

Comparative study on morphometric traits of local chicken (*Gallus domesticus* L.) in wilaya of Adrar

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Abstract

A study was conducted in the wilaya of Adrar in Algeria (a part of Sahara) to describe the phenotype and morphometric characteristics of local chickens. Six regions namely (part of the wilaya of Adrar) Tamentit, Zawyet Elkenta, Wlad Ahmed, Adrar city, Anezjmir and Founoughil were selected for data collection. A field survey was used to extract information from the farmers concerning production attributes of their local chickens. Measurements on body weight, tarsal length and width, high Length, thigh width, bill length, spout width, total length, breast width and eggs number per year were taken on 89 mature chickens (69 females and 20 males). The results obtained indicate that there exists significant variation between regions with respect to some production attributes as well as body weight and other body measurements. Founoughil and Adrar city regions had the heaviest chickens (2.54kg-2.40kg respectively) while Zawyet Elkenta had the lightest birds (1.8kg). Overall, male chickens were higher than female birds with respects to all attributes studied. Body weight appeared to be highly positively correlated to some other body measurements considered in this study. The observed variation about the morphometric traits in the present study illustrate by the principal component analysis suggests that there are two groups, the first of which is represented by individuals from the Adrar city region, in the other hand the second grouped all the rest of the 5 regions. There is need to pay particular attention to the Adrar city region chicken population for possible consideration for conservation and selection plan.

Keywords: Local Chicken; Adrar; Algeria; Morphometric traits

Introduction

All developing countries must make great efforts to bring to the ever-growing population; Animal protein of good quality and insufficient quantity. FAO standards giving an average consumption of 100g of meat per person per day. (Amadou, 2014).

Backyard poultry farming, in most developing countries, is found in rural areas but also in peri-urban and urban areas. Industrial poultry farming is practiced around urban centers. Family poultry farming requires low levels of inputs, contributes significantly to food security, the fight against poverty, the sound ecological management of natural resources and represents a source of employment for disadvantaged groups (Guèye, 1998 and 2003).

Poultry products are an easily renewed protein resource that is accepted around the world; is not subject to any cultural or religious prohibition. Therefore, throughout the centuries poultry products are becoming the growing products requested by the market. Actually, breeding and genetic improvement of the chicken have moved in one direction, for improved egg and meat production performance. This fact is at the origin of the creation of the farmer or traditional sector. (Mukherjee, 1992).

Village chicken production plays an important role in the economy of a developing country (Lindell, 2015). They play an important socio-economic role because they ensure food security by providing the meat and eggs that contribute to the improvement of human health thanks to their high nutritional value; they generate a respectful income from the sale of the products of and a religious and cultural role (Mtileni et al., 2012; Packard 2014; Mahammi et al., 2014; Lindell 2015; Berrezoug et al., 2019).

In Africa in general, family poultry is exploited by more than 80% of the mostly rural populations. It plays an important role in both the rural and urban economy. In 2018, there were over 23.7 billion chickens living in world which China has the largest number with 5.27 billion chickens, 110 million ducks and 46 million turkeys (FAOstat, 2018). These poultry genetic resources, in a traditional breeding system, are made up of a multitude of often poorly characterized populations. The abilities of these populations result from the combined effects of genetic drift, mutations, natural selection and human action, which have accumulated since domestication under different environmental conditions (Guèye and Bessei, 1995).

In Algeria, the poultry sector has reached a stage of development that now gives it a place of choice in the national economy in general and in the agricultural economy, in particular (Said, 2015). In 2007, it generated a turnover of 100 billion dinars (\$ 1.4 million) and a gross value added of \$ 300 million, which represents a significant part of the national agricultural wealth, providing in return revenues to broad layers of the population (Kaci, 2015). According to industry professionals, this sector employs around 350,000 people.

On the organizational level, the process of recovery of the poultry sector was only partially achieved and remained stuck at the breeding stage "Chair" and "Ponte" (Kaci and Cheriet, 2013). In fact, basic trades (multiplication of grandparents and great-grandparents, as well as the poultry equipment industry) do not yet exist in Algeria (Belaid, 2015). The genetic diversity of the species *Gallus gallus domesticus*, consisting of a set of populations, is thought to be the result of domestication from 7 to 8 millennia through a spread that was ensured by human migration (West and Zhou, 1988).

