Phenotypic features and fleece quantitative traits in Chilota sheep breed

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Abstract

Chilota sheep is a typical animal population from Chiloé Archipelago in the south of Chile. In 2010, Chilota was officially recognised as the first ovine breed in Chile, with a high conservation value as a result of its contribution to the genetic variability of sheep breeds in the country. Previous studies on Chilota breed have been carried out on partial population samples. This study seeks to clarify the frequency and magnitude of the characteristic external aspects of this animal population that allow to distinguishing it among others. The study was conducted in Chiloé, on 151 Chilota sheep registered in the Chilota sheep breed´s Official Genealogical Record Book. Eighteen ethnical exterior characters (presence-absence) and 6 quantitative characteristics of the fleece were scored. Results showed that most of the breed descriptors defined for Chilota sheep breed are robust in their population frequency. However, some descriptors in the offspring that had not been previously determined in the specimens studied during the recovery phase of the population were observed. These descriptors are due to the genetic background of the population as a consequence of their genetic diversity. In addition, changes in the frequency of some features were also observed; this fact can be due to the breeder´s selection process. In addition, it is concluded that the fleece´s quantitative traits arise as a support to the racial description, since it is rough and has a low comfort index.

Keywords: Chiloé; Chilota; sheep; genetics; wool; characterization.

Introduction

Chilota sheep is a typical animal population from Chiloé Archipelago in the south of Chile. This breed is not autochthonous in the Archipelago, and was first introduced by Spanish conquerors in 1568 (De la Barra et al., 2011; De la Barra et al., 2012a). In 1788, there were near 90.000 head (Torrejón et al. 2004), and nowadays there is a total population of about 40.000 head (De la Barra et al., 2011). In 2010, Chilota was officially recognised as the first sheep breed in Chile, with a high conservation value as a result of its contribution to the genetic variability of sheep breeds in the country (De la Barra et al., 2010). Since the recognison of the breed, the population census has increased, allowing the characterization of some aspects of this animal population. Nevertheless, today the Official Genealogical Register controls a total of 800 females and 112 males throughout the archipelago, so the population is at high risk according to FAO (1998).

The initial studies investigating its productive value indicate that it is a very hardy breed, with regard to feeding and health (Calderón et al., 2011; Martínez et al., 2012), with high potential for milk production (Martínez et al., 2011). The breed produces early lambs (De la Barra et al., 2012b) and shows differential meat characteristics (Gallardo et al., 2014; Ramírez et al., 2013; Ramírez-Retamal et al., 2014).

The utility of a breed as a productive tool to project the distinctive attributes of a population on the farm´s outcomes requires users to discriminate and distinguish the breed from other animal population (Sierra, 2001). That is why an important part of the studies on this new breed are related to characterization (Calderón et al., 2009; De la Barra et al., 2011; Mujica et al., 2012). Nevertheless, these studies have been carried out on partial population samples. This study seeks to clarify the frequency and magnitude of the characteristic phenotypic aspects of this animal population that allow to distinguishing it among others.

Material and methods

The study was conducted in Chiloé Archipelago, Chile, between August and December 2012. A hundred and fifty one three to five year Chilota sheep randomly selected from the animals registered in the Official Chilota Sheep Breed Genealogical Register were used. Eighteen phenotypic characters (presence-absence) were ethnologically scored. These characters were: wool under the hamstring in forelimbs (**WFo**) (Fig. 1a) , hindlimbs (**WH**) (Fig. 1b), face (**WFa**) (Fig. 1c) and belly (**WB**) (Fig. 1d); rust (**RC**) (Fig. 1j), grey (**GC**) (Fig. 1k) or black-colored coat (**BC**) (Fig. 1l); black hooves (**BH**) (Fig. 1r); forehead (**FoS**) (Fig. 1e), face (**FaS**) (Fig. 1f), limbs (**LS**) (Fig. 1g), tail (**TS**) (Fig. 1h) and fleece (**FlS**) (Fig. 1i) color spots; equilateral triangle cephalic profile (**EH**) (Fig. 1n), horns (**H**) (Fig. 1m), horizontal ears (**HE**) (Fig. 1p), hanging chin (**HC**) (Fig. 1q), leaning rump (**LR**) (Fig. 1o).

