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Morphometric Assessment of Common Guinea Fowl (*Numida meleagris*) in Cameroon

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Abstract

A survey was conducted in the Sudano-Sahelian, High Savannah, and Western Highlands agroecological zones of Cameroon to assess the morphometric features and to determine the population structure of the native common guinea fowl breed. A total of 1021 adult common guinea fowls were sampled in the dominant pastoral production system. The main results showed that there was a phenotypic variability ($p < 0.01$) of the morphometric characteristics of common guinea fowls with a dominance of pearl gray coloring of the plumage (23.02%), bluish red barbels (29.09%), black eyes (36.04%) and tarsi (39.18%). The development of the barbels and the shape of the comb are determinants of the sex ($p < 0.01$), as well as the live weight which presents a dimorphism in favor of the females ($p < 0.01$). The average measurements (in cm) were: Crest height (2.07 ± 0.03), Crest length (2.79 ± 0.03), Barbel length (3.35 ± 0.04), Barbel height (2.28 ± 0.02), Spout length (2.11 ± 0.01), Caruncle length (0.69 ± 0.01), Baleen length (4.32 ± 0.04), Chest circumference (31.81 ± 0.99), Wing length (25.99 ± 0.18), wingspan (41.82 ± 0.32), Thigh diameter (9.17 ± 0.10), Thigh length (11.30 ± 0.07), Tarsus length (6.62 ± 0.04), Tarsus diameter (1.20 ± 0.07), Body length (40.13 ± 0.15), and Live weight (1.68 ± 0.02 kg). The highest positive correlation ($r < 0.70$) was observed between thigh and ridge length. The PCR revealed that three (3) components (F1, F2 and F3) make it possible to better explain phenotypic variability (50.21%). The variables that contributed most to the explanation of the observed total variability are the length of the crest (0.70%), the beak (0.61%), the wattle (0.70%), the body (0.44%), the wing (0.35%), thigh (0.68%), tarsus (0.29%) and wing span (0.41%) for the main component F1 while the F2 and F3 components mainly concern the length of the barbel (0.43%) and the height of the crest (0.48%) respectively. The F1 factor constitutes the most discriminating variable

(89.40%). The AFD and the CAH made it possible to detect 03 sub-populations (T1, T2, and T3) which can be grouped into 2 subgroups on the basis of intra/inter population variations and genetic distances. Morphometric assessment coupled with genomics would increase the efficiency of selection, improvement, and conservation of common guinea fowl in Cameroun.

Keywords

Genetic Diversity, Measurement, Guinea Fowl, Cameroon

1. Introduction

Poultry farming is critical for livelihoods and food security in rural communities, especially in developing countries [1] [2]. Maintaining the genetic diversity of livestock is vital to face future challenges such as threats from climate change, emerging diseases, and food insecurity for a growing human population [3] [4]. Indigenous African poultry genetic resources currently contribute about 70% to the agricultural gross domestic product of most African countries [5] [6]. However, a better knowledge of the diversity of indigenous poultry species can contribute to the improvement of its productivity and preservation [7]. Morpho-biometric characterization has been used to describe and classify wild animal populations as well as domestic animal populations including livestock [8] [9].

In Sub Sahara Africa in general and in Cameroon in particular, a lot of attention has been paid to industrial livestock farming which has become very unsustainable and fragile in the face of global changes; yet non-conventional species are better adapted and resistant to weather as well as to diseases in various environments. They are sources of animal protein and income mainly for rural and peri-urban populations [10]. Among these species, the guinea fowl represents 3% of the world's poultry population [11]. In addition to its socio-economic and environmental interest [12], Dongmo *et al.* [13] [14] [15], the genetic diversity of Guinea fowl is an enigma. Hence, the purpose of this study was to assess the morphometric characteristics of Guinea fowls in Cameroon, which is a prerequisite for any characterization program and the conservation of this genetic resource.

2. Material and Methods

2.1. Period and Area Study

This study was conducted in three agro-ecological zones (Sudano-Sahelian, High Savannah and Western Highlands). This choice was motivated by the relative density of guinea fowl in these areas as well as their interests and importance. In addition to the agro-ecological zones, information availability, and the particularities of the contact zones between phenotypically distinct populations, which are places of probable genetic reconstitution were considered. The Sudano-Sahelian zone is characterized by fertile, fluvial and light vertisols with an altitude of 0 to

500 m; the average annual rainfall is 500 mm (with a long dry season) and the temperature fluctuates between 28˚C and 45˚C with grassy vegetation. The High Savannah zone is characterized by ferralitic soils which are a little deep in some places; plateau with peaks over 1800 m; the average annual precipitation is 1500 m, in a single season of about 5 months and the annual temperatures vary from 20˚C to 26˚C; There are wooded savannahs. The Western Highlands area has ferralitic soils, with andosols in places and an average altitude of 1300 m and peaks of more than 3000 m; the average annual rainfall reaches 2000 mm with an average temperature of 19˚C and high humidity of more than 80%. It also harbours wooded vegetation, gallery forests, and grassy plateaus [16].

