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(RESEARCH ARTICLE)

Morpho-biometric characterization of local chicken population in Niger

Ousseini Moussa Hassan [1,*], Christian Keambou Tiambo [3], Salissou Issa [2], Karmadine Hima [1], Maman Laouali Ibrahim Adamou [1] and Yacoubou Bakasso [1]

[1] *Abdou Moumouni University of Niamey, Faculty of Sciences and Technics BP 10662 Niamey, Niger.*
[2] *National Institute for Agronomic Research of Niger, BP 429 Niamey, Niger.*
[3] *Centre for Tropical Livestock Genetics and Health (CTGLH)-International Livestock Research Institute (ILRI), P.O. Box 30709-00100, Nairobi, Kenya.*

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Abstract

The present study was initiated to determine the morphobiometric characteristics of local chicken population in Niger. A total of 554 chickens (156 males and 398 females) were sampled in the four (4) agro-ecological zones of the country. A complete description by direct observation, individual weighing and body measurements were performed on the entire sample. The results of the study showed an important diversity of plumage colours in the populations studied. Out of the thirteen (13) plumages stains observed, the most common are red (13.5%), pebbles (12.1%), white (11.9%), golden partridge (11.2%) and the fawn (10.8%). Feather distribution was normal over most of the sample (96.6%). The main tarsal colours observed were white, grey and yellow with respectively 45.1%, 39.0% and 15.3%. The eye colourings were mainly orange (55.1%), yellow (31%) and red (12.1%). A normal ridge was observed on 99.5% of individuals while 80% had a red barbillon.

From body measurements, it appeared that only the thoracic perimeter remains decisive in the prediction of individual live weight. The average weight obtained over the whole treated sample was 1141.24g. An ANOVA with sex as a source of variation showed that the roosters had an average weight of 1484.24g much higher than that of hens whose average was 1266.64g.

This study only concerned the descriptive part of the local chicken of Niger. Other aspects such as productivity remains to be elucidated to better discover the performance of the local chicken of Niger.

Keywords: characterization; Local chicken; Niger; Phenotype; Diversity

1. Introduction

Family poultry in sub-Saharan Africa is practiced in an extensive system in rural and peri-urban areas and responds to the culinary habits and tastes of African populations [1]. This type of farming presents savings and investment opportunities [2]. The importance of family poultry for producers is that it contributes significantly to food security, the fight against poverty and the healthy preservation of different ecotypes of local chicken. Thus, it offers employment to disadvantaged groups, especially women [3, 4] and requires low levels of inputs.

In Niger, the local chicken accounts for 55% of the total number of poultry species [5]. This family poultry contributes to the food security of rural Nigerian households and ensures their nutritional quality through the source of protein that

* Corresponding author: Ousseini Moussa Hassan; Email: moussah_ousseini@yahoo.fr
Abdou Moumouni University of Niamey, Faculty of Sciences and Technics BP 10662 Niamey, Niger.

it provides to them [6]. It also contributes to poverty reduction in rural and peri-urban areas through the substantial income it generates for producers [5].

However, the characteristics of the local chicken of Niger are not well known. This lack of information could be an obstacle to a possible livestock development program for this population. Indeed, in 2012 [7], the United Nations Food and Agriculture Fund (FAO) affirmed that the phenotypic and zootechnical characterization of local chicken populations is a preliminary step in the choice of suitable genotypes and to enhance regional scale. It is within this framework that the present study was initiated to determine the morpho-biometric characteristics of local chicken populations in Nige.

2. Material and methods

2.1. Samplings

Sampling was carried out between July and August 2017 and involved 12 rural municipalities in 6 regions (Agadez, Dosso, Maradi, Tahoua, Tillabery and Zinder) representative of the four agro-ecological zones of Niger [8]. For the Sahelian and Sudanian zones, which are the main zones producing local chicken in Niger, six and three municipalities were selected respectively. In the Sahelo-Saharan zone, two municipalities were concerned against one municipality in the Saharan zone. In each of the 12 municipalities selected, two localities were targeted. A total of twenty-four (24) localities were sampled (Figure 1). The choice of localities was made in agreement with the departmental directorates of livestock of the concerned departments that are Gaya, Doutchi, Flingué, Torodi, Dakoro, Madarounfa, Ingal, Abalak, Tanout and Magaria. The choice criteria mainly concerned the seniority of the local chicken farming practice in the locality, within households, the accessibility of the locality, the availability of traditional poultry farmers. Also the distance between the selected localities within one municipality must be at least 15km.

