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BARYMETRIC CHARACTERIZATION OF ALGERIAN SHEEP BREEDS IN WESTERN ALGERIA

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Abstract

To study of the biodiversity of the sheep genetic resources, our phenotypic approach consists on the barymetric parameters of Algerian sheep breeds in western Algeria using the body measurements in 166 sheep of six breeds: Ouled Djellal, Hamra, Barbarine, Srandi, Daraa and Tazegzawt. The body measurements studied are: WH, SIL, HG, CD, SW, RW, TW, PL, HL, HW, EL, EW and CP, they are respectively : 84.71±7.15 cm ; 84.08±7.96 cm ; 103.53±10.79 cm ; 30.21±4.18 cm ; 17.34±2.09 cm ; 21.63±2.90 cm ; 26.01±2.32 cm ; 24.40± 4.07 cm ; 25.58±1.99 cm ; 15.18±1.62 cm ; 16.22±2.60 cm ; 8.24±0.96cm et 9.09±1.21 cm. The barymetric characterization revealed clear barymetric diversity between the breeds studied and between males and females, with very highly significant differences ($p<0.001$) for the most of body measurements used. A principal component analysis (CPA) was performed on the barymetric characteristics, revealed two main principal components accounting for 55.63% and 18.02% of the inertia, being related to WH, HG, CD, TW and SIL. The results of the CPA allowed establishing 3 classes, which only one class presents the majority of the population.

Key words: Characterization; Body measurements; Sheep; Local breed, West Algerian, Algeria.

Introduction

In Algeria, the sheep population was estimated at around 26 million head in 2015 according to the statistics of the Ministry of Agriculture and Fisheries (MADRP, 2016), despite the variability richness of sheep genetics resources is not exploited, we have identified the presence of 12 Algerian sheep breeds as : Ouled Djellal, Rembi , Hamra ,Berbere ,Barbarine , D'man , Sidaou ,Taadmit ,Tazegzawet ,Ifilene ,Srandi and Daraa that are well-adapted to adapted to local conditions; , some are unknown (Ifilene and Tazegzawt), others are in danger (D'Man), or are endangered (Berber, Barbarine, Taadmit and Rembi). Unfortunately, uncotrolled crossings led to dispersion, an erosion of the capital genetics, the increase in inbreeding in herds and declining livestock yields. The risk in future is the absorption of some breeds by others (Ouled Djellal, Hamra and Sidaou), then the loss of some characters that improve the specificity of our breeds (Djaout, 2018).

It is quite obvious that any program for the selection or improvement of the performance of a population or an animal race must pass through a prior knowledge of the "phenotypic or morphological characterization" of these breeds.

Any program of selection or improvement of the performances of a population or of breed should necessarily passes by a previous knowledge of the "phenotypic or morphological characterizations" of these breeds.

Indeed, the documentation of the diversity of sheep breeds in Algeria is minimal or even absent, so several breeds require a phenotypic and zootechnical description to know their performances.

Without published works on the phenotypic description of Algerian sheep breeds Sagne (1950), Trouette (1929) et (Chellig, 1992) very few studies have been carried out for the phenotypic characterization of Algerian breeds using body measurements in the Ouled Djellal breed (Djaout et al., 2012 ; Harkat et al., 2015), in Rembi breed (Djaout et al., 2015 ; Laoun et al., 2015), in Tazegzawt breed (El-Bouyahiaoui et al., 2015), in D'man breed (Boubakeur et al., 2015) and in five breeds : Ouled-Djellal, Rembi, Barbarine, Berbère and Hamra (Afri-Bouzebda et al., 2018). For this, we contributed to the barymetric characterization of six sheep breeds in western Algeria. A total of 166 sheep was the subject of this study. Our study consists of studying - for the first time - the barymetric characters of the Hamra, Barbarine, Daraa and Srandi breeds in Algeria.

Materials and methods

Presentation of study area

The current study was carried out following a field survey, to study the barymetric characterization of six sheep breeds (Ouled Djellal, Hamra, Barbarine, Srandi, Daraa and Tazegzawt) in three provinces with different biotopes (Tlemcen, Oran et Saida). This morphological study is conducted on private and institutional farms (ITELV).