To assess the quantitative characteristics of the fleece, sheep were shorn in October 2012. Dirty fleeces were weighed, and 120 g of wool were extracted from the left side of each fleece (between the second and third rib). Samples were processed in an optical fiber diameter analyzer (OFDA), measuring in real-time the characteristics of the wool fiber. The characters analyzed were: fiber diameter (**FD**), percentage of ≤ 30 μm-fibers (comfort factor, **CF**), lock length (**LL**), likely-break point (**BP**) thickest point (**TP**) and dirty wool performance (**DWP**).

The phenotypic characters that qualify for presence-absence were evaluated by their absolute and relative frequencies. For quantitative characteristics of wool, population parameters as mean, standard deviation, coefficient of variation, maximum and minimum values were estimated. The results were analyzed by means of the SPSS (v.20) statistical program.

Results

Phenotypic characters that allow differentiating a sheep population are associated with fleece descriptors, how the fleece extends along the body and limbs, the colors of the fleece and some other body distinctive aspects.

As can be observed in Table 1, Chilota sheep population shows a high frequency of presence of wool under the hamstring in hindlimbs and belly, but in the other hand, the presence of wool in the face and under the hamstring in forelimbs is not a modal feature. Table 1 also shows the variety of fleece colors in this breed. The color of the coat is mainly black (55.62%), followed by grey (25.82%) and rust (18.54%). The hooves are black in the entire population. A white spot in te forehead is present in 33.73% of the population; 15.23% have spots on their face; 21.19% has white spots on the tail; 32.45% shows white spots on limbs, and 11.25% exhibits fleece spots.

Relating to body features, there is a low frequency of horns (9.27%), but other features are relatively important, e. g. equilateral triangle cephalic profile (85.43%), horizontal ears (95.36%), hanging chin (96.68%) and leaning rump (89.40%).

The quantitative attributes of wool are listed in table 2. The average fineness of the fiber is 29.94 µm, varying from 23.9 to 39.7 µm. The comfort factor indicates that 56.02% of the fibers are over 30 µm, varying between 17.50% and 86.30%. Lock length shows an average of 70.4 mm (between 40 and 125 mm). Likely-break point was set up at 27.58 µm, between 20 and 37 µm. The wool fiber thickest point was 32.73 µm, between 25.80 and 43.40 µm. Finally, the average dirty wool performance was 2.08 kg, with minimum and maximum values of 1.20 and 3.83 kg, respectively.

Table 1 Frequency of phenotypic characters in Chilota sheep breed

Feature	n	F
Fleece		
WFo	32	21.19
WH	147	97.35
WFa	79	52.31
WB	151	100.00
Color		
FoS	51	33.77
FaS	23	15.23
TS	32	21.19
LS	49	32.45
FIS	17	11.25
RC	28	18.25
GC	39	25.82
BC	84	55.62
BH	151	100.00
Head and Body		
EH	129	85.43
H	14	9.27
HE	144	95.36
HC	146	96.68
LR	135	89.40