On the basis of these different criteria, a total sample of 554 adult chicken was collected, including 156 males and 398 females. The sample sizes vary according to the importance of poultry farming. Thus, the ratio per village is 29 individuals in Sahelian zones, 25 in the Sahelo-Sudanese zone, 19 individuals in the Sahelo-Saharan zone and 10 in the Saharan zone.

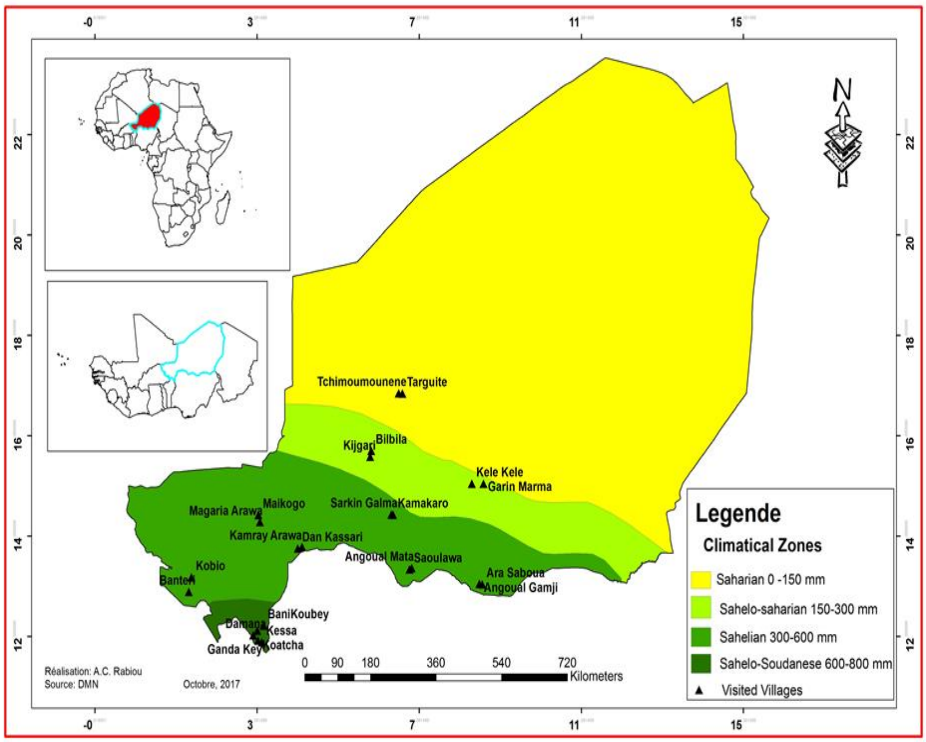


Figure 1 Sampling sites spread over different agro-ecological zones of Niger

2.2. Observations and measurements made

Visual characteristics included feather color and distribution, foot coloring, beak coloring, eye color, barb staining, and ridge type.

Biometric data were obtained using body weighing and body measurements generally used for the biometric characterization of poultry [9, 7]. Measured parameters were live weight, body length, tarsal tour, tarsal length, wing length, barb length and beak length, thoracic perimeter and wingspan (Table 1). For weighing, an electronic scale (range 20kg, precision 1g) was used. The body measurements were made using a measuring tape graduated in millimeters.

