Small Ruminant Research 116 (2014) 1–13

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

The Grey Goat of Lanzo Valleys (*Fiurinà*): Breed characteristics, genetic diversity, and quantitative-qualitative milk traits

P. Cornale[a,*], M. Renna[a], C. Lussiana[a], D. Bigi[b], S. Chessa[c], A. Mimosi[a]

[a] *Dipartimento di Scienze Agrarie, Forestali e Alimentari, Università degli Studi di Torino, Grugliasco (TO) 10095, Italy*
[b] *Dipartimento di Scienze e Tecnologie Agro-Alimentari – Sezione Allevamenti Zootecnici, Università di Bologna, Reggio Emilia 42123, Italy*
[c] *Istituto di Biologia e Biotecnologia Agraria, CNR Milano, Milano 20133, Italy*

ARTICLE INFO

Article history:
Received 21 January 2013
Received in revised form 9 September 2013
Accepted 7 October 2013
Available online 23 October 2013

Keywords:
Local goat breed
Breeding system
Genetic diversity
Milk quality

ABSTRACT

The aim of this study was to provide an overview on breed's characteristics of a small dairy goat population recently identified in the Piedmont region (NW Italy): the Grey Goat of Lanzo Valleys. This goat, locally named *Fiurinà*, is composed of about 150 heads. Increasing knowledge on threatened breeds is an effective tool to develop conservation programs aiming at preserving loss of genetic resources, economically valorizing animal-derived food products, maintaining traditions and cultural values, as well as appropriately managing native habitats. Data and samples were collected in 15 representative farms to obtain information on geographical distribution, breeding systems, morphometric measures, and genetic diversity. Milk traits, including fatty acids profile and caseins polymorphism, were also investigated. The prevalent breeding system is extensive or semi-extensive, mostly with vertical transhumance from lowland to alpine pastures during the grazing season. The breed is characterized by a peculiar color of the fleece (mixture of white, grey and black course outer hairs with brown under-down) from which the local name "*Fiurinà*" (=speckled) derives. The breed is of medium size, with a quite high frequency of well-developed and turned backward horns. More than 80% of does have pear-shaped udder, typical of goats, with cylindrical teats directed downward. The microsatellite analysis pointed out significant distances between *Fiurinà* and other goat breeds reared in the same area. Consequently, *Fiurinà* has to be considered as a unique breed. Although highly variable, quite appreciable milk yields were observed. Considering milk gross composition and fatty acids profile, *Fiurinà* goat showed comparable results to other local breeds reared in alpine environment and mainly fed with fresh and conserved forages. A remarkable amount of α-linolenic acid (0.82 g 100 g^{-1} fat) was detected. The breed is also characterized by an interesting and wide variability in the casein cluster, with some haplotypes (i.e., *A-C-F-C′*, *E-A-C-B*, *F-C_1-F-C′*) detected only in *Fiurinà*, confirming the genetic uniqueness of the breed. The balanced frequency of medium-strong and weak-null *CSN1S1* alleles could be exploited for different breeding strategies.

* Corresponding author at: Dipartimento di Scienze Agrarie, Forestali e Alimentari, Università degli Studi di Torino, via L. da Vinci, 44 – Grugliasco, (TO) 10095, Italy. Tel.: +39 011 6708576; fax: +39 011 6708563.
E-mail addresses: paolo.cornale@unito.it (P. Cornale), manuela.renna@unito.it (M. Renna), carola.lussiana@unito.it (C. Lussiana), daniele.bigi@unibo.it (D. Bigi), chessa@ibba.cnr.it (S. Chessa), antonio.mimosi@unito.it (A. Mimosi).

0921-4488/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.smallrumres.2013.10.006

1. Introduction

The positive trend in the number of goats around the world (+58%) occurred from 1980 to 2000 has recently been confirmed in the last 10 years when goat stocks increased by about 23%. These data are even more interesting if compared to the modest increase in cattle and sheep stocks (+9% and +3%, respectively). The growing success in goat farming is noticed worldwide, in developing countries as well as in industrialized areas (FAOSTAT, 2010).

Goats play an important role in rural economy of developing countries, especially in areas with unfavorable environmental and climatic conditions, thanks to their capacity for adaptation to very different environments and because they are important users of marginal and rural lands (Kalantzopoulos et al., 2004). In developed countries, goats are presently considered as 'ecological' animals and seem to adequately respond to increasing consumers' demand concerning product quality, animal welfare, and environment respect (Morand-Fehr et al., 2004). In these contexts, goat dairy products often gain niche market reaching higher prices than other dairy products. Furthermore, goat milk has some distinctive traits, such as high digestibility and low allergenicity, which bring it to be widely considered the alternative to bovine milk, especially for people with allergies and other gastrointestinal disorders (El-Agamy, 2007; Park et al., 2007).