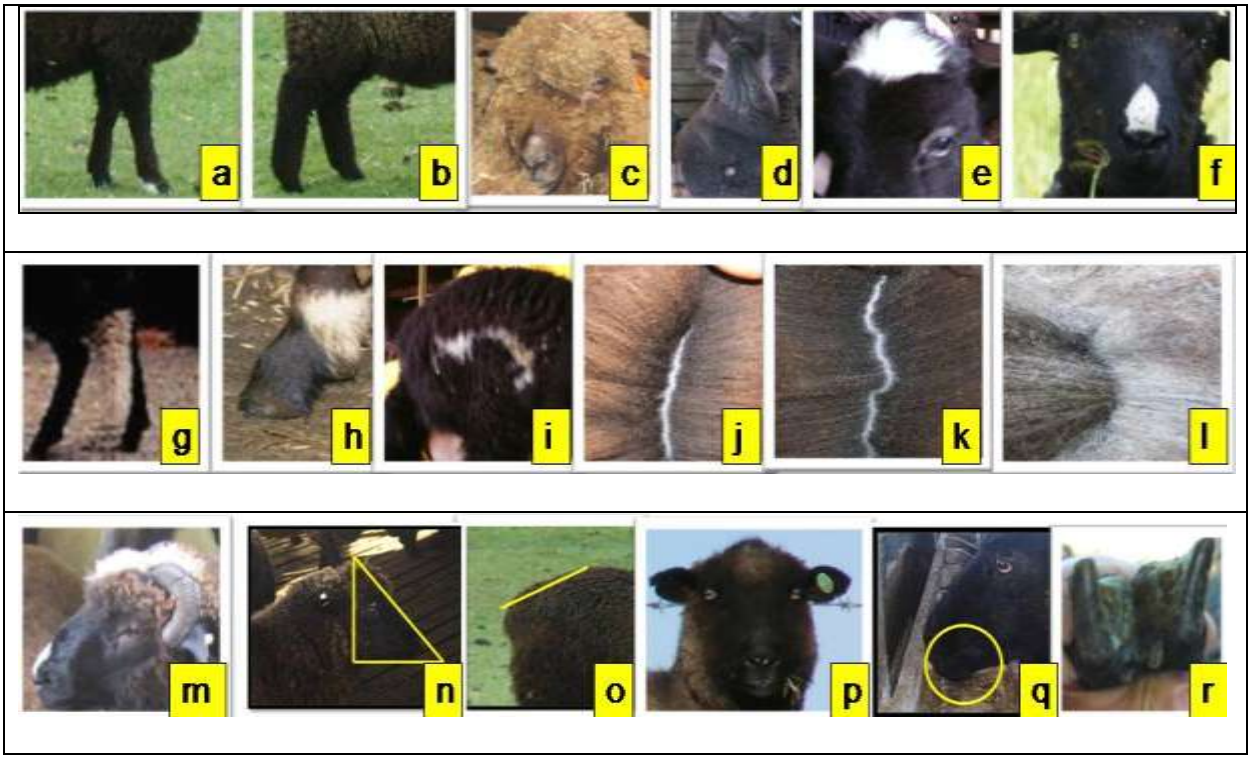
n: absolute frequency; **F:** relative frequency, expressed as percentage**; Wfo**: Wool under the hamstring in forelimbs; **WH**: wool under the hamstring in hindlimbs; **Wfa:** wool in face; **WB:** wool in belly; **FoS:** forehead color spots, **FaS:** face color spots, **LS:** limbs color spots; **TS:** tail color spots; **FlS:** fleece color spots; **RC:** rust-colored coat; **GC:** grey-colored coat; **BC:** black-colored coat; **BH:** black hooves; **EH**: equilateral triangle cephalic profile; **H:** horns, **HE:** horizontal ears; **HC:** hanging chin; **LR:** leaning rump.

Table 2 Wool quantitative traits in Chilota sheep breed

Trait	mean	s.d.	c.v.	min.	max.
FD	29,94	3,62	12,08	23,90	39,70
CF	56,02	18,83	33,61	17,50	86,30
LL	70,40	19,57	27,81	40,00	125,00
BP	27,58	3,54	12,82	20,00	37,00
TP	32,73	4,41	13,47	25,80	43,40
DWP	2,08	0,40	19,49	1,20	3,83

s.d.: standard deviation; c.v. coefficient of variation; **min:** minimum; **max:** maximum; **FD:** fiber diameter (µm); **CF**: comfort factor (percentage of ≤ 30 µm-fibers); **LL:** lock length (mm); **BP:** likely-break point (µm); **TP:** thickest point (µm); **DWP**:dirty wool performance (Kg).

Fg 1 Phenotypic characters of Chilota sheep breed



a) wool under the hamstring in forelimbs; b) wool under the hamstring in hindlimbs; c) wool in face, d) wool in belly; e) forehead color spots; f) face color spots; g) tail color spots; h) limbs color spots; i) fleece color spots; j) rust-colored coat; k) grey-colored coat; l) black-colored coat; m) horns; n) equilateral triangle cephalic profile; o) leaning rump; p) horizontal ears; q) hanging chin; r) black hooves.

Discussion

Chilota breed is a sheep population derived from Iberian sheep (De la Barra et al., 2012a); in this regard, many of their body phenotypic characters have genetic similarity with this original genetics, especially considering their genetic proximity to Churra and Castellana Spanish sheep breeds (De la Barra et al., 2011).