The aim of this study is to contribute to a better development of the local chicken in the wilaya of Adrar, in order to define their morphological characteristics and their phenotype differences between regions of the *Gallus Gallus Domesticus* chicken.

Materials and methods

Field survey:

In order to apprehend the situation of the poultry sector in the wilaya of Adrar, a field survey was carried out among the different actors of the poultry sector. We first proposed to highlight the objectives of this survey. Second, we exposed the scope of the survey and the methodological approach chosen to achieve the objectives outlined

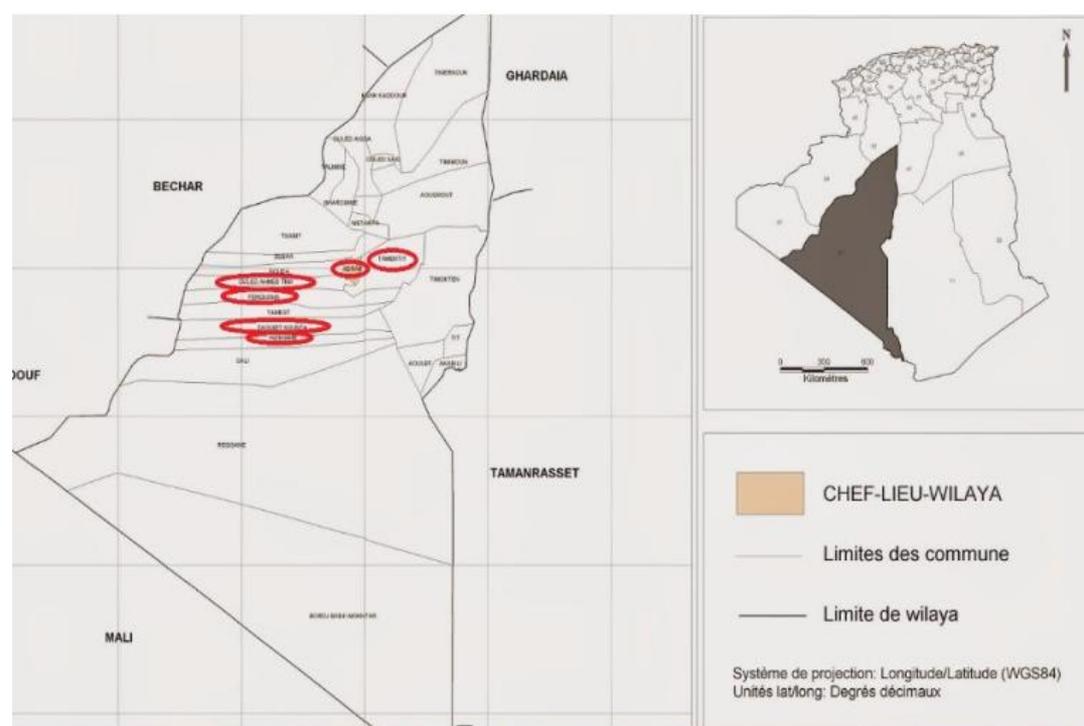


Figure 1: Geographical presentation of the study regions in the wilaya of Adrar.

Table 1: Origin and sample size of 6 regions in the wilaya of Adrar

Region	Tamentit	Zawyet elkenta	Wlad ahmed	Adrar city	Anezjmir	Founoghil	Whole population
Hen	9	8	9	20	9	14	69
Cock	4	4	2	5	3	2	20
Total	13	12	11	25	12	16	89

Animals and breeding conditions:

The survey was conducted in 06 communes as follows; Anjmir, Tamantit, Ahmed Wlad, zawyet EL kenta, Founoghil, Adrar city (figure 1). In each commune, the villages sufficiently distant from the urban area were chosen in order to better understand the typical rural farming system by minimizing the interference with industrial farms in urban and peri-urban areas (Desta et al., 2013).

A total of 89 adult chickens (69 females and 20 males) aged between 13 months to 4 years have been chosen from 16 rural families (Table1).

The animals are reared using a traditional system of rambling. During the day, the animals kept at liberty, look for their foods around the households. Generally, all farmers give dietary supplements to their birds throughout the year. Poultry habitats when they exist are generally rudimentary, built mostly with wood and plastic clay, and do not provide enough protection from cold, heat and predators during the night (Figure 2).

Figure 2: Examples of shelters provided for local poultry.