Table 1 Description of the biometric characters used to measure the local chicken of Niger

Variables	Abbreviation	Description
Body length (cm)	BL	distance between the tip of the upper mandible and that of the tail (without feather)
Thoracic Perimeter (cm)	TP	chest circumference taken below the wings and at the projecting area of the keel bone
Wing length (cm)	WL	length of the extended wing from the junction of the humerus to the spine to the tip of the wing (featherless)
length of Beak (cm)	LBe	distance between the tip of the upper mandible and the commissure of the two mandibles
Length of tarsus (cm)	LT	Length from the joint of the fingers to the articulation of the thigh.
Tarsus tour (cm)	TT	circumference of the tarsus
Live weight (g)	LW	Gram weight of the chicken
barb length (cm)	LBa	Excrescence from under the beak to its end
wingspan (cm)	EW	Length between the tips of the right and left wings after both are stretched completely

2.3. Ethical Statement

The National Committee of Ethics on Health Research authorized us to collect this data (authorization No.010 / 2017 / CNERS).

2.4. Data processing and analysis

The morphological data were processed with the SPSS software (Statistical Package for the Social Sciences) version 20. The analysis of variance was done with the R software according to the fixed linear factor model with 3 factors (ANOVA) according to sex, local ecotype and agro ecological zones. The R software was used for Spearman's descriptive analyzes and correlation measurements on biometric variables.

3. Results

3.1. Morphological characterization of the local chicken of Niger

A normal distribution of the feathers predominant within the populations of local chicken of Niger with 96.6%. Nevertheless, 4 other types of plumage distribution were identified. They included crested, frizzle, and feathered tarsi (Table 2) with respective frequencies of 1.8, 0.7, 0.5 and 0.4%. An important diversity of plumage colorations was also observed. Out of the thirteen (13) different plumage observed, the most frequent were red (13.5%), pebbles (12.1%), white (11.9%), golden partridge (11.2%) and the fawn (10.8%). The other colours Mille fleur, Silver Partridge, Silver Cuckoo, Splash, Black, Golden Cuckoo, Black whith Golden Camail and Golden Salmon all have frequencies below 10% (Table 2, Figure 2). Cases of polydactyl were rarely observed, and individuals carrying polydactyly represent only 0.2% of the total sample. The tarsi were mainly white (45.1%), grey (39.0%) and yellow (15.3%). With a few exceptions, the presence of normal ridges was observed on almost all individuals (99.5%, Table 3). The two barbel colors observed were red (which ranges from light red to dark red) for nearly 95% of individuals and black (around 5%). As for the eyes, they are predominantly orange (55.1%) followed by yellow and red with respectively 31% and 12.1% (Table 4). The beaks are grey on a little over 40% of the population, horny for 27.1% of individuals, white for 17,1% and yellow for 15.5% (Table 5).

Table 2 Types of plumage distribution and plumage colors

Parameters	Modalities	Size	Frequencies (%)
Types of plumage distribution	Normal	535	96,6
	Naked neck	4	0,7
	Frizzle	3	0,5
	Crested	10	1,8
	Feathered tarsi	2	0,4
	Total	554	100,0
Pulmage color	White	66	11,9
	Red	75	13,5
	Mille fleur	46	8,3
	Golden Partridge	62	11,2
	Silver cuckoo	31	5,6
	Black	28	5,1
	Mottled	67	12,1
	Splash	31	5,6
	Golden cuckoo	19	3,4
	Black with golden caimail	20	3,6
	Silver Partridge	40	7,2
	Fawn	60	10,8
	Golden samon	9	1,6
	Total	554	100,0

Table 3 Presence / absence of polydactyly and tarsi color

Parameters	Modalities	Size	Frequencies (%)
Presence of polydactyly	Normal	553	99.8
	5 fingers	1	0.2
	Total	554	100.0
Tarsi color	White	250	45.1
	Yellow	85	15.3
	Grey	216	39.0
	Brown	3	0.5
	Total	554	100.0

Table 4 Colors of the eyes and the barbell

Parameters	Modalities	Size	Frequencies (%)
Eyes color	Orange	305	55.1
	Yellow	172	31.0
	Red	67	12.1
	Black	10	1.8
	Total	554	100.0
Barbel Color	Red	443	80.0
	Red-white	57	10.3
	Black	25	4.5
	Dark red	29	5.2
	Total	554	100.0

Table 5 Comb types and beak color

Parameters	Modalities	Size	Frequencies (%)
Comb types	Normal	551	99.5
	Rosea	3	0.5
	Total	554	100.0
Beak color	Blanc	95	17.1
	corne	150	27.1
	Jaune	86	15.5
	Grey	223	40.3
	Total	554	100.0