2.2. Sampling Techniques

With the support of the Livestock, Fisheries and Animal Industries (MINEPIA), the main guinea fowl production areas were identified; the breeders were identified by the snowball method and according to the accessibility of the sites. The guinea fowls being raised through scavenging, were captured at the end of the day around the houses on the one hand and in the markets on the other hand. Thus, the direct measurements were obtained on a total number of 1021 adult guinea fowls (440 males and 581 females) randomly chosen in 04 regions (**Table 1**).

All data collected were recorded on sheets developed from those proposed by FAO [8] and adapted by AU-IBAR [9] for the characterization of local poultry genetic resources, using the Open Data Kit data collection application (ODK). The morphological data of guinea fowls collected visually by direct observations in daylight mainly concerned the color of the plumage, the arrangement and color of the barbels, the color of the eyes and the color of the tarsi, …while the biometric data mainly concerned with the body measurements and were collected using a 0.02 mm precision caliper and a measuring tape while the live weight was recorded using an electronic scale. The main characteristics considered here were the live weight, the height and length of the crest, the length of the barbel, the beak, the wings, the body, the tarsus, the dewlap, the thigh, the thoracic circumference, the diameter tarsi and thigh and so on (**Figure 1**).

Table 1. Distribution of sampled guinea fowl by sex and region.

Region	Number of guinea fowl		
	Female	**Male**	**Total**
Far North	196	217	413
North	193	85	278
Adamawa	129	55	184
West	63	83	146
Total	**581**	**440**	**1021**

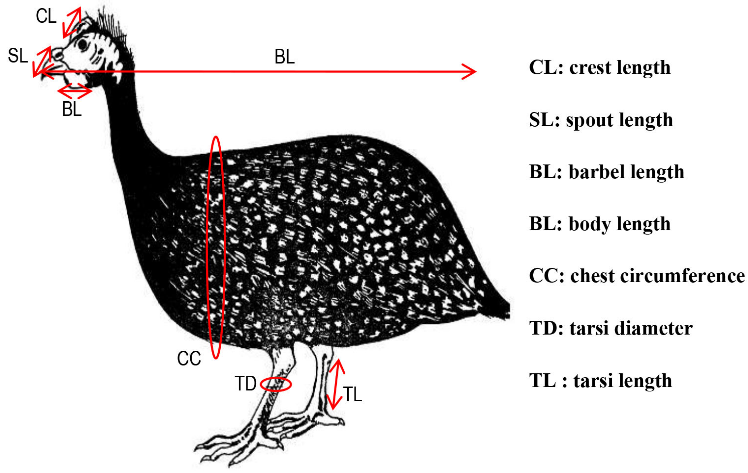

Figure 1. Somebody measurements for guinea fowl (Dongmo *et al.* [17]).

2.3. Statistical Analysis

Descriptive statistics was used to calculate the means, standard deviations, and coefficient of variation of the various measurements. The analysis of variance was used to test the influence of region, color of the plumage and genetic type on the measurement.

The meaning and degree of association between measurements and biometric indices were assessed using Pearson's correlation coefficients. Principal Component Analysis (PCA) based on measurement was performed to assess the cause of genetic diversity. Discriminant Factor Analysis (DFA) based on 16 bodies measurements [8] was used to identify the types of genetic relationships of the studied population. A coefficient of variation of less than 15% is considered to indicate that the population is homogeneous, while a coefficient of more than 15% indicates that the values are relatively dispersed [18] [19]. The construction of the phylogenetic tree following the Hierarchical Ascending Classification (HAC) protocol was used to establish the genetic relationship between the genetic types [20]. These different statistical analyses were done using SPSS 21.0 and XLSTAT 2022 softwares [21].

3. Results

3.1. Morphology of Common Guinea Fowl in Cameroon

Table 2 shows the morphological characteristics of common guinea fowl in Cameroon. There is a diversity of morphological characteristics of common guinea fowl in Cameroon as follows:

- Irrespective of the factors, the pearl gray color (23.02%) followed by royal purple (20.57%) and buff (16.65%) are the predominant colours in Cameroonian guinea fowls. However, the contingency test reveals that this variable, plumage coloration is significantly influenced ($p < 0.01$) by region and genetic type factors. The royal purple color is more abundant in guinea fowl populations in the North (6.66%) and Far North (7.35%) regions belonging mostly to genetic type 3 (10.38%).