Data collection:

The 89 animals used for morphobiometric characterization all are adult chicken (all over 13 months old) of local populations. The quantitative data was collected using a digital scale accurately to the gram, a caliper accurate to 0.01 mm and a measuring tape. The data related to the age, weight, the number of eggs, the total length of the body for each animal are described and we used the same both sides of animals (Table 2, Figure 3). In addition, all these measurements were carried out according to FAO standard descriptors (FAO, 2007).

Table 2: Abbreviation and description of different quantitative traits.

Quantitative traits	Characters Description
BW	Body weight
AGE	Age of animal
TL	Tarsal length
TW	Tarsal width
THL	Thigh length
THW	Thigh width
BL	Bill length
SW	Spout width
TL	Total length
BW	Breast width
Eggs Nbr	Eggs number per year



Figure 3: describing method of measuring of body length (a); spout length (b), tarsal length (c), thigh length (d) and body weight (e)

Statistical analysis

The descriptive statistical analyzes were carried out by the software XLSTAT (Version 2014.5.03), the effect of sex and area was tested by ANOVA with Fisher Post-Hoc Analysis (LSD). In addition, the multivariate analysis was performed through principal component analysis (PCA) and hierarchical ascending classification (HAC) were calculated between continuous variables.

Results and discussion

Many observations were carried out during this work in order to revealed the phenotypic diversity in local chicken in the wilaya of Adrar in southern Algeria. In fact, we note from our study that the breeding conditions are not appropriate and no health program. It has also been noted that animals are not in any way protected from the weather and predators. We also noticed that the body weight and the production of eggs are low, because of type of breeding and the unfavorable climatic conditions.

Body weight and body measurements:

We studied 89 individuals, which means 69 females and 20 males of different phenotypes at the wilaya of Adrar in the following regions: Tamentit, Wlad Ahmed, Zawyet el Kenta, Adrar city, Founoghil and Anejmir. The results of the morphological description are summarized in Table 3 by regions and by sexes.

Table 3. Least square means (\pm SE) for body weights and other body measurements of population chickens summarized by regions and sexes

Effect	Quantitative traits										Eggs Nbr	
	BW Kg	AGE (year)	TL cm	TW cm	THL cm	THW cm	BL cm	SW cm	TL cm	BW cm		
Region		*	*	***	***	***	***	***	***	***	***	ns
Adrar	2,43 \pm 0,64 a	2,23 \pm 0,58a,b	8,08 \pm 0,62 a,b	1,63 \pm 0,35a	14,94 \pm 0,83a	5,74 \pm 0,5a	2,43 \pm 0,58a	0,55 \pm 0,1c	10,63 \pm 0,72a	51,04 \pm 9,22a	140 \pm 27,91 ab.	
Anzejmir	2,05 \pm 0,74a,b	2,3 \pm 0,6a,b	7,7 \pm 0,87b	1,26 \pm 0,24 b	12,53 \pm 1,79b	4,3 \pm 0,88b	0,86 \pm 0,16b	54,5 \pm 8,59a,b	2,23 \pm 0,43b	7,88 \pm 1,27c	82.22 \pm 2,048 c	
Wlad	2,14 \pm 0,48 a,b	2,21 \pm 0,51a,b	8,35 \pm 0,57a	1,81 \pm 0,24a	14,66 \pm 0,72a	4,33 \pm 1,13b	0,49 \pm 0,14c	50,19 \pm 6,07b	2,52 \pm 0,36b	12,12 \pm 0,88c	160 \pm 22,36a	
Ahmed Tamentit	2,05 \pm 0,56a,b	1,95 \pm 0,45b	8,03 \pm 0,43 a,b	1,69 \pm 0,37a	14,62 \pm 0,92a	4,23 \pm 1,04b	0,7 \pm 0,15b,c	51,31 \pm 8,22b	2,62 \pm 0,22b	10,42 \pm 0,82b,c	160 \pm 22,36a	
Zawyet Elkenta	1,83 \pm 0,62b	1,73 \pm 0,34b	7,65 \pm 0,53b	1,62 \pm 0,35a	13,3 \pm 1,3b	4,05 \pm 0,8b	0,55 \pm 0,09b	50 \pm 3,57a	2,62 \pm 0,32b	7,04 \pm 1,36b	120 \pm 27,26b	
Fonoughil	2,54 \pm 0,51a	2,41 \pm 0,68a	8,24 \pm 0,64a	1,75 \pm 0,35a	14,83 \pm 0,89a	4,51 \pm 1,36b	0,51 \pm 0,19c	58,17 \pm 8,6b	2,53 \pm 0,39b	12,41 \pm 0,52b	150 \pm 30,63a	
Sex	***	**	***	**	***	***	ns	ns	ns	ns	ns	
Male	2.92 \pm 0.41a	2.48 \pm 0.5a	8.51 \pm 0.46a	1.82 \pm 0.26a	15.46 \pm 0.9a	5.67 \pm 0.75a	1.22 \pm 0.93a	46.31 \pm 7.47a	4.76 \pm 0.6a	25.56 \pm 2.517a	-	
Female	2.01 \pm 0.55b	2.07 \pm 0.58b	7.90 \pm 0.66b	1.58 \pm 0.37b	13.97 \pm 1.32b	4.42 \pm 1.11b	1.10 \pm 0.89a	35.65 \pm 3.25a	4.79 \pm 0.76a	20.51 \pm 1.719b	-	