Figure 2 Different colors of plumage observed in Nigerien's local chickens

3.2. Biometric characterization of the local chicken of Niger

3.2.1. Description of the sample

The average weight obtained on the total sample of 554 individuals of the local chicken of Niger, was 1141, 24g with a standard error of 12.74. The average length of the tarsi, the body and wingspan were respectively 8.13 cm, 36.50 cm and 42.49 cm. (Table 6)

Table 6 Summary of the different parameters measured

Variables	Effective	Minimum	Maximum	Average	Standard error
PV (g)	554	515	2535	1141.24	12.74
LT (cm)	554	5.40	11.50	8.13	0.04
LC (cm)	554	22.20	48	36.50	0.13
PT (cm)	554	7.20	37.80	28.16	0.12
TT (cm)	554	2.60	5.70	3.53	0.02
LA (cm)	554	15	27.50	17.66	0.07
LBa (cm)	554	0.10	6	1.50	0.05
LBe (cm)	554	1.50	12.70	2.92	0.02
EA (cm)	554	30.50	55.30	42.49	0.16

PV = live weight; LT = Tarsus length; LC = length of the body; PT = Thoracic Perimeter; TT = Tarsus Tower; LA = Length of the Wing; LBa = Length of the Barbillon; LBe = Length of the spout; EA = Wingspan

On the basis of information received from producers, the local chicken population in Niger is subdivided into 6 ecotypes (Figure 3)

- The Dourgou ecotype: it is a dwarf chicken very rarely encountered in the local chicken population in Niger.
- The Goggori ecotype: especially encountered in the Sahelian zone, particularly in the south of Maradi (Madarounfa) region, it is characterized by the absence of tail.
- The Gouzou-gouzou ecotype: it is a type of frizzle chicken ecotype that is also rared. Few individuals were mostly met in the Sahelian and Sahelo-Sudanian zone.
- Kolonto ecotype: this chicken is characterized by its large size and rapid growth. It is found mainly in the Sahelo-Sudanian and Sahelian zone.
- The Tchagara ecotype: it is characterized by its small and large laying capacity. It is more met in the Sudanian zone.
- The popular ecotype: this ecotype is of medium size. It represents the largest proportion of the local chicken population in Niger (411 out of 554 total individuals in the sample). She does not have a specific local name. But because it is found in all the agro-ecological zones of Niger, we named it a popular ecotype.

Figure 3 The different ecotypes of local chicken in Niger

3.2.2. Biometric variation in population of the local chicken in Niger

According to sex

The analysis of variance (ANOVA) with sex as the source of variance showed highly significant differences (P value = 0.000) between the roosters and hens for all the characters studied. For live weight, the roosters mean weight exceeds the hens one by more than 220g and tarsi were significantly longer than female one (Table 7). This superiority of the values found on males compared to those obtained on females was observed for all the variables studied (Table 7).

Table 7 Mean values by sex, various parameters measured

Variables mesurées	**Roosters (N=156)**	**Hens (N= 398)**	**F. val**	**Pr(>F)**
	$\bar{X}$ ± ES	**$\bar{X}$ ± ES**		
PV (g)	1484.24±45.86[a]	1266,64±45,05[b]	73.39	0.000***
LT (cm)	9.22±0.10[a]	7.70±0.10[b]	778.25	0.000***
LC (cm)	40.30±0.44[a]	37.21±0.43[b]	157.87	0.000***
PT (cm)	30.63 ±0.47[a]	29.28±0.46[b]	26.96	0.000***
TT (cm)	4.19±0.07[a]	3.69±0.07[b]	175.17	0.000***
LA (cm)	19.36±0.22[a]	17.18±0.22[b]	310.23	0.000***
LBa (cm)	3.38 ±0.13[a]	1.25±0.13[b]	857.83	0.000***
LBe (cm)	3.07±0.09[a]	2.93±0.09[b]	6.84	0.009**
EA (cm)	46.34±0.46[a]	41.44±0.45[b]	365.43	0.000***

a, b: on the same line, the same letter is given to the values showing no statistically significant difference between them at risk alpha = 0.05; * = significant; ** = very significant; *** = highly significant, N = effective; $\bar{X}$ = adjusted average; ES = Standard error; PV = live weight; LT = Tarsus length; LC = length of the body; PT = Thoracic Perimeter; TT = Tarsus Tower; LA = Length of the Wing; LBa = Length of the Barbillon; LBe = Length of the spout; EA = Wingspan; F.val = Fisher's test value

