

Original

Morphological and phaneroptic characterization of Sudan female Colombian Creole Hair Sheep "OPC"

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ABSTRACT

Objective. The objective of this research was to describe the qualitative morphology and phaneroptic of Sudán Colombian creole woolless sheep (OPC). **Materials and methods.** Six phaneroptic and seven qualitative morphological characteristics were evaluated in a total of 115 Sudán Bayo and Sudán Blanco ewes, from the departments Córdoba, Cesar and La Guajira. The data obtained were analyzed through the statistical program InfoStat[®], relative and absolute frequencies were estimated for each evaluated trait. **Results.** Sudán Bayo OPC were distinguished by being yellow coat color. Sudán Blanco were white-and-chestnut spotted coat color, but white always predominated over chestnut. These ovines usually had black-rosy mucosae and in lesser amount there were individuals with rosy mucosae. Besides, they presented horizontal ears always, sub-convex profile in more than 80% of cases, generally medium-sized and scant muscled necks, usually inclined rumps, partially pigmented and depigmented udders as well. Likewise, they were characterized by showing marbled hooves mostly, but with a high percentage of clear hooves in Sudán Blanco sheep. **Conclusions.** This research has allowed to characterize specifically. Sudán OPC sheep from morphology and phaneroptic; thus, important information has been obtained to delimit the parameters of belonging to this group and for proposing the creation of a breed standard.

Keywords: Phenotype; ewe; landraces; animal genetic resources (*Sources: National agricultural library, AGROVOC thesaurus*).

RESUMEN

Objetivo. Esta investigación tuvo como objetivo describir la morfología cualitativa y faneróptica de hembras Ovino de Pelo Criollo Colombiano (OPC) Sudán. **Materiales y métodos.** Se evaluaron seis características fanerópticas y siete morfológicas cualitativas en 115 hembras Sudán Bayo y Sudán Blanco, de los departamentos Córdoba, Cesar y La Guajira. Los datos obtenidos se analizaron a través del programa estadístico InfoStat[®] y se estimaron las frecuencias relativas y absolutas para cada uno de los caracteres evaluados. **Resultados.** Los OPC Sudán Bayo se distinguieron por ser de un color

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de capa bayo amarillo. Los Sudán Blanco fueron de capa overo castaño, pero predominando siempre el blanco sobre el castaño. Estos ovinos se caracterizaron por poseer mucosas negra-rosadas y en menor proporción habían individuos con mucosas rosadas. Además, presentaron orejas horizontales siempre, perfiles subconvexos en más del 80% de los casos, cuellos generalmente medianos y poco musculados, grupas usualmente inclinadas, ubres parcialmente pigmentadas y también despigmentadas. Asimismo, se caracterizaron por ostentar pezuñas veteadas mayoritariamente, aunque con un alto porcentaje de pezuñas claras en las Sudán Blanco. **Conclusiones.** Este trabajo ha permitido caracterizar de manera específica a las OPC Sudán desde la morfología y la faneróptica, obteniéndose así información de importancia para delimitar los parámetros de pertenencia a este grupo y para la propuesta de creación de un estándar racial.

Palabras clave: Fenotipo; oveja; razas nativas; recursos genéticos (*Fuentes: National agricultural library, AGROVOC thesaurus*).

INTRODUCTION

The arrival to the American continent of the woolless sheep goes back to the second trip made by Christopher Columbus (1), and the arrival of animals in ships dedicated to slavery is not ruled out (2), but they emphasize that by the time African slaves were transferred to the new world, the Caribbean islands already had many woolless sheep from the Canary Islands. This allowed the spread of woolless sheep breeds throughout continental America from the Caribbean bases, which suggests that there is no coincidence in the great phenotypic resemblance between the Canarian hair sheep breed in Spain, and the American creole hair or the Sudan sheep as the Pelibuey (3).

The Colombian Sudan and Etiope Creole Hair Sheep (OPC) have been the result of the events narrated in the previous paragraph, and although at a national level, there has not been a unified criterion in relation to considering them as one or two breeds, it has been suggested from the genetics by Vivas (4) and from the morpho-structural characterization by Florez et al (5), that the Sudan and Etiope sheep should be catalogued different in terms of breed.

