

RESEARCH ARTICLE

PHENOTYPIC CHARACTERIZATION OF SENEGALESE PEUL-PEUL SHEEP.

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Manuscript Info

Manuscript History Received: 14 December 2018 Final Accepted: 16 January 2019 Published: February 2019

Key words:-

Peul-peul sheep, phenotypic characterization, semi–arid zone, Senegal.

Abstract

..... Peul-peul sheep population is numerically the most important among sheep raised in Senegal. It is well adapted to the extensive farming system in the arid zone and plays an important socio-economic role in rural and urban livelihood. Despite to this importance, few studies have been done on this breed. In order to contribute to better knowledge of this breed, the objective of this study was carried out phenotypical characterization of Peul-peul sheep. In four eco-geographical zones of Ferlo, nine (9) phenotypic traits were measured on one hundred and ninety-seven (197) unrelated sheep aged at least 3 years old. All results were expressed as an average with the corresponding standard error. Student t and Kruskal-Wallis tests were used to analyze differences between sex and zone sources of variation respectively for parametric and non-parametric variables. The main results show that Peul-peul sheep has 70.2 ± 3.8 cm for height at withers, 63.6 ± 3.9 and 80.6 ± 5.3 cm respectively for body length and chest girth. Sexual dimorphism is marked between males and females with significant differences. Considering, eco-geographical zones, potential ecotypes reported could be due to difference in animal husbandry practices and / or introgression of genes from other sheep breeds.

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Introduction:-

Small ruminants, like other short-cycle livestock providing food for humans, have an important place in rural and urban households' economy in Senegal. For populations, they are sources of proteins, incomes, cash, prestige and they represent savings especially in the current context of climate change. Sheep are very popular in family consumption, fast food in specialized grillrooms called "dibiteries", religious and customary celebrations. Several sheep breeds are raised in Senegal, including the local breeds: Ladoum, Touabire, Waralé, Djallonké and Peul-peul (Lô 1989; Fadiga 1990). Farmers appreciate more Peul-peul sheep because of its adaptation to mobility and drought in semi-arid zone conditions aggravated by rainfall decrease. In fact, originated from Ferlo, Peul-peul sheep is widely reared in Ferlo in the extensive system characterized by a high mobility of animals (Gueye, 1997; Magrin et al., 2011; Missohou et al., 2016).

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Address:-Laboratoire National de l'Elevage et de Recherches Vétérinaires (LNERV), BP 2057 Route du Front de Terre Dakar-Hann, Sénégal. Moreover, in this semi–arid area rainfall varies with succession of dry years and wet years (Ndiaye et al., 2013; ANACIM data base). Like other sahelian countries several rainfall deficits at the origin of the major drought crises (1968-1974, 1983-1984,2002-2003, 2005, 2009) which heavily affected human and animal populations (Garba et al., 2012). The decrease of the rain was observed in this actual climate change context. Therefore, Peul-peul sheep is the most important ovine population in terms of numbers of heads (CEP/MEPA, 2017). A few studies have been done on Peul-peul sheep, its morphology and farmer husbandry practices have been described by Ndiaye et al. (2018). In spite of the low productivity attributed to this local breed (Clément et al., 1997), Peul-peul sheep greatly contributes to the supply of large cities in ovine meat and living sheep because of its affordable selling price (Ninot, 2010). In the context of climate change and genetic mixing, the objective of our study was to phenotypically characterize Senegalese Peul-peul sheep in order to contribute to a better knowledge of this highly exploited local sheep breed.

Material And Methods:-

Study sites

The study was carried out from March to August 2016 in a part of Ferlo area precisely in the administrative departments of Linguère (Louga region) and Ranérou (Matam region). Geographically, Ferlo is situated between latitudes 15 ° and 16 ° 30 North and longitudes 13° 30 and 16° West. A year period can be divided into a dry season (from October to June) and a rainy season (from July to September). The study area was subdivided into 4 eco-geographical zones based on soil type (Diop 1989, Ndiaye et al., 2013), rainfall, feed availability and floristic diversity (Ndiaye et al., 2013; Ndong et al., 2015; ACF, 2016). These four zones are :(i) in the North-east, Ferlo Ferrugineux, bordering Touabire sheep raising area, this zone is composed of four "communes" (Ranérou, Oudalaye, Younouféré and Lougré Thioly); (ii) in the North-west, the Ferlo sableux where are located the communes of Dodji, Yang Yang, Kamb, Mboula, Tessékéré and Mbeuleukhé; (iii) in the South, the Ferlo Sud, located in border of Bassin arachidier (agricultural zone), is represented by the communes of Thiel, Doli and Barkédji and; iv) the South-West: the Dahra zone with the famous Dahra livestock market, includes the communes of Dahra, Sagatta Djoloff, Déaly, Boulal and Thiamène Pass.