According to agro ecological zones

Analysis of variance (ANOVA) with agroecological zones as a source of variation between the population of the Sahelian, Saharan, Sahelo-Saharan and Sahelo-Sudanian zones showed significant differences (P value = 0.031), very significant (P value = 0.003) and highly significant (P value = 0.003) with the variables live weight, body length and tarsal length, respectively. for live weight, the Sahelian and Saharan zone average of 1387.33g and 1458.77g, respectively, is higher than that of the Sahelo-Saharan zone and the Sahelo-Sudanian zone, which were respectively 1375.09g and 1280.58g. For the length of the tarsi, the local chicken of the Sahelo-Sudanian and Sahelo-Saharan zone have tarsi of 8.57 cm, longer than those of the Sahelian and Saharan zone which are respectively 8.28 cm and 8.43 cm. Regarding the average length of the body, the chicken of the Sahelo-Saharan zone has a value 39.46cm higher than those obtained in the Sahelo-Sudanese, Saharan and Sahelian zones which are respectively 38.71cm, 38.58cm and 38.27cm. Of the variables measured, only 3 variables (live weight, tarsal length and body length) make it possible to differentiate chicken according to agro-ecological zones.

According to the ecotypes

Analysis of variance (ANOVA) based on the local chickens' ecotypes found in Niger showed that it is only the beak length where the difference is the Kolonto with an average weight of 1454.17g are the ecotypes with the highest live weight. They are followed by the Gouzou-gouzou and Dourgou ecotypes with successive weights of 1388.31g and 1378.31g. Finally, the less heavy chicken ecotypes in Niger are the Popular and Tchagara with average weights not significant (table 8). For the variable live weight, the Goggori with an average weight of 1521.40g and of 1160.69g and 1084.01g respectively (Table 8).

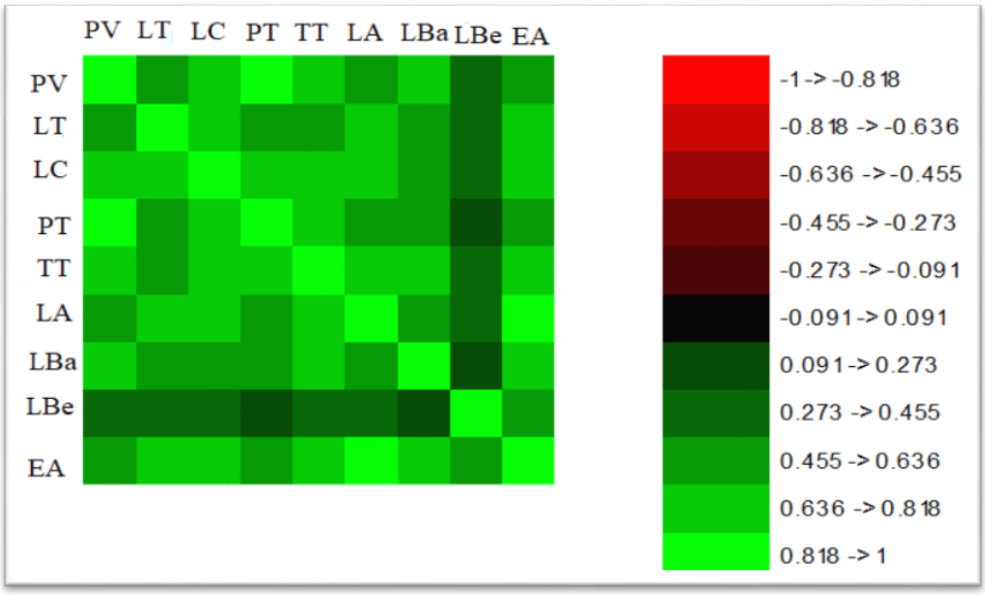
Table 8 Mean values of the different parameters measured, reflecting the morphological differences between the local chicken ecotype of Niger