a,b,c / Fisher (LSD) / Analysis of the differences between the categories with a confidence interval of 95%: ns: no significant, * (0.01) ** (0.001) *** (0.0001)

Table 3 shows least square means for various quantitative variables of local chicken population in the study area. All regions and sexes differed with respect to body weight. The results of the present study show that body weight chickens were ranged between 1,83 \pm 0,62 to 2,54 \pm 0,51 kg for Zawyet Elkenta and Fonoughil region respectively. There are significant differences between regions. As expected, male chickens were heavier than female across the study area (Table 3).

In addition, all traits show a significant variation between regions except the eggs number (Eggs nbrs). The average body weight observed in the present study falls within the range of 1.030 to 2.860kg, and 1.107 to 2.915kg reported by Katule (1998) and Msoffe et al. (2001) respectively, but higher than those reported from other studies (Mwalusanya et al., 2002; Guèye et al., 1998; Olawunmi et al., 2008; Dana et al., 2010; Mahammi et al., 2014 and Berrezoug et al., 2019).

Furthermore, total length (LT) and breast width (LP) show very variable results between regions, in fact, the Adrar city region contains very long individuals with a size significantly larger than the other regions. The observed heavier chickens from Adrar city region than those of other regions might be due to both genetic and factors such as a selective feeding and environmental

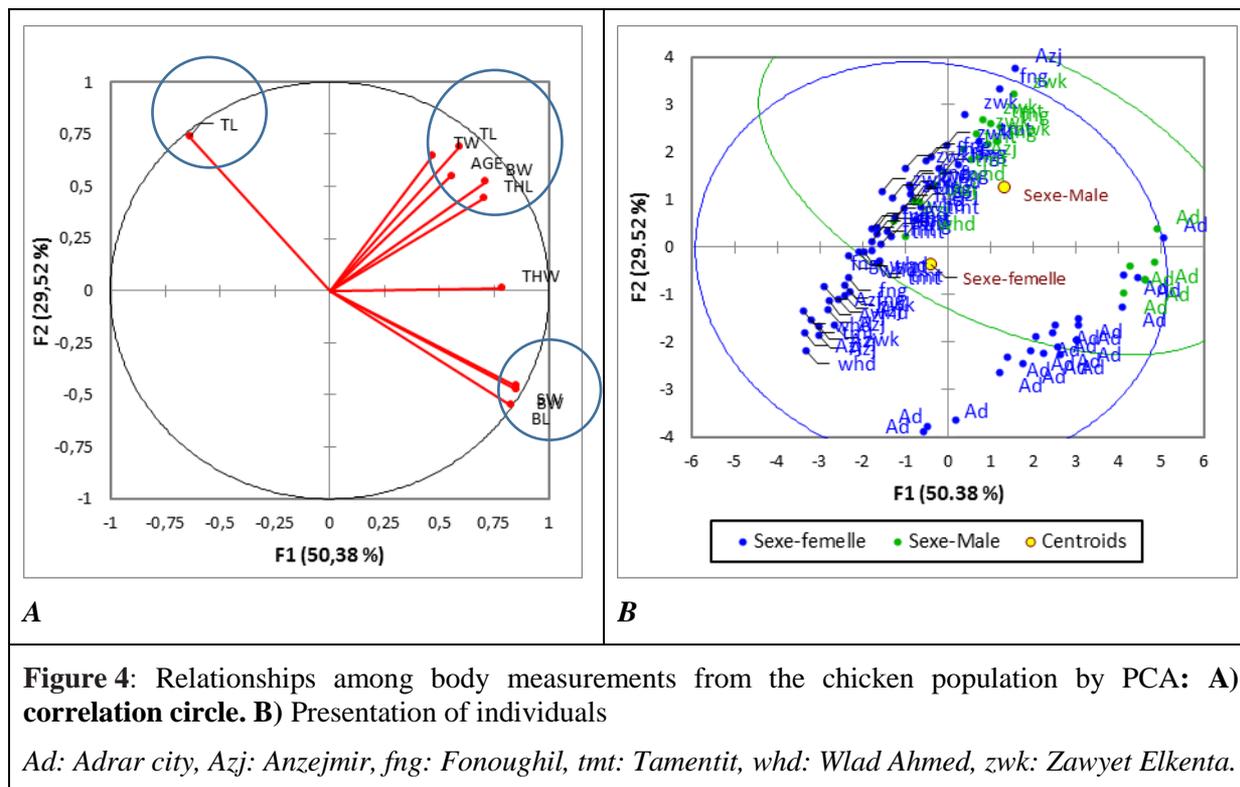
The average total length observed in the present study were much higher than those reported by Badubi et al., (2006) in Botswana, which was 0.2 and 18.1cm for male and female chickens respectively. However, our population is lower than those reported by Guni et al (2013) in Tanzania, which was 45.7 and 40.2 cm for male and female chickens respectively. Such difference might be due to description and measurement procedures for body length since there is more than one approach (Guni et al., 2013).