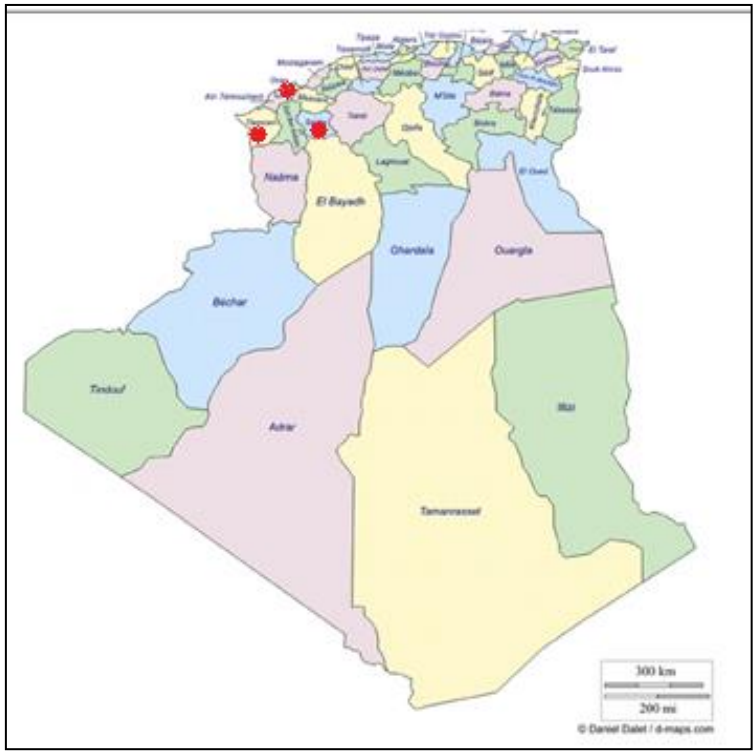

Figure 1. The national map shows the study areas.

Climate

Table 1. Climat de chaque zone d'étude (**Climate-Data.org**)

Province	Climate	Altitude
Tlemcen	The climate in Tlemcen is warm and temperate. The winter months are wetter than the summer months in Tlemcen. According to Köppen and Geiger, this climate is classified as Csa. In Tlemcen, the average annual temperature is 16.0 ° C. The average annual rainfall is 484 mm.	812 m
Oran	The climate is warm and temperate. In winter, there is much more rainfall than in summer. The Köppen-Geiger climate classification is Csa. The average annual temperature is 18.1 ° C. The average annual rainfall is 376 mm	81 m
Saida	A climate of steppe. During the year, there is little rain. The Köppen-Geiger climate classification is BSk. The average temperature is 16.1 ° C. The average annual rainfall is 341 mm	839 m

Animals studied

The study focused on the phenotypic description of 166 sheep (54 males and 112 females) aged more than one year belonging to six Algerian sheep breeds (Ouled Djellal, Hamra, Srandi, Daraa, Barbarine and Tazegzawt), using the body measurements, during the period 2016/2017 in three provinces different (Tlemcen, Oran et Saida).

The numbers of animals by order of breeds, sex and regions are shown in the table 2

Table 2. Distribution of the sheep population studied by region and sex

Breed	Region		Effectif	Sex		Total
	study areas	Province		Males	Females	
Ouled Djellal	Al-Gor	Tlemcen	7	2	5	**60**
	Maghnia		41	15	26	
	Souani		10	2	8	
	Boufatis	Oran	2	2	0	
Babarine	Ain El hadjar	Saida	20	8	12	**20**
Hamra	Ain El hadjar	Saida	20	8	12	**21**
	Maghnia	Tlemcen	1	0	1	
Srandi	Maghnia	Tlemcen	11	2	9	**33**
	Souani		2	0	2	
	Al Gor		9	0	9	
	Boufatis	Oran	3	0	3	
	Hassi Bounif		6	0	6	
	Es-sénia		2	2	0	
Tazegzawt	Souani	Tlemcen	2	0	2	**10**
	Maghnia		4	1	3	
	Es-sénia	Oran	4	1	3	
Daraa	Maghnia	Tlemcen	12	8	4	**22**
	Souani		1	1	0	
	Al gor		2	0	2	
	Boufatis	Oran	3	0	3	
	Hassi Bounif		2	0	2	
	Es-sénia		2	2	0	
Total				**54**	**112**	**166**

Table 3. Summary of the distribution by breed and sex.