The Sudan OPC are a valuable resource for the Colombian farmer, since although the management systems used for their breeding, in their great majority have been extensive and not technical, where it is necessary to improve especially the feeding systems to achieve a higher growth rate, they have been able to maintain the conditions of the Colombian low tropic, demonstrating adaptation and high prolificacy (4,6). This makes them an alternative to contribute to the development of communities, especially the less favored ones, who are the main knowers and owners of these sheep (7).

In recent years, Sudan has been threatened by the introduction of exotic breeds that supposedly have higher productivity, and the rusticity of creole animals is ignored (8). This threat is based on the fact that a breed can be in danger not only from the point of view of the numerical reduction of its specimens, but also by hybridization processes, which in the case of this population have been very affected (5). The picture of this situation worsens when the lack of OPC census information is taken into account.

Under these conditions, the need to preserve the genetic integrity of Sudan OPC is clear in order to take advantage of their qualities, both productive and rusticity in commercial cross-breeds. For this, it is necessary that a rigorous morphological characterization of this population be made initially, since there are no criteria of breed delimitation defined, and, it is not even clear nor has its condition as breed or subpopulation that belongs to a breed been specified yet, being all this of importance to conserve and to foment the Sudan.

In order to contribute to the definition and consensus on the breed status of Sudan OPC, this research was carried out, in which a morphological description was made, which consisted in evaluating aspects of the animal exterior, including qualitative characteristics, the appreciation of which is subjective, and phaneroptic variables, a term that makes specific reference to skin characteristics that can be seen with the naked eye and dermal productions (9).

Therefore, the objective of this work is to describe in a detailed way the qualitative and phaneroptic morphological traits of the Colombian creole hair Sudan sheep, with the purpose of providing bases that delimit the class of specimens that can belong to this breed entity, which in the future will contribute to establish a breed standard and to correctly direct animal breeding plans.

MATERIALS AND METHODS

Type of study. A descriptive, cross-sectional study was carried out in this work. The sampling used was non-probabilistic for convenience.

Location. Sudan Blanco sheep were located in the municipalities of San Juan del Cesar, La Guajira (10°49'46.0" Lat. North - 72°56'53.8" Long. West) and Valledupar, Cesar (10°25'36.6" Lat. North - 73°21'16.0" Long. West), while the Sudan Bayo were distributed in the municipalities of Valledupar, Cesar (10°07'37.3" Lat. North - 73°39'45.4" Long. West and 10°07'01.4" Lat. North - 73°33'02.2" Long. West), Montería and Ciénaga de Oro, Córdoba (8°34'15.7" Lat. North - 75°56'54.5" Long. West and 8°52'43.1" Lat. North - 75°42'12.3" Long. West). The municipalities belonging to La Guajira and Cesar are considered as Very Dry Tropical Forest and the municipalities of Córdoba are catalogued as Tropical Dry Forest (5).

Study animals. The first report in the literature describing the Sudan OPC was made by Bautista (2), who basically defined them as woolless sheep, ranging from yellow to white, "rectilinear semiconvex" profile, hornless, short and horizontal ears, brown or yellow eyes, with occasional wattles and light or pigmented hooves.

Within the Sudan subgroup are the Sudan Bayo (Figure 1) and Sudan Blanco (Figure 2), which in turn belongs to the group called Ovinos de Pelo Criollos Colombianos (OPC), a group in which there is at least another subgroup called Etiope, being these OPC in general known as Camuros, Ovejas africanas, Pelonas, Criollas, among other diverse ways according to their geographical location.



Figure 1. Sudan Bayo sheep.

Although Sudan Bayo and Sudan Blanco belong to the same subgroup and are similar to each

other, both are bred separately and as different populations, the latter being markedly scarce with respect to the first.



Figure 2. Sudan Blanco Sheep.

Animal management and characteristics analyzed. For morphological characterization of sheep, specimens were selected to match the phenotypic description of the Sudan OPC found in the literature (2). The number of specimens evaluated was 115, being 87 females Sudan Bayo and 28 females Sudan Blanco, which were over one year old. Any animal that presented anatomical anomalies, that evidenced crossbreeding, disease or that was pregnant was discarded.