• The coloring of the barbels is varied and dominated by the red-white color (40.74%); and the simple arrangement of the barbels (56.51%). This arrangement of barbels can be used for sexual dimorphism in guinea fowls. Indeed, the males (42.90%) have a more developed and folded barbels under the beak while the females (56.32%) have simple barbels oriented towards the back of the beak. Except for sex and plumage coloration which have a significant influence ($p < 0.01$) on the arrangement and coloration of the barbels respectively; region and genetic type have significant effects ($p < 0.01$) on both variables.

Table 2. Morphological characteristics of guinea fowl in Cameroon according to factors region, sex, plumage color and genetic types.

Variables	Characteristics	Frequencies (%)	p-values			
			Region	Sex	CP	GP
Plumage color	Chamois	16.65	0.00	0.30	//	0.00
	Pearl grey	23.02				
	Lavender	08.52				
	Lite lavender	04.60				
	Variegated	08.42				
	White-breasted pearl	10.28				
	Magpie	07.93				
	Royal purple	20.57				
Color and arrangement of barbels	Bluish	07.05	0.00	0.57	0.00	0.00
	Red	23.11				
	Red white	40.74				
	Bluish red	29.09				
	Folded up	43.49	0.00	0.00	0.43	0.00
	Simple	56.51				
Ridge pace	Upright	65.62	0.04	0.00	0.01	0.00
	Curved	34.38				
Eye color	B/dark	15.96	0.00	0.43	0.00	0.00
	White	17.53				
	Yellow	02.55				
	Chestnut	27.91				
	Black	36.04				
Color of the tarsi	White	05.00	0.00	0.06	0.00	0.00
	Gray	30.17				
	Yellow	25.66				
	Black	39.18				

CP: Plumage coloring; GT: Genetic type.

- A distinction is made between straight (65.62%) and curved (34.38%) crests in guinea fowl in Cameroon. The contingency test reveals that the shape of the crest varies ($p < 0.01$) according to sex, plumage coloration and genetic type.
- Black eyes (36.04%) and chestnut (27.91%) are the most common. The diversity of eye color depends on the region, plumage color and genetic type. The black color of the eyes is more frequent in the guinea fowls of the North region (15.87%) which have a pearl gray plumage (10.48%) and mostly belonging to genetic type 3 (21.35%).
- The tarsi of common guinea fowl in Cameroon are dominated by black (39.18%) and gray (30.17%) followed by yellow (25.66%) and light white (5%) colour. This variable is significantly influenced ($p < 0.01$) by region, plumage coloration and genetic type. The black color is more abundant in the North region (14.89%), among pearl gray guinea fowl (11.66%) and genetic type 3 (23.11%).

3.2. Body Measurements of Common Guinea Fowl in Cameroon

Table 3 shows the metric characteristics of common guinea fowl in Cameroon. It follows from this table that the body measurements of common guinea fowls are varied and may or may not be influenced by the factor's regions, sex, plumage color and genetic type. Except for baleen length, chest circumference and tarsus diameter which are not significantly influenced ($p > 0.05$) by the region, the other variables are under the effect of this factor. Sex has a significant influence on all variables except the thoraxic circumference and the diameter of the tarsi. Factors such as plumage coloration and genetic type had no significant effect ($p > 0.05$) on the height of the crest, the length of the baleen, and the thorax circumference. The coefficient of variation suggests that the population of common guinea fowl in Cameroon is relatively dispersed for almost all the 16 variables studied.

3.3. Correlation between Body Measurements of Guinea Fowl in Cameroon

Table 4 shows the correlations between body measurements. These correlations are varied as we observed strong and weak correlations, significant or not, positive or negative. A strong correlation ($r = 0.70$) and significant ($p < 0.01$) was found between Thigh length and Crest length. Correlations between Live weight and body measurements are relatively weak ($r < 0.50$); however, there is a significant ($p < 0.01$) and positive ($r = 0.37$) correlation between Live weight and Caruncle length. A significantly negative correlation ($r = -0.44$) was obtained between Live weight and Thigh length.

3.4. Genetic Variability of Common Guinea Fowl Populations in Cameroon

The Kayser-Meyer-Olkin (KMO) index for the efficiency of samples for the Principal Component Analysis (CPA) of the measurements was 0.83. **Figure 2**

Table 3. Metric characteristics of common guinea fowl in Cameroon according to region factors, sex, plumage coloration and genetic types.

