A review on the species *Ovis aries* (Linnaeus, 1758)

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Abstract: In this work, the taxonomy of the domestic sheep (*Ovis aries*) will be presented in the first part, detailing the characteristics that classify this animal in a given group, then main cytological data on the species will be presented in the second part and the last part will be devoted to the presentation of the sheep diversity breeds in the world, specifically in Tunisia.
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1.Introduction

Sheep are easy to breed and tame, therefore they were among the first species domesticated and used as a source of meat and wool (Ryder, 1983; Clutton-Brock, 1987). As in other species, the domestication of sheep resulted in a much greater phenotypic variety than observed in wild species (Simm, 1998). More than 850 breeds are recognized worldwide (Rege and Gibson, 2003), which reflects the diversity of the species *Ovis aries*. The classification of animals into breeds is usually based on specific phenotypic characteristics, but other factors such as geographical location can be criterion for classification. The breeds can also be classified according to the purpose for which they are raised. There are meet breeds that can provide a high quality meat, dairy breeds that have good milk and wool, breeds that have a dense wool pile, appreciated by the industry, the last group is mainly represented by the Merino breed. Sheep can also be classified by the presence or absence of fat in their tail; fat tailed and thin tailed breeds are distinguished. The fat-tailed sheep are found in Africa and Asia. The other features are also used to classify the sheep, such as the color of the head, the presence or absence of horns. This work will be aimed at the presentation of the species Ovis aries (Linnaeus, 1758).

2.Taxonomy

The domestic sheep (Ovis aries) belongs to:

The kingdom of animals (Animalia or Metazoa)

The kingdom is the highest level of classification of living things. Animals are living beings eukaryotes, multicellular, heterotrophic and constitute a rule as proposed by Whittaker (1969) who has five classifications (Monera, protists, fungi, plants and animals).

The phylum of chordates (Chordata)

Animals belonging to this branch have three features: a dorsal neural tube, ventral gut and notochord (a rigid cartilaginous rod between the neural tube and the gut, which serves as the axial skeleton and helps to support body). This branch includes the sub-branches of prochordates (urochordata and cephalochordates) and vertebrates. The rope is transient in vertebrates, it disappears during development and contributes to the formation of the spine (mineralization of the notochord by the calcium phosphate). It is present only in the larval stage in urochordata and is permanent in cephalochordates (Hyman, 1979).

The subphylum of vertebrates (vertebrata)

Vertebrates are characterized by the presence of a bony cartilaginous spine consists of vertebrae that surround and protect the central nervous system (Hyman, 1979).

The class of mammals (mammalia)

The animals of this class are essentially characterized by the fact that the female suckles its young through specialized glands but also by the presence of hairs that cover the skin and homeothermy (Hyman, 1979).

The subclass of Eutheria or placental (Eutheria or placentalia)

The main feature of this subclass is that the embryo develops in the uterus, intra-abdominal organ, and is fed through the placenta, a common embryonic annex to the embryo and the mother (Hyman, 1979).

The super-order of ungulates (ungulata)

The super-order of ungulates includes species walking on the fingertips, trimmed hooves (Hyman, 1979).

The order of Artiodactyls (Artiodactylia)

The animals of this order have an even number of toes on the feet. The order of artiodactyls contains ten

families and approximately 200 species (Franklin, 1997; Ruvinsky and Rothschild, 1998). It includes several families of high commercial value as the Suidae family containing the domestic pig (*Sus scrofa domesticus*), the camelid family containing the lama (*Lama glama*) and the deer family that owns the deer (*Dama dama*) (Owen, 1848).

The suborder of ruminants (Ruminanta)

These animals are able to use cellulosic biomass and simple forms of nitrogen through their digestive tract that has the distinction of having three compartments called "pre-stomachs": the rumen, reticulum and the omasum placed in front of the abomasum (Scopoli, 1777; Church, 1993).

The family of bovids (Bovidae)

The family of cattle represents a high proportion of African wildlife. It includes 124 species belonging to 47 genera (Honacki et al., 1982). The number varies from eight subfamilies according Pilgrim et Schaub (1939) (cited by Faadiel et al., 1997) to 11 in Flower and Lydekker (1891). The most important are the bovines (Bovinae), caprids (Caprinae), antelopes (Antilopinae) and duikers (Cephalophinae) (Gray, 1821; Leakey, 2009).