The evaluation of the morphological and phaneroptic characteristics was done through visual inspection, with the support of a camera and a digital goniometer. This last instrument was used to have a greater precision in assessing the trait relative to the rump; this information was annotated in collection formats elaborated by the authors. Because of the evaluation of these characteristics was subjective in nature, there was always unification of criteria among the authors in each evaluation.

To choose the qualitative phaneroptic and morphological characteristics studied, the authors took as references the works carried out by De la Barra et al (10), Peña et al (11), De la Rosa et al (12), Bravo and Sepulveda (13), Hick (14) and Montes et al (15). The first authors took into account the color of the coat, secondly, the color of the skin, third, the direction of the ears and pigmentation of the mucous membranes, fourth, the pigmentation of the udder, characteristic of the belly and cephalic profile, fifth, the pigmentation of the hooves and sixth, the appearance of the neck, inclination of the rump and depth of the udder; the presence of wattles and the length of the neck were included upon initiative of the authors, in order to give a more detailed description of the Sudan OPC.

Phaneroptic characteristics:

Coat color (CCa). The Sudan Bayo sheep had three shades of light bay, yellow bay and waxed bay, while for Sudan Blanco two coat colors were considered, white and brown overo. All of the characteristics described below were assessed under the same criteria in both Sudan Bayo and Sudan Blanco sheep.

Skin color (CP). This characteristic was evaluated on the back and on the costal region, considering four colors ranging from pink to total pigmentation, including wax white and partial pigmentation.

Mucosa pigmentation (PMu). Pigmentation was observed taking into account the nose, lips and tongue, classified as pink, black and black-pink (Figure 3).

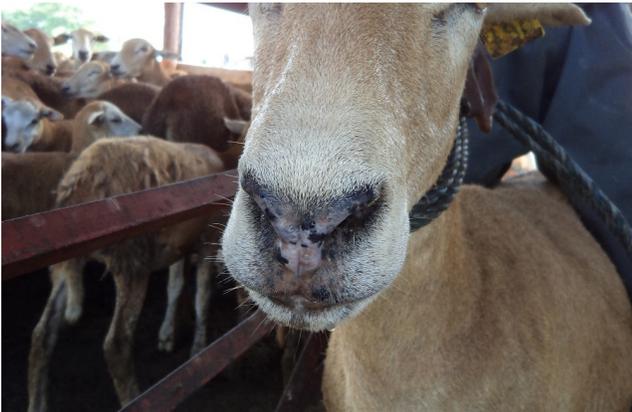


Figure 3. Black-pink nose and lips.

Presence of wattles (PM). For this characteristic it was analyzed if there was presence or absence of wattles, also called mamellas, marmellas, tendrils or earrings. Wattles are cartilaginous appendages located at the top of the tracheal edge of the neck.

Hoof Pigmentation (PP). Based on pigmentation three types were considered: marbled, light and dark, the first being a partial pigmentation.

Udder pigmentation (PU). For the evaluation of such pigmentation the criteria of non-pigmented, pigmented and partially pigmented udder were used (Figure 4).

Qualitative morphological characteristics:

Direction of the ears (DO). Whether they were horizontally directed, erect or on the contrary fallen was assessed (Figure 5).



Figure 4. Partially pigmented udder.



Figure 5. Sudan Blanco specimen with horizontal ears and straight profile.

Cephalic profile (PCe). Based on aloidism, concave, straight and convex naso-frontal profiles were considered, also considering the intermediate points between them, i.e. subconcave and subconvex (Figure 5).

Neck length (LCu). It was evaluated according to the proportion of the specimens between the length of the neck and the trunk, qualifying as long, medium or short (Figure 6).

Appearance of the neck (ACu). In order to evaluate this characteristic, its proportionality with respect to the body was considered, and it was catalogued as poorly muscled, moderately muscled or very muscled (Figure 6).



Figure 6. Side view for neck and belly assessment.

Belly conformation (C_{Ve}). According to the ventral curvature, sheep were categorized as greyhound belly, collected belly or bellyful (Figure 6).