Sampling methods

In the study area, based on their presence of Peul-peul breed, accessibility of the farm and receptivity of the animal owners, forty (40) georeferenced rural farms were selected with the guidance of the local technical agents of veterinary public services (Figure 1). In these farms, data collection was carried out at the level of forty (40) sheep flocks distant from at least 10 km in order to reduce the risk of relationships between animals. The number of animals to be enrolled in the study depended on the size of the sheep flock. In large herds (\geq than 200 heads), maximum of ten (10) unrelated animals were selected for the study. For medium (100-200 heads) and small flock (< 100 heads), respectively three (3) and five (5) animals were considered. In each flock, one animal was chosen by lineage. A total of one hundred eighty-four (184) ewes and thirteen (13) rams at least three (3) years old were enrolled in this study. The age of animals was estimated from their dental table.

Collection of data and parameters studied

As recommended by FAO's Animal Genetic Resource Characterization Guide (2012), nine (9) quantitative traits : height at withers (hg), chest depth (Pth), chest girth (pt), body length (Lcp), ear length (Lo), horn length (Lco), distance between horns from base to base (dbb), the middle facial height (Lt) and tail length (Lq) have been considered. On animals enrolled for this study, hg and Pth were measured using a sliding metallic ruler. A standard measuring tape was used for other body measurements such as pt, Lcp, Lo, Lco, dbb, Lt and Lq. All of these measurements were taken on immobilized animal. All measurements taken in centimeters were taken in the morning before animals were fed.

Statistical Analysis:-

Collected data were entered on the Excel spreadsheet and the normality of variables was tested with Shapiro-Wilk normality test. The analysis of variance (ANOVA) test was used to detect significant differences between sex and zone sources of variation and Kruskal-Wallis non-parametric test was used for variables which unfollow normal distribution. All variables were expressed as an average with the corresponding standard error. According to results of the normality test, means comparison was performed with Student's t-test or Wilcoxon test. The threshold of significance was set at 5% for all comparison tests. All analyzes were performed using R software Version 3.3.1 (R-Core Team, 2016).

Results:-

The normality test revealed that only Lt, Lq and pt variables followed the normal distribution-

Body measurements of Senegalese Peul-peul sheep

Peul-peul sheep has a small format with averages measurements at adult age with 70.2 \pm 3.8 cm for hg, 63.6 \pm 3.9 cm and 80.6 \pm 5.3 cm respectively for Lcp and pt (Figure 2). The rams have an average hg of 74.3 \pm 1.2 cm and 69.9 \pm 0.3 cm for ewe with highly significant differences between males and females (p<0.001). Lq measures 39.6 \pm 4.5 cm. This variable has been measured only on twenty-eight (28) ewes because the tail of the majority of females was cut by their owners.

The results of analysis of variance revealed that all body measurements excepted Lq showed highly significant differences (p<0.001) depending on study's zone and sex of the animal (Tables 1 and 2).

Measurements of middle facial height, ears and horns

The ears of the Peul-peul sheep are short; an average of 13.3 ± 1.2 cm is reported. His Lt measures in average of 17.5 ± 0.3 cm and 16.2 ± 0.1 cm respectively for ram and ewe. Horns are more developed for ram (40.7 ± 3.2 cm) than for ewe (10.5 ± 0.2 cm). For dbb, an average of 8.1 ± 0.9 cm has been reported. The results of variance analysis revealed that measurements of Lt, Lo and Lco variations depended on study's zone and sex (Tables 3 and 4). Indeed, Lo and dbb showed significant differences (p<0.01) according to the study's zone and Lt and Lco vary with sex with highly significant differences (p<0.001).

Influence of study's zone on morphometric measurements of Peul-peul sheep

Lo, dbb and all body variable measurements except Lq vary significantly between the four study's zones (Table 5). Indeed, considering Lcp, Pth and pt, it appears that the Peul-peul sheep of the Ferlo Sud have better format than those found in others zones. However, these animals have some similarities with those of Ferlo ferrugineux if hg and Pth variables have been considered. A close resemblance has been observed between Ferlo ferrugineux and Dahra animals if all studied variables excepted hg are taken into account. Peul-peul sheep from Ferlo sableux have the smallest format.

