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## Editorial

Dear readers of the Journal "World Family Poultry Journal", we are particularly pleased to share the content of this new issue of our Journal *Volume 3 N°1* for the year 2024. It contains scientific articles on the genetic characterization of poultry species and their constitution into populations whose structure has been well defined in each of the studies. The species in the spotlight are the duck and the guinea fowl. These articles, made available to us by the scientific committee, have been carefully selected to draw your attention to certain aspects of research concerning Family Poultry (AF). Indeed, the editorial committee of the Journal expresses its deep gratitude to our reviewers; Indeed, they devote a lot of their precious time and effort to bring their expertise to the editing of the various manuscripts submitted to them.

The conclusions that emerged from this report refer to factors that can be taken into account when developing a genetic improvement programme for the various poultry species mentioned above.

Whatsoever, we encourage more authors from different scientific spheres to use our Journal to publish their research results or reviews as well when they know that they have something different or new. We strongly recommend reading and writing their manuscripts in conformity to our *Instructions to authors* which are at the end of each published WFPJ issue.

We wish you a happy reading of the menu presented in the current issue. However, we are thankful to the authors who have confidence into our Journal by submitting their manuscripts for assessment and their publication if accepted.

Very best and warmest regards!

**Pr FOTSA Jean Claude,**  
*Editor-in-Chief*

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## **Editorial**

Chers lecteurs du Journal « *Journal Mondial de l'Aviculture Familiale* », nous sommes particulièrement heureux de partager le contenu de cette nouvelle parution de notre journal du *Volume 3 N°1* l'année 2024. Il contient les articles scientifiques portant sur la caractérisation génétique des espèces avicoles et sa répartition en populations dont la structure a été bien définie dans chacune des études. Les espèces en exergue sont le canard et la pintade. Ces articles, mis à notre disposition par le comité scientifique, ont été savamment sélectionnés pour attirer votre attention sur certains aspects de la recherche concernant l'Aviculture Familiale (AF). En effet, le comité éditorial du Journal exprime sa profonde gratitude empreinte de beaucoup de reconnaissance à nos relecteurs ; en effet, ils consentent beaucoup de leurs temps et effort précieux pour apporter leurs expertises lors de l'édition des différents manuscrits qui leurs sont soumis.

Les conclusions qui en sont issues évoquent des facteurs qui pourront être pris en compte lors de l'élaboration d'un programme d'amélioration génétique des différentes espèces avicoles indiquées plus haut.

Quoi qu'il en soit, nous encourageons un plus grand nombre d'auteurs, de différentes sphères scientifiques et concernant les espèces avicoles, à utiliser notre Journal pour publier leurs résultats de recherche ou leurs revues de synthèse lorsqu'il faut partager des informations nouvelles. En effet, nous acceptons les articles dans les domaines aussi variés que possible comme le précisent nos « *Recommandations aux auteurs* » contenues au bas de chaque édition de JMAF.

Nous vous souhaitons une excellente lecture du menu qui est ici servi. Par ailleurs, nous vous renouvelons notre reconnaissance pour la confiance que vous avez eue en notre journal en soumettant vos articles pour évaluation et publication, si acceptés.

Très cordialement

**Pr FOTSA Jean Claude**  
*Editeur-En-Chef*

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## **Editorial**

Estimados lectores de la Revista "World Family Poultry Journal", nos complace especialmente compartir el contenido de este nuevo número de nuestra Revista *Volumen 3 N°1* para el año 2024. Contiene artículos científicos sobre la caracterización genética de las especies avícolas y su constitución en poblaciones cuya estructura ha sido bien definida en cada uno de los estudios. Las especies en el centro de atención son el pato y la gallina de Guinea. Estos artículos, puestos a nuestra disposición por el comité científico, han sido cuidadosamente seleccionados para llamar su atención sobre ciertos aspectos de la investigación relacionada con la Avicultura Familiar (FA). De hecho, el comité editorial de la Revista expresa su profundo agradecimiento a nuestros revisores; De hecho, dedican gran parte de su valioso tiempo y esfuerzo a aportar su experiencia a la edición de los diversos manuscritos que se les presentan.

Las conclusiones que se desprenden de este informe se refieren a factores que pueden tenerse en cuenta a la hora de desarrollar un programa de mejoramiento genético para las distintas especies avícolas mencionadas anteriormente.

Por lo tanto, animamos a los científicos con resultados de investigación diferentes y nuevos e interesados en la familia Aviculture, para compartirlos con otros a través de sus publicaciones en nuestra revista. De hecho, aceptamos los artículos en los campos tan variados como sea posible según lo especificado en nuestras "*Recomendaciones a los autores*" que figuran en la parte inferior de cada edición de JMAF.

Finalmente, le agradecemos a los miembros del consejo editorial, especialmente a aquellos que ayudaron en la traducción de estos artículos al español y al francés.  
Mis mejores deseos.

**Pr. FOTSA Jean Claude**

*Editor-En-Jefe*

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## Phenotypic characterization of Muscovy duck (*Cairina moschata*) in Sudano-Sahelian and bimodal rainfall forest zones of Cameroon

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### Abstract

The Muscovy duck is a species that has been overlooked due to the paucity of scientific information generated on it and its minimal involvement in development projects. Paradoxically, ducks have a better growth performance than chickens and are more resistant to avian diseases; their lower requirements than chickens can be explained by their better hardiness, which deserves greater attention because of their rich potential. This requires a study of their phenotypic traits, which would serve as the basis for any duck breeding program and could be a future forerunner for this breed's numerical and weight productivity. This study was carried out for the preceding reasons, with the primary objective being to contribute to a better understanding of the phenotypic diversity of Muscovy ducks in Cameroon. A total of 171 adult ducks (males and females) were surveyed in 5 regions (North, Far North, East, South and Center) of Cameroon. Descriptive statistics tools revealed the variability in phanera coloration. White-black plumage dominated (27.49%), as well as yellowish-black shank (47.37%), reddish beak (33.33%) and brown-black eyes (50.88%). All these morphological traits were influenced by sex ( $P \leq 0.05$ ). The mean live weight of males in kg ( $3.03 \pm 0.50$ ) was significantly higher than in females ( $1.70 \pm 0.33$ ). Locality had a highly significant influence ( $P \leq 0.01$ ) on only some biometric traits; however, the sex factor influenced all the biometric traits (body length:  $39.72 \pm 6.26$  cm, beak length:  $5.68 \pm 3.35$  cm). Discriminant factor analysis and phylogenetic analysis revealed that the assessed population comprised 3 morphotypes, with types 2 and 3 being closer to each other and types 1 and 3 further apart. The high variability observed ( $CV=25\%$ ) reveals the existence of a non-selected population governed by natural selection. More efforts are needed to make genetic improvements through adequate selection tools.

**Key words:** Bimodal rainfall forest zone; Cameroon; Phenotypic traits; Muscovy duck, Sudano-Sahelian zone.

## **Caractérisation phénotypique du canard de Barbarie (*Cairina moschata*) dans les zones sahélo-soudanienne et forestière à pluviométrie bimodale du Cameroun**

### **Résumé**

Le canard de Barbarie est une espèce laissée pour compte en raison du peu de travaux scientifiques qui lui sont consacrés et de sa faible implication dans les projets de développement. Pourtant, les canards ont de meilleures performances de croissance que les poules et sont plus résistants aux pathologies aviaires ; leurs faibles besoins par rapport aux poules s'expliquent par leur plus grande rusticité qui mérite une attention plus que d'ordinaire en raison de tout leur riche potentiel. Ceci nécessite une étude de leurs caractéristiques phénotypiques qui servirait de base dans l'élaboration de tout programme d'élevage de canards et pourrait aussi être un précurseur à la productivité numérique et pondérale ultérieures de ladite espèce. C'est dans cette optique que cette étude a été menée avec pour objectif principal de contribuer à une meilleure connaissance de la diversité phénotypique du canard de Barbarie au Cameroun. Pour ce faire, un total de 171 canards adultes (mâles et femelles), a été échantillonné dans 5 régions (Nord, Extrême-Nord, Est, Sud et Centre) du Cameroun. Les outils de statistiques descriptives ont ressorti la variabilité de coloration des phanères. Ainsi, le plumage blanc-noir est dominant (27,49%) ainsi que le tarse noir jaunâtre (47,37%), le bec rougeâtre (33,33%) et les yeux brun-noir (50,88%). Toutes ces colorations morphologiques sont influencées par le sexe ( $P \leq 0,05$ ). Le poids vif moyen des mâles en kg ( $3,03 \pm 0,50$ ) est significativement plus élevé que celui des femelles ( $1,70 \pm 0,33$ ). La localité n'a eu une influence hautement significative ( $P \leq 0,01$ ) que sur quelques mensurations biométriques; cependant, le facteur sexe a influencé tous les caractères biométriques (longueur du corps:  $39,72 \pm 6,26$ , longueur du bec:  $5,68 \pm 3,35$ ). L'analyse factorielle discriminante et l'analyse phylogénétique révèlent que la population évaluée est constituée de 3 morphotypes, les types 2 et 3 sont plus rapprochés alors que les types 1 et 3 sont plus éloignés. La grande variabilité observée (CV=25%) révèle l'existence d'une population non sélectionnée et dont le pool de gènes a été façonné par la sélection naturelle. Des efforts d'amélioration génétique sont attendus à travers des outils de sélection appropriés.

**Mots clés :** caractères phénotypiques ; canard de Barbarie, zone soudano-sahélienne ; zone forestière à pluviométrie bimodale ; Cameroun.

## **Caracterización fenotípica del pato moscovita (*Cairina moschata*) en las zonas sahelo-sudanesas y de bosque pluvial bimodal de Camerún**

### **Resumen**

El pato moscovita es una especie que ha sido descuidada debido a la falta de trabajo científico dedicado a él y su baja participación en proyectos de desarrollo. Sin embargo, los patos tienen un mejor rendimiento de crecimiento que los pollos y son más resistentes a las enfermedades aviares; Sus bajas necesidades en comparación con los pollos pueden explicarse por su mayor resistencia, que merece más atención de lo habitual debido a todo su rico potencial. Ello requiere un estudio de sus características fenotípicas que sirva de base para el desarrollo de cualquier programa de cría de patos y que también pueda ser precursor de la posterior productividad numérica y de peso de dichas especies. Con esto en mente, se llevó a cabo este estudio con el objetivo principal de contribuir a un mejor conocimiento de la diversidad fenotípica del pato moscovita en Camerún. Para ello, se muestrearon un total de 171 patos adultos (machos y hembras) en 5 regiones (Norte, Extremo Norte, Este, Sur y Centro) de Camerún. Las herramientas de estadística descriptiva han puesto de manifiesto la

variabilidad en la coloración de los apéndices. Así, predomina el plumaje blanco-negro (27,49%), el tarso negro amarillento (47,37%), el pico rojizo (33,33%) y los ojos marrón-negro (50,88%). Todas estas tinciones morfológicas están influenciadas por el sexo ( $P \leq 0.05$ ). El peso vivo promedio de los machos en kg ( $3,03 \pm 0,50$ ) es significativamente mayor que el de las hembras ( $1,70 \pm 0,33$ ). La localidad tuvo una influencia altamente significativa ( $P \leq 0.01$ ) en solo unas pocas mediciones biométricas; Sin embargo, el factor de género influyó en todos los rasgos biométricos (longitud corporal:  $39,72 \pm 6,26$ , longitud del pico:  $5,68 \pm 3,35$ ). El análisis factorial discriminante y el análisis filogenético revelan que la población evaluada está compuesta por 3 morfotipos, los tipos 2 y 3 están más cerca mientras que los tipos 1 y 3 están más distantes. La gran variabilidad observada ( $CV=25\%$ ) revela la existencia de una población no seleccionada cuyo acervo genético ha sido moldeado por la selección natural. Se espera que los esfuerzos de mejoramiento genético se realicen a través de herramientas de selección adecuadas.

**Palabras clave:** Caracteres fenotípicos; Pato moscovita, zona sudano-saheliana; área forestal con precipitaciones bimodales; Camerún.

## Introduction

The notion of biodiversity is widely disseminated today, its importance is recognised, and undoubtedly, it contributes to safeguarding ecosystems and different species (Mahammi, 2014). However, the development of livestock sectors aims to meet the significant challenge of reducing food insecurity while guaranteeing the nutritional and sanitary quality of different types of food for consumers (Couvét, 2015). This aim also involves characterizing animal genetic resources as essential for proper management and sustainable use (FAO, 2013). In Africa, family poultry farming is crucial as the primary source of animal protein supply for populations and income (Zaman *et al.*, 2004; Youssao *et al.*, 2013). Indeed, family poultry is used by over 80% of the population stakeholders, primarily rural, and plays a vital role in rural and urban economies (Fotsa *et al.*, 2007).

