^{a}	12.85^{a}	8.85^{a}
BWS	1425.83^{a}	64.92^{a}	64.59^{a}	13.26^{a}	22.16^{a}	11.58^{b}	21.45^{a}	12.96^{a}	8.85^{a}
Yellow	1449.00^{a}	63.75^{a}	66.95^{a}	13.30^{a}	20.05^{a}	11.38^{b}	22.08^{a}	12.02^{a}	8.89^{a}
Brown	1471.57^{a}	64.31^{a}	64.82^{a}	13.10^{a}	22.21^{a}	12.01^{a}	21.52^{a}	12.61^{a}	0.04^{a}
Multicolour	1475.25^{a}	63.81^{a}	64.63^{a}	13.89^{a}	21.98^{a}	11.87^{b}	21.40^{a}	13.10^{a}	9.01^{a}
Others	1484.36^{a}	63.53^{a}	64.67^{a}	13.40^{a}	21.77^{a}	12.17^{a}	21.54^{a}	13.00^{a}	9.08^{a}
White	1497.84^{a}	63.98^{a}	65.01^{a}	13.40^{a}	21.71^{a}	11.76^{b}	21.49^{a}	13.09^{a}	9.17^{a}

Means with different superscript (a,b,c) in the same row differ significantly ($P<0.05$)

Effect of comb type on body weight and morphological measurements of indigenous chickens

Table 3 presents the result of effect of comb types on body weight and morphological characteristics of indigenous chickens. The result revealed that out of all the morphological traits studied, only two (thigh and shank length) were significantly ($P<0.05$) affected by comb type. Chickens with rose comb had the longest thigh (13.29 cm) and shank (9.22 cm) while those of V-shape comb were observed to have least values for thigh (12.22 cm) and shank (8.07 cm) lengths. Notably, thigh lengths of pea, single and V-shaped chickens were similar ($P>0.05$). It could therefore imply that chickens with rose comb would show better potential to selection for improvement of thigh length than those of other comb types.

In this study, the significant effect ($P<0.05$) of comb type recorded on morphological traits corresponds with the observation of Apuno *et al.* (2011) who reported significant effect of comb type on body girth ($P<0.01$). In their study, the authors further reported that birds with rose comb had the highest body girth (22.93 cm). This has equally been observed in this study that chickens with rose comb had the longest thigh and shank. However, Apuno *et al.* (2011) reported that single combed chickens had the least body weight as against V-shape combed chickens in this study. Contrary to the outcome of this study, Onasanya *et al.* (2018) reported that comb type remarkably affected only comb height and comb length traits. The reason for the differences in the reports could be linked with the varieties of comb types, breeds of birds investigated as well as geographical locations of the study areas which may justify preference for comb type.

Effect of ear lobe, eye colour and crestedness on body weight and morphological measurements of indigenous chickens

Effect of earlobe, eye colour as well as crestedness on body weight and morphological measurements is shown on Table 4. Significant ($P<0.05$) effect of earlobe colours on ornithological measurement, wing span and back length of indigenous chickens was observed. However, significant effect of ear lobe colour on body weight was not observed in this study. In contrary to this, Shuaibu *et al*. (2020) observed significant effect of ear lobe colour on body weight. Chickens with blue white ear lobe had the highest ornithological measurement (68.67 cm), wing span (72.33 cm) and back length (23.33 cm). This finding thus suggests that blue white earlobe could be utilized to improve ornithological measurements (comprising head, neck, back, tail lengths) and wing span.

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Table 3: Effect of comb type on morphological measurements (cm) of indigenous chickens

Comb type	Morphological traits								
	Body weight (kg)	Ornithological measurement	Wing span	Neck length	Back length	Keel length	Tail length	Thigh length	Shank length
Pea	1403.85[a]	64.08[a]	65.65[a]	13.51[a]	21.80[a]	11.48[a]	22.79[a]	12.92[b]	9.12[a]
Rose	1506.32[a]	64.92[a]	67.45[a]	13.59[a]	22.39[a]	11.87[a]	22.21[a]	13.29[a]	9.22[a]
Single	1446.69[a]	64.57[a]	63.59[a]	13.27[a]	21.78[a]	11.73[a]	21.24[a]	12.87[b]	8.92[a]
V/shape	1445.83[a]	64.83[a]	65.75[a]	12.79[a]	21.92[a]	11.00[a]	22.50[a]	12.22[b]	8.07[b]

Mean with different superscript (a,b,c) in the same row differ significantly (P<0.05)

Eye colour of indigenous chickens was observed (Table 4) to have significant effect (P<0.05) on only wing span. Chickens with pearl eye pigmentation had the widest wing (67.16 cm). Orange eye coloured birds were found to have the least (63.93 cm). Pearl eye coloured chickens that had better wingspan than any of other chicken type is an indication of better response to wing span improvement through selection. This would be useful especially when the chicken is selected for cultural uses such as fight and flight.