Race	Females	Males	**Total**	**% males**
Ouled Djellal	39	21	60	53,8%
Barbarine	12	8	20	66,6%
Hamra	13	8	21	61,5%
Srandi	29	4	33	13,7%
Tazegzewt	8	2	10	25%
Daraa	11	11	22	100%
Total	**112**	**54**	**166**	**48,2%**

Variables studied

The different body measurements were measured by the same operator in the morning, 13 measurements were used for each animal: Withers height (WH), body lenght or scapular-ischial length (SIL), heart girth (HG), chest depth (CD), shoulder width (SW), rump width (RW), trochanter width (TW), pelvis length (PL), head length (HL), head width (HW), ear length (EL), ear width (EW) and cannon perimeter (CP) (Table 4).

Table 4. Definition of the Body measurements calculated for each animal.

Measurements	**Definition**
Withers height (WH)	Distance from the highest point of the processus spinalis of the vertebra thoracica to the ground
Scapular-ischial length or body length (SIL)	Distance between the tip of the shoulder and the tip of the ischium
Heart girth (HG)	Measured as body circumference just behind the forelegs
Chest depth (CD)	Vertical distance from the top of the withers to the xyfoid process of the sternum,
Shoulder width(SW)	Measurement taken between the two heads of humerii
Rump width (RW)	Maximum distance between the outer edges of the major hip bones on the right and left side
Pelvis length(PL)	Distance from point of hiptothe tip of the ischiumorileo-ischial distance
Trochanter width (TW)	Distance between the two trochanters (hip joint)
Head length (HL)	Distance between the top of the forehead and the mouth
Head width (HW)	Maximum distance between the two zygomatic bones
Ear length (EL)	Distance from the base to the tip of the right ear throughout the dorsal surface
Ear width (EW)	Distance between the two side edges of the right ear in the middle
Cannon perimeter (CP)	Perimeter of the right foreleg, between the knee and the pastern.

The body measurements were taken through the sheep measuring scale and a two-dimensional measurement of the size of the body.

Statistical Analysis

Barymetric data were processed using descriptive statistics ie the values for quantitative variables (continuous type).

The effect of breed was compared by the one-way ANOVA test followed by the Student Newman-Keuls multiple comparison test. All these data were analyzed using the statistical analysis software SPSS (version 19).

A Principal Component Analysis (PCA) was conducted to group homogeneous individuals with the same traits studied based on body measurements to differentiate sheep according to these criteria, define a classification of animals, and construct a typology which consists of identifying individuals who are fairly similar to one another in order to present common barymetric characteristics. Finally, to obtain the optimal number of groups, an ascending hierarchical classification (CHA) was used. These tests were processed by the SPSS software (version 19).

Results

Descriptive statistical analysis

The population studied has an average height (WH) of 84.71±7.15 cm ; an average body length (SIL) of 84.08 ± 7.96 cm and a chest girth (HG) of 103.53 ± 10.79 cm on average. These three measures have very high variance values, which explain phenotypic variability in the population. The other measures: ear width (EW), cannon perimeter (CP), head length (HL), head width (HW) and ear length (EL) have values of very low variance. (Table 5)

Table 5. Descriptive analysis of body measurements in the sheep breeds studied

	Moy	SD	Var	Min	Max
WH	84.71	7.15	51.09	72	104
SIL	84.08	7.96	63.33	68	105
HG	103.53	10.79	116.42	81	130
CD	30.21	4.18	17.47	20	46
SW	17.34	2.09	4.35	12.20	23
RW	21.63	2.90	8.41	13	28
PL	26.01	2.32	5.37	21	32
TW	24.40	4.07	16.58	16	37
HL	25.58	1.99	3.98	21	34
HW	15.18	1.62	2.61	10	20
EL	16.22	2.60	6.75	9.50	30
EW	8.24	0.96	0.93	6	11
CP	9.09	1.21	1.47	7	13

Withers height (WH), body lenght or scapular-ischial length (SIL), heart girth (HG), chest depth (CD), shoulder width (SW), rump width (RW), trochanter width (TW), pelvis length (PL), head length (HL), head width (HW), ear length (EL), ear width (EW) and cannon perimeter (CP)

Variation Factors

Effect of the breed

Very highly significant differences ($p < 0.001$) were observed for all body measurements, which explains a significant phenotypic diversity between the breeds studied. Except for body length (SIL) ($p > 0.05$), it does not indicate a diversity of length between breeds.