The subfamily of caprids (Caprinae)

The caprinae subfamily includes cattle that are adapted to harsh climatic conditions; it includes 13 genera grouped into four tribes Ovini (sheep), Ovibovini (musk ox and gorals), Caprini (goats) and Rupicaprini (chamois) (Gray, 1821; Gentry, 1992).

The genus Ovis

Domestic sheep belongs to the genus *Ovis*, however its origin remains unclear. Several studies have found that species or subspecies of wild sheep are the ancestors of domestic sheep or at least have contributed to this species, particularly the urial (*O. vignei*) and mouflon (*O. musimon* or *O. orientalis*) (Ryder, 1984). The contribution of Argali has also been proposed (Zeuner, 1963). Hiendleder et al. (1998) analyzed the mitochondrial DNA of domestic sheep and found that one of the two major mitochondrial lineages in sheep is similar to the mouflon's. They did not find any matching with wildlife for the other line. Others molecular data suggest two groups within the species *Ovis aries*, the first having a common ancestor with the European mouflon and the second is derived from another common ancestor that is not the urial or argali (Hiendleder et al., 1998; Hiendleder et al., 2002). The classification within the genus *Ovis* is controversial, with a variable number of species, according to the authors it ranges from four to eight. Much of this controversy is due to the fact that all species can reproduce them (Franklin, 1997). However, an argument for the differentiation between species is a different number of chromosomes. Based on morphological data, many classifications of wild sheep and revisions have been proposed over the last two centuries. However, there is a fundamental disagreement in the number of recognized species. In a classification based on the number of chromosomes and the geographical distribution of wild sheep, Nadel et al. (1973) and Geist (1991) recognize six different groups of wild sheep (Table 1). Despite the difference in the number of chromosomes, different species of the genus *Ovis* can reproduce in captivity (Hiendleder et al., 1998; Nadler et al. 1973) and in natural habitats producing fertile offspring (Nadler et al., 1971; Valdez et al.1978). Consequently, the cross sheep/urial provides individuals with an intermediate number of chromosomes from 55 to 57 and have been observed in the north (Nadler et al., 1971) and south of Iran (Valdez et al., 1978). Some authors have described a species called Ovis gmelini which is usually confused with Ovis orientalis (Shackleton and Lovari, 1997).

3.Cytological data

By the size, physiology, behavior and life expectancy, sheep is a suitable model for studying a variety of biological functions in mammals, including physiology, immunology, endocrinology, reproduction, embryology and embryonic development. Sheep are also useful as models for inherited diseases such as asthma (Wright et al., 1999), muscular dystrophy (McGavin, 1974), McArdle's disease (phosphorylase deficiency) (Tan et al., 1997), the neuronal ceroid-lipofuscinosis (Broom et al., 1998) and several infectious diseases. The study of fetal sheep was also greatly expanded and was an important contribution regarding the physiology of the human fetus. Another benefit for scientific research in sheep is the availability of post-mortem tissues of sheep from slaughterhouses. This facilitated the study of the organs such as the pituitary gland, allowing the discovery and characterization of new hormones such as hormones that control the secretion of growth hormone (GH), luteinizing hormone (LH) and adrenocorticotropin hormone (ACTH). Sheep are an excellent test subject for laboratory studies, first of all, their body weight is comparable to humans, they easily adapt to the experimental manipulation (usually a two weeks period of adjustment in the laboratory is sufficient), which makes these experiments successful with unstressed animals. Animal size allows easy insertion of catheters in the different blood vessels, bladder, and rumen. The blood test for physiological and molecular analysis is simple and allows obtaining sufficient quantities (Hecker, 1974). Chromosome studies have described the karyotype of domestic sheep by Berry (1938), Ahmed (1940) and Cribu and Matejka (1985). It is composed of 54 chromosomes, including 3 pairs of metacentric, 23 pairs of acrocentric and 2 sex chromosomes X and Y acrocentric and metacentric,

respectively. They are characterized by the importance of the size of chromosomes 1, 2 and 3 relative to the others. These three chromosomes are metacentric while the remaining chromosomes are telocentric. The X chromosome is acrocentric and relatively large while the Y chromosome is very small and metacentric. Chromosomal characteristics of the genus Ovis are given in Table 1.