Crestedness (Table 4) in indigenous chickens had significant effect on body weight and all the morphological traits (P<0.05). It was observed that chickens with normal heads (without crest) had better performance for all the traits except tail length of which chickens with crested heads had higher value (22.19 cm). The higher body weight (1488.38 g) observed for the chickens with normal heads could be as a result of diverting the protein meant for nurturing the growth of extra feather as crest to acquiring additional weight. There is dearth of information to explain the effects of ear lobe, eye colour and head crestedness of indigenous chickens on morphological traits in this study.

Table 4: Effect of ear lobe colour, eye colour and crestedness on body weight (kg) and morphological measurements (cm) of indigenous chickens

Ear lobe colour	Morphological traits								
	Body weight	Ornitho-logical measure-ment	Wing span	Neck length	Back length	Keel length	Tail length	Thigh length	Shank length
Black	1376.96[a]	60.87[b]	62.69[b]	12.79[a]	21.18[c]	11.77[a]	20.61[a]	12.98[a]	9.15[a]
Blue	1472.00[a]	66.37[b]	65.74[b]	13.44[a]	22.01[b]	11.46[a]	21.87[a]	13.05[a]	8.87[a]
Blue black	1440.74[a]	66.70[b]	65.07[b]	13.11[a]	22.33[a]	11.24[a]	22.19[a]	12.30[a]	8.55[a]
Red	1431.08[a]	63.48[b]	64.20[b]	13.09[a]	21.78[b]	11.78[a]	20.99[a]	12.84[a]	8.88[a]
Blue white	1333.33[a]	68.67[a]	72.33[a]	13.33[a]	23.33[a]	11.17[a]	20.66[a]	13.33[a]	8.88[a]
Red white	1429.26[a]	63.25[b]	63.69[b]	13.29[a]	21.87[b]	11.76[a]	21.44[a]	12.84[a]	8.98[a]
White	1489.86[a]	63.27[b]	64.38[b]	13.50[a]	21.91[b]	11.85[a]	21.69[a]	13.06[a]	9.09[a]
Eye colour									
Brown	1448.47[a]	63.31[a]	64.99[ab]	13.49[a]	21.99[a]	11.80[a]	21.46[a]	12.93[a]	8.84[a]
Orange	1442.14[a]	63.15[a]	63.93[c]	13.29[a]	21.83[a]	11.64[a]	21.62[a]	13.01[a]	8.96[a]
Pearl	1421.61[a]	64.10[a]	67.16[a]	13.29[a]	21.94[a]	11.81[a]	22.03[a]	12.86[a]	8.85[a]
Red	1479.71[a]	63.77[a]	64.18[c]	13.26[a]	21.89[a]	11.77[a]	21.31[a]	12.85[a]	9.06[a]
Crestedness									
Crested head	1320.42[b]	63.07[b]	63.89[b]	12.77[b]	21.78[b]	10.96[b]	22.19[a]	12.55[b]	8.32[b]
Normal head	1488.38[a]	64.05[a]	64.53[a]	13.46[a]	21.92[a]	11.91[a]	21.34[b]	13.02[a]	9.13[a]

Means with different superscript (a,b,c) in the same column differ significantly (P<0.05)

CONCLUSION

Qualitative characteristics did not exert effect on body weight of the chickens except crestedness. Chickens with green shank demonstrated longest keel while longest tail was expressed by those with black coloured shank. Chickens having white-with-black-strips and brown plumage colours had better performance for keel length. Chickens carrying rose comb expressed longest thigh and shank. Better ornithological measurement, wing span and back length were demonstrated by chickens with blue white ear lobe. Widest wing was attributed to chickens with pearl eye pigmentation. Normal-headed chickens had better performance for body weight and all the traits. Meanwhile, crested chickens demonstrated longest tail. This information is useful in designing effective breeding strategies for chicken improvement and conservation priority.

REFERENCES

Abdulraheem, A.O. (2021). Molecular and phenotypic diversity of indigenous chickens in the central and southern parts of Borno State. Ph. D. Thesis, University of Maiduguri, Borno State, Nigeria.

Abdulraheem, A.O., Alade, N.K., Allamin, H., Raji, A.O., Mohammed, I.D., Aliyu, J. and Adamu, J. (2021). Association between heamoglobin genotype and body measurements in Nigerian indigenous chicken populations. Nigeria. *Proceedings of* 26th *Annual Conference of Animal Science Association of Nigeria (ASAN),* Uyo, Nigeria, September 538-541.

Abdulraheem, A.O., Gideon, G., Mohammed, A., Shettima, M.M. and Raji, A.O. (2023). Growth patterns of indigenous normal feathered chickens reared extensively in Borrno, Northeast Nigeria. *Proceedings of* 28th *Annual Conference of Animal Science Association of Nigeria (ASAN),* Abuja, Nigeria, September 80-83.

Apuno, A. A., Mbap, S. T. and Ibrahim, T. (2011). Characterization of local chickens (*Gallus gallus domesticus*) in Shelleng and Song Local Government Areas of Adamawa State, Nigeria. *Agric Bio J North Am*, doi:10.5251/abjna. 2.1.6.14.

Desta, T. (2020). Indigenous village chicken production: A tool for poverty alleviation, the empowerment of women, and rural development. *Trop*. *Anim. Health Prod*., 53(1):1–16.