Rump inclination (G_I). When the angle was equal to or less than 20° the rump was classified as straight, when the inclination was greater than 20° and less than 25° the classification was slightly straight, if it had a rump that oscillated between 25° and 35° it was called inclined, if the angulation was greater than 35° and less than 40° it was considered as slightly knocked down and if it went from 40° forward it was classified as knocked down rump.

Udder depth (P_{Fu}). It is the distance between the posterior insertion and the base of the udder, whose qualification is made in relation to the height of the specimen, having as reference the hock. In order to evaluate this trait, the udders were classified as very deep, moderately deep and shallow, with the first rating given with a score of nine to seven, the second with a score of six to four and the third when the rating was three to one; as the numbers decreased, the depth was smaller (16).

Results Analysis. The information collected was transcribed to Microsoft Excel® 2013 and then depurated to give way to the estimation of relative and absolute frequencies, through the statistical program InfoStat® version 2016I (17).

RESULTS

Phaneroptic characteristics. The results of the phaneroptic characteristics are presented in Table 1. The first character evaluated is the C_{Ca}, where more than 90% of Sudan Bayo sheep were yellow bay, with the remaining percentage distributed in C_{Ca} clear bay (8.05%) and waxed bay (1.15%). More than half of the Sudan Blanco were brown C_{Ca} overo (60.71%), that is, white with brown spots, but always predominantly white with respect to brown spots, spots that even generally presented small and/or only on the head or in a delimited region of the body. The remaining percentage of Sudan Blanco was characterized by a completely white coat color.

Table 1. Absolute and relative frequencies of the phaneroptic characteristics of ewes Sudan Bayo and Sudan Blanco.

Phaneroptic characteristics	Sudan Bayo		Sudan Blanco		
	FA*	FR (%)**	FA	FR (%)	
Coat color (C_{Ca})***	1	7	8.05	11	39.29
	2	79	90.8	17	60.71
	3	1	1.15	-	-
Skin color (C_P)	Rosy	1	1.15	0	0
	White wax	86	98.85	28	100
	Partially Pigmented	0	0	0	0
	Fully Pigmented	0	0	0	0
Mucose pigmentation (P_{Mu})	Pink	0	0	11	39.29
	Black-pink	87	100	17	60.71
	Black	0	0	0	0
Presence of Wattles (P_M)	Yes.	13	14.94	7	25
	No	74	85.06	21	75
Foot Pigmentation (P_P)	Clear	1	1.15	12	42.86
	Marbled	86	98.85	16	57.14
	Dark	0	0	0	0
Udder pigmentation (P_U)	Yes	2	2.3	0	0
	Partial	70	80.46	14	50
	No	15	17.24	14	50

* FA: absolute frequency; ** FR: to relative frequency in percentage.

*** Sudan Bayo: 1. light Bayo, 2. yellow Bayo, 3. waxed Bayo; Sudan Blanco: 1. white, 2. brown Overo.

In the case of the CP, all Sudan sheep were wax-white, except for one Sudan Bayo, which had a rosy CP. As for PMu, it was observed that in Sudan Bayo 100% had black-pink mucous membranes, with black predominating over pink or vice versa. On the other hand, in Sudan Blanco females 39.29% had pink mucous membranes and the rest were black-pink.

The absence of wattles was a characteristic shown by a large part of Sudan Bayo (85.06%) and Blanco (75%) sheep, while the remaining percentages of the specimens, which frame a considerable number of the population, did have wattles.

As far as PP is concerned, Sudan Bayo flaunted marbled hoofs on almost all sheep, except for one individual whose hoofs were clear, i.e. without pigmentation. In Sudan Blanco, a different behavior was presented for this characteristic, since, although the highest percentage of the

population studied presented marbled hooves, 42.86% presented clear hooves.

The last faneroptic characteristic was PU, which was characterized by partial pigmentation in 80.46% of Sudan Bayo and 50% of Sudan Blanco, with the other 50% of Sudan Blanco with depigmented udders, and 17.24% of Sudan Bayo; only two Sudan Bayo specimens had pigmented udders.

Qualitative morphological characteristics.