Variables	Moy ± S.D	CV (%)	Factors			
			Region	Sex	PC	GT
Crest height	2.07 ± 0.03	23.01	*	*	ns	Ns
Crest length	2.79 ± 0.03	31.48	*	*	*	*
Barbel length	3.35 ± 0.04	21.41	*	*	*	*
Barbel height	2.28 ± 0.02	18.22	*	*	*	*
Spout length	2.11 ± 0.01	12.52	*	*	*	*
Caruncle length	0.69 ± 0.01	26.07	*	*	*	*
Baleen length	4.32 ± 0.04	13.41	ns	*	ns	Ns
Chest circumference	31.81 ± 0.99	44,76	ns	ns	ns	Ns
Wing length	25.99 ± 0.18	27.99	*	*	*	*
wingspan	41.82 ± 0.32	14.54	*	*	*	*
Thigh diameter	9.17 ± 0.10	17.00	*	*	*	*
Thigh length	11.30 ± 0.07	18.23	*	*	*	*
Tarsus length	6.62 ± 0.04	10.62	*	*	*	*
Tarsus diameter	1.20 ± 0.07	88.48	ns	ns	*	*
Body length	40.13 ± 0.15	8.44	*	*	*	*
Live weight	1.68 ± 0.02	33.16	*	*	*	*

Moy ± S.D: Average ± Standard Deviation; CV: Coefficient of variation; %: Percentage; *: Significate à 0.01; ns: Non significate; PC: Plumage coloring; GT: Genetic type.

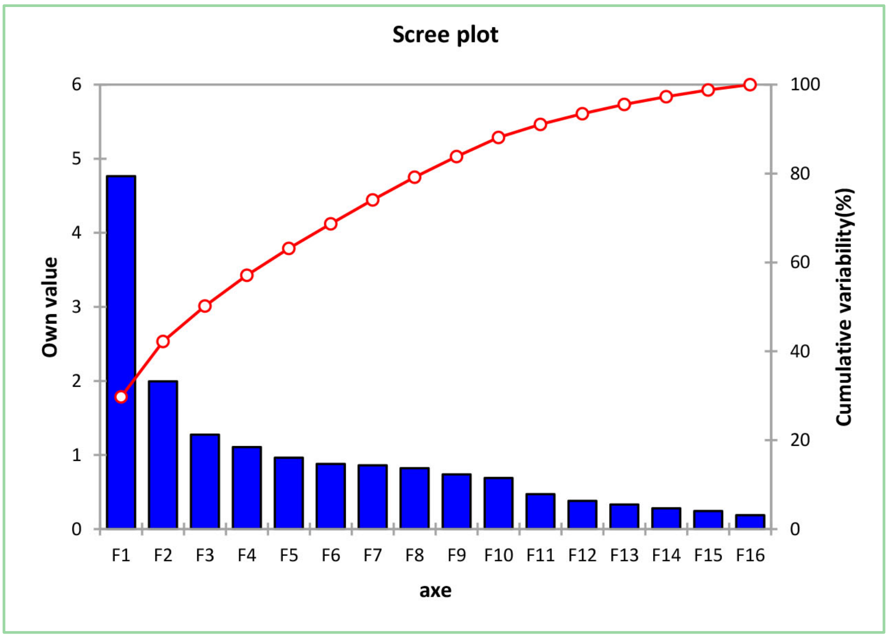

Figure 2. Distribution of eigenvalues and cumulative variability as a function of factors.

Table 4. Correlation matrix (pearson (n)) between measurements of common guinea fowl in Cameroon.

	CH	CrL	BaL	BH	SL	CL	BL	WL	CC	TiD	TiL	TaL	TaD	BalL	LW	WS
CH	1															
CrL	0.25**	1														
BaL	0.31**	−0.13**	1													
BH	−0.03	−0.24**	0.37**	1												
SL	0.15**	0.61**	−0.07*	−0.13**	1											
CL	−0.06	−0.68**	0.38**	0.03**	−0.57**	1										
BL	0.15**	0.47**	0.04	−0.15**	0.58**	−0.45**	1									
WL	0.06	0.41**	0.05	−0.04	0.59**	−0.41**	0.69**	1								
CC	−0.02	0.03	−0.03	−0.01	0.07*	0.07*	0.06	0.09**	1							
TiD	0.04	0.17**	0.03	0.00	0.26**	−0.11**	0.23**	0.32**	0.05	1						
TiL	0.07*	0.70**	−0.38**	−0.32**	0.55**	−0.71**	0.39**	0.22**	0.00	0.10**	1					
TaL	0.01	0.45**	−0.26**	−0.22**	0.25**	−0.44**	0.24**	0.06*	0.02	0.02	0.59**	1				
TaD	0.13**	0.14**	0.04	−0.08*	0.19**	−0.13**	0.12**	0.07*	0.00	0.05	0.14**	0.11**	1			
BalL	−0.01	0.10**	−0.02	−0.09**	0.09**	−0.04	0.02	0.06	0.10**	0.00	0.08*	008**	−0.04	1		
LW	0.03	−0.37**	0.03**	0.27**	−0.20**	0.37**	−0.09**	0.00	0.02	0.04	−0.44**	−0.28**	−0.04	−0.02	1	
WS	−0.04	−0.46**	0.20**	0.18**	−0.54**	0.50**	−0.35**	−0.44**	−0.04	−0.16**	−0.44**	−0.15**	−0.03	0.01	0.19**	1