Hendriyanto, W. (2019). *Guide to Breeding and Doing Village Chicken Business*. Laksana, Yogyakarta, Indonesia.

Mahnunin, R., Sutanto, A., Sari, D.K., Hilda, H., Ahmad, F. Wirawan, W., Sebayang, N.S., Hadinoto, H., Suhesti, E., Amri, U. and Busa, Y. (2022). Potential utilization of dried rice leftover of household organic waste for poultry functional feed. *Jord J. B Sci*, 15(5): 879–886.https://doi.org/10.54319/jjbs/150517

Manyelo T.G., Selaledi L., Hassan, Z.M. and Mabalebele, M. (2020). Local chicken breeds of Africa: Their description, uses and conservation methods. *Anim.* 10(12- 2257):1– 18.

Onasanya, G.O., Ikeobi, C.O.N. and Amusan, S. (2018). Morphostructural profiling of comb types and plumage pigmenta tion and their influences on ecometric traits of extensively managed Nigerian indigenous chickens. *Nig. J. Anim. Sci. Tech.* 1(2):10-17.

Permadi, A.N.N., Kurnianto, E. and Sutiyono, S. (2020). Morphometric characteristics of male and female Kampung Chickens in Tirtomulyo Village, Plantungan District, Kendal Regency Central.

Sarker, N.R., Hoque, A., Faruque, S., Islam, N. and Bhuiyan, F.H. (2014). An ex-situ study on body characteristics and effect of plumage color on body weight of indigenous chicken (*Gallus domesticus*) in Bangladish, *Ani. Sci.* 36:79-84. *Sci. J*., 6(2): 181–190.

Shen, X., Wang, Y., Cui, C., Zhao, X., Li, D., Zhu, Q., Jiang, X., Yang, C., Qiu, M., Yu, C., Li, Q., Du, H., Zhang, Z. and Yin, H. (2019). Detection of SNPs in the Melanocortin 1-Receptor (MC1R) and its association with shank color trait in Hs Chicken., *Braz. J. Poult. Sci*., 21(3):1–9. https://doi.org/10.1590/1806-9061-2018-0845.

Shuaibu A, Ma'aruf BS, Maigado AI, Abdu I, Ibrahim Y and Mijinyawa A. (2020). Phenotypic characteristics of local chickens in Dass and Tafawa Balewa local government areas of Bauchi State, Nigeria. *Niger. J. Ani. Sci*., 22(2):19–31.

SPSS (2011). *Statistical Package for Social Sciences*. SPSS Version 20 IBM Inc. 444 Michigan Avenue, Chicago, IL60611, USA.

Suyatno, S., Sujono1, S., Winaya1, A., Zalizar, L. and Pangestu, M. (2023). Characterization of Qualitative and Quantitative Traits of Four Types of Indonesian Native Chickens as Ancestor of New Strains of Local Super Laying Hens. *Jordan J. of Bio Sci*, 16(2):171-179.

Tabassum, F., Hoque, M.A., Islam, F., Ritchil, C.H., Faruque, M.O. and Bhuiya, A.K.F.H. (2014). Phenotypic and mophemetric characterization of indigenous chickens at Jhenaigati Upazila of Sherpur district in Bangladish, *South Asia Asso Reg Coop J Agric.*, 12(2)"154-169.

Tareke, M., Assefa, B., Abate, T. and Tekletsadik, E. (2018). Evaluation of morphometric differences among indigenous chicken populations in Bale zone, Oromia Regional State, Ethiopia. *Poult*.

Tonda R, Manar FMA, Setyobudi RH, Zalizar L, Widodo W, Zahoor M, Hermawan D, Damat D, Fauzi A, Putri A, Zainuddin Z, Yuniati S, Hawayanti E, Rosa I, Sapar S, Adil A, RA DS, Supartini N, Indriatiningtias R, Kalsum U, Iswahyudi I, and Pakarti TA. (2023). Food waste product for overcoming heat stress in broilers. E3S *Web Conf*., 374(00031):1–14.

Tonda, R., Zalizar, L., Widodo, W., Setyobudi, R.H., Hermawan, D., Damat, D., Endang Dwi Purbajanti, E.D., Prasetyo, H., Ekawati, I., Jani, Y., Burlakovs, J., Wahono, S.K., Anam, C., Pakarti, T.A., Susanti, M.S., Widodo, W., Rahayu, I.D., Sutanto, A., Anggraini, A.D., Sahara, H., Safitri, S. and Yaro, A. (2021). Curcuma xanthorriza Roxb. as feed additive on the carcass and fat weight percentage, meat nutrient, and nutrient digestibility of super kampong chicken. *Sarhad J. Agric*, 37(1):41–47.

Widodo, W., Rahayu, I.D., Sutanto, A., Setyobudi, R.H. and Mel, M. (2019). The effectiveness of curcuma (Curcuma xanthorriza Roxb.) addition in the feed toward super Kampong chicken performances. *Proc. Pak. Acad. Sci.*: *B*, 56(4): 39–46.