The results for these seven characteristics are shown in Table 2.

DO was characterized by being in 100% of Sudan OPC horizontally. In relation to PCe, more than 80% of Sudan presented a subconvex profile, with the remaining percentage framed in the straight profile category, more specifically 14.94% of Sudan Bayo and 17.86% of the Blanco.

Table 2. Absolute and relative frequencies of qualitative morphological characteristics of Sudan Bayo and Sudan Blanco females.

Qualitative morphological characteristics	Sudan Bayo		Sudan Blanco			
	FA*	FR (%)**	FA	FR (%)		
Ear direction (DO)	Horizontal	87	100	28	100	
	Upright	0	0	0	0	
	Falls	0	0	0	0	
	Concave	0	0	0	0	
Head profile (PCe)	Subconcave	0	0	0	0	
	Straight	13	14.94	5	17.86	
	Subconvex	74	85.06	23	82.14	
	Convex	0	0	0	0	
Neck length (LCu)	Long	11	12.64	8	28.57	
	Medium	73	83.91	13	46.43	
	Short	3	3.45	7	25	
Neck Appearance (ACu)	Poorly muscled	55	63.22	28	100	
	Moderately muscled	32	36.78	0	0	
	Very muscular	0	0	0	0	
	Greyhound belly	0	0	0	0	
Belly conformation (Cve)	Collected belly	22	25.29	16	57.14	
	Bellyful	65	74.71	12	42.86	
	Straight rump	0	0	0	0	
Rump inclination (IG)	Rump slightly straight	15	17.24	8	28.57	
	Inclined rump	66	75.86	20	71.43	
	Rump slightly knocked down	6	6.9	0	0	
	Crushed rump	0	0	0	0	
		1	15	17.24	10	35.71
Udder depth (PFu)	Shallow udders	2	38	43.68	5	17.86
		3	24	27.59	10	35.71
		4	6	6.9	0	0
	Medium deep udders	5	4	4.6	3	10.72
		6	0	0	0	0
	Very deep udders	7, 8, 9	0	0	0	0

* FA: absolute frequency.

** FR: relative frequency in percentage.

As for LCu of the Sudan Bayo, the highest percentage of the population (83.91%) presented a medium LCu, with the lowest number being the short LCu (3.45%) and the remaining percentage being assigned to long neck individuals (12.64%). In Sudan Blanco more than half of the females were found distributed in neck lengths catalogued as long (28.57%) and short (25%), while the remaining percentage of the sheep were framed within what was considered a medium LCu. All of the Sudan Blanco evaluated and 63.22% of the Sudan Bayo had a poorly muscled neck appearance, while the remaining percentage of the latter were considered to have moderately muscled necks.

As for Cve in Sudan Bayo 74.71% of the sheep were bellyful and the remaining had collected bellies, occurring the opposite for Sudan Blanco, where more than half (57.41%) presented collected bellies and in smaller percentage (42.59%) were bellyful. Regarding the GI, a large part of Sudan females presented a rump that was characterized by being inclined (>70%), with the remaining percentage in Sudan Blanco with a slightly straight GI (28.57%). In Sudan Bayo, the remaining percentage was distributed in minority in slightly knocked down groups (6.9%) and in slightly straight groups (17.24%).

The last character was PFu, which allowed most of the Sudan to be classified as shallow udder, more specifically 88.51% of Sudan Bayo sheep and 89.28% of Sudan Blanco; the remaining females were classified as moderately deep udder.

DISCUSSION

Phaneroptic characteristics. The Sudan Bayo independently of the yellowish tonality of the coat color, presented degradation of this one to level of the muzzle, the eyes, the ears, the groin, the interaxillary region, the belly and sometimes and less noticeably in the extremities; the intensity of the degradation varied between the individuals. These degradation characteristics had also been exposed by Bautista (2) in these OPC, who affirmed that the yellow Cca tended to degrade in the terminal portion of the specimens.