In Cameroon, the poultry that makes up this village poultry farming remains poor in terms of investment and supervision, as it is raised in rudimentary breeding systems that can suffer up to 80% loss in numbers, depending on climatic variations (Oguntundji *et al.*, 2015). However, poultry production has generally focused on developing chicken production, neglecting other species, including ducks (Fogang, 2016). Unlike the local chicken, the muscovy duck is an orphan species due to the lack of scientific work carried out on it and its few implications for development projects. However, it has been shown that ducks have better growth performance than chickens and are more resistant to avian diseases (Houessionon *and* Youssao, 2018); their low requirements compared to chickens can be explained by their better hardiness (Amanidja *et al.*, 2018) to avian diseases and their thriftiness despite the dietary deficiencies to which they are subjected (Nkidiaka *and* Huart, 2013). Baruwa *et al.* (2018) also reported that these birds only require a little investment, especially concerning their habitat. However, phenotypic and molecular knowledge of this species (*Cairina moschata*) is very limited in Cameroon. It is for the preceding reasons that this study was undertaken with the main aim of contributing to a better understanding of the phenotypic traits of Muscovy ducks in the Sudano-Sahelian and bimodal-rainfall forest zones of Cameroon, with a future view to preserve them while improving their productivity.

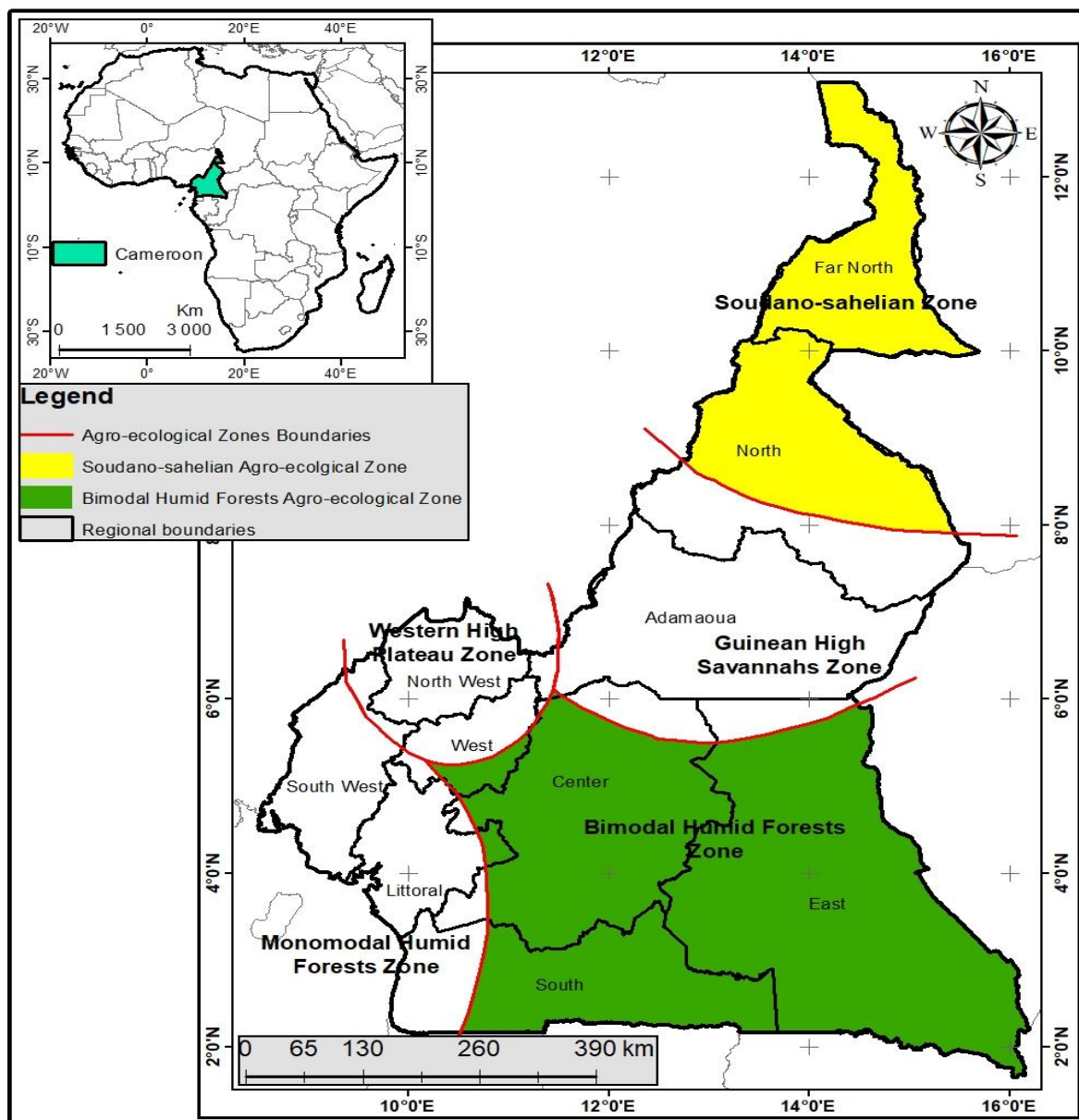
## Methodology

### Period, area of study and zones' description

This study was conducted in the Sudano-Sahelian and bimodal-rainfall forest zones of Cameroon between January and April 2022. These zones are described (Figure 1) as shown below:

**The Sudano-Sahelian zone** lies between the parallels of latitude 8°36' and 12°54' North and the meridians of longitude 12°30' to 15°42' East and covers the Far North and North Regions. Its altitude varies from 0 to 500 m. The climate is characterized by monomodal rainfall of varying duration and intensity (from 400 to 1200 mm per year from North to South). Temperatures vary from South to North, between 28 and 45°C (IRAD, 2008). The vegetation consists of savannahs and grasslands that are sometimes subjected to flooding and steppes (Onana, 2018), with a wide diversity of soils (Ambassa, 2000; IRAD, 2008).

**The bimodal rainfall forest zone** is characterized by a warm, humid, Guinean-type tropical climate, with an average rainfall of around 2,500 mm, divided into two distinct wet seasons. The bimodal rainfall regime allows for two crop cycles per year. The average temperature is 27°C. The Southern Cameroon plate is a morphological unit consisting of a succession of convex hills at altitudes ranging from 650 to 900 m and blunt, sometimes armoured interfluves, characterize the vegetation in this zone.



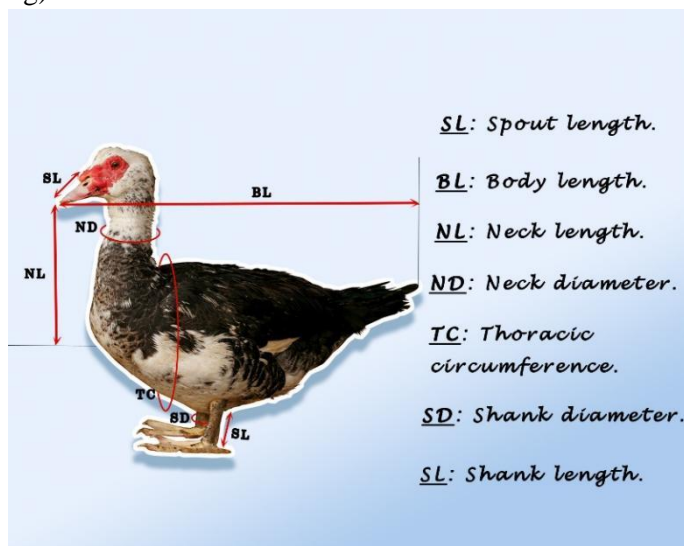
**Figure1:** Location of study area (IRAD, 2008).

### Sampling techniques

The study population comprised adult Muscovy ducks found in each agroecological zone and a representative sample of 171 adult birds (111 females and 60 males). With the collaboration of the appropriate departments of the Ministry of Livestock Fisheries and Animal Industries (MINEPIA) Regional, Divisional and Sub-divisional delegations, where various contacts were made with breeders in the zones concerned to collect data; the animals considered were chosen based on the accessibility of the breeding site and the availability of breeders. However, these birds were selected at random in 05 regions. Genetically closely related ducks and apparently sick ones were not considered in the sampling. Phenotypic identification was based on phaneroptotic and biometric parameters. Information was collected using a survey form adapted to FAO (2013) and AU-IBAR (2015) standards.

The phaneroptotic description was obtained by direct observation of the animals in daylight. The information information was focused on traits presenting a visible polymorphism. These were

plumage colour, shank colour, eye colour and beak colour. Body measurements were taken using a tape measure and callipers (0.1 mm precision) on the various easily measurable parts of the body. In contrast, live weights were taken using an electronic balance with a capacity of 7000g and a precision of 1g (make and model of the balance). The main measurements (in cm) were: BoL: body length; BL: beak length; ND: neck diameter; TC: thoracic circumference; WS: wingspan; WL: wing length; TL: tarsal length; TD: tarsal diameter; ThL: thigh length; ThD: thigh diameter and LW: Live weight (in kg)



**Figure 2:** Body measurements in Muscovy duck.

## Statistical analysis

Descriptive statistics were used to describe the distribution of qualitative traits (plumage colour; shank, beak and eye colourations). The Chi-square analysis was used to show the influence of factors (sex and region), and the Analysis of variance (ANOVA) was used to assess the influence of factors (sex and region) on the different body measurements considered. Significant means were compared using Duncan's multiple test according to the following statistical model:

$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$ : where:  $Y_{ijk}$  is each of the body measurements of animal  $k$  of locality  $j$  and sex  $i$ ;  $\mu$ : population mean;  $\alpha_i$ : mean effect of sex  $i$ ;  $\beta_j$ : mean effect of locality  $j$ ;  $(\alpha\beta)_{ij}$ : mean effect of first-degree interaction;  $\epsilon_{ijk}$ : residual error on individual  $k$  of sex  $i$  and locality  $j$ . To assess the genetic variability of the Muscovy duck population, Principal Component Analysis (PCA) was performed on the basis of biometric traits. To determine the population structure, Discriminant Factorial Analysis (DFA) was used (FAO, 2013). The dendrogram was constructed using the Hierarchical Ascending Classification (HAC) protocol to establish relationships between morphotypes (Roux, 2006). Statistical analyses were carried out using SPSS 21.0 and XLSTAT 2022.

## Results

### Phaneroptical traits

The Chi-Square analysis of value traits shows that plumage, eyes and shank colors are highly influenced by regions and sex ( $p \leq 0.01$ ). However, beak coloration was not influenced by the sex factor. Table 1 summarizes the frequencies of the various traits (plumage, eye, beak and shank colourations) according to the region and sex factors of Muscovy duck populations in the Sudano-Sahelian and bimodal forest agro-ecological zones of Cameroon.

**Table 1:** Phaneroptic traits of Muscovy duck in Cameroon according to region and sex.

| Phenotype      | traits | Alleles                          | N    | Allelic Frequences (%) | P – values |           |
|----------------|--------|----------------------------------|------|------------------------|------------|-----------|
|                |        |                                  |      |                        | Region     | Sex       |
| Plumage colour | W      | C*C                              | 17   | 9.94                   | 0.001***   | 0.023*    |
|                | GW     | Lav*C                            | 19   | 11.11                  |            |           |
|                | GBW    | //                               | 3    | 1.75                   |            |           |
|                | BW     | D*C                              | 18   | 10.53                  |            |           |
|                | GBG    | //                               | 8    | 4.68                   |            |           |
|                | B      | D*D                              | 3    | 1.75                   |            |           |
|                | Bl     | E*E                              | 2    | 1.17                   |            |           |
|                | BIW    | E*C                              | 47   | 27.49                  |            |           |
|                | BIGW   | E*C                              | 3    | 1.75                   |            |           |
|                | BIBW   | //                               | 17   | 9.94                   |            |           |
|                | BIBWG  | //                               | 3    | 1.75                   |            |           |
|                | BIWG   | //                               | 17   | 9.94                   |            |           |
|                | BIGG   | //                               | 3    | 1.75                   |            |           |
|                | BIB    | E*E                              | 4    | 2.34                   |            |           |
|                | BIBG   | //                               | 4    | 2.34                   |            |           |
| BIG            | E*Lav  | 3                                | 1.75 |                        |            |           |
| Eyes colour    | BIW    | E*C                              | 25   | 14.62                  | 0.000***   | 0.001***  |
|                | YB     | W*D                              | 5    | 2.92                   |            |           |
|                | BB     | D*E                              | 87   | 0.88                   |            |           |
|                | BY     | E*W                              | 45   | 31.58                  |            |           |
| Beak colour    | Bl     | E*E                              | 5    | 2.92                   | 0.004**    | 0.059(ns) |
|                | BIW    | E*C                              | 28   | 16.37                  |            |           |
|                | RW     | e <sup>wh</sup> *C               | 28   | 16.37                  |            |           |
|                | W      | C*C                              | 12   | 7.02                   |            |           |
|                | R      | e <sup>wh</sup> *e <sup>wh</sup> | 57   | 33.33                  |            |           |
|                | RB     | e <sup>wh</sup> *E               | 41   | 23.98                  |            |           |
| Shank colour   | Y      | W*W                              | 28   | 16.37                  | 0.003**    | 0.036*    |
|                | BY     | E*W                              | 81   | 47.37                  |            |           |
|                | Bl     | E*E                              | 31   | 18.13                  |            |           |
|                | BIW    | E*C                              | 31   | 18.13                  |            |           |

**W:** white, **GW:** grey white, **GBW:** grey-brown white, **BW:** brown white, **GBG:** gray brown green: **B :** brown: **Bl :** black, **BIW:** black-white, **BIGW:** black grey white, **BIBW:** black brown white, **BIBWG:** black brown white green, **BIWG:** black white green, **BIGG:** black grey green, **BIB:** black brown, **BIBG:** black brown green, **BIG:** black green, **YB:** yellow brown, **BB:** black brown, **RW:** reddish white, **R:** reddish, **RB:** reddish black: **Y :** yellow, **BY:** black yellow, **% :** frequency of muscovy ducks; \*\*\*  $P \leq 0.001$ ; \*\*  $P \leq 0.01$ ; \*  $P \leq 0.05$ ; NS  $P > 0.05$ .