Table 1. The genus *Ovis* and their characteristics.

Species	Common Name	Chromosome number
Ovis aries	Domestic sheep	2n=54
Ovis musimon/orientalis	European mouflon	2n=54
Ovis vignei	Urial	2n=58
Ovis ammon	Argali	2n=56
Ovis canadensis	Bighorn sheep	2n=54
Ovis dalli	Dall sheep	2n=54
Ovis nivicola	Snow sheep	2n=52

The linkage map of sheep has undergone several revisions and currently contains 1062 loci covering 3400 cM for the autosomes and 132 cM on chromosome X (Crawford et al, 1995. Galloway et al, 1996. De Gortari et al, 1998. Maddox et al, 2001). The hematology of sheep has also been studied for several years and has been summarized by Schalm (1961). Seven blood group systems have been identified in domestic sheep (A, B, C, D, M, K, X), the system B is the most complex and multifaceted (Ramusen, 1958, 1960; Nguyen and Bunch, 1975; Nguyen and Ruffet, 1980). Haematological standards in sheep are given in Table 2.

Table 2. Blood Standards in sheep.

Hemoglobin (g/l)	90-130
Hematocrit %	27-41
Erythrocytes T/L*	8-13
Leukocytes $x10^9$/l	5-17
Neutrophiles %	10-53
Eosinophilics %	0-24
Basophils %	0-1
Monocytes %	0-1

(according to Brugère-Picoux, 2004), * Tera/ litre = million/mm^3

4.Diversity of sheep breeds

The domestic sheep is primarily raised for meat, milk and wool. More than 850 breeds are recognized worldwide (Rege and Gibson, 2003), they are unevenly distributed across the different continents and countries. Breeds can be classified according to the purpose for which they are raised; it distinguishes different breeds that can achieve good weight performance and provide a good quality of meat, dairy breeds that have interesting milk productivity, and wool breeds that have a dense wool pile and appreciated by the industry, the latter group is mainly represented by the Merino breed. Sheep can also be classified by the presence or absence of fat in their tail. The fat-tailed sheep are found in Africa and Asia. Other features are also used to classify the sheep such as the color of the head, the presence or absence of horns ... Europe has the largest number of races from other continents (Rege and Gibson, 2003).

In Tunisia, Sheep farming plays a vital role in food security. This sector provides more than 48% in the production of an estimated 120 000 tones red meat (Mohamed Brahmi et al, 2010). The Tunisian sheep population is about four million females, arranged in four main breeds: the Barbarine, the Western thin tail, the Black of thibar and the Sicilo sarde, representing respectively 60.3%, 34.6%, 2.1% and 0.7% of the total population (Rekik et al., 2005). Moroccan prolific D'man was introduced in Tunisia in 1994 to improve herd productivity (El Hentati et al., 2006). Other foreign breeds: Comisana, Moroccan Sardinian and Lacaune (Rekik et al., 2005) exist as reduced number. The introduced breed was not very successful for the inbreeding that characterizes this breed. Attempts hybridization with local breeds has failed because of the difficulty of breeding this breed under normal grazing conditions in Tunisia. For cons, the two predominant native breeds (Barbarine and Western thin tail) are better suited to rearing conditions of the country and often high pure breeds. El Hentati et al. (2012a, 2012b, 2012c, 2013a, 2013b) estimated the genetic diversity in the two most common breeds of sheep in Tunisia (the Barbarine and the Western thin tail) using RAPD-PCR technique and showed that these two breeds keep a fairly large genetic diversity. There is a significant genetic differentiation between breeds despite the existence of a significant gene flow, and that Tunisian breeds are well adapted to their environment, which would explain the lack of success of the Moroccan introduced breed. It is therefore necessary to maintain the purity of breeds that are well adapted to the bioclimatic and environmental conditions in their country and to avoid uncontrolled crossbreeding between different breeds.

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