Variables mesurées	Kolonto (N=46)	Goggori (N=10)	Tchagara (79)	Gouzou-gouzou (N=3)	Dourgou (N=3)	Populaire (413)	F.val	Pr(>F)
	$\bar{X}$ ± ES	$\bar{X}$ ± ES	$\bar{X}$ ± ES	$\bar{X}$ ± ES	$\bar{X}$ ± ES	$\bar{X}$ ± ES		
PV (g)	1454.17±63.40^{b}	1521.40±84.58^{b}	1084.01±64.03^{a}	1388.31±149.20^{ab}	1378.31±149.20^{ab}	1160.69±22.33^{a}	10.85	0.000***
LT (cm)	9.58±0,13^{c}	8.80±0,17^{b}	8.19±0,13^{b}	8,89±0,31^{bc}	6.62±0,31^{a}	8.47±0,05^{b}	30.14	0.000***
LC (cm)	40.22±0.63^{c}	40.04±0,84^{bc}	36.92±0,64^{ab}	38.50±1.48^{abc}	38.99±1,48^{abc}	37.09±0,22^{a}	8.83	0.000***
PT (cm)	31.12±0,67^{c}	31.17±0,90^{bc}	28.00±0,68^{ab}	30.28±1,58^{abc}	30.61±1,58^{abc}	28,00±0,24^{a}	8.31	0.000***
TT (cm)	4.14±0.09^{b}	3.86±0.12^{ab}	3.63±0.09^{a}	3.92±0.22^{ab}	4.05±0.22^{ab}	3.58±0,03^{a}	9.83	0.000***
LA (cm)	20.11±0.29^{c}	18.52±0.39^{b}	18.71±0.29^{b}	18.39±0.68^{abc}	16.25±0.68^{a}	17.88±0.10^{ab}	12.24	0.000***
LBa (cm)	2.39±0.18^{b}	2.36±0.24^{ab}	1.71±0.18^{a}	2.60±0.43^{ab}	2.30±0.43^{ab}	1.97±0.06^{ab}	3.44	0.004**
LBe (cm)	2.93±0.14^{a}	2.93±0.19^{a}	2.69±0,15^{a}	2.98±0.34^{a}	3.15±0.34^{a}	3.01±0.05	0.95	0.445
EA (cm)	47.38±0.62^{b}	45.65±0.83^{ab}	42.72±0.63^{a}	41.41±1.46^{a}	41.31±1.46^{a}	43.61±0.22^{a}	13.25	0.000***

a, b, c: on the same line, the same letter is given to the values showing no statistically significant difference between them at risk alpha = 0.05; * = significant; ** = very significant; *** = highly significant, N = effective; $\bar{X}$ = adjusted average; ES = Standard error; PV = live weight; LT = Tarsus length; LC = length of the body; PT = Thoracic Perimeter; TT = Tarsus Tower; LA = Length of the Wing; LBa = Length of the Barbillon; LBe = Length of the spout; EA = Wingspan; F.val = Fisher's test value

3.2.3. Relationship between the live weight of the chicken and other biometric parameters

All measured variables are correlated with each other. For values obtained between 0.091 and 1, the variables are positively correlated; this correlation is stronger for values close to 1. But the values obtained between -1 to -0.091, the variables are negatively correlated; this correlation is stronger for values close to -1. Live weight is positively correlated with all studied variables (Figure 4). This correlation is strong with the thoracic perimeter, the length of the body, the tarsal turn and the length of the barbillon. Beak length represents the variable that is less correlated with live weight and other variables.