Irrespective of the factors (regions and sex), the results of phenotypic traits show that there is variability in plumage, shank and eye colour in Muscovy ducks: black-white plumage (27.49%) is more frequent, followed by grey-white plumage (11.11%). In comparison black plumage (1.17%) is poorly represented. Eye colour is predominantly brown-black (50.88%); however, yellow-black shank (47.37%) is more frequent, followed by black shank (18.13%) and black-white shank (18.13%).

### **Biometric traits**

The analysis of variance presented in Tables 2 and 3 indicates the significant influence of the region and sex factors on live weight and other measured biometric traits ( $p \leq 0.05$ ). These tables provide means, standard deviations and coefficients of variation for different body measurements of Muscovy ducks in the Sudano-Sahelian and bimodal-rainfall forest agroecological zones of Cameroon according to their region and sex.

The mean live weight (LW) was  $2.16 \pm 0.75$  kg, with a coefficient of variation of 34.72%. Males are more homogeneous (CV=16.50%), whereas females are more dispersed (CV=19.41%). Mean body length (BoL) was  $39.72 \pm 6.28$  cm, and mean beak length (BL) was  $5.44 \pm 0.92$  cm with a coefficient of variation of 16.91%. The mean neck diameter (ND) was  $2.10 \pm 0.62$  cm with a coefficient of variation of 29.52%. It was higher in the southern region; the average thoracic circumference (TC) was  $37.00 \pm 4.54$  cm with a coefficient of variation of 12.27%, reflecting the homogeneity of the duck population for the trait, the average wingspan (WS) was  $64.90 \pm 5.20$  cm with a coefficient of variation of 11.16%. A low rate of coefficient of variation was noted for this trait in all regions; the average wing length (WL) was  $33.40 \pm 5.04$  cm with a coefficient of variation of 15.09%. It was higher in the southern region, where Muscovy ducks were more dispersed (CV = 23.09%); average thigh length (ThL) was  $9.64 \pm 0.07$  cm, with a coefficient of variation of 12.40%. This trait shows minimal variation throughout the study area due to the low coefficient of variation observed. The average thigh diameter (ThD) was  $2.26 \pm 0.62$  cm, with a coefficient of variation of 27.43%. In General, coefficients of variation are relatively high for this parameter, reflecting the wide dispersion of Muscovy ducks for this trait; the shank length mean (LT) was  $5.95 \pm 1.05$  cm, and shank diameter (DT) was higher in males, with a higher coefficient of variation in the East region (CV=20.99%). It should also be noted that considering all the animals regardless of sex, the coefficient of variation mean is revised upwards. Therefore, in a crossbreeding context, the performance of the animals will be improved.

**Table 2:** Means, standard deviations and coefficients of variation of biometric traits in Muscovy duck of Cameroon.

| Agroecological zones    | Regions     | Sex    | n                      | body measurements      |                         |                          |                        |                        |                         |                          |                         |                          |        |
|-------------------------|-------------|--------|------------------------|------------------------|-------------------------|--------------------------|------------------------|------------------------|-------------------------|--------------------------|-------------------------|--------------------------|--------|
|                         |             |        |                        | LW (Kg)                |                         | BoL(Cm)                  |                        | BL (Cm)                |                         | ND (Cm)                  |                         | TC (Cm)                  |        |
|                         |             |        |                        | $\bar{X}\pm\delta$     | CV(%)                   | $\bar{X}\pm\delta$       | CV (%)                 | $\bar{X}\pm\delta$     | CV (%)                  | $\bar{X}\pm\delta$       | CV (%)                  | $\bar{X}\pm\delta$       | CV (%) |
| Soudano- Sahelian       | Far North   | Female | 31                     | 1.83±0.31              | 16.94                   | 34.44±2.98               | 8.65                   | 5.21±0.82              | 15.74                   | 1.93±0.51                | 26.42                   | 35.49±2.31               | 6.51   |
|                         |             | Male   | 21                     | 3.34±0.53              | 15.87                   | 41.51±3.18               | 7.66                   | 6.15±0.66              | 10.73                   | 2.56±0.44                | 17.19                   | 43.49±3.57               | 8.21   |
|                         |             | Mean   | 52                     | 2.44±0.86 <sup>a</sup> | 35.25                   | 37.29±4.63 <sup>d</sup>  | 12.42                  | 5.59±0.88 <sup>a</sup> | 15.74                   | 2.18±0.57 <sup>ab</sup>  | 26.15                   | 38.72±4.89 <sup>a</sup>  | 12.63  |
|                         | North       | Female | 30                     | 1.63±0.33              | 20.25                   | 35.21±7.36               | 20.90                  | 6.44±0.80              | 12.11                   | 1.70±0.28                | 16.47                   | 33.94±2.84               | 8.37   |
|                         |             | Male   | 15                     | 2.98±0.45              | 15.10                   | 43.51±5.46               | 12.55                  | 5.77±0.81              | 14.04                   | 2.14±0.37                | 17.29                   | 40.91±3.10               | 7.58   |
|                         |             | Mean   | 45                     | 2.08±0.74 <sup>b</sup> | 35.58                   | 37.98±7.80 <sup>cd</sup> | 20.53                  | 5.31±0.77 <sup>a</sup> | 14.50                   | 1.84±0.38 <sup>c</sup>   | 20.65                   | 36.26±4.41 <sup>b</sup>  | 12.16  |
| Center                  | Female      | 15     | 1.53±0.24              | 15.69                  | 39.57±2.65              | 6.70                     | 5.20±0.69              | 13.26                  | 1.95±0.58               | 29.74                    | 32.25±2.17              | 6.73                     |        |
|                         | Male        | 4      | 2.58±0.29              | 11.24                  | 46.63±4.20              | 9.00                     | 5.80±0.33              | 5.69                   | 2.3±0.66                | 28.70                    | 37.25±5.23              | 14.04                    |        |
|                         | Mean        | 19     | 1.75±0.50 <sup>a</sup> | 28.57                  | 41.06±4.14 <sup>b</sup> | 10.08                    | 5.33±0.67 <sup>a</sup> | 12.57                  | 2.02±0.59 <sup>bc</sup> | 29.21                    | 33.31±3.55 <sup>c</sup> | 10.66                    |        |
| bimodal-rainfall forest | East        | Female | 12                     | 1.73±0.36              | 20.81                   | 37.68±3.22               | 8.54                   | 5.22±0.29              | 5.56                    | 1.78±0.29                | 16.29                   | 36.71±4.57               | 12.45  |
|                         |             | Male   | 8                      | 2.83±0.35              | 12.37                   | 43.19±2.89               | 6.69                   | 6.31±1.68              | 26.62                   | 2.50±0.81                | 32.40                   | 38.83±1.37               | 3.53   |
|                         |             | Mean   | 20                     | 2.17±0.65 <sup>b</sup> | 29.95                   | 39.88±4.10 <sup>bc</sup> | 10.28                  | 5.66±1.18 <sup>a</sup> | 20.84                   | 2.07±0.65 <sup>abc</sup> | 31.40                   | 37.56±3.73 <sup>ab</sup> | 9.93   |
|                         | South       | Female | 23                     | 1.70±0.36              | 21.17                   | 42.44±4.27               | 10.06                  | 4.97±1.19              | 23.94                   | 2.22±0.96                | 43.24                   | 35.00±2.81               | 8.03   |
|                         |             | Male   | 12                     | 2.83±0.34              | 12.01                   | 49.15±4.16               | 8.46                   | 5.95±0.51              | 8.57                    | 2.68±0.22                | 8.21                    | 41.08±1.77               | 4.31   |
|                         |             | Mean   | 35                     | 2.08±0.64 <sup>b</sup> | 30.77                   | 44.74±5.28 <sup>a</sup>  | 11.80                  | 5.31±1.10 <sup>a</sup> | 20.71                   | 2.38±0.81 <sup>a</sup>   | 34.03                   | 37.09±3.83 <sup>b</sup>  | 10.33  |
| Total                   | Female      | 111    | 37.35±5.66             | 15.15                  | 37.35±5.66              | 15.15                    | 5.50±4.11              | 74.72                  | 1.91±0.60               | 31.41                    | 34.66±3.08              | 8.89                     |        |
|                         | Male        | 60     | 44.10±4.88             | 11.06                  | 44.10±4.88              | 11.06                    | 6.02±0.85              | 14.12                  | 2.45±0.50               | 20.41                    | 41.32±3.54              | 8.56                     |        |
|                         | All Regions | 171    | 39.72±6.28             | 15.81                  | 39.72±6.28              | 15.81                    | 5.44±0.92              | 16.91                  | 2.10±0.62               | 29.52                    | 37.00±4.54              | 12.27                    |        |
| Level of significancy   |             |        |                        | *                      | *                       | NS                       | *                      | *                      |                         |                          |                         |                          |        |

**a, b, c:** values bearing the same letter in the same column are not significantly different ( $p>0.05$ );  $\bar{X}\pm\delta$ : mean and standard deviation; **CV:** coefficient of variation; %: percentage; **LW** : Live weight; **BoL**: body length; **BL**: beak length; **ND**: neck diameter; **TC**: thoracic circumference; \*  $P\leq 0.05$ ; NS (non-significant)  $P>0.05$

**Table 3:** Means, standard deviations and coefficients of variation of biometric traits in Muscovy duck of Cameroon.

| Agroecological zones    | Regions     | Sex    | n                       | body measurements       |                         |                         |                         |                        |                        |                         |                         |                         |       |
|-------------------------|-------------|--------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|-------|
|                         |             |        |                         | WL (Cm)                 |                         | ThL (Cm)                |                         | ThD (Cm)               |                        | TL (Cm)                 |                         | TD (Cm)                 |       |
|                         |             |        |                         | $\bar{X}\pm\delta$      | CV(%)                   | $\bar{X}\pm\delta$      | CV(%)                   | $\bar{X}\pm\delta$     | CV(%)                  | $\bar{X}\pm\delta$      | CV(%)                   | $\bar{X}\pm\delta$      | CV(%) |
| Soudano- Sahelian       | Far North   | Female | 31                      | 31.48±1.79              | 5.68                    | 9.51±1.27               | 13.35                   | 2.18±0.46              | 21.10                  | 5.55±0.81               | 14.59                   | 1.32±0.33               | 25.00 |
|                         |             | Male   | 21                      | 37.34±3.56              | 9.53                    | 11.50±1.03              | 8.95                    | 2.75±0.53              | 19.27                  | 6.86±0.74               | 10.78                   | 1.61±0.36               | 22.36 |
|                         |             | Mean   | 52                      | 33.85±3.91 <sup>a</sup> | 11.55                   | 10.31±1.53 <sup>a</sup> | 14.84                   | 2.41±0.56 <sup>a</sup> | 23.24                  | 6.08±1.01 <sup>a</sup>  | 16.61                   | 1.43±0.37 <sup>ab</sup> | 25.87 |
|                         | North       | Female | 30                      | 30.70±2.65              | 8.63                    | 9.41±0.85               | 9.03                    | 1.87±0.34              | 18.18                  | 5.34±0.74               | 13.86                   | 1.08±0.30               | 27.77 |
|                         |             | Male   | 15                      | 5.79±2.60               | 7.26                    | 11.75±0.82              | 6.98                    | 2.51±0.41              | 16.33                  | 6.77±0.97               | 14.33                   | 1.43±0.24               | 16.78 |
|                         |             | Mean   | 45                      | 32.40±3.56 <sup>a</sup> | 10.99                   | 10.19±1.39 <sup>a</sup> | 13.64                   | 2.08±0.47 <sup>a</sup> | 22.60                  | 5.82±1.06 <sup>ab</sup> | 18.21                   | 1.19±0.33 <sup>b</sup>  | 27.73 |
| Center                  | Female      | 15     | 31.66±1.60              | 5.05                    | 9.94±0.92               | 9.25                    | 2.36±0.72               | 30.51                  | 5.63±0.76              | 13.50                   | 1.47±0.65               | 44.21                   |       |
|                         | Male        | 4      | 33.33±2.13              | 6.39                    | 10.68±1.11              | 10.39                   | 2.18±0.85               | 38.99                  | 5.18±2.08              | 40.15                   | 1.30±0.34               | 26.15                   |       |
|                         | Mean        | 19     | 32.01±1.80 <sup>a</sup> | 5.62                    | 10.09±0.98 <sup>a</sup> | 9.71                    | 2.32±0.73 <sup>ab</sup> | 31.47                  | 5.53±1.10 <sup>b</sup> | 19.89                   | 1.44±0.59 <sup>ab</sup> | 40.97                   |       |
| bimodal-rainfall forest | East        | Female | 12                      | 32.06±6.51              | 20.31                   | 9.81±0.68               | 6.93                    | 2.24±0.42              | 18.75                  | 5.18±0.65               | 12.55                   | 1.40±0.35               | 25.00 |
|                         |             | Male   | 8                       | 36.73±3.00              | 8.16                    | 11.24±0.67              | 5.96                    | 2.93±1.00              | 34.13                  | 6.95±0.61               | 8.78                    | 1.91±0.90               | 47.12 |
|                         |             | Mean   | 20                      | 33.93±5.77 <sup>a</sup> | 17.01                   | 10.38±0.96 <sup>a</sup> | 9.25                    | 2.52±0.76 <sup>a</sup> | 30.16                  | 5.89±1.08 <sup>ab</sup> | 18.33                   | 1.61±0.66 <sup>a</sup>  | 40.99 |
|                         | South       | Female | 23                      | 31.97±3.33              | 10.41                   | 10.17±0.93              | 9.14                    | 2.09±0.51              | 24.40                  | 5.76±0.83               | 14.40                   | 1.43±0.50               | 34.96 |
|                         |             | Male   | 12                      | 39.28±11.63             | 29.60                   | 11.45±0.58              | 5.07                    | 2.12±0.84              | 9.62                   | 6.98±0.99               | 14.18                   | 1.55±0.59               | 38.06 |
|                         |             | Mean   | 35                      | 34.48±7.96 <sup>a</sup> | 23.09                   | 10.61±1.02 <sup>a</sup> | 9.61                    | 2.10±0.63 <sup>b</sup> | 30.00                  | 6.17±1.05 <sup>a</sup>  | 17.02                   | 1.47±0.53 <sup>a</sup>  | 36.05 |
| Total                   | Female      | 111    | 31.46±3.12              | 9.92                    | 9.71±1.02               | 10.50                   | 2.11±0.50               | 23.70                  | 5.51±0.78              | 14.15                   | 1.31±0.44               | 33.58                   |       |
|                         | Male        | 60     | 36.99±5.90              | 15.95                   | 11.46±0.88              | 7.67                    | 2.55±0.71               | 27.84                  | 6.76±1.02              | 15.08                   | 1.57±0.50               | 31.84                   |       |
|                         | All Regions | 171    | 33.40±5.04              | 15.09                   | 10.32±1.28              | 12.40                   | 2.26±0.62               | 27.43                  | 5.95±1.05              | 17.65                   | 1.40±0.48               | 34.29                   |       |
| Level of significancy   |             |        |                         | NS                      | NS                      | *                       | *                       | *                      |                        |                         |                         |                         |       |