The Ouled Djellal breed has a higher format than other breeds ($p < 0.001$). Indeed, It is higher (WH: 88.23 ± 7.29 cm) with a very developed chest (CD: 32.67 ± 4.19 cm), a wide head (HW: 16.00 ± 1.74 cm) and very long and very wide ears (EL: 18.17 ± 2.32 cm; EW: 8.96 ± 0.90 cm). The cannon perimeter (CP: 9.77 ± 1.26 cm) is very developed.

Animals of the Barbarine breed have a smaller size compared to other breeds ($p < 0.001$), they are lower (WH: 79.65 ± 4.18 cm) and less wide (SW: 15.10 ± 1, 56 cm and RW: 20.20 ± 1.99 cm) with a short head (HL: 24.30 ± 1.53 cm) and a less developed chest depth (CD: 26.03 ± 2.93 cm). Dominant traits ($p < 0.001$) in the Hamra breed are chest depth (CD), length and width of the ears (EL, EW). They have

very short ears (EL: 12.55 ± 1.51 cm) and very narrow ears (EW: 7.13 ± 0.43 cm) with a less developed chest compared to other breeds. The Srandi breed, the Daraa breed and the Tazegzawt breed have body measurements very similar to the Ouled Djellal breed (p <0.001)

Table 6. Variations of variables by breed

	OD	Bar	Ham	Sar	Dar	Taz	P
N	60	20	21	33	22	10	
WH	88.23^{a}±7.29	79.65^{c}±4.18	82.10b^{c}±5.31	81.48b^{c}±5.22	87.05^{ab}±7.56	84.7^{abc}±20	***
SIL	85.65±9.90	86.00±6.14	83.00±4.79	81.33±5.53	84.50±6.53	81.30±10.75	ns
HG	107.77^{a}±12.32	102.10^{bc}±8.99	100.76^{bc}±8.25	98.35^{c}±7.27	106.68^{ab}±10.06	96.90^{c}±8.95	***
CD	32.67^{a}±4.19	26.03^{c}±2.93	26.34^{c}±2.33	29.82^{b}±3.37	30.93^{b}±2.05	31.60^{ab}±2.67	***
SW	18.33^{a}±2.05	15.10^{c}±1.56	16.12bc±1.30	17.03b±1.63	18.59a±1.47	16.70b±1.81	***
RW	21.83^{a}±3.62	20.20^{b}±1.99	21.26ab±1.73	22.33a±2.64	22.23a±2.45	20.40ab±2.27	***
PL	27.21^{a}±2.23	25.53^{b}±1.77	24.21^{c}±2.09	25.27^{bc}±1.77	26.35^{ab}±2.34	25.20^{bc}±2.24	***
TW	25.88^{a}±4.04	21.19^{b}±3.06	21.16^{b}±2.24	24.79^{a}±4.06	24.93^{a}±3.13	26.30^{a}±4.16	***
HL	26.45a±2.00	24.30^{b}±1.53	25.05^{b}±1.75	24.61^{b}±1.68	26.50^{a}±1.57	25.30^{ab}±2.11	***
HW	16^{a}±1.74	14.30^{cd}±1.17	15.14^{bc}±1.31	14.27^{d}±1.42	15.32^{ab}±1.25	14.80^{bcd}±1.03	***
EL	18.17^{a}±2.32	15.18^{c}±1.03	12.55^{d}±1.51	15.45^{c}±1.72	16.64^{b}±1.53	15.90^{bc}±1.85	***
EW	8.96^{a}±0.90	7.86^{c}±0.60	7.13^{d}±0.43	7.80^{c}±0.61	8.36^{b}±0.64	8.20^{bc}±0.92	***
CP	9.77^{a}±1.26	8.58^{bc}±1.01	8.60^{bc}±1.00	8.40^{d}±0.78	9.23^{ab}±1.11	9.10^{abc}±1.02	***

** Significant at 0.05, *** Significant at 0.001, ns : no Significant; Number of animals studied (N), Withers height (WH), body lenght or scapular-ischial length (SIL), heart girth (HG), chest depth (CD), shoulder width (SW), rump width (RW), trochanter width (TW), pelvis length (PL), head length (HL), head width (HW), ear length (EL), ear width (EW) and cannon perimeter (CP)*

Effect of the region

Table 7. presents the body measurements studied in both sexes (males and females) of the sheep breeds studied (Ouled Djellal, Barbarine, Hamra, Srandi, Daraa and Tazegzawt).