The average Thigh length (give the value) for both male and female observed in the present study falls within the range reported by Francesch et al. (2011) and Guni et al. (2013) from Spain and Tanzania respectively but shorter than those reported from Nigerian local chickens (Olawunmi et al., 2008).

The lower body measurement values observed for females than for male chickens in this study are consistent with the findings from other studies (Msoffe et al 2001; Alabi et al., 2012; Semakula et al., 2011; Guèye et al., 1998; Olawunmi et al., 2008), suggesting that sexual dimorphism in chickens is

manifested with respect to a large number of body attributes and in most breeds. This may be attributed to sex hormones which may promote larger muscle development in males than in females.

Regarding the morphobiometric characterization, a significant phenotypic diversity was observed in the local hens of wilaya of Adrar. This variation in phenotype generally characterizes local hens and indicates the presence of several morphological mutations that result from domestication and the mode of random reproduction (Mahammi et al., 2014).



Principal component Analysis (PCA)

The principal component analysis (PCA) is performed on 89 individuals of the local breed of the wilaya of Adrar, all the individuals are female and male adult. The PCA allows identifying two main axes of variation, which forms the foreground by relating 79.89 % of total variability (figure 4 A and B). The first axis, explaining 50.38 % of the total variation, while the second axis that explains 29.52% of total variation. In fact, we observe at the PCA that the characters studied in the chicken population are closer in their majority to the circle, which statistically means a high level of significance. It is also noted that the PCA represents 79.89 % of the information used for statistical processing which is very significant. We distinguish the formation of three groups of characters. This reflects a positive correlation between these parameters at the level of each group. The first group includes Body Weight (PC), Tarsal Length (LTA), Tarsal Width (LAT), AGE and Thigh Length (LC). While the second group contains Bill Length (LB), Breast Width (LP), Total Length (LT). Lastly, third group noted a negative correlation between these parameters at Spout Width (LAB) level.

We can say that the group of characters which is at the level of each group are influenced by the same group of genes or they react in the same way visa life climatic and environmental conditions (adaptation). Our PCA shows us clearly the negative correlation between LAB and LB (when LB increases the LAB decreases). This result is mentioned in certain environment and type of farming (Guni et al., 2013).

On the other hand, the positive correlation between the weight and the other body measurements (Tarsal Length, Tarsal Width and Thigh Length) suggests that the selection for one of these body parameters would lead to an indirect improvement in body weight, a similar result is reported by Apuno et al. (2011).