*a, b, c:* values bearing the same letter in the same column are not significantly different ( $p>0.05$ );  $\bar{X}\pm\delta$ : mean and standard deviation; *CV*: coefficient of variation; %: percentage; *WS*: wingspan; *WL*: wing length; *TL*: tarsus length; *TD*: tarsus diameter; *ThL*: thigh length; *ThD*: thigh diameter. \*  $P\leq 0.05$ ; NS (non-significant)  $P>0.05$

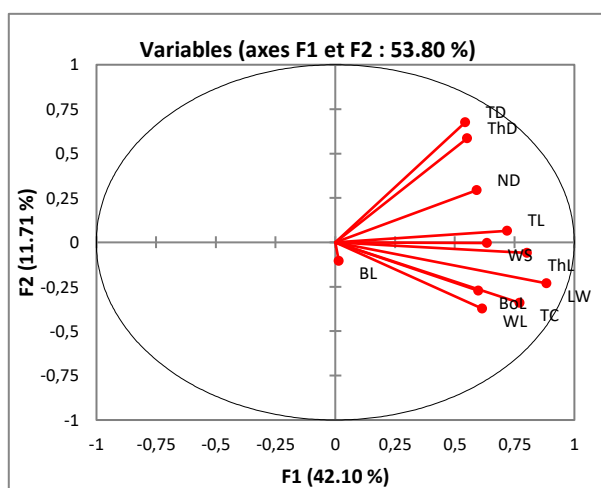
## Phenotypic variability and population structure

Principal component analysis was carried out to show the contribution of quantitative variables to explain the total phenotypic variability observed within the Muscovy duck population in the Sudano-Sahelian and bimodal rainfall forest zones of Cameroon.

Table 4 and Figure 3 provide an overview of how each of the 11 principal components contributed to the genetic variability observed within the study population.

**Table 4:** Eigen values and cumulative variability of principal components in the analysis of variability observed in the Muscovy duck population.

| Main component (F)  | F1    | F2    | F3    | F4    | F5    | F6    | F7    | F8    | F9    | F10   | F11    |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Eigen value         | 4,63  | 1,28  | 1,01  | 0,83  | 0,70  | 0,63  | 0,60  | 0,45  | 0,42  | 0,30  | 0,11   |
| Variance (%)        | 42,09 | 11,70 | 9,17  | 7,58  | 6,39  | 5,78  | 5,51  | 4,12  | 3,83  | 2,77  | 1,00   |
| cumulative variance | 42,09 | 53,80 | 62,98 | 70,56 | 76,96 | 82,74 | 88,25 | 92,38 | 96,21 | 98,99 | 100,00 |



**Figure 3:** Population variability by body measurements.

**BoL:** body length; **BL:** beak length; **ND:** neck diameter; **TC:** thoracic Circumference, **WS:** wingspan; **WL:** wing length; **TL:** tarsus length; **TD:** tarsus diameter; **ThL:** thigh length; **ThD:** thigh Diameter, **LW:** Live weight

Figure 3 indicates that the initial six components (TD, ThD, WS, LW, WL, and BL) account for 82.74% of the aggregate variability in the population. Components F1 and F2, which represent shank diameter and beak length, respectively, contribute to 53.81% of the overall phenotypic variability (Figure 3).

## Population structure

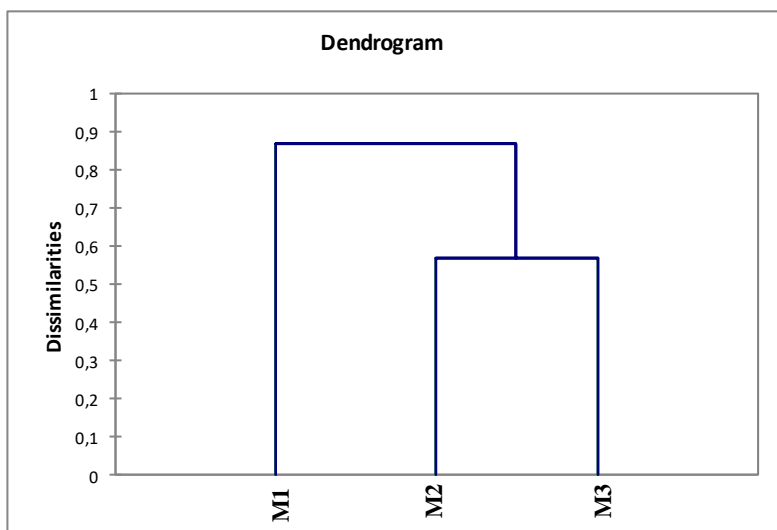
**Table 5:** Characteristics of different morphotypes.

| Variables | Morphotype 1 | Morphotype 2 | Morphotype 3 |
|-----------|--------------|--------------|--------------|
| BoL       | 39.86        | 38.57        | 40.10        |
| BL        | 5.51         | 5.09         | 6.32         |
| ND        | 2.18         | 1.92         | 2.04         |
| TC        | 38.84        | 36.57        | 33.94        |
| WS        | 70.02        | 64.69        | 65.73        |
| WL        | 33.92        | 34.45        | 31.86        |
| TL        | 6.32         | 5.03         | 5.79         |
| TD        | 1.33         | 1.35         | 1.54         |
| ThL       | 10.69        | 9.59         | 10.09        |
| ThD       | 2.10         | 2.23         | 2.55         |
| LW        | 2.43         | 2.07         | 1.72         |

**BoL:** body length; **BL:** beak length; **ND:** neck diameter; **TC:** thoracic Circumference, **WS:** wingspan; **WL:** wing length; **TL:** tarsus length; **TD:** tarsus diameter; **ThL:** thigh length; **ThD:** thigh Diameter, **LW:** Live weight.

Table 5 shows that morphotype 3 was characterized by a lower live weight than morphotypes 1 and 2. The differences observed may be due to endogenous factors (breed and strain) or exogenous factors (climate and breeding management.) and the interaction of the two factors.

Figure 4 shows the dendrogram of our population of Muscovy ducks.



**Figure 4:** Dendrogram of Muscovy duck populations.

**Table 6:** Distances between morphotype barycenters.

|   | 1    | 2    | 3    |
|---|------|------|------|
| 1 | 0    | 6.24 | 6.99 |
| 2 | 6.24 | 0    | 4.44 |
| 3 | 6.99 | 4.44 | 0    |

We used the dendrogram (Figure 4) and the distance between class barycenters (Table 6) to understand the relationships between morphotypes. Our analysis indicated that types 2 and 3 are more similar to each other, while types 1 and 3 are less similar. This difference in similarity may be due to the genetic distance between these morphotypes.

## Discussion

The phaneroptic traits observed in the study area revealed various colorations in the plumage, eyes, beak and shank. These indicated the existence of genetic variability, with the colors being due to the effects of many genes, the action of the environment and the various interactions between genes and the environment (Périquet, 1997). The most dominant plumage color was black-white, followed by grey-white, brown-white and black-white-green. This observation concurs with that made in Nigeria by Oguntunji and Ayorinde (2014), Muslim *et al.* (2020), Tamzil *et al.* (2018), and in Indonesia and Ivory Coast by Akou *et al.* (2021). The plumage of these birds is most often a combination in very diverse proportions between black and white (Sauveur, 1990; Houessionon, 2019), showing the epistatic expression of genes and modifying genes. This may be due to the migratory effect of men with their birds, which are introduced in other populations for crossbreeding. Other studies have shown that most domestic animal breeds are characterized by visible polymorphism, as visible mutants have a relatively higher degree of viability (Dongmo *et al.*, 2023).

Concerning shank color, we found that a yellow-black shank was predominant, followed by black-white shank. This result is in agreement with the observations of Oguntunji *et al.* (2014) in Nigeria, who found that yellow shanks are predominant (50%), followed by black shanks (32.75%) and Houessionon *et al.* (2019) in Benin. Half of the animals in our study had brown eyes, a result similar to those of Guessom (2019) in the Adamawa region of Cameroon and Muslim *et al.* (2020) in Nigeria. However, the differences would be due to environmental and non-allelic gene interaction effects. This suggests that Muscovy duck populations have yet to be subjected to an appropriate selection program and can, therefore, serve as a forerunner for the genetic improvement of this breed.

The average body length is closer to those obtained by Yakubu (2011) and Oguntunji *et al.* (2014), with a difference of 1cm. On the other hand, it differs from that observed by Raji *et al.* (2009), Oguntunji *et al.* (2014) in Nigeria, who used a mean body length ranging from 52 cm to 59 cm in Muscovy ducks, and those observed in Northern pintails by Flint *et al.* (1997), Del Hoyo *et al.* (1992); Johnsgard (1978), who used a mean length ranging from 52 cm to 67 cm. All these differences are due to environmental and breeding conditions that differ from those in the Sudano-Sahelian and bimodal-rainfall forest zones of Cameroon and a combination of genes from various crossbreeding among and within population. Concerning beak length, our results are within the range obtained by Oguntunji and Ayorinde (2014), Cramp and Simmons (1977), and Guessom (2019), who indicate that beak length varies between 47 mm and 59 mm in males. It agrees with the result observed by Johnsgard (1978), who states that beak size in females varies from 42 to 51 mm for its extreme values. The results recorded for the thoracic circumference are in the margin of what was previously found by Mounirou (2018) in the highlands of western Cameroon and comparable to those of Kleczek *et al.* (2006) with a difference ranging from 2.13 to 4.52 respectively for females and males in our

results. Thus, this result is lower by 3-5 cm than that reported by Yakubu *et al.* (2011) on Muscovy ducks from the Guinean savannah and humid forest zone in Nigeria and those of Fogang (2016) in the humid forest zone of Cameroon. This difference is probably due to environmental effects, rearing conditions and non-controlled genetic effects. Del Hoyo *et al.* (1992), Cramps and Simmons (1977), and Girard (1998) set the male's wingspan at 80-95 cm and the female's at 80-85 cm. These observations are well above our results (73.29±8.86 cm for males and 64.90±5.20 cm for females) and below those found by Mounirou (2018) in the highlands of western Cameroon (53.35±0.30 cm for males and 44.81±0.27 cm for females). Genetic effects for the traits described could be highly implicated in the differences observed.