Studies that allowed the registration of Chilota breed considered 15 phaneroptic features as basic descriptors for this population, in addition to the fleece color variables (De la Barra et al., 2011). The previously reported frequency of appearance of wool was 89% (De la Barra et al., 2008), without specifying whether it was presented in fore or hindlimbs, nor if all the limbs were included. By specifying this information (Table 1) it can be observed that the frequency of

appearance of wool under the hamstring in hindlimbs is high, while in forelimbs is low. The presence of wool on the belly has not been previously described; this feature is present in the total population. Meanwhile, the presence of wool in the face was reported at a frequency of 75. 9% (De la Barra et al., 2008); the decrease in this feature´s frequency found in this work (52.31%) is probably due to the selection effect, since wooly face is considered an undesirable feature related to handling difficulties and association with low productivity.

Chilota sheep breed shows a marked and varied fleece polychromy, as well as color spots on limbs, head and body (De la Barra et al, 2011), similar to breeds such as Castellana, Merino Preto, Serra da Estrela, Xalda, Churra and Manchego (Sánchez, 1986; Sánchez and Sánchez, 1986; González et al, 2001; Yáñez, 2002). Literature reported a mean frequency of 72% for color in limbs, head and tail (De la Barra, 2008). However, detailed analysis (Table 1) exhibited frequencies not exceeding 34%. This difference is probably due to selection bias of the first specimens studied. Black colored hoof is present in all animals, as previously described (De la Barra, 2008).

Four different coat colors described previously (De la Barra et al., 2008) were: rust (36.7%), spotted (27.8%), grey (19.0%) and black (16.5%), which is different from the frequencies found nowadays in the population: spotted color no longer exist, while black has the highest frequency (55.62%), followed by grey (25.82%) and rust (18.54%). Differences can arise from a samplig mistake or, more likely, to the selection effect.

Chilota sheep breed shows a morphostructural functionality similar to those described for Iberic breeds such as Churra, Segureña and Lojeña (Luque et al., 2005), Canaria breed (Álvarez et al.2000), Gallega (Sánchez et al., 2000), Cartera (Lara et al., 2005) and Ojinegra (Picazo et al., 2005). Chilota sheep has been described as a straight-profile breed, with a very proportionated format (De la Barra et al., 2011), with equilateral head (Mujica et al., 2012) at a frequency of 93.7% (De la Barra et al., 2008). This is slightly higher than the 85.43% observed in the present study. Leaning rump, hanging chin and horizontal ears were described by de la Barra et al (2008) with a frequency of 98.7% each, and now show frequencies of 89.4%, 96.68% and 95.36%, respectively, confirming that these characters are robust as descriptors for this population.

The breed has been described as polled; nevertheless, horns were found in 9.27% of the population. In this regard, we must consider that from their genetic origin (De la Barra et al., 2012a), their genetic diversity (De la Barra et al., 2010) and the process recovery, it is expected the appearance of Iberian traits, although these have not been expressed in the animals previously studied.

The quantitative characteristics of the fleece in the Chilota sheep has not been described in details previously, although De la Barra et al. (2011) mentioned that Chilota is a “coarse wool” breed. The fiber diameter as well as the likely-rupture and thickest point (Table 2) confirm that it is a thick wool, as described for the Spanish breeds Latxa, Churra (Perezgrovas, 1998; Rojas et al, 2005) and Castellana (González et al., 2001). Simultaneously, Chilota sheep wool is within the ranges of fineness achieved by other breeds as Awassi (Keskin and Dag, 2009), Kari (Ahmad et al., 2010), Karakas and Norduz (Karakus et al., 2005) and Morkaraman (Erisir and Osbey, 2005). The lock lenght is lower than those described for Churra breed (Rojas et al., 2005), and with low performance compared to other coarse wool breeds (Erisir and Osbey, 2005; Keskin and Dag, 2009). Quantitative fleece characteristics appear as a good breed descriptor, and also indicate a potential use linked to the manufacture of products such as carpets and crafts rather than clothes, as is the case with wool produced by other similar breeds described. In this sense, the quantitative characteristics of the fleece appear as a support to breed description as it is a coarse and low-comfort index fleece.

Conclusion

Most of breed descriptors for Chilota sheep breed defined in this work are robust in their population frequency. However, some descriptors not described before are observed in the offspring, due to the genetic origin of the population and their own genetic diversity. Changes in the frequency of various features suggest an effect of animal selection by producers. It is also concluded that quantitative fleece characteristics appear as a support to racial description since Chilota sheep breed shows coarse fleece and low comfort index wool.

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