**: The correlation is significant at the 0.01 level; *: The correlation is significant at the 0.05 level; CH: Crest height; CrL: Crest length; BaL: Barbel length; BH: Barbel height; SL: Spout length; CL: Caruncle length; BalL: Baleen length; CC: Chest circumference; WL: Wing length; WS: wing span; TiD: Thigh diameter; TiL: Thigh length; TaL: Tarsus length; TaD: Tarsus diameter; BL: Body length; LW: Live weight.

shows the distribution of cumulative eigenvalues and variances as a function of the components. Three (03) components make it possible to better explain phenotypic variability. Components 1, 2 and 3 contribute to 29.78%; 12.46% and 7.97% respectively for a cumulative variability of 50.21%. The eigenvalues of these components are respectively 4.76; 1.99 and 1.28. This means that if we represent the data on 2 axes, then we will always have a preservation of 50.21% of the total variability.

Each eigenvalue corresponds to a factor; the factors have the particularity of not being correlated with each other. Moreover, they can be in association with the variables. The factor is equal to the dimension of the PCA which is equal to the axis of the PCA. The factor being a linear combination of the 16 quantitative starting variables, it is thus necessary to highlight the contribution of each variable to the explanation of the total phenotypic variability observed (Table 5) and the correlations between the variables (Figure 3).

It appears from Table 5 that the variables which contributed the most to the explanation of the total variability observed within the Meleager population of Cameroon are the length of the crest, beak, wattle, body, wing, thigh, tarsus and wingspan for the main component F1 while the F2 and F3 components are mainly related to the length of the barbel and the height of the crest respectively.

Table 5. Squared cosines of the variables.

	F1	F2	F3
CH	0.02	0.12	**0.48**
CrL	**0.70**	0.00	0.04
BaL	0.10	**0.43**	0.16
BH	0.15	0.18	0.00
SL	**0.61**	0.10	0.00
CL	**0.70**	0.03	0.00
BL	**0.44**	0.19	0.01
WL	**0.35**	0.33	0.09
CC	0.00	0.01	0.09
TiD	0.07	0.16	0.06
TiL	**0.68**	0.09	0.01
TaL	**0.29**	0.13	0.04
TaD	0.04	0.01	0.21
BalL	0.01	0.00	0.01
LW	0.19	0.20	0.02
WS	**0.41**	0.01	0.06

The values in bold correspond for each variable to the factor for which the squared cosine is the largest.

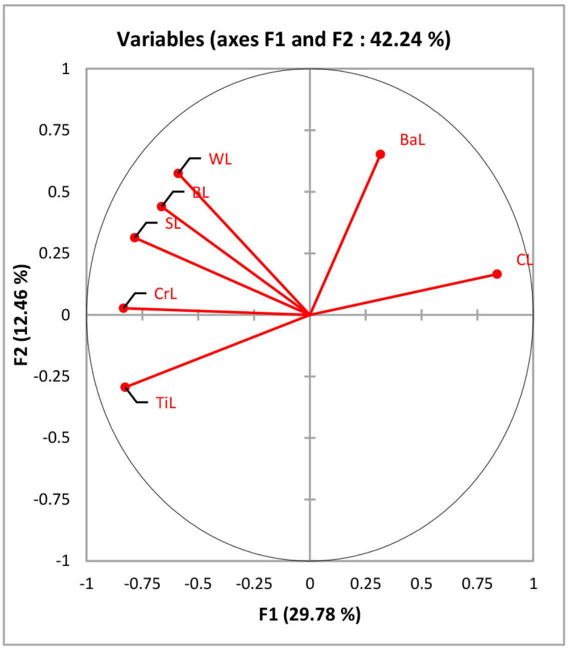

Figure 3. Circle of correlations. CH: Crest height; CrL: Crest length; BaL: Barbel length; BH: Barbel height; SL: Spout length; CL: Caruncle length; BalL: Baleen length; CC: Chest circumference; WL: Wing length; WS: wing span; TiD: Thigh diameter; TiL: Thigh length; TaD: Tarsus length; TaD: Tarsus diameter; BL: Body length; LW: Live weight.

The circle of correlations (**Figure 3**) corresponds to a projection of the initial variables on a two-dimensional plane made up of the first two factors. It thus shows that the variables length of the crest, beak, body, and the wing are negatively correlated with each other while the length of the barbel is positively associated with that of the wattle.

Figure 4 represents individuals on a two-dimensional map (F1 and F2), and thus to identify trends. It can thus be observed that apart from a few individuals who are quite specific, the population of common guinea fowl in Cameroon can be grouped into 03 distinct subpopulations.