As for wing length, our result is closer to that reported by Oguntunji *et al.* (2014) on ducks in Nigeria and those of Raji *et al.* (2009), who found an average wing length between 27 and 35cm. On the other hand, it is greater than the results of Yakubu *et al.* (2011) in Nigeria (25.68 cm and 16.43 cm in males and females, respectively). In addition to the environmental conditions varying from one study to another, differences could also be due to the non-respect of the sampling method during data collection. The average weight (2.16±0.75 kg) of the Muscovy duck recorded in this study is close to observations reported by Kadurumba *et al.* (2022) in Nigeria, Fogang (2016) in the humid forest zone of Cameroon (2.16 ±0.26 kg), by Yacubu *et al.* (2011) on Muscovy ducks in the Guinean savannah and rainforest zone of Nigeria, where live weights vary between 2 ± 0.05kg and 2.2 ± 0.05 kg, and by Banga-Mboko (2007) on Muscovy ducks in congo-brazaville (2.115kg). On the other hand, it is lower than the live weight recorded by FAO (2009) in Egypt on Muscovy ducks, where the weight varies between 1.53 and 1.86 kg. Although these live weights are within the ranges of the results reported by several authors (Etuk *et al.*, 2006; Tegua *et al.*, 2008), they are well below the values obtained in improved breeding (Baéza *et al.*, 2005). Dietary considerations (variations in availability according to season or locality) may explain the wide range of weight fluctuations added to various epistatic gene expressions. These results probably reflect the low feed utilisation efficiency and lack of genetic selection of Muscovy ducks raised in Cameroon. Sexual dimorphism favouring males was observed on all body measurements in Muscovy ducks. However, these significant differences between males and females align with the work done by Yakubu (2011) and Oguntunji and Ayorinde (2015), in Nigeria. This dimorphism in favour of males is proves that a selection program for meat prediction would be more advantageous for males than females, particularly for important traits such as live weight (Keambou, 2006). This result contradicts observations made in other species where weight dimorphism favours females. Such is the case of work carried out on guinea fowl by Gnassingbe (1983) in Togo, Laurenson (2002) in Benin, Sanfo *et al.* (2008) in Burkina Faso, and Dongmo *et al.* (2023) in Cameroon.

The high coefficients of variation of birds in the two agroecological zones in this study may be due to the susceptibility of these traits to environmental changes, such as temperature and nutrition, which can vary between studies. Additionally, the difference in collection methods between our respective studies may have contributed to this large difference. As a practical implication, the observed variations indicate a potential for genetic improvement.

## **Conclusion**

The Muscovy duck is a natural genetic resource that exhibits diverse phenotypes, indicating high biodiversity. Six components, including shank diameter, thigh diameter, wingspan, live weight, wing length, and beak length, explained most of the phenotype variations in the Muscovy duck. This variability is crucial for genetically improving and preserving the duck population through conventional and crossing breeding methods. However, polymorphic and molecular assessments are advisable for further studies in order to conclude definitely.

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## Impact

This study holds significant importance as it aims to provide a comprehensive understanding of the characteristics of Muscovy ducks within the study area. The study's findings could serve as a fundamental basis for future programs geared towards enhancing genetics and conserving this species. The presence of three sub groups of birds could be more implicated in a breeding program leading to a well selected yielding ducks. Moreover, the research's outcomes could potentially contribute to addressing the issue of insufficient animal protein in the animal production industry.

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# Exploitation characteristics of common guinea fowl (*Numida meleagris*) in Cameroon

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## Abstract

The diversity of natural biological resources is at the heart of concerns relating to food security and climate change, hence the interest in characterizing local species and their exploitation systems. It is in this context that the present study, which took place from April 2020 to December 2022, aimed to evaluate the exploitation characteristics of guinea fowl in Cameroon. For this purpose, a random sample of 509 voluntary farms of guinea fowl was characterized in the Sudano-Sahelian agro-ecological zones, Guinean High Savannas and Western Highlands. The data collected through surveys and direct observations were subjected to appropriate statistical analyses. The main results showed that: the breeding of guinea fowl in Cameroon is not subject to any prohibition and is practiced mainly for self-consumption (37%) and marketing (27%) ; it is an extensive family farm type. Plumage constitutes the main criterion for choosing guinea fowl. Natural incubation of eggs and/or capture-taming of non-domestic flocks constitute the primary source of supply. The mortality of guinea fowl (20.24%), the low brooding ability of guinea fowl (17.49%), the low level of in-depth technical knowledge (15.13%) as well as diseases (12.77%) are the main constraints of mixed farming. Thus, guinea fowl constitutes a natural genetic resource adapted to environmental conditions and has the variability necessary for its genetic improvement and, even better, its preservation.

**Key words:** Exploitation characteristics, Biodiversity, Guinea fowl, Cameroon

## Caractéristiques d'exploitation de la pintade commune (*Numida meleagris*) au Cameroun

### Résumé

La diversité des ressources biologiques naturelles est au cœur des préoccupations liées à la sécurité alimentaire et au changement climatique, d'où l'intérêt de caractériser les espèces locales et leurs systèmes d'exploitation. C'est dans ce contexte que la présente étude, qui s'est déroulée d'avril 2020 à décembre 2022, visait à évaluer les caractéristiques d'exploitation de la pintade au Cameroun. À cette fin, un échantillon aléatoire de 509 élevages volontaires de pintades a été caractérisé dans les zones agro-écologiques soudano-sahéliennes, les hautes savanes guinéennes et les hauts plateaux de l'Ouest. Les données recueillies par le biais d'enquêtes et d'observations directes ont fait l'objet d'analyses statistiques appropriées. Les principaux résultats ont montré que : l'élevage de pintades au Cameroun n'est soumis à aucune interdiction et est pratiqué principalement pour l'autoconsommation (37%) et la commercialisation (27%) ; Il s'agit d'une ferme familiale extensive. Le plumage constitue le principal critère de choix de la pintade. L'incubation naturelle des œufs et/ou la capture-approvisionnement des troupeaux non domestiques constituent la principale source d'approvisionnement. La mortalité des pintades (20,24%), la faible capacité de couvaison des

pintades (17,49%), le faible niveau de connaissances techniques approfondies (15,13%) ainsi que les maladies (12,77%) sont les principales contraintes de l'élevage mixte. Ainsi, la pintade constitue une ressource génétique naturelle adaptée aux conditions environnementales et présente la variabilité nécessaire à son amélioration génétique et, mieux encore, à sa préservation.

**Mots clés :** Caractéristiques d'exploitation, Biodiversité, Pintade, Cameroun

## **Características de la explotación de la pintada común (*Numida meleagris*) en Camerún**

### **Resumen**

La diversidad de los recursos biológicos naturales está en el centro de las preocupaciones relacionadas con la seguridad alimentaria y el cambio climático, de ahí el interés en caracterizar las especies locales y sus sistemas de explotación. Es en este contexto que el presente estudio, que se llevó a cabo de abril de 2020 a diciembre de 2022, tuvo como objetivo evaluar las características de explotación de las gallinas de Guinea en Camerún. Para ello, se caracterizó una muestra aleatoria de 509 granjas voluntarias de gallinas de Guinea en las zonas agroecológicas sudano-sahelianas, las altas sabanas de Guinea y las tierras altas occidentales. Los datos recopilados a través de encuestas y observaciones directas se sometieron a análisis estadísticos adecuados. Los principales resultados mostraron que: la cría de gallinas de Guinea en Camerún no está sujeta a ninguna prohibición y se practica principalmente para el autoconsumo (37%) y la comercialización (27%); Es un tipo de granja familiar extensiva. El plumaje constituye el criterio principal para la elección de las gallinas de Guinea. La incubación natural de los huevos y/o la captura-domesticación de las parvadas no domésticas constituyen la principal fuente de abastecimiento. La mortalidad de las gallinas de Guinea (20,24%), la baja capacidad de incubación de las gallinas de Guinea (17,49%), el bajo nivel de conocimientos técnicos profundos (15,13%) y las enfermedades (12,77%) son las principales limitaciones de la agricultura mixta. Así, la gallina de Guinea constituye un recurso genético natural adaptado a las condiciones ambientales y cuenta con la variabilidad necesaria para su mejoramiento genético y, aún mejor, su preservación.

**Palabras clave :** Características de explotación, Biodiversidad, Pintada, Camerún

### **Introduction**

Livestock farming is an important socio-economic activity in many African countries, where almost all well-adapted but unevenly distributed animal species are found (Sidibe, 2001). However, only a small number of selected breeds are used in intensive production systems; this often leads to genetic erosion, threatening biodiversity (Chi-Sheng, 2012). However, the diversity of natural biological resources is at the heart of concerns about food security and climate change in the context of a globalized economy (Seo *et al.*, 2007; Couvert, 2015). Thus, the characterization of the production systems of local species was identified as the first global field of interest for the sustainable management of animal genetic resources (FAO, 2007). The lack of coherent management strategies for these species has resulted in weakened performance, uncontrolled cross-breeding and loss of diversity (FAO, 2015; Chepnda, 2012).

While the characterization of poultry species production systems is becoming more widespread around the world, the exploration of non-conventional species in Cameroon is relatively recent; Very little attention has been paid to the management of non-conventional poultry genetic resources in general and guinea fowl in particular. However, guinea fowl is a source of income and animal protein (Moreiki, 2009; Annor *et al.*, 2013; Djonwe, 2017; Dongmo *et al.*, 2016; Massawa *et al.*, 2020). To this end, the promotion

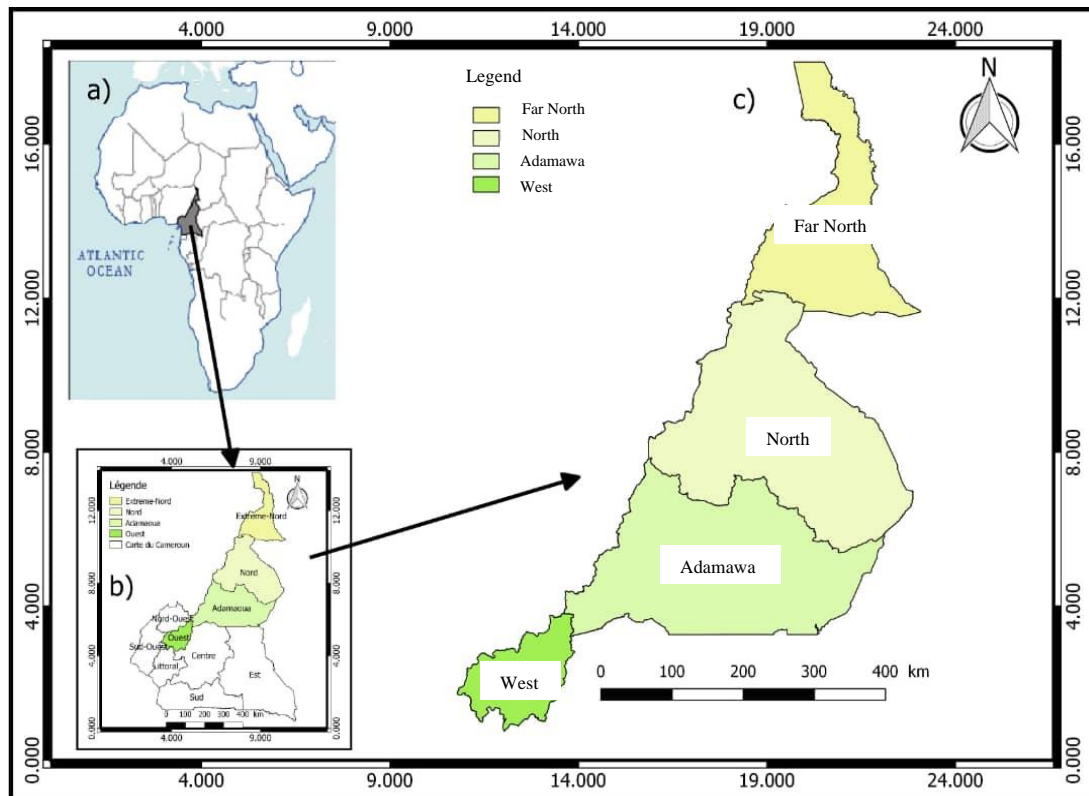
of their breeding as well as the gradual improvement of zootechnical performance can be both a source of economic development and the preservation of biodiversity (FAO, 1998; Kabore, 2012). This would only be possible through a better knowledge of the characteristics of guinea fowl exploitation.

### **Presentation of the study area**

The study took place in Cameroon between April 2020 and December 2022. Cameroon lies between the 2<sup>nd</sup> and 13<sup>th</sup> parallels north and between the 9<sup>th</sup> and 16<sup>th</sup> longitudes east, with a littoral region on the Atlantic Ocean and its tip in Lake Chad. This area includes five major agro-ecological zones, the main geo-climatic characteristics of which are summarized in Table 1 and illustrated in Figure 1. Only the Sudano-Sahelian, highland and western highland areas were considered. For these areas, the choice of the Far North, North, Adamawa and West regions (Figure 1) was motivated by the relative density of guinea fowl as well as their interest and importance.

**Table 1:** Main characteristics of study zone.

| <b>Agroecological zones</b>       | <b>Pedology and altitude</b>                                                                           | <b>Precipitation and temperatures</b>                                                                         | <b>Vegetation</b>                            | <b>Agriculture and Livestock</b>                                                                                              |
|-----------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>Sudano-Sahelian Zone</b>       | Fertile Vertisols, floodable and light. 0 to 500 m                                                     | Annual average of 500 mm (with long dry season), temperature between 28 and 45 °C                             | Grassy                                       | Breeding of cattle, small ruminants, poultry, pigs, horses and donkeys                                                        |
| <b>Guinean High Savannah Zone</b> | Ferralitic soils and a little deep in places. Plateau with peaks over 1800 m                           | Annual average of 1500 m, in a single season of about 05 months. Annual temperatures ranging from 20 to 26 °C | Wooded savannahs                             | Large herd of diversified cattle cattle, small ruminants, horses and donkeys, poultry                                         |
| <b>Western Highlands Zone</b>     | Ferralitic soils and with andosols in places. Average altitude of 1300 m and peaks of more than 3000 m | Annual average of 2000 mm, average temperature of 19°C and high humidity (>80%)                               | Wooded, forest galleries and grassy plateaus | Mixed family type, semi-intensive or intensive: poultry and pigs, small ruminants; Horses and donkeys, unconventional species |



**Figure 1 :** Zone of study

### Sampling

With the support of the Livestock, Fisheries and Animal Industries (MINEPIA) services, the main areas of guinea fowl exploitation have been identified, taking into account the safety and accessibility of the sites. Sampling in these different areas was carried out using the "snowball" method (Johnson, 2005; Alexandru and Dragan, 2013); This is non-probability sampling. This is because this sampling method implies that a primary data source identifies other potential data sources. It has been applied to voluntary guinea fowl farms that have had at least one egg-laying season. A total of 509 operators were interviewed. The various actors (breeders and traders) completed the information on the age, sex and origin of guinea fowl. The numbers of operators sampled by location are presented in Table 1.