PV = live weight; LT = Tarsus length; LC = length of the body; PT = Thoracic Perimeter; TT = Tarsus Tower; LA = Length of the Wing; LBa = Length of the Barbillon; LBe = Length of the spout; EA = Wingspan

Figure 4 Spearman correlation image between biometric variables Studied

3.2.4. Prediction equations for live weight of Niger's local chicken population

The thoracic perimeter is the variable that helps to predict the live weight of the local chicken in Niger (Table 9). The best prediction equation of this weight is of linear type:

PV = 86.304PT-1289.258; R2 = 0.682

Table 9 Regression between live weight and some biometric parameters

Measurements	Equations	R^2
Thoracic perimeter	PV = 86.304PT-1289.258	0.682
length of the body	PV = 67.534LC-1323.588	0.492
Tarsus Tower	PV = 475.095TT -537.540	0.592

4. Discussion

This study aims to determine the characteristics of the local chicken in Niger.

In the first place, the study showed a large phenotypic diversity of local chicken populations in Niger, which confirms the work of Mc Ainsh et *al.,* [10] who considered that phenotypic variation is characteristic of local chickens. This observed phenotypic diversity would also probably reflect the existence of numerous morphological mutations resulting from domestication and non-control breeding [11].

There is a great variability of plumage in the local chicken population of Niger. The main colors of plumage encountered in the Niger's' chicken are Red (13.5%), Pebble (12.1%), White (11.9%), Golden Partridge (11.2%), Fawn (10.8%) and the Thousand Flowers (8.3%). The plumage diversity of local chickens has been reported in other studies in several countries. This is the case of Congo Brazzaville by Akouango et *al.,* [12], Benin by Chabi-Toko [13], Cameroon by Fotsa et *al.,* [14] and Keambou et *al.,* [15], Central African Republic by Bembide et *al.,* [16], Côte d'Ivoire by Yapi-Gnaoré et *al.,* [17], South Africa by Van Marle-Koster and Casey [18], and China by Lujiang et *al.,* [19]. The plausible explanation for this diversity is that several genes interacted to determine this multitude of feather coloring [20]. The hypothesis that Oluyemi and Roberts [21] have put forth to explain this feather diversity is that local chickens would not be subject to any artificial selection. For Périquet [22], these colors are due to the existence of major effect genes and interact with many of them. The presence of light colors such as white or cuckoo (silver and gold) in our study, can translate a level of dilution of local genes through the introduction of commercial chicken type [23].

Our study showed that the normal distribution of feathers is more prevalent in the local chicken population in Niger with a proportion of 96.6%. This result is slightly higher than that of El-Safty, [24] in Libya, that of Egahi et *al.,* [25] in Nigeria and that of Dao et *al.,* [26] in Togo which reported respectively a proportion of 87.1%, 82.05% and 82%. Types of feathers such as crested, feathered tarsi, neckless and curly are rare in the local chicken of Niger. Egahi et *al.,* [25] found a proportion of 17.8% of crested birds in the chicken population in Nigeria. The proportion of naked neck obtained in our study is well below 6% found by Guèye [3] in Nigeria.

[20] reported that the crested head is due to an incompletely dominant (Cr) gene that causes a tuft of feathers above the head behind the ridges. For the genes responsible for the neck (Na) or Frizzle (F) type, they induce heat tolerance of the chicken [27, 28, 29, 30]. In hot conditions, the "naked neck" phenotype is better in meat and egg production than the normal phenotype [26]. This rarity of the naked neck or frizzle phenotype in our study is probably related to some considerations of producers who link their breeding to a fetish character, which exerts a negative selection pressure on these types of chicken in Niger. Sonaiya and Olori [31] reported that producers find their naked neck and frizzle naughty, and therefore, are only raised by older people for occult purposes.

The simple ridge type is more dominant in the chicken population in Niger with a proportion of 99.5%. This result is consistent with that of Dao et *al.,* [26] in Togo, Bembide [16] in the Central African Republic, Badubi et *al.,* [32] in Botswana, FAO [33] in Bangladesh, Keambou et *al.,* [15] in western Cameroon, Wani [34] in Sudan, Moges et *al.,* [35] in Ethiopia and Apuno et *al.,* [36] in Nigeria. In contrast to our finding, Nigussie et *al.,* [37] reported that the pitch ridge is the most common in the local chicken population in the Farta, Mandura, Horro, Konso and Sheka areas of Ethiopia. Crawford [20] has stated that the type of crest type inheritance in chickens is due to two pairs of genes carried by autosomes (Rose, RR and pitch ridge, PP), so the simple crest type is a recessive type. (rrpp).