Although the literature does not mention a white Cca with small and few brown spots (brown overo) for the Sudan, but a Cca that is almost white, the authors decided to catalogue the individuals of brown overo Cca as Sudan Blanco,

because their ascendants and descendants were from a Cca like theirs or completely white, being a priority for the owners that there was no introgression of individuals of another breed in these herds. In addition, breeders in Sudan Blanco did not discriminate on whether the Cca was white or brown overo. Therefore, the authors considered that what was indicated was the inclusion in the Sudan Blanco of the brown overo Cca, which is a reflection of the fact that the phaneroptics of the Sudan OPC today is probably different from what was found four decades ago by Bautista (2), who was the first to describe the Sudan OPC and the only one who has done so far, from the phaneroptics and qualitative morphology, differentiation of them from the other "types" of OPC.

In the study done by Montes et al (15), who evaluated the OPC Cca in Sucre, 24% were yellow (bayos), 45% brown (similar to red), 12% white, 7% black and the remaining percentage corresponded to the combination of various colors. However, sheep with a Cca that falls outside the range of shades from yellow to white are not considered as Sudan OPC (2), and are sometimes found in the same herds as these, as they are often crosses of OPC with foreign breeds, except that this does not apply when OPC are of a Cca of reddish shades, as this is the main distinguishing feature of Etiope OPC (2).

In some of the Sudan Bayo and Sudan Blanco OPC studied, the presence of wool rudiments in the dorsal and lumbosacral regions was evidenced, which is considered to be a phenotypic response to the environment, especially to prolonged exposure to solar radiation, which is probably made possible by past hybridizations of OPC with woolly individuals. This is based on the fact that Vivas (4) found that there is not much genetic distance between the OPCs of Córdoba and the sheep breeds of Nariño and Boyacá.

Contrary to what was found in this study for PMu, where Sudan had black-pink or pink mucous membranes, Montes et al (15) reported that most (82%) OPCs they evaluated had black PMu. Bravo and Sepulveda (13) found in Araucanian Creole females, that 50% had black mucous membranes, 46.81% darkened and the remaining percentage was pink.

In the productive context, there are hypotheses that PM grants greater breed purity in OPC, or that this is a factor that includes or excludes the fact of belonging to this population. However,

through the results of this research, the presence or absence of wattles is normal, so that this characteristic should not be attributed any merit. In addition, there is no research in which wattles are accurately related to any reproductive aspects, therefore, it is suggested that they should be considered as a neutral characteristic in the selection.

Although no pigmented hoofs were found in Sudan Bayo and Blanco, these types of hoofs were reported in OPCs by Montes et al (15) in 28.6% of the population, while Bautista (2) states that clear hoofs is normal in Sudan, as found in this study.

The majority of Sudan sheep presented partially pigmented udders, with depigmentation usually predominating over the pigmented areas. However, Montes et al (15) did not find OPC females with this characteristic, and 96.7% of the specimens in this study had depigmented udders.

Qualitative morphological characteristics.

As in this paper, Bautista (2) found that Sudan OPC had horizontally directed ears, a result similar to that reported in OPC from Sucre (15), where 99% of the sheep had a horizontal DO. In Araucanian Creole females, 97.87% were found to have horizontal ears and 2.13% had fallen ears (13).

The PCe found in Sudan Bayo and Blanco females disagrees markedly with that of the OPCs of Sucre (15), which were catalogued as generally straight PCe, which is consistent with less than 15% in Sudan Bayo and 18% in Sudan Blanco females. These differences are possibly due to the fact that Montes et al (15) did not use the intermediate classifications of subconcave and subconvex in their evaluation, so that the latter, having a slight tendency to straightness, could be taken as straight PCe. In addition, another factor that probably influenced was the genetic component, since, although Montes et al (15) carried out their work in OPCs, only 36% of the individuals presented a CCa consistent with the classic Sudan OPC.

Regarding the LCu, what was reported by Bautista (2) is contrary to what was found in the Sudan, since this author describes the Sudan PCOs as having long necks, when in the current investigation the specimens with a LCu catalogued as long did not exceed 13% in Sudan Bayo and 29% in Sudan Blanco, since most of

the Sudan sheep were of a medium LCu. What was found in Sudan for the CVe is consistent with Bautista (2) for this characteristic, confirming that these OPC are often bellyful.