**Table 1:** Presentation of number of operator’s interviewed.

| Locations    | Operators interviewed |            |
|--------------|-----------------------|------------|
|              | n                     | %          |
| Far North    | 205                   | 40,28      |
| North        | 139                   | 27,31      |
| Adamawa      | 92                    | 18,07      |
| West         | 73                    | 14,34      |
| <b>Total</b> | <b>509</b>            | <b>100</b> |

n : sampling number ; (%) : frequency

### Data collection

All the data collected were recorded on sheets developed from those proposed by FAO (2013) and adapted by AU-IBAR (2015) for the characterization of local poultry genetic resources, using the Open Data Kit (ODK) data collection application.

### **Characteristics of guinea fowl exploitation in Cameroon**

Data on the farm characteristics of guinea fowl were collected through interviews with farmers and direct observations during the interviews. A survey framework previously established in accordance with the guidelines of FAO (2013) and AU-IBAR (2015) made it possible to capitalize on the data, which mainly focused on:

- the identification of the producer: gender, age, religion, marital status, level of education
- guinea fowl production objectives
- the choice of genotype and the source of supply,
- Guinea fowl rearing techniques and improvement
- performance and constraints
- the exploitation of the products of meleaculture

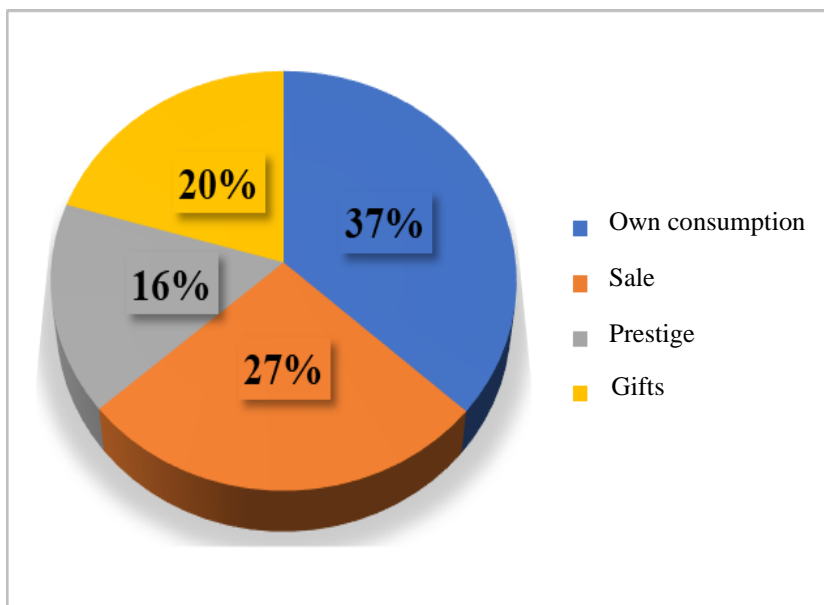
### **Statistical analysis of the data**

The data collected in this way were subjected to descriptive statistics; it was used to calculate frequencies to describe the operating characteristics of guinea fowl. This descriptive statistic was performed using SPSS 21.0 software.

## **Results**

### ***a)- Producer identification and production targets***

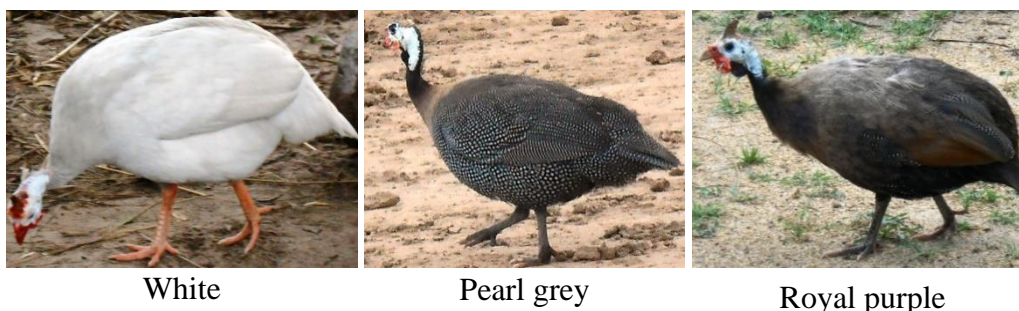
Descriptive statistics have shown that guinea fowl breeding is not subject to any prohibition and is practiced by all social strata. Women and children take care of the daily monitoring of guinea fowl while more than 82% of men are responsible for almost all decisions related to this activity. Only 13.10% of pastoralists have received a primary education. Figure 2 shows the production targets for guinea fowl in Cameroon. This figure shows that guinea fowl is mainly bred for self-consumption (37%) followed by the marketing (27%) of live guinea fowl and eggs. However, some farms are set up for gifts (20%) and prestige (16%).



**Figure 2:** Presentation of common guinea fowl production objectives in Cameroon

***b)- Genotype Selection and Source of Supply***

Descriptive statistics have revealed that there is currently a great diversity of varieties or strains of guinea fowl. To successfully raise guinea fowl, it is important to control your choice. First of all, you have to take into account the breeding areas and the production objectives. The main guinea fowl production areas in Cameroon are the Far North, North, Adamawa and West regions; In the latter area, the majority (76%) of the selected heavy guinea fowl from imports are found. One of the criteria for choosing guinea fowl is plumage. There are three major colours: pearl grey, white or buff and royal purple (Figure 18). Guinea fowl with white plumage appear more docile, while pearl-grey and royal purple guinea fowl are characteristic of the non-domestic types and therefore appear timider.



**Figure 3:** Main guinea fowl plumage colors in Cameroon.

In terms of general growth and carcass yield, guinea fowl from genetic selection are the heaviest. As curious as it may seem, the selected guinea fowl are imported from specialized incubators in France and Belgium. In some areas of Cameroon, local guinea fowl farmers collect the eggs and incubate under local hens; or by capture-taming, and gradual domestication of wild flocks. In the latter case, the size of the wings is decisive in limiting seasonal migratory behaviour. A good knowledge of the differences between males and females is important (size of the barrels, horn and type of call) if you want to build a breeding herd, respecting the sex ratio.

### ***c)- Characteristics of the farms***

In order to contribute to the improvement and sustainable development of this farm, we diagnosed the management system practiced by evaluating the various key factors of a conventional farm. This system takes into account the types of habitats encountered, the feeding and watering systems, health and reproduction, which is the essential link in the multiplication of numbers and the sustainability of species.

In Cameroon, guinea fowl farming is extensive (85%) and of the family farming type. In this type of farming, guinea fowl wander all day long and spend nights either perched on trees around the concessions, or in basic shelters in association with other types of animals. No interest is given to the food ration except for a few handfuls of cereals which are generally distributed in the morning. The breeders do not have the breeding equipment, the birds drink from the pools of water and small rivers and sometimes from the old gourds placed in the courtyards for this purpose. In terms of health, treatments, which are mostly preventive, are based on medicinal plants and no prophylaxis program is available. Incubations are generally carried out by previously identified local hens and the average duration is 28 days; they are also responsible for driving the guinea fowl. Because of the seasonality of reproduction and in order to limit the mortality rate of guinea fowl due to the cold climate, some breeders recover guinea fowl at hatching for artificial heating. Local guinea fowl can lay between 60 and 100 eggs per year, while improved guinea fowl produced in a semi-intensive system averages 180 eggs per year. This type of breeding has been found in a few producers (5%) in the North and West (10%).

### ***d)- Marketing of meleagre products***

From the descriptive statistics, it appears that guinea fowl farming is an important source of income, in fact 95.4% of farmers sell guinea fowl and mainly eggs in case of need of money and the age of the bird. Exchanges are mainly made at the market and the price of an adult guinea fowl without distinction of sex in the northern part of Cameroon is between 1,800 and 2,000 CFA francs; Young guinea fowl are sold only in exceptional cases, as they are kept for the next laying season due to the relatively small size of the herd. The price of an egg varies from 50 to 65 CFA francs when raw and 75 CFA francs when boiled. However, the price of a guinea fowl can be influenced by the weight and color of the plumage. In the West, as well as in the Centre and in the Littoral, average prices of an adult guinea fowl exceed 10,000 CFA francs; The eggs are usually used for breeding in these areas.

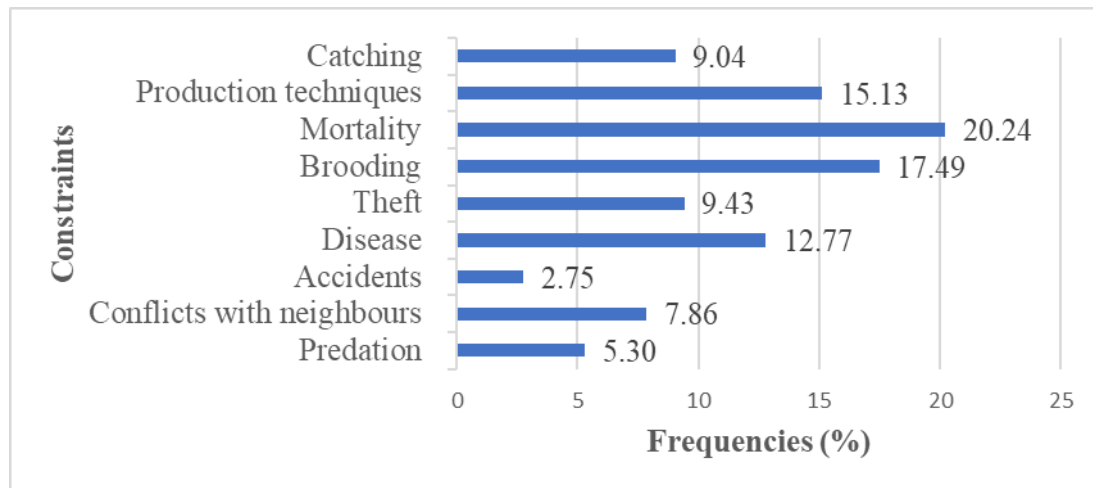
The meat and eggs of the guinea fowl are very popular with the entire population; They are not subject to any taboo and are used by certain groups in the pharmacopoeia. However, by-products such as droppings are not sufficiently valued. In general, this livestock contributes to more than 30% of the farmers' household life.

### ***e)- Constraints of Guinea Fowl Farming***

Descriptive statistics have highlighted several constraints responsible for the poor performance of common guinea fowl breeding in Cameroon. The major constraints (Figure 19) are the high mortality of guinea fowl (20.24%), the poor brooding ability of guinea fowl (17.49%) and a low knowledge of the improved techniques (15.13%) of this activity. In addition to these constraints, there are bird losses due to theft (9.43%), disease (12.77%), predation (5.30%) and accidents (2.75%); conflicts with neighbours (7.86%) are no less so, as is the difficulty of catching guinea fowl on the vine (9.04%). Due to the lack of technical data on meleagre farming, the local guinea fowl is considered an unconventional poultry in Cameroon.

The factors leading to low guinea fowl rearing are the subject of a multitude of empirical researches. In order to ensure a better future for the eggs that would develop guinea fowl and then guinea fowl, the farmers

entrust the eggs to the hens who turn out to be better incubators and then good leaders. Guinea fowl are habituated by supplementing their feed with a few handfuls of cereals, usually distributed very early in the morning; The farmer uses the same call each time to call the birds. Another technique for capturing guinea fowl is to drug it with local alcoholic beverages such as "harki". The feathers of guinea fowl wings are trimmed to prevent them from flying away to escape.