Discussion:-

General characteristics

Peul-peul sheep is a small-shaped animal (70.2 \pm 3.8 cm), not very corpulent (63.6 \pm 3.9 cm for body length and 80.6 \pm 5.3 cm for chest girth) with short ears (13.3 \pm 1.2 cm) and fairly developed horns (14.1 \pm 11.1 cm for ram). These results corroborate those of Gueye's (1997) study done on 364 Peul-peul sheep in the Ferlo. The constant presence of this breed in the herds testifies to the willingness of farmers to preserve the local breed Peul-peul for its rusticity and its adaptation to semi-arid area as underlined by Ndiaye et al. (2018). The previous study of Dumas (1980) and Sangaré (2005) carried out on several Sahelian sheep breeds have reported an average hg varying from 65 to 90 cm. The measurements of the sheep Peul-peul found in this study are in the range. Compared with other local sheep breeds raised in Senegal, body measurements of Peul-peul sheep are intermediate between those of Touabire and Djallonke sheep which is a trypanotolerant ovine breed living in the humid zone in Southern part of the country. In fact, Gueye (1997) reported average hg of 75.78 \pm 3.93 and 58.87 \pm 3.9 cm respectively for Touabire and Djallonke sheep. Dayo et al. (2015) reported a mean hg of 71.65 \pm 5.79 cm for Vogan sheep (crossbred Djallonke sheep x Sahelian sheep) and 75.43 \pm 5.43 cm for Sahelian sheep. Also, study in Sudanese Shugor sheep (Musa et al. 2012) revealed for rams of eight (8) months old, an hg and an Lcp respectively 69.46 \pm 0.52 and 60.06 \pm 0.55 cm.

The predominance of Peul-peul ewe into the herds in Ferlo zone was highlighted by Faugère et al. (1990) and Ndiaye et al. (2018). At the flock level, males are the first animals sold. Also, farmers in their practices cut the tail of females at a young age (Ndiaye et al., 2018). Although the small number of rams in this study, hg, Lcp, Lco, Pth, pt and Lt measurements highlighted sexual dimorphism in Peul-peul sheep. These results corroborate those of Gueye (1997) who pointed out that Touabire and Peul-peul sheep showed a marked sexual dimorphism for body measurements, unlike the Djallonke sheep.

Differences between eco-geographical zones

Considering Pth, pt, and Lcp, the format differences of Peul-peul sheep observed into four study's zones (ecotypes) may be due to differences in husbandry practices more specifically in animal nutrition and genetic improvement. In fact, Peul-peul sheep reared in Ferlo ferrugineux (close to Touabire sheep rearing area) and Ferlo Sud (bordering the Bassin arachidier) has an average hg upper compared to sheep raised in Ferlo sableux and Dahra area. In the southern part of the study site, particularly in the Ferlo Sud, Peul-peul sheep has a better format with higher body measurements such as Pth, pt and Lcp. These performances observed in this zone could be due to animal improvement by using crop residues for animal nutrition in addition to natural pastures as reported by previous studies of Clément et al. (1997). Also, it is important to underline that Ferlo Sud constitutes a meeting area of transhumance where many different sheep breeds flocks are rearing a part of a year. Considering this fact, the format of Ferlo Sud animals could be due to breeding between different ovine breeds. About links existing between morphology and biometric measurements of Peul-peul sheep, Ndiaye et al. (2018) reported a predominance of white coat with black patches for sheep reared in Ferlo ferrugineux and Ferlo Sud areas. As a reminder, for Sahelian Senegalese breeds a white coat is characteristic for Touabire and the bicolor one for Peul-peul sheep. A white coat with black patches is described for Warale, crossbred between Peul-peul and Touabire. Thus, our results showing an average hg of Ferlo ferrugineux and Ferlo Sud sheep higher than those of Ferlo sableux and Dahra zone sheep enhance the hypothesis of genetic admixture between sheep breeds. This correlation between hg and coat color would reinforce the existence of Peul-peul ecotypes that can be confirmed by molecular characterization.

Conclusion:-

Peul-peul sheep is an animal with a small format compared to other local Sahelian breeds reared in Senegal such as Touabire and Waralé. Despite this, Peul-peul sheep is prized by farmers because of its hardiness and adaptation to walk and drought.

Its breeding continues to be developed with adaptive practices of farmers to face harsh semi-arid zone farming conditions emphasized with contextual climate change. Studies of Peul-peul performances in its environment may complete the results of this phenotypical characterization and will permit to propose strategies for increase economical value of the breed production. Also, potential ecotypes of Peul-peul sheep described by this study should be confirmed by molecular characterization.