The worldwide increase in goat stocks has also been possible with the diffusion of some specialized breeds (e.g., Saanen). However, the widespread use of a reduced number of high producing breeds led to a dramatic reduction of autochthonous ones, placing most of them in an endangered status. In Europe, for example, although there is only about 4% of the world's goat population, there is the largest share of goat genetic resources, approximately 33% (Galal, 2005). However, the 35% of European local breeds are endangered (Bertaglia et al., 2007).

Effective management of farm animal resources requires comprehensive knowledge of the breeds' characteristics, including data on population size and structure, geographical distribution, production environment, and within- and between-breed genetic diversity (Groeneveld et al., 2010). Such an exhaustive overview on breeds' characteristics, as well as on products' quality, represents the starting point for the development of a preservation program (Canali, 2006; Lauvie et al., 2011; Verrier et al., 2005). An effective safeguard of a local breed prevents extinction and erosion of genetic resources and allows the economic valorization of derived products, the maintenance of traditions and cultural values as well as the appropriate management of native habitats (Dubeuf, 2011; Rosa García et al., 2012).

In Italy, goats are mainly reared in the Center-South, where the age-long dairying tradition counts several cheeses obtained from sheep and goat milk (Pirisi et al., 2011). Nevertheless, goats are also reared in the Italian alpine regions where dairy products are recently increasing their relevance on the market. An Italian native goat dairy population, officially named Grey Goat of Lanzo Valleys (*Capra Grigia delle Valli di Lanzo*) and locally known as "*Fiurinà*" has been recently identified in the Piedmont region (Cornale et al., 2012, 2010).

To prove comprehensive information, the goat population has been the subject of a multidisciplinary project concerning with population size, geographical distribution, breeding systems, morphometric measures, and genetic diversity (microsatellite and mitochondrial DNA analyses). Furthermore, since the main purpose of the *Fiurinà* breed is milk production, quanti-qualitative traits of milk were investigated, including fatty acid profile, for its well known human health implications, and caseins polymorphisms, for their relation with milk composition and technological properties.

2. Materials and methods

The *Fiurinà* goat population is reared in the Piedmont region (NW Italy). All the investigated farms breeding the *Fiurinà* goats are located in uplands and highlands of the northwestern territories of the Torino province.

The 3-year research project on the *Fiurinà* breed lasted from the beginning of 2009 to the end of 2011, and was developed on two main research lines. The first topic included the collection of data related to population size, geographical distribution, farm management, morphometric characteristics, as well as the analysis of genetic diversity to evaluate if the *Fiurinà* goat could be considered a new breed. These data were collected between 2009 and 2010 by examining 15 farms, breeding approximately the 50% of the *Fiurinà* population. The second topic focused on milk production and quality, including fatty acids and caseins polymorphism analyses. These surveys were carried out between 2010 and 2011, by collecting milk samples in 11 representative farms.

2.1. Morphometric measurements

Body measurements are of primary importance for breed phenotypical description and they represent a starting point in the definition of breed standards (Zaitoun et al., 2005; Dossa et al., 2007). In the 15 investigated farms, all reproductive females ($n = 77$), corresponding approximately to 50% of the registered population, were measured.

The goats were weighed using a spring balance. Height at withers, rump height, rump width, trunk length, and chest girth were also measured by using a flexible tape or a Lydtin stick. With the animal standing upright, the height at withers and the rump height were measured as the distance from the floor to the shoulders and to the highest point of the rump, respectively. The rump width was measured as the distance between the pin bones. The trunk length was the distance between the crown and the sacrococcygeal joint. The chest girth was the circumference of the thoracic cavity taken just behind the forelimbs.

A five-point scale was carried out to assess traits of udder morphology based on the scoring system proposed by de la Fuente et al. (1996) for ewes and modified for dairy goats as stated below. The udder depth was evaluated by considering the position of the udder floor with respect to hock (score 3: at the same hock's level; score <3: above the hock; score >3: below the hock). The fore udder attachment evaluates the strength of the attachment of the lateral ligaments to the body wall. The score can range from extremely loose (score 1) to snug and strong (score 5). The rear udder attachment was evaluated through the insertion to the abdominal wall by assessing the udder height. The cistern shape was assessed through the degree of separation between the left and right halves (score 1, pronounced separation; score 5, no separation). Finally, halves' symmetry was recorded.

Concerning teats' traits, their shape, inclination, and orientation were assessed. The teats' shape can range from short and small (score 1) to squat and cone-shaped (score 5). The physiological inclination of the teats is almost vertical (score 3), but it can be directed cranially (score 1) or caudally (score 5). The teats' orientation can be divergent (score 1), parallel (score 3) or convergent (score 5). Furthermore, symmetry of teats and presence/absence of supernumerary teats were also evaluated. All the morphometric assessments were performed by the three same operators.