Figure (4 B) represents individuals distribution by PCA where clearly notice that there are two groups, the first group contains a small number of individuals represented by the animals from Adrar city region. While the second group represents a large number of animals whose are from regions of Tamentit, Zawyet Elkenta, Wlad Ahmed, Anezjmir and Founoughil. This geographical distribution of individuals in the study can be explained by the fact that individuals from the Adrar city region belonging to the same origin. However the rest of the chickens from the other five regions constitute a same clad and are from different genetic origins about Adrar city region.

Agglomerative Hierarchical Clustering (AHC) of chicken population

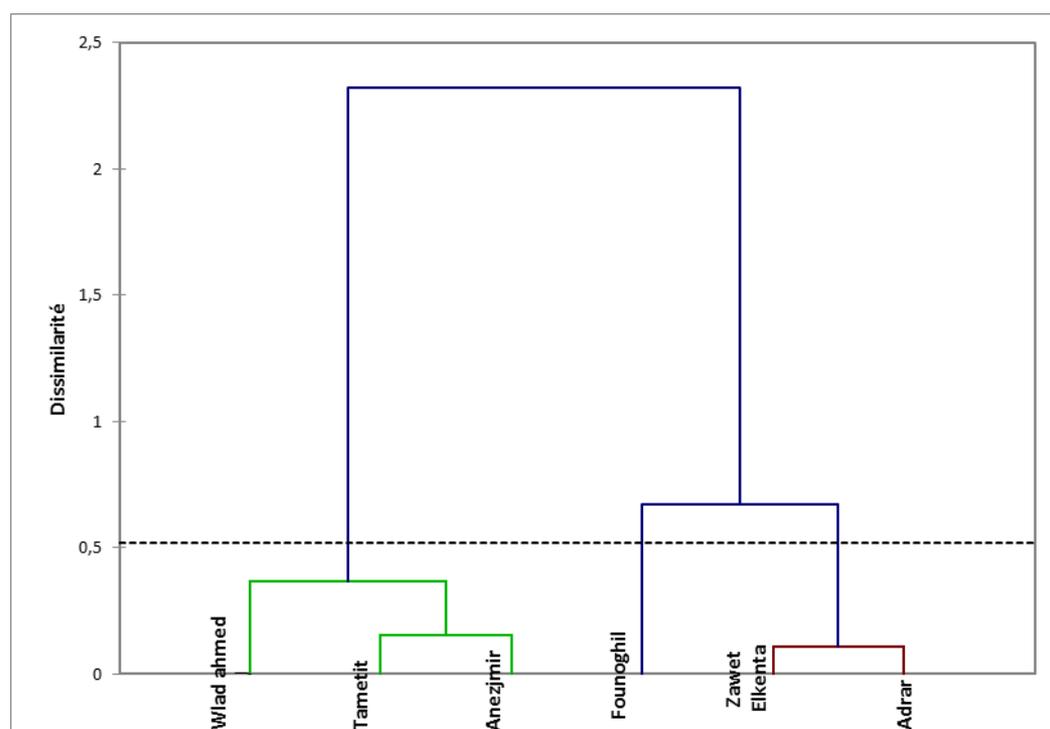


Figure 5: Hierarchical tree using average distance (between classes) among the population

We have used Agglomerative Hierarchical Clustering to make up homogeneous groups of objects (classes) on the basis of their description by a set of variables, or from a matrix describing the dissimilarity between the regions (figure 5). In fact, the dendrogram shows the relation between the different regions studied divides its last ones into three large groups in which, the first group includes two subgroups, the first one consisting of two regions Tameitit and Anezjmir, the second subgroup contains Wlad Ahmed region alone. The second group includes only one region; it is Founoghil region, while the third group contains the Zawet Elkenta and Adrar city region. Therefore, we can explain this distribution tree by a genetic effect because we have a different morphology in the same region.

Conclusion

The present study indicates that the chickens in wilaya of Adrar had multiple variations physical traits and according to our observations carried out in six regions inspected, it has been noticed that most breeders raise the animals in their houses for self-consumption. The production in the studied area is

insufficient, and was influenced by the conditions of breeding and climatic. Furthermore, the phenotypic diversity in this local chicken population in Sahara revealed some particularities compared to those raised in the north of the country in term body weight and total body length. However, conservation efforts need to be immediately undertaken especially when restocking was carried out by introducing the exotic and synthetic strains of chickens.

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