A very highly significant difference (p <0.001) of biometric measurements was observed between the two sexes for the characters WH, SIL, HG, HP, CD, RW, PL, HL, EL, CP. This shows a phenotypic heterogeneity between the two sexes with a preference for males. However, the sex of the animals does not have a discriminating effect (P> 0.05) on trochanter width (TW), ear length (EL) and ear width (EW).

Thus, this result shows that the males are more rangy (SIL: 90.17 ± 6.36 cm), higher (WH: 90.89 ± 6.83 cm) and wider in front (SW: 18.37 ± 2.07 cm) with a very developed chest (HG: 112.48 ± 8.50 cm, CD: 31.93 ± 4.67 cm) and a long and wide head (HL: 26.81 ± 2.00 cm, HW: 16.19 ± 1.51 cm).

Diversity of individuals according to body measurements

Analysis of variables

A principal component analysis (PCA) was carried out, on all the variables at the beginning, and revealed 58.21% of the total inertia on both axes. It is relatively very low. In order to obtain more significant representation, 05 variables with very high variances were used (SIL, HG, CD, SW and TW). The cumulative share of information returned in this case is 73.65%. The analysis of the studied parameters showed that the two axes respectively presented 55.63% and 18.02% of the total inertia.

Table 7. Variations of variables by sex.

	Male	Female	P
N	54	112	
WH	90.89±6.83	81.73±5.11	***
SIL	90.17±6.36	81.15±6.94	***
HG	112.48±8.50	99.21±8.99	***
CD	31.93±4.67	29.38±3.66	***
SW	18.37±2.07	16.84±1.91	***
RW	20.49±3.23	22.18±2.57	***
PL	26.57±2.73	25.73±2.05	*
TW	25.26±4.77	23.99±3.64	ns
HL	26.81±2.00	24.99±1.71	***
HW	16.19±1.51	14.70±1.44	***
EL	16.26±3.29	16.20±2.21	ns
EW	8.44±1.06	8.14±0.91	ns
CP	10.23±0.89	8.54±0.94	***

** Significant at 0.05, *** Significant at 0.001, ns : no Significant; Number of animals studied (N); Withers height (WH), body lenght or scapular-ischial length (SIL), heart girth (HG), chest depth (CD), shoulder width (SW), rump width (RW), trochanter width (TW), pelvis length (PL), head length (HL), head width (HW), ear length (EL), ear width (EW) and cannon perimeter (CP)*

Axis 1 (55.63%): is represented by the following variables: WH, HG, CD, SW, TW and SIL. Axis 2 (18.02%): is represented by the following variables: SIL and TW (Table 8).

Tableau 8. Présentation des variables par ACP chez la population ovine étudiée

	Component	
	1	2
WH	0.87	-0.25
HG	0.81	-0.23
SIL	0.58	-0.51
TW	0.64	0.60
CD	0.79	0.41

Withers height (WH), heart girth (HG), body length or scapular-ischial length (SIL), trochanter width (TW), chest depth (CD)

Analysis of Individuals

A hierarchical ascending classification (CAH) resulting from the PCA allowed the determination of three classes (Figure 2 and 3).