3.5. Correlation between Measurements of the Common Guinea Fowl and the Factors (Axes) in Cameroon

It appears from **Table 6** and **Figure 5** that the factor F1 constitutes the most distinctives variables (89.40%). The variables most correlated to this factor are, among others, the length of the caruncle, the thigh, the crest and the wingspan. The live weight seems to be more correlated with the F2 axis which contributes nearly 10% to the discrimination of common guinea fowl populations in Cameroon.

Figure 6 presents the distribution of genetic types of common guinea fowl populations in Cameroon on the factorial axes.

Figure 6 confirms that the individuals are well differentiated on the factor axes obtained from the 16 initial explanatory variables. Thus, it is the F1 axis (76.74%) that best distinguishes the three genetic types. It is therefore interesting to analyze the phylogenetic relationships that would exist between the common guinea fowl populations of Cameroon.

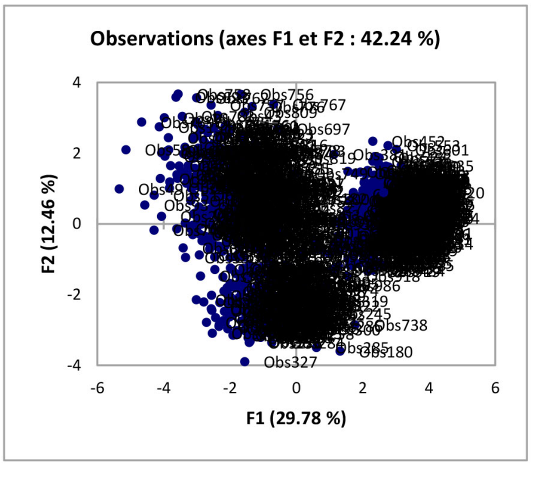

Figure 4. Representation of individuals on a two-dimensional map.

Table 6. Eigenvalues and % variance.

	F1	F2	F3
Own value	10.94	1.23	0.07
Discrimination (%)	89.40	10.07	0.53
Cumulative %	89.40	99.47	100.00

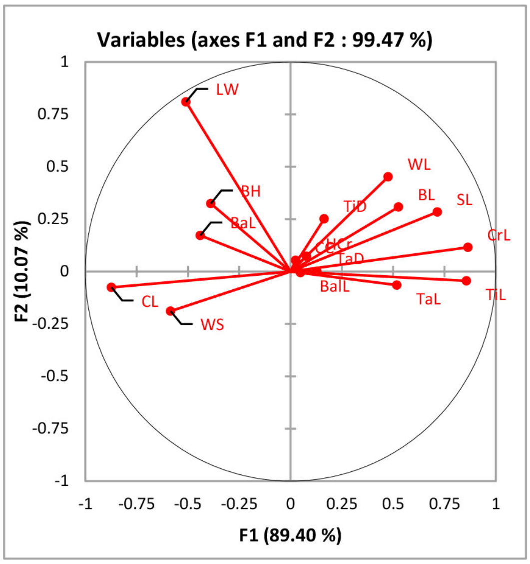

Figure 5. Correlation between variables and factors of common guinea fowl in Cameroon. CH: Crest height; CrL: Crest length; BaL: Barbel length; BH: Barbel height; SL: Spout length; CL: Caruncle length; BalL: Baleen length; CC: Chest circumference; WL: Wing length; WS: wing span; TiD: Thigh diameter; TiL: Thigh length; TaL: Tarsus length; TaD: Tarsus diameter; BL: Body length; LW: Live weight.

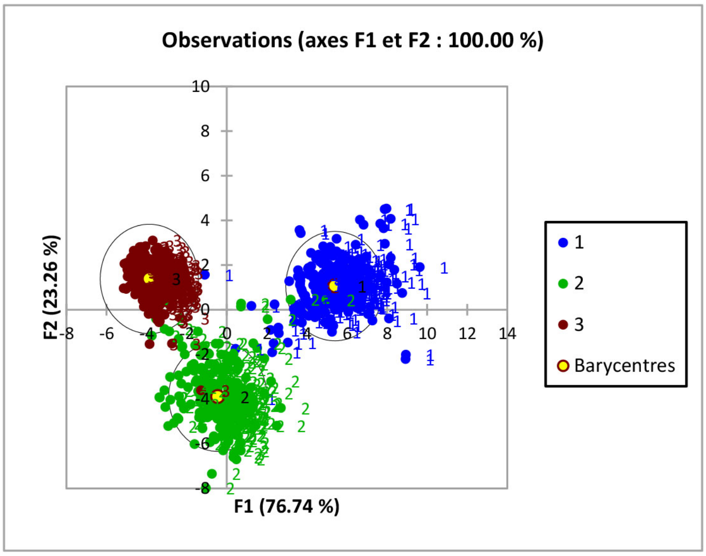

Figure 6. Distribution of common guinea fowl in Cameroon on the factorial axis.