Acknowledgements:-

The authors would like to thank UEMOA (Union Economique et Monétaire Ouest-Africaine) and CORAF/WECARD (Conseil Ouest et Centre Africain pour la recherche et le développement agricoles / West and Central Africa Council for Agricultural Research and Development) for their financial support provided for the PROGEVAL project. Their acknowledgments are addressed to Dr Guiguigbaza-Kossigan Dayo and Moussa Camara. Thanks to Technical agents of veterinary public services of Linguère and Matam departments for their assistance and farmers for their cooperation during the study.

	Ram (n=13)	Ewe (n= 184)	SIG
	Mean±SE	Mean±SE	P-value
Tail length ^a (Lq)	$41,0 \pm 0,8$	39,0 ± 0,3	NS
Height at wither (hg)	74,3 ± 1,2	$69,9 \pm 0,3$	<0,01**
Chest depth (Pth)	$32,5 \pm 0,8$	$30,3 \pm 0,2$	0,01**
Chest girth (pt)	85,9 ± 1,8	80,3 ± 0,4	<0,01**
Body length (Lcp)	$67,5 \pm 1,4$	63,3 ± 0,3	0,01**

Table 1:-Average values (cm) of quantitative morphometrical traits of Peul-peul sheep

SIG = Signification level, NS = Not Significant, * p<0.05, ** p<0.01, *** p<0.001, SE = Standard Error, a: for this measurement, the number of females is twenty eight (28).

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Source of variation	Df	Average squares and significance				
		Variables				
		Hg	Pth	pt	Lcp	Lq
Zones	3	34,017***	30,529***	311,26***	16,828***	10,271 ^{NS}
Sexe	1	12,1***	9,0648**	404,03***	8,5632***	25,878 ^{NS}

Table 2:-Factors of variation of body measurements in Peul-peul sheep

hg = height at wither, Pth = chest depth, pt = chest girth, Lq = tail length, Lcp = body length, df=degree of freedom, NS = not significant, ** p<0.01, *** p<0.001.

Table 3:-Average values (cm) of	quantitative mor	phometrical traits of Peul-	-peul sheep according to sex
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	Ram (n=13)	Ewe (n= 184)	SIG
	Mean \pm SE	Mean \pm SE	P-value
Middle facial height (Lt)	$17,5 \pm 0,3$	$16,2 \pm 0,1$	<0,01**
Ear length (Lo)	$13,3 \pm 0,4$	$13,2 \pm 0,1$	NS
Horn length (Lco)	40,7 ± 3,2	$10,5 \pm 0,2$	<0,001***
Distance between horns (dbb)	$8,6 \pm 0,4$	$8,07\pm0,1$	NS

SIG = signification level, SE = Standard Error.

 Table 4:-Factors of variation of head traits measurements in Peul-peul sheep

Source of variation	Df	Average squares and significance				
		Variables				
		Lt	Lo	Lco	dbb	
Areas	3	1,3351 ^{NS}	14,338**	1,5351 ^{NS}	12,534**	
Sex	1	20,5134***	0,0004151 ^{NS}	34,004***	$1,0763^{NS}$	

NS = not significant, df = degree of freedom, Lt = middle facial height, Lco = horn length, dbb = distance between horns, Lo = ear length, NS = not significant, ** p < 0.01, *** p < 0.001.

	Ferlo ferrugineux (n=41)	Ferlo sableux (n=78)	Ferlo Sud (n=27)	Dahra (n=51)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Height at wither	$72,5 \pm 0,6^{a}$	$69,3 \pm 0,4^{b}$	71.8 ± 1.0^{a}	$69,0 \pm 0,4^{b}$
Chest depth	$31,1 \pm 0,4^{a}$	$29,6 \pm 0,3^{b}$	$31,8 \pm 0,4^{a,c}$	$30,5 \pm 0,2^{a}$
Chest girth	$81,7 \pm 0,8^{a}$	$78,5 \pm 0,5^{b}$	85,0 ± 1,1 ^c	$80,8 \pm 0,7^{a}$
Body length	$62,5 \pm 0,7^{a}$	$62,8 \pm 0,4^{a}$	$65,9 \pm 0,8^{b}$	$64,3 \pm 0,5^{a,b}$
Ear length	$12,9 \pm 0,2^{a}$	$13,0 \pm 0,1^{a}$	$13,9 \pm 0,2^{b}$	$13,6 \pm 0,2^{a,b}$
Distance between horns	$7,7 \pm 0,1^{a}$	$8,1 \pm 0,1^{a,b}$	$8,6 \pm 0,3^{b}$	$8,3 \pm 0,1^{a,b}$

Table 5:-Average values (cm) of quantitative morphometrical traits of Peul-peul sheep according to study's zone

SE= Standard Error, Averages with the same letters are not statistically different



Figure 1:-Study location in study area in Ferlo

Figure2:-Peul-peul ewe with bicolor coat



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