Inclined rumps, like rumps from most of the Sudan of the current work, were reported in 97.4% of Sucre OPC females (15); only 2.6% of the sheep from the previous study presented a straight GI. The inclined rumps from the previous work were possibly more frequent than those in Sudan, because the classification system used in this investigation was more specific, however, both were similar.

Finally, Montes et al (15) found shallow udders (71.1%) in OPC sheep for PFu. Shallow udders were also found in the Sudan OPC in this study. The reduced PFu was more marked in the Sudan Bayo and Blanco than in the OPC of Sucre (15).

In Araucanian Creole ewes (13) the PFu itself was not evaluated. However, the size was valued, thus cataloguing the udders of these sheep as small for 97.87% of cases, which allows inferring that the Araucanian Creole, like most of the Sudan, were shallow udders, results that were to be expected, as both breeds are oriented towards meat production.

Based on the phaneroptic and qualitative morphological variables evaluated, it is concluded that the Sudan OPC females are characterized by the following.

For being covered with short and smooth hair, whose length decreases in the head, the ventral region and along the extremities, especially towards the lower part; occasionally possess wool rudiments; they have no horns. The Sudan Bayo always have a yellowish CCa, while in the Sudan Blanco apart from finding specimens of completely white coat colors, have individuals of brown overo coat.

They tend to have a waxy white skin color, with black-pink mucous membranes in most cases. Their ears are always oriented horizontally and with no hair in the inner auricle. They have subconvex PCe, although they tend to be of straight front, being also normal, but less frequent completely straight cephalic profiles, which favor that the orbits protrude and a depression is formed behind each orbital arch; they are characterized for having amber color eyes.

Generally, they have cone-shaped necks, of medium length and little muscular appearance, although there are also some with moderately muscular necks, a considerable proportion of Sudan have wattles, the shape of the trunk is usually cylindrical. The Sudan Bayo stand out for being bellyful and the Sudan Blanco for having collected bellies, however, both characteristics are usually present in both populations. They normally present inclined rumps; they have hoofs that are mostly marbled; their udders are generally of little depth and tend to be partially pigmented.

Although a larger population sample would have been ideal, it is suggested that the results of this first stage of morphological and phaneroptic characterization of Sudan are of high importance, since they provide detailed information on the current state of the external features of this

specific group of OPC. Data that, if found for this particular population were basic and in addition, presented differences with the studies that did not discriminate on the class of OPC studied, Sudan or Etiope.

Therefore, these results have made it possible to characterize Sudan and will be useful in order to reach a consensus on the appropriate breedclassification of OPC, in order to subsequently define a breed standard for Sudan, in such a way as to establish from the discriminatory parameters that define whether or not this population belongs, to those that mark the guidelines towards which selection should be directed, from a qualitative and phaneroptic morphological perspective. This, in turn, would have a positive impact on the conservation and protection of the Sudan OPC, which have demonstrated their adaptability to the Colombian low tropics.

REFERENCES

1. Delgado JV, Perez Grovas R, Camacho ME, Fresno M, Barba C. The Wool-less Canary sheep and their relationship with the present breeds in America. *Anim Genet Resour*. 2000; 28:27-34. <https://doi.org/10.1017/S1014233900001334>
2. Bautista Otero R. Apuntes Sobre Ovino Africano en Colombia. Carta Agraria (ed.) Carta Agraria N° 277. Colombia: Caja de Crédito Agrario; 1980.
3. Aguilar Martínez CU, Berruecos Villalobos JM, Espinoza Gutiérrez B, Segura Correa JC, Valencia Méndez J, Roldán Roldán A. Origen, historia y situación actual de la oveja Pelibuey en México. *Trop Subtrop Agroecosyst* 2017; 20:429-439. <http://www.revista.coba.uady.mx/ojs/index.php/TSA/article/view/2348/1085>
4. Vivas Ascue NJ. Diversidad genética de ovinos criollos colombianos. [Tesis de Maestría]. Palmira, Colombia: Universidad Nacional de Colombia; 2013. <http://bdigital.unal.edu.co/12683/>
5. Flórez Murillo JM, Hernández Pérez M de J, Bustamante Yáñez M de J, Vergara Garay OD. Caracterización morfoestructural de tres poblaciones de Ovino de Pelo Criollo Colombiano "OPC". *Arch Zootec* 2018; 67(259):340-348. <https://doi.org/10.21071/az.v67i259.3789>
6. Simanca J, Vergara O, Bustamante M. Description of growth in sheep creole (*Ovis aries*) in two populations from Córdoba, Colombia. *Rev MVZ Córdoba* 2017; 22(3):6310-6319. <http://dx.doi.org/10.21897/rmvz.1135>
7. Acero Plazas VM. El bienestar animal en sistemas productivos de ovinos-caprinos en Colombia. *Spei Domus* 2014; 10(21):57-62. <https://doi.org/10.16925/sp.v10i21.918>
8. Parra RI, Magaña MA, Duarte JH, Téllez G. Caracterización técnica y rentabilidad de granjas ovinas con visión empresarial del departamento del Tolima. *Rev Colombiana Cienc Anim*. 2014; 7(1):64-72. <http://revistas.ut.edu.co/index.php/ciencianimal/article/view/543>