3.6. Phylogenetic Analysis of Guinea Fowl Populations in Cameroon

The dendrogram in **Figure 7** illustrates the links between the 3 genetic types (T) of the guinea fowl population based on dissimilarity from Euclidean distance with Ward's method. This dendrogram shows that the guinea fowl population in Cameroon would be made up of 2 subgroups, the first consisting of T1 and the second consisting of T2 + T3. This rapprochement would probably be linked either to the inter/intra-population variation, or to the genetic distances between the 3 types.

Table 7 and Table 8 present the inter- and intra-population variability of common guinea fowl in Cameroon as well as the distances between the barycentres of the genetic types respectively.

It appears from Table 7 that the variation within the population is higher than that observed between the populations. This suggests that the common guinea fowl population of Cameroon would be related to a relatively high inbreeding rate. The distances between the barycentres of the genetic types are shown in Table 8.

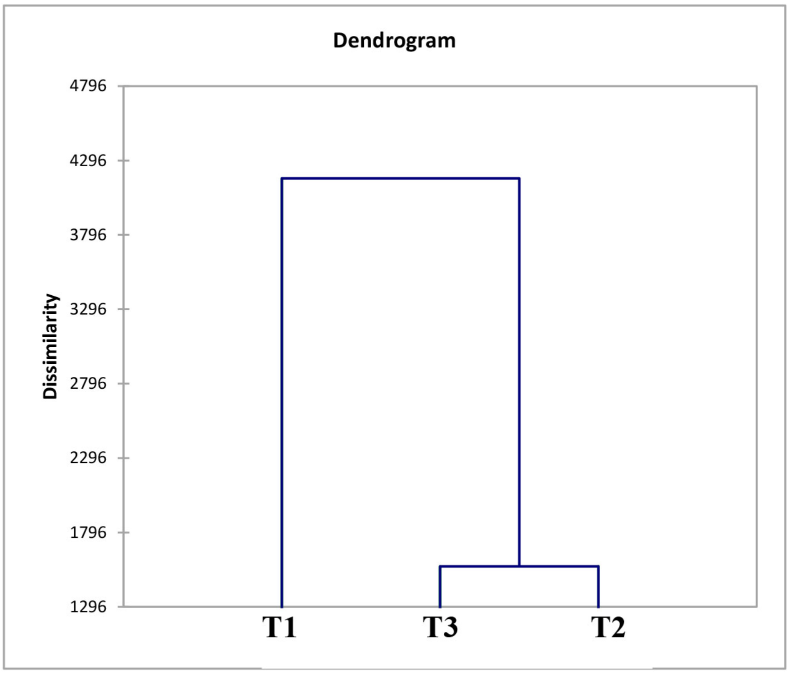

Figure 7. Dendrogram of common guinea fowl population genetic types in Cameroon.

Table 7. Variance decomposition for optimal classification.

	Absolute	Percentage
Within population	247.32	77.15%
Inter-population	73.25	22.85%
Total	**320.57**	**100.00%**

Table 8. Distances between the barycentres of the genetic types.

	T1	T2	T3
T1	0		
T2	17.78	0	
T3	17.62	6.80	0

T: genetic type.

Table 8 reveals that the distances between the barycenters of genetic types of 1-2 and 1-3 are substantially comparable while that between types 2 and 3 is the smallest, suggesting that they share a greater number of genetic characteristics in common.

4. Discussion

The morphometric characteristics of common guinea fowls are varied and could be due either to the effects of genes, or to the action of the environment and/or to gene-environment interactions; the effects of production systems are no less significant as Dongmo *et al.* [13]; Massawa *et al.* [15], Lauvergne *et al.* [22] showed that most domestic animal breeds are characterized by visible polymorphism because visible mutants would have a relatively higher degree of viability.