**Figure 4:** Constraints related to Guinea fowl breeding in Cameroon

## Discussion

Guinea fowl farming in Cameroon (Dongmo *et al.*, 2016; Djonwe, 2017; Massawa *et al.*, 2020; Dongmo *et al.*, 2023) and in many countries in Africa, including Benin (Boko, 2004; Dahouda, 2009; Boko *et al.*, 2012) in Burkina Faso (Bouba 2017; Dao, 2018) in Zimbabwe (Saina *et al.*, 2005), Botswana (Sayila, 2009) and Ghana (Teye *et al.*, 2000) is extensive, family-like. This type of farming is characterized by the straying of guinea fowl during the day; They usually spend nights perched on trees around concessions or in basic shelters in association with other species. No interest is generally given to breeding equipment suitable for guinea fowl. However, there are some semi-intensive and intensive livestock farms in some areas; these types of farms are generally adapted to the selected strains with the best performance (Champagne and Segret, 2013). The production targets recorded in this study are comparable to those noted by Annor *et al.*, (2013) in Ghana and in Botswana by Moreiki (2009). These objectives are mainly self-consumption and marketing. The guinea fowl's diet consists of green vegetables, kitchen scraps and grains. Guinea fowl has an omnivorous tendency. Very few producers formulate complete feeds for this species (Bastianelli *et al.* 2002; Sanfo *et al.*, 2009; Dahouda, 2009; Savadogo, 2013; Dongmo *et al.*, 2016; Massawa *et al.*, 2020). Guinea fowl can be the victim of almost all the health problems and technical constraints encountered in village chicken farming. Although they are less susceptible to Newcastle disease, guinea fowl remains an important reservoir. It is particularly sensitive to internal parasites (Nagalo, 1984; Susan, 1992; Sidibé, 2001; Bastianelli *et al.*, 2002; Massawa *et al.*, 2020). The sex ratio is generally not respected; however, a ratio of one male to 03 or 04 females is sometimes observed. A local female guinea fowl lays between 80 and 100 eggs per year. However, adult guinea fowl with a body weight of more than 2 kg and the ability to lay more than 150 eggs per year have been recorded by several authors in various farming contexts (Champagne and Segret, 2013). Egg-laying begins from the 8th month and the brooding period is 28 days; natural incubations are generally carried out by other poultry species, in particular hens and ducks (SAILD, 2001; Sanfo, 2005; Sanou, 2005; Sanfo *et al.*, 2007; Sanfo *et al.*, 2008; Dongmo *et al.*, 2016; Massawa *et al.*, 2020). Guinea fowl farming is still a primitive activity and is mainly traditional in sub-Saharan Africa. Faced with the multifactorial constraints that reduce guinea fowl productivity, and despite empirical research, farmers have been able to develop endogenous know-how, in particular the practice of trimming feathers to prevent guinea fowl from flying away, the provision of complementary feed, generally consisting of a few handfuls of

cereals for habituation, and the placement of eggs under hens and ducks to incubate (Biagini, 2006; Annor et al., 2013; Dongmo *et al.*, 2016). Even if the guinea fowl value chain is not relatively structured in Cameroon, the average price of an adult guinea fowl (12 weeks) is equivalent to about 2.5 euros (SAILD, 2001; Djovonou, 2010; Annor *et al.*, 2013; Dongmo *et al.*, 2016). This price is usually higher for females than for males due to weight dimorphism in favor of females; in addition, plumage coloration and season are factors that influence the cost of melee products (Dahouda *et al.*, 2007).

## Conclusion

This study shows that guinea fowl breeding is not subjected to any prohibition; it is practiced by men, women and young people with men being the decision makers. The main objective of the production is for self-consumption and for commercialization. Since the plumage coloration is the main criterion for selecting the birds, it came out that the most exploited strains are pearl grey, white and royal purple; Pearl-grey and royal purple guinea fowl are characteristics of wild strains, while white guinea fowl appear more docile. These guinea fowl are generally the result of the incubation of eggs and/or the capture, taming and progressive domestication of wild flocks. Heavy strains come from imports from Europe, particularly from Belgium and France. Guinea fowl farming in Cameroon is extensive in nature and of a family farming type. Natural incubations are generally carried out by other poultry species, in particular the *Gallus gallus domesticus species*, with an average duration of 28 days. Spawning is seasonal and a female guinea fowl lays between 80-100 eggs per year. The main products of guinea fowl rearing are eggs and meat; Exchanges take place directly in local markets between producers and consumers. The relatively poor performance of guinea fowl is due to several constraints, including guinea fowl mortality, poor brooding ability of guinea fowl and lack of in-depth technical knowledge of this type of disease. The contact of guinea fowl with non-domesticated species suggests that it would be interesting to consider a study on the impact of the consumption of guinea fowl products on human health.

## Impact

The results of this study highlight the characteristics of guinea fowl exploitation in Cameroon. They allow farmers to make a judicious choice of the guinea fowl strain according to the production objective; and serve as a basis for researchers to consider the implementation of a conservation plan and better still the preservation of Guinea fowl genetic resources.

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## Recommandations aux auteurs

Les instructions de mise en forme doivent être suivies attentivement. Les auteurs ont la responsabilité d'assurer la mise en forme correcte avant la soumission des articles. Les articles non conformes aux instructions seront retournés.

### Contenu

Le Journal *Journal Mondial de l'Aviculture Familiale (JMAF)* publie des articles originaux ainsi que ceux de synthèse sur tous les aspects de la science de l'aviculture familiale. Le bulletin publie aussi des rapports sur le développement de la production en aviculture familiale à travers le monde entier, des rapports de conférences, séminaires, symposia, ateliers, des rapports de groupes de travaux scientifiques constitués, ainsi que des manuels de synthèse, des nouvelles, des notes d'informations provenant des associations, en même temps qu'une liste des événements futurs concernant le RIDAF (Réseau International pour le développement de l'Aviculture Familiale) et autres organisations pertinentes. Un article original soumis pour publication doit se porter sur les activités de recherche et de développement. Il doit comporter les grandes sections suivantes: Introduction, matériels et méthodes, résultats, discussion et conclusion. Un article de synthèse doit être exhaustif dans le domaine défini par le titre, la structure doit être logique et les citations doivent être sujettes à des révisions critiques, tout comme la méthodologie et l'analyse statistique des résultats. En préparant un article de synthèse, des déductions et des démarches constructives doivent être employées afin d'aboutir à des conclusions valides, utiles et clairement présentées. Il est encouragé d'utiliser des figures, tableaux, formules et illustrations appropriés. L'objectif est toujours d'apporter une contribution appréciable à la littérature déjà disponible.

### Préparation du manuscrit

Les articles soumis, qui seront sujets à une évaluation minutieuse par des évaluateurs spécialisés indépendants ainsi qu'une révision de l'équipe éditoriale ne doivent normalement pas dépasser l'équivalent de 8-10 pages du bulletin (ou approximativement 6000 mots), y compris les tableaux, les illustrations, et les références bibliographiques. Des articles plus longs peuvent être acceptés mais il est préférable de contacter l'éditeur avant leur soumission.

Les articles doivent être présentés sous le logiciel Word, avec une feuille de dimension A4, en utilisant la police Times New Roman de taille 12, l'interligne doit être double, les marges à 2,5 cm et avec une numérotation consécutive des lignes (en continue au delà des pages), le long de la marge gauche. Les pages doivent être numérotées à droite et en haut.

La première page des manuscrits doit contenir les informations ci-après:

**Titre:** Doit être directement lié au thème de l'article

**Nom(s) et adresse(s)** postale(s) de(s) auteur(s)

**Adresse électronique** de l'auteur pour correspondance.

**Le résumé** doit comporter 100-300 mots et sera traduit dans les deux autres langues officielles (Anglais, Français et/ou Espagnol)

**Mots clés:** Jusqu'à 8 mots.

### Utilisation des italiques

Les expressions latines telles que *in vivo*, *et al.* doivent être écrites en italique. Les noms d'espèces ne doivent être en italique que si le nom entier est utilisé (p.ex. *Chlamydia psittaci*) ou bien si accompagné du suffixe "spp" (*Gossypium spp.*) lorsqu'il fait référence à des espèces indéfinies ou multiples. La première partie du nom d'espèce doit être en majuscule, et la seconde en minuscule, sans exception (p.ex. *Eimeria tenella*, *Trichomonas gallinarum*). Toutes références à des noms de familles pour les bactéries, les animaux ou les végétaux doivent apparaître sous une forme identique au texte régulier (p.ex. "les poules appartiennent à la famille des phasianidae")

### Important

Prévoir un paragraphe d'au plus 150 mots expliquant aux non spécialistes du RIDAF l'importance de vos résultats trouvés. Ces points seront publiés sous le sous-titre '**Impact**' à la fin de l'article.

### Références bibliographiques

Les auteurs prendront les précautions lors de la citation des références, en particulier pour ce qui concerne la mise en forme (gras, italique, etc.) et en donnant le nom entier de la publication qui ne doit pas être abrégée (écrivez les noms

des journaux en entier, pas d'abréviation!). Les références bibliographiques listées ne comprendront que celles citées dans le corps du texte.

Les références concernant les travaux antérieurs doivent tenir compte de celles qui sont en relation avec le thème de l'article. Elles doivent être citées dans le texte par le nom de l'auteur suivi de l'année de publication entre parenthèses, p.ex. "Guèye (1998) a trouvé que..." ou "Sonaiya *et* Agbede (2002) ont confirmé les récentes conclusions de Fotsa *et al.* (2012) montrant..."

Dans la liste des références, les différents travaux doivent être classés par ordre alphabétique du nom de famille du premier auteur, tous les auteurs devant être cités. Le nom du journal doit être écrit en entier, y compris les numéros de la première et de la dernière page de l'article concerné:

**GUÈYE, E.F.** (2009) Titre de l'article. *Nom du journal* **Vol. Nr:** numéros des pages (voir l'exemple ci-dessous).

### Exemples

**GUÈYE, E.F.** (2009) The role of networks in information dissemination to family poultry farmers. *World's Poultry Science Journal* **65**: 115-124.

**AGBEDE, J.O., KLUTH, H. and RODEHUTSCORD, M.** (2009) Studies on the effects of microbial phytase on amino acid digestibility and energy metabolisability in caecotomised laying hens and the interaction with the dietary phosphorus level. *British Poultry Science* **50** (5): 583-591.

**GUNARATNE, S.P., CHANDRASIRI, A.D.N., HEMALATHA, W.A.P.M. and ROBERTS, J.A.** (1993) The feed resource base for scavenging village chickens in Sri-Lanka. *Tropical Animal Health and Production* **26**: 249-257.

**FOTSA, J.C.** (2012) Genetic diversity of Indigenous Chickens in Cameroon. *Bulletin of Animal Health and Production in Africa* **60** (1): 63-70.

**BONKOUNGOU, G.F.X.** (2002) L'amélioration de l'élevage traditionnel de la volaille locale en zone Sahélienne du Burkina Faso. *Proceedings of the 10<sup>th</sup> International Conference of AITVM*, Copenhagen, Denmark, pp. 207-217.

**FAO (2004)** Economie de la production. *Dans: Production en Aviculture Familiale* (Sonaiya, E.B. & Swan, S.E.J., Eds.). *Production et Santé Animale*, Rome, Italie, pp. 82-82.

**HODGETTS, B.** (1981) Dealing with dirty hatching eggs. *MAFF Information for Flock Farms and Hatcheries: Hatch Handout* No.17.

**CAMACHO, E.M., LIRA T.I., RAMÍREZ, C., LÓPEZ, P.R. y ARCOS, G. J** (2006) La avicultura de traspatio en la costa de Oaxaca, México. *Ciencia y Mar* **28**: 3 – 11.

**BOUSSINI, H.** (1995) Contribution à l'étude des facteurs de mortalité des pintadeaux au Burkina Faso. *Thèse de Médecine Vétérinaire*, EISMV, Dakar, Sénégal.

Le(s) auteur(s) est(sont) pleinement responsable(s) de la véracité et la correcte citation des références bibliographiques. Les éditeurs n'endossent aucune responsabilité sur les citations bibliographiques inexactes.

### Tableaux, dessins et photos

Les titres des figures et tableaux doivent être brefs avec assez d'informations les rendant compréhensibles en dehors du texte. Les tableaux peuvent être insérés dans le texte. Les tableaux plus larges peuvent être placés séparément à la fin du document sur de nouvelles pages et leur emplacement approximatif sera indiqué dans le texte. Tous les tableaux doivent suivre la fonction spécifique de création de "tableau" du logiciel Word. En outre, les tabs et les espacements ne doivent pas être utilisés. Les espaces des tableaux doivent être appropriés, et les titres des colonnes aussi brefs que possible, avec une légende explicative, si nécessaire. Les significances statistiques entre les moyennes à l'intérieur des colonnes ou des lignes doivent être indiquées par des lettres en exposant, et accompagnées par une note explicative standard au bas du tableau ou de la figure concerné(e), p.ex. "Les moyennes ayant des lettres différentes en exposant sur la même ligne (ou colonne) sont significativement différentes à  $P < 0.05$ ". Les graphiques doivent être créés sous forme de diagramme Excel, et devront être envoyés sous fichier séparé, au moment de la soumission du texte. Les fichiers de graphiques et tableaux photographiques ne seront pas acceptés. En cas d'utilisation d'images photos, discuter directement avec l'éditeur sur le format final à envoyé. Les dessins en ligne doivent être envoyés sous fichier séparé, et doivent être scannés en noir et blanc, et chaque image doit être accompagnée d'une légende et d'une référence. Les photos scannées dont la mémoire est supérieure à 1MB doivent être envoyées sous forme de fichiers attachés séparés. La résolution des images doit être de 250 dpi pour les images en noir et blanc et de 300 dpi pour les images en couleur à l'impression de

l'image. *Adobe Illustrator*, *CorelDraw* ou *PowerPoint* peuvent être utilisés pour la soumission des dessins.

### Notes de bas de page

Les notes de bas de page, en cas de nécessité, doivent être indiquées dans le texte par des astérisques (\*), des croix (†) et des doubles croix (‡), dans cet ordre. Néanmoins, l'utilisation des notes de bas de page doit être évitée, à chaque fois que c'est possible. Dans le manuscrit, une note de bas de page doit être placée au bas de la même page où elle est indiquée, et doit être séparée du reste du texte par une ligne horizontale. Les notes de pieds de page relatives à un tableau doivent être placées immédiatement sous le tableau concerné.