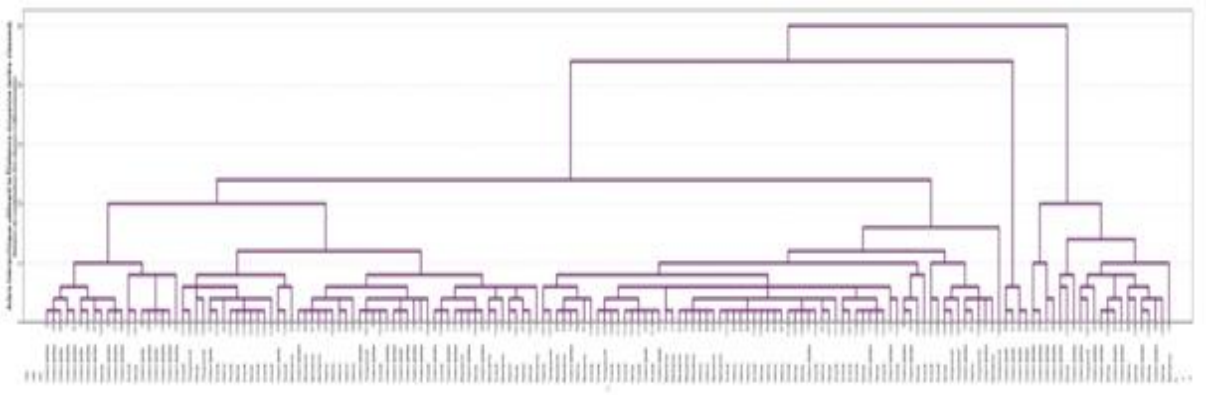

Figure 2. Hierarchical tree using the average distance (between classes) in the population studied according to the barymetric characters.

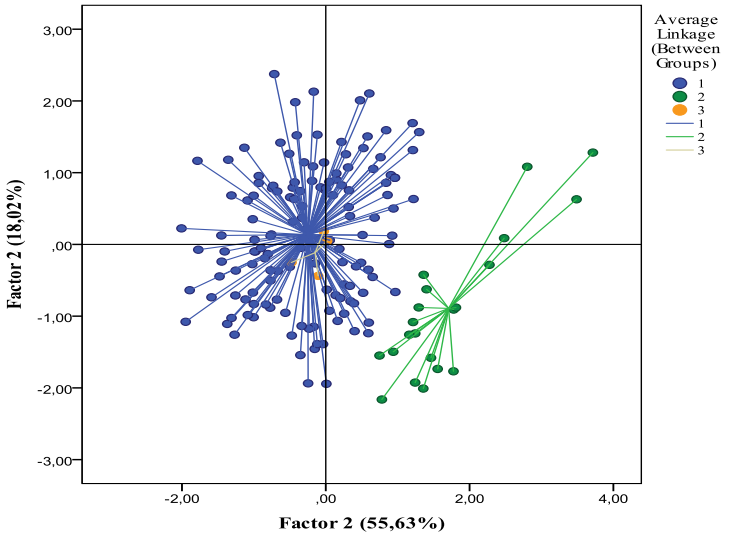

Figure 3. Presentation of individuals by PCA.

Figure 4 presents the importance of the different characters studied whose the classification was carried out according to the significant difference of the individuals according to withers height (WH: 100%) and the heart girth (HG: 62%). Other characters such as SIL, CD and TW are important criteria with percentages of 40%, 39% and 23% respectively.

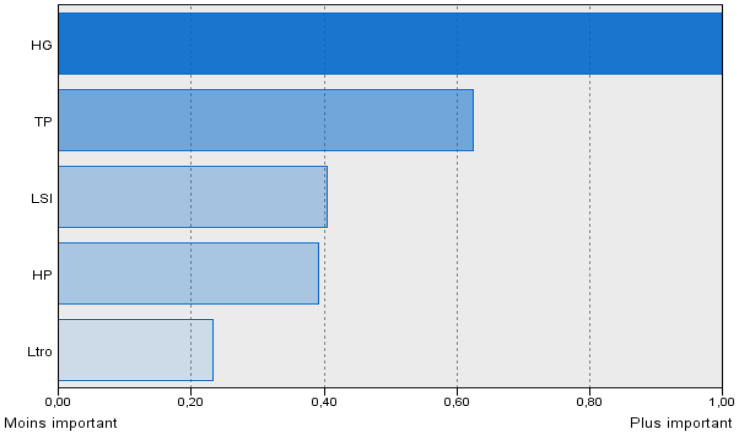

Figure 4. Importance of body measurements in the population studied.

Class 1: The animals in this class (141 individuals) constitute the majority of the population studied, they have measurements very close to the average of the total population.

Class 2: The animals of this class (21 individuals) are the highest (WH: 97.38 ± 4.46cm) with a very high thoracic development compared to the other classes (HG: 119.81 ± 5.92cm and CD: 34.02 ± 5.6cm).