The different plumage colors recorded in Cameroon corroborate the observations made by several authors in different African countries. In different guinea fowl production contexts, Moreiki and Seabo in Botswana [23], Djovonou in Benin [24], Annor *et al.* in Ghana [12], Panyako *et al.* in Kenya [25], Mwandwe in the Democratic Republic of Congo [26], Gondebne in Chad [27], and many other authors Boussini [28]; Moreiki and Seabo [23]; Agbolosu *et al.* [29] observed that pearl gray guinea fowl are the most produced in farms. However, Meutchieye *et al.* [30] recorded a higher frequency of the white color plumage, which seems characteristic of the docile behavior of guinea fowls in the sudano-sahelian zone of Cameroon. Several studies have identified three (03) main dominant varieties of guinea fowl based on plumage color and the presence or absence of pearls. These include pearl gray, lavender, and white varieties. In a report on animal genetic resources [9], nearly forty plumage colorations of guinea fowls were summarized. The characteristic color of the red barbels, generally nuanced with a bluish color, is comparable to that observed in the ancestor of domestic guinea fowl (Numida meleagris) also called the red-barbed guinea fowl [31]. However, Gnassimgbe [32] previously recorded red-vermilion barbels in Togo. The determination of the color of the barbels thus seems to be a function of the geo-climatic characteristics while their arrangements would be an indicator of sex in guinea fowls. The result obtained during this study regarding the color of the eyes is not consistent with that recorded by Jacop and Pescatore [33]; the latter authors showed that the eyes of the common guinea fowl are generally dark brown. The black color of the tarsi is comparable to that observed by Nagalo in Burkina Faso [34], and by Jacop and Pescatore [35] indeed, they showed that the tarsi of adults are blackish brown. However, this result does not seem to agree with that of Cauchard [31] who, in fact, observed grey-brown tarsi and showed the existence of additional red scales in certain areas. The color of the tarsi varies in an individual depending on the stage of development as shown by the previously cited authors and confirmed by AU-IBAR [9].

The results of the analysis of biometric data testify to the phenotypic variability ($p < 0.01$) of common guinea fowl in Cameroon. These body measurements have relatively low values for most variables recorded in Nigeria by Fajemilehim

[36]; and Ogah [37]. However, these measurements are comparable to the values recorded by some authors: Laurenson [38]; Dahouda *et al.* [39]; Boko *et al.* [40]; Savadogo [41]; and Issoufou [42]. The significant differences observed between sexes regarding live weight agree with the work carried out in Togo by Gnassimgbe; Laurenson and Dahouda *et al.*; Orounladji *et al.* in Benin; Hien *et al.*, Sanfo *et al.*, Bouda in Burkina Faso; Dongmo *et al.* in the sudano-sahelian zone of Cameroon [17] [32] [38] [39] [43] [44] [45] [46]. This weight dimorphism in favor of females is proof that a selection program for meat production would be more advantageous with the latter than with the males. The high and low coefficients of variation reflect respectively the heterogeneity and the homogeneity that exists within the Cameroonian guinea fowl population for the characters studied. The correlations between live weight and body measurements express the variability of the local guinea fowl and the obligation to take this into account during its genetic improvement.

Principal Component Analysis (PCA) was performed to show the contribution of quantitative variables to the explanation of the total genetic variability observed within the guinea fowl population. The eigenvalues obtained correspond to each factor; the factor being the linear combination of all the starting variables. The factors have the particularity of not being correlated with each other. Eigenvalues and factors are sorted in descending order of represented variability. Contrary to the results obtained in this study which shows preservation of variability of more than 50% with only the first 3 components, it was observed in the DRC that the first four components contribute 43% to the total phenotypic variability of guinea fowl [26]; in the Sudano-Sahelian zone of Cameroon, it took the contribution of the first 4 components to reach 50% [47]; Dongmo *et al.* [48]; the variables primarily involved are wing span, wing length, crest height, total leg length and body length. Principal Component Analysis is often used before a classification because it allows to identification of the structure of the population and possibly determines the number of groups to build [21].

Discriminant Factor Analysis (DFA) and Hierarchical Ascending Classification (HAC) have made it possible to graphically detect that guinea fowl subpopulations are distinct and the phylogenetic relationships that exist between them would probably be due to either variation within and/or between populations, or to genetic distances. Since DFA is both an explanatory and a predictive method [49], it also makes it possible to identify the characteristics of the different groups based on explanatory variables. Just like in this study, 03 genetic types were identified in the provinces of Lualaba and Haut-Katanga in the DRC [26] and presented almost the same characteristics as the guinea fowls of Chad [27], in Burkina Faso [50] and Sudano-Sahelian zone in Cameroon [47]; Dongmo *et al.* [48]. Guinea fowl populations in Africa seem to be related due to migrations and date back to the century of slave trade [31] [32] [34].

5. Conclusion

A relatively wide phenotypic variability was observed in the common guinea fowl population in Cameroon. Also, a high and significant correlation was obtained between thigh and ridge length. Correlations between live weight and body measurements are relatively weak; however, there was a significant and positive correlation between live weight and caruncle length. The ACP revealed that three (3) components make it possible to better explain phenotypic variability. The variables that contributed most to the explanation of the observed total variability are the length of the crest, beak, caruncle, body, wing, thigh, tarsus, and the wingspan for the main component F1 while the components F2 and F3 mainly related to the length of the barbel and the height of the crest respectively. The factor F1 constitutes the most discriminating variables. The AFD and the CAH made it possible to detect 03 subpopulations which can be grouped into 2 subgroups according to the inter/intra-population variability and/or the genetic distances between the different groups. Biometric assessment coupled with genomics would increase the efficiency of the selection, improvement, and conservation of common guinea fowl in Cameroon.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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