### Révision des articles

Lors de la soumission d'une version révisée de votre manuscrit en réponse aux observations de relecteurs, vous voudriez bien l'accompagner des corrections détaillées apportées pour être transmises aux relecteurs. Si des changements ont été en réponse aux remarques du relecteur, il est important de le mentionner et indiquer où les retrouver. Il est fortement recommandé d'envoyer une deuxième version de votre manuscrit portant les modifications marquées ou soulignées.

### Recommandations

Les commentaires du relecteur doivent être pris en considération. Veuillez, s'il vous plaît, vous assurer que la copie révisée de votre manuscrit a été envoyée et pas simplement l'envoi à nouveau de la version originale. En vous conformant aux instructions aux auteurs, vous aiderez les Editeurs et relecteurs de JMAF qui donnent de leur temps pour éditer les manuscrits. Si vous préparez soigneusement votre manuscrit conformément à ces recommandations, vous aurez aidé les Editeurs des JMAF à économiser de leur temps pour se consacrer à l'amélioration du processus de publication de vos articles.

### Appel de la décision

Les éditeurs de *Journal Mondial de l'Aviculture Familiale* (JMAF) admettront l'appel aux décisions par ceux des auteurs qui le souhaiteraient. Dans ce cas, vous voudrez bien le faire par courrier électronique muni des explications détaillées des raisons pour lesquelles vous faites appel aux décisions des éditeurs.

### Epreuves

Les observations et corrections sur le manuscrit seront renvoyées à l'auteur principal qui aura la responsabilité de les partager avec les éventuels co-auteurs de l'article pour leur prise en compte. À ce stade, seules les petites erreurs de frappe pourront être corrigées. Des changements majeurs sur le document pourront être acceptés sur indulgence de l'éditeur. Par conséquent, le(s) auteur(s) doit(vent) s'assurer d'envoyer la version finale de l'article, mis en forme selon le format requis. Le manuscrit doit être corrigé et envoyé dans les 7 jours suivant la réception des observations et corrections.

### Soumission des articles

Les manuscrits doivent être soumis dans l'une des trois langues de travail du RIDAF (Anglais, Français et Espagnol), par email, aux éditeurs de *Journal Mondial de l'Aviculture Familiale*, Dr. Jean-Claude Fotsa et/ou Pr. Oluwasola Johnson Agbede.

### Anciens numéros

Les anciens volumes de *Journal Mondial de l'Aviculture Familiale* sont disponibles sur le site:

[http://infpd.net/e\\_news\\_letter/user\\_list](http://infpd.net/e_news_letter/user_list)

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**Éditeur-en-Chef Adjoint:** Pr. Oluwasola Johnson Agbede, Dept. of Animal Production and Health, Federal University of Technology, P.M.B. 704, Akure, Nigeria  
E-mail: <[joagbede@yahoo.com](mailto:joagbede@yahoo.com)>

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## Instrucciones para autores

Las siguientes instrucciones de formato deben seguirse con mucha precaución. Los autores son responsables y deben asegurarse de que el formato sea el correcto antes de enviar sus trabajos. Los manuscritos que no llenen los requerimientos no serán considerados.

### Contenido

*Diario Mundial de Avicultura Familiar (DMAF)* publica revisiones, trabajos originales de todos los aspectos de la ciencia avícola familiar, reportes sobre el desarrollo de la producción avícola familiar de todas partes del mundo, reportes de conferencias, seminarios, simposios y equipos de trabajo científico conocidos, al igual que revisiones de libros, noticias y un listado de próximos eventos de la Red Internacional para el Desarrollo de la Avicultura Familiar (INFPD- International Network for Family Poultry Development) y otras organizaciones relevantes. Los trabajos originales deben basarse en investigaciones relevantes y actividades de desarrollo. Debe por lo menos tener las siguientes secciones: Introducción, materiales y métodos, resultados, discusión y conclusiones. Un artículo de revisión debe ser integral en el ámbito definido por su título, la estructura debe ser lógica y las citas sujetas a evaluación crítica al igual que la metodología y el análisis estadístico de los resultados. En la preparación de un documento de revisión, el toque deductivo y procesos constructivos deben ser utilizados para producir conclusiones válidas, útiles y puedan ser presentadas con claridad. Se alienta a utilizar las figuras apropiadas, tablas, fórmulas e ilustraciones. El objetivo siempre debe ser producir una adición valiosa para el cuerpo de la literatura disponible.

### Preparación del manuscrito

Trabajos enviados, los cuales serán sujetos a escrutinio por árbitros independientes y revisión editorial, normalmente no deben exceder 8-10 páginas (o aproximadamente 6000 palabras) incluyendo tablas, ilustraciones y referencias. Trabajos más extensos pueden ser aceptados pero se sugiere a los autores contactar al editor antes de enviar los trabajos.

Los trabajos deben ser en formato Word, en un diseño A4, usando letra Times New Roman 12, doble espacio, márgenes de 2.5 cm y con número de línea consecutivo (continuo sobre páginas) de lado del margen izquierdo. Las páginas deben ser numeradas en la esquina superior derecha.

La primera página del manuscrito debe tener las siguientes características:

**Título:** directamente relacionado con el tema del trabajo

**Nombre(s) y dirección(es) postal** de los autor(es)

**Correo electrónico** del autor correspondiente

**Resumen:** debe ser de 100-300 palabras y traducido a las otras dos lenguas oficiales (Inglés, Francés y/o Español).

**Palabras clave:** hasta 8 palabras

### Uso de itálicas

Frases en Latin, por ejemplo, *in vivo*, *et al.* deben estar en itálicas. Nombres de Especie deben ser en itálicas solo si se utiliza el nombre completo (p.e. *Chlamydia psittaci*) o si se utiliza el sufijo por "spp" (*Gossypium spp.*) cuando se refiere a múltiples o especies indefinidas. La primera parte del nombre de la especie debe ser con letra mayúscula, y la segunda en minúscula, sin excepción (p.e. *Eimeria tenella*, *Trichomonas gallinarum*). Todas las referencias a nombres de la familia de origen animal, bacteriana o planta deben tener el formato de texto normal (por ejemplo, "los pollos pertenecen a la familia de phasianidae").

**Nota:** Proporciona un párrafo de no más de 150 palabras explicando a la INFPD que no son especialistas, la importancia de los hallazgos de tu investigación. Estos puntos serán publicados al final del artículo en la sub-sección "Impacto".

### Referencias

Los autores deben tener cuidado cuando citan las referencias, especialmente con respecto al formato (negritas, itálicas, etc.) y anotar el nombre completo de la publicación que no debe ser abreviado (anotar el título completo de la revista, no abreviaciones!). Se deben de incluir solo las referencias citadas en el cuerpo del texto.

La referencia a trabajos anteriores sólo podrán referirse a las relacionadas con el tema del artículo y deben ser citadas en el texto con el nombre del autor y el año de publicación entre paréntesis, p.e. "Gueye (1998) encontró que..." o como "Sonaiya y Agbede (2002) confirmaron la reciente conclusión de Fotsa *et al.* (2012) mostrando..."

En la lista de referencias, las referencias deben estar ordenadas por orden alfabético de los apellidos del primer autor con todos los autores citados. El nombre completo de las revistas debe ser escrito con los números de página inicial y final de los documentos de que se trate:

**GUEYE, E.F.** (2009) Título del trabajo. Título de la revista **Vol. (Nr):** número de páginas (ver ejemplos abajo)

### Ejemplos

**GUÈYE, E.F. (2009)** The role of networks in information dissemination to family poultry farmers. *World's Poultry*

*Science Journal* **65**: 115-124.

- AGBEDE, J.O., KLUTH, H. and RODEHUTSCORD, M.** (2009) Studies on the effects of microbial phytase on amino acid digestibility and energy metabolisability in caecectomised laying hens and the interaction with the dietary phosphorus level. *British Poultry Science* **50** (5): 583-591.
- GUNARATNE, S.P., CHANDRASIRI, A.D.N., HEMALATHA, W.A.P.M. and ROBERTS, J.A.** (1993) The feed resource base for scavenging village chickens in Sri-Lanka. *Tropical Animal Health and Production* **26**: 249-257.
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- HODGETTS, B.** (1981) Dealing with dirty hatching eggs. MAFF *Information for Flock Farms and Hatcheries: Hatch Handout* No.17.
- CAMACHO, E.M., LIRA T.I., RAMÍREZ, C., LÓPEZ, P.R. y ARCOS, G. J** (2006) La avicultura de traspatio en la costa de Oaxaca, México. *Ciencia y Mar* **28**: 3 – 11.
- BOUSSINI, H.** (1995) Contribution à l'étude des facteurs de mortalité des pintadeaux au Burkina Faso. *Thèse de Médecine Vétérinaire*, EISMV, Dakar, Sénégal.

El autor / s es / son totalmente responsables de garantizar la exactitud y la correcta citación de las referencias. Los editores del *Diario Mundial de Avicultura Familiar (DMAF)* no pueden asumir ninguna responsabilidad por las citas incorrectas.

### **Tablas, dibujos lineales y fotografías**

Los títulos de las figuras y tablas deben ser breves con información suficiente para que se entienda muy lejos del texto. Las tablas pueden aparecer dentro del texto. Tablas más grandes se pueden poner en páginas separadas al final del artículo, mientras que su ubicación aproximada se indica en el texto. Todas las tablas deben seguir la función de creación específica "tabla" de software en Word, y, las tabulaciones y espacios no deben ser utilizados. El espaciado de las tablas debe ser adecuado, y los encabezados de columna lo más breve posible, con una leyenda fácil de entender, si es necesario. Significancias estadísticas entre las medias de las columnas o filas deben indicarse por letras en superíndice y acompañado de una declaración estándar por debajo de la tabla o figura, por ejemplo, "Medias con diferentes superíndices en la misma fila (o columna) son significativamente diferentes a  $P < 0.05$ ." Figuras gráficas deben ser creadas como gráficos de Excel que se pueden enviar en un archivo separado junto con el texto. Archivos de Bitmap o imágenes de gráficos o tablas no serán aceptados. El uso de fotografías debe ser discutido directamente con el editor para el formato de presentación final. Los dibujos deben ser enviados en un archivo separado, deben ser escaneados en blanco y negro, y cada imagen debe ir acompañada de la leyenda y la referencia. Fotografías escaneadas con un tamaño de memoria más grande ( $> 1$  MB) deberán enviarse como archivos adjuntos individuales. La resolución de las imágenes debe ser de 250 dpi para imágenes en blanco y negro y 300 dpi para imágenes a color del tamaño de la imagen impresa. *Adobe Illustrator, CorelDraw o PowerPoint* pueden ser utilizados para enviar los dibujos.

### **Pie de página**

Cuando la utilización de las notas es esencial, deben ser indicadas por un asterisco (\*), dagas (†) y dagas dobles (‡) en ese orden. Sin embargo, las notas deben evitarse siempre que sea posible. Notas al pie deben estar situadas en la parte inferior de la página en la que se hace referencia y separadas del texto principal por una línea horizontal por encima de la nota. Notas al pie de la tabla deben ser colocadas debajo de la tabla a la que se refieren.

### **Revisión de sus artículos**

Al presentar una versión revisada de su trabajo en respuesta a los comentarios del árbitro, deberá ser acompañado con las modificaciones detalladas realizadas para su transmisión al árbitro. Cuando los cambios han sido en respuesta a las declaraciones del árbitro, es importante mencionar esto e indicar dónde se pueden encontrar. Se ruega encarecidamente enviar una segunda copia de su documento con los cambios marcados o subrayados.

### **Recomendaciones**

Los comentarios del árbitro deben ser tomados en consideración. Por favor, asegúrese de enviar la copia revisada de su papel y no simplemente la versión original de nuevo. Al cumplir con las siguientes pautas, usted estará ayudando a los editores de la *DMAF* y críticos que toman su tiempo para revisar los manuscritos. Si prepara cuidadosamente su manuscrito, es una gran ayuda que le da a los editores de la *FPC* y que les permite ahorrar tiempo y mejorar el proceso de publicación.

## **Apelación de la decisión**

Los editores de *Diario Mundial de Avicultura Familiar (DMAF)* dan la bienvenida a las apelaciones acerca de la decisión hecha por los autores que deseen hacerlo. Esto se debe hacer por correo electrónico con una explicación detallada del propósito por el cual se esta apelando la decisión de los editores.

## **Pruebas**

El autor principal contará con pruebas de imprenta y será responsable de contactar a los posibles coautores en la verificación de las pruebas. Errores de composición tipográfica sólo podrán ser corregidos en este nivel mientras que la materia adicional y modificaciones sólo podrán ser aceptados con la indulgencia de los editores. Por lo tanto, es responsabilidad del autor(s) asegurar el formato correcto de presentación requerido. Dentro de 07 días de recepción, las pruebas deben ser corregidas y devueltas.

## **Presentación (envío) de trabajos**

Los trabajos deben ser enviados en uno de los tres idiomas de trabajo de la INFPD (Inglés, Francés y Español) con los resúmenes traducidos a los otros dos idiomas por correo electrónico a los Editores de *Diario Mundial de Avicultura Familiar (DMAF)*, Pr. Jean-Claude FOTSA y/o Pr. Oluwasola Johnson Agbede.

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