9. Sierra I. Importancia de la morfología y su valoración en los animales domésticos. En: Sañudo C dir. Valoración morfológica de los animales domésticos. Madrid: Ministerio de Medio Ambiente y Medio Rural y Marino; 2009. https://www.mapa.gob.es/es/ganaderia/temas/zootecnia/LIBRO%20valoracion%20morfolologica%20SEZ_tcm30-119157.pdf
10. De la Barra R, Martínez ME, Calderón C. Phenotypic features and fleece quantitative traits in Chilota sheep breed. *J Livestock Sci* 2014; 5:28-34. <http://livestockscience.in/wp-content/uploads/De-la-Barra-2014.pdf>
11. Peña S, López G, Martínez R, Abbiati N, Género E, Guarófaló M. Relevamiento morfológico de ovinos criollos en cuatro regiones de la Argentina. Informe preliminar. AICA 2012; 2:61-66. <https://aicarevista.jimdo.com/n%C3%BAmoros/vol%C3%BAmen-2-2012/>
12. De la Rosa SA, Revidatti MA, Tejerina ER, Orga A, Cappello JS, Petrina JF. Estudio para la caracterización de la oveja criolla en la región semiárida de Formosa, Argentina. AICA 2012; 2(1):87-94. http://www.uco.es/conbiand/aica/templatemo_110_lin_photo/articulos/2012/Trabajo041_AICA2012.pdf
13. Bravo S, Sepúlveda N. Índices zoométricos en ovejas criollas Araucanas. *Int J Morphol*. 2010; 28(2):489-495. <http://dx.doi.org/10.4067/S0717-95022010000200025>
14. Hick MV. Caracterización etnozootécnica de poblaciones primarias (criollas) de ovinos, caprinos y camélidos domésticos productores de fibra. [Tesis Doctoral]. Córdoba, Argentina: Universidad Católica de Córdoba; 2015. <http://pa.bibdigital.uccor.edu.ar/137/>
15. Montes Vergara D, Moreno J, Hurtado-Lugo N, Ramírez R, Celis A y Garay G. Caracterización faneróptica y morfológica de la hembra ovina de pelo criollo (Camura) colombiana, en la Sub Región Sabanas y Golfo de Morrosquillo departamento de Sucre. *Rev Colombiana Cienc Anim*. 2013; 5(1):104-115. <https://doi.org/10.24188/recia.v5.n1.2013.475>
16. Castañares N. Recría de corderas de raza Assaf Española: efecto de la alimentación entre el nacimiento y los cinco meses de edad sobre el crecimiento de los animales, el desarrollo de la glándula mamaria y la producción de leche en la primera lactación. [Tesis Doctoral]. León, España: Universidad de León; 2008. <https://digital.csic.es/handle/10261/5237>
17. Di Rienzo JA, Casanoves F, Balzarini MG, Gonzalez L, Tablada M, Robledo YC. InfoStat. Versión 2016. Argentina: Universidad Nacional de Córdoba; 2016. <https://www.infostat.com.ar/>