Class 3: 4 individuals of Ouled Djellal breed have constituted this class. They are most rangy (LSI: 100.25 ± 3.4 cm) with less developed chest depth (HG: 82.5 ± 1.29cm)

Tableau 9. Body measurements of animals by class found

	Class 1	Class 2	Class 3
N	141	21	4
WH	82.91±5.42	97.38±4.46	81.5±4.2
HG	101.7±8.74	119.81±5.92	82.5±1.29
SIL	81.87±6.19	95.9±4.33	100.25±3.4
TW	23.94±3.83	26.98±4.82	27.25±2.06
CD	29.65±3.69	34.02±5.6	29.75±0.96

Withers height (WH), heart girth (HG), body length or scapular-ischial length (SIL), trochanter width (TW), chest depth (CD)

Discussion

Gaouar et al. (2015) presented the existence of a great phenotypic diversity between the breeds Ouled Djellal, Hamra, Rembi, Berber and Barbarine. This diversity is important with a significant superiority ($p < 0.001$) of the Ouled Djellal breed.

Our results show that Ouled Djellal breed is larger compared to other Algerian sheep breeds ($p<0.001$), it is the best meat breed in Algeria (Harkat et al., 2015). In fact, this breed is the highest, the largest of sheep breeds studied with more developed frame. These results are according to Harkat et al. (2015).

The Hamra breed studied was similar to the Moroccan Beni-Iguil breed (Boukhliq, 2002) and has the same origin (Chellig, 1992). It has a medium size characterized by very short and very narrows ears. Given the absence of data on the phenotypic and morphological characterization of this breed, apart from the documents of Chellig (1992) and other authors Trouette M (1929); Jores D'Arces , (1947) ; Magneville, (1959), it is to be noted that our results cannot be discussed.

Comparing the Barbarine breed with the Tunisian breed (Khaldi et al., 2011) and other fat-tailed breeds in West Africa (Parés-Casanova PM et al., 2010; Paracute and Casanova , 2013) Barbarine studied has superior body measurements with a medium size. But this breed has semi-fat tail.

In our study, three new breeds were studied: Daraa, Tazegzawt and Srandi breeds. Data on these three breeds are minimal or absent except for the Tazegzawt, a recent study of this breed has shown the phenotypic characteristics. (El-Bouyahiaoui et al., 2015). The Tazegzawt (Blue) is called Tazegzawt in Kabyle and Ham in the region of Mechria (Nâama) (Djaout et al., 2017).

Comparing our results with those reported by El-Bouyahiaoui et al. (2015), the Tazegzawt studied in western Algeria is higher and less rangy then Tazegzawt breed studied in eastern Algeria with short ears and narrow cannon perimeter (El-Bouyahiaoui R et al., 2015).

The Srandi breed with its homologue Sardi of Morocco, exists in Algeria, with a small flocks especially in the regions of the Algerian-Moroccan borders (zone of study), its origin is not really defined (Djaout A et al., 2017). This breed has body measurements close to the Ouled Djellal.

The Daraa breed, which exists in all Algerian territory but at low numbers, is found in herds mixed with other breeds, its origin is unknown. It is characterized by a head and members entirely black (hence its name Darâa: Black) with a brown wool (Djaout et al., 2017). Animals studied have a format very close to Ouled Djellal.

Indeed, several local breeds are at risk of extinction (Iniguez, 2005) following the genetic dilution caused by crossing with the Ouled Djellal breed or by the dominance of this breed (Gaouar et al., 2016). Crossing between the Ouled Djellal breed and the other Algerian sheep breeds have been carried out to improve the performances of these breeds (Madani et al., 2003).

Conclusion

The study of body measurements determined the phenotypic variability of the six sheep breeds studied (Ouled Djellal, Hamra, Barbarine, Srandi, Daraa and Tazegzawt). A clear superiority of the Ouled Djellal breed for all the characters studied (height, width, thoracic perimeter, measurements of the head, ears, pelvis and bone) compared to other breeds. Breeders prefer the breeding of this breed following its performances; which leads to the marginalization of other breeds in the time, which implies a reduction in herd size. It should also be noted that the circulation of herds on the national territory has greatly evolved. These resources are hardly exploited appropriately species with all breeds, varieties and populations that characterize them are endangered.

The reasons for the disappearance of the phenotypic standards can be caused by the absence of the intervention and the monitoring of the state consequently the farms have become disorganized, the reproductions not mastered and the crossings uncontrolled that lead to the reduction of genetic variability are anarchic in all the Algerian territory.

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