The "polydactyl" phenotype encountered in this study has a frequency of 0.2%. This phenotype is significantly lower than that reported by Akinokun [38] and Ikeobi et *al.,* [39], who respectively found a frequency of 10% and 8% of this "polydactyl" phenotype in Nigeria. The orange coloring of the eyes is the most predominant in the local chicken population of Niger with a proportion of 55.1%. It is the same in Togo [26] and in the plateau region of Nigeria Mancha [40].

The tarsi of white, black and yellow are respectively the most predominant with respective values of 45.1%, 31% and 12.1%. El-Safty, [24] in Libya found that black tarsi (39.9%) are the most common, followed by yellow (24.5%), blue (18.7%) and white (17.9%). For Dao et *al.,* [26] in Togo, he found that chicken tarsi are white (34%), yellow (30%), gray (26.83%) and black (9.17%). The yellow color found in our study would result from the introduction of exotic breeds. In fact, the presence of the W mutation that causes a xanthophyll pigment deposit in the epidermis of the skin and tarsi [41] comes from commercial lines introduced in traditional farms [42,43].

On the basis of knowledge of the producers of the local chicken of Niger, we identified the existence of 6 ecotypes namely: Tchagara, Goggori, Gouzou-gouzou, Dourgou, Popular and Kolonto. This last ecotype has already been described by Moussa et *al.,* [44] as a large strain which he nicknamed the traditional broiler chicken. The Goggori ecotype also has a character of flesh production because of its high weight. Thus, the breeding of the Kolonto and Goggori strain can be encouraged for the production of flesh while that of the Tchagara strain can be encouraged for the production of eggs. In order to fight against poverty, it is very important to popularize the breeding of Kolonto, Goggori and Tchagara ecotypes because of their productive specificity. The ecotype Gouzou-gouzou is not liked by the producers of the local chicken of Niger because of certain consideration. Thus its popularization will not be a success despite being a strain adapted to the warm environment. The popular ecotype has no specific characteristic. Because it presents intermediate characters between the other ecotype, we think that it would be the result of multiple interbreeding between the different strains of local chicken of Niger.

The study found a sexual dimorphism within the local chicken populations studied and this on all the measured variables. Sexual dimorphism is not a new phenomenon in poultry and particularly in chickens where roosters are morphologically different from hens [45, 3, 46, 47, 48, 49]. The roosters of Niger with an average weight of 1484.24g, are heavier than hens with an average weight of 1266.64g. The values of the average weight of roosters and hens obtained are lower than those found by Hassaballah et *al.,* [50] in Tchad, but higher than those found by Youssao et *al.,* [42] in Benin. Sexual dimorphism shows that a breeding program for chicken meat production would be more beneficial with roosters [51].

The average thoracic perimeter obtained in this study is 28.16 cm. It is intermediate between that found by Guni et *al.,* [52] in Tanzania (24.3 to 26.6 cm) and that obtained by Keambou et *al.,* [15] in the highlands of Cameroon (39.1 cm). The length of tarsus obtained is lower than that of chicken in the forest zone of Cameroon [53] which is 9.1 cm.

This study showed positive and significant correlations (P = 0.001) between body weight and body measurements. This type of correlation was also found by Mancha [40] and Sudik [54] on local chicken individuals in Nigeria, which shows that these traits can be used in animal production in predicting chicken weight [55, 3, 56].

5. Conclusion

The main characteristic identified by this study on local chicken populations in Niger is its large phenotypic diversity which is due to the chicken production system. The different morpho-biometric parameters observed and measured also show that the local chicken of Niger still has its natural character and a potential exploitable by possible future programs of improvement of the poultry sector in particular and animal program in general. And, to get there, investigations on the local chicken of Niger must continue in particular on zootechnical and genetic performances.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare no conflict of interest in this study.

Statement of ethical approval

The National Committee of Ethics on Health Research authorized us to collect this data (authorization No.010 / 2017 / CNERS)

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