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Knowledge of ethnoveterinary medicine in the Province of Granada, Andalusia, Spain

Guillermo Benítez[a,*], M. Reyes González-Tejero[b], Joaquín Molero-Mesa[b]

[a] European University of Madrid, Biomedical Sciences Dept., C. Tajo s/n 28670, Villaviciosa de Odón, Madrid, Spain
[b] University of Granada, Department of Botany, Campus de Cartuja s/n 18071, Granada, Spain

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ABSTRACT

Ethnopharmacological relevance: This paper constitutes an important contribution to the knowledge of biological resources used in ethnoveterinary practices (EVPs) in southern Europe, a territory with a clear lack of information on the subject.
Aim of the study: To catalogue, analyze, and disseminate the knowledge of plant and animal use in ethnoveterinary practices in the province of Granada. Data have been analyzed to highlight the similarities between ethnoveterinary practices and human ethnopharmacology for the same study area.
Methodology: Information was gathered through open and semi-structured interviews with local people, mainly elderly shepherds and farmers, in the western part of the province. The primary data have been supplemented with information on EVPs from previous ethnobotanical works for the province. Data were gathered using the same field methods.
Results: A total of 88 ethnoveterinary uses are documented for the treatment of 24 animal conditions. Of these, 82 uses involve 60 different plant species. Over three-quarters of these plants are also used for some human conditions in the same study area. Moreover, 6 animal species were catalogued for 6 other ethnoveterinary uses; four of these species were also used for similar conditions in humans. Ritual and health-prevention practices are also discussed.
Conclusions: EVPs in southern Spain involve a high number of species and conditions and are strongly linked to folk tradition (i.e. how local people understand certain conditions and their treatment, sometimes in a ritual manner). Unfortunately, some evidence of their slow disappearance has been found.

1. Introduction

It has been said that there is increasing interest in the traditional use of medicinal plants in the West today (Rates, 2001; Palombo and Semple, 2001; Viegi et al., 2003). While most research on the subject focuses on the use of plants in human medicine, knowledge of the medicinal use of biological resources is not restricted to humans, and also extends to the treatment of animal conditions (Lans et al., 2006). Literature on plants used in veterinary medicine, defined as ethnoveterinary medicine (McCorkle, 1986) and commonly referred to as Ethonoveterinary Practices (EVPs), is increasing, and is highly developed in some countries, for example Italy (Viegi et al., 2003). Recent papers for Africa (Gradé et al., 2009; Moreki et al., 2010; Opiro et al., 2010; Gakuya et al., 2011), America (Jernigan, 2009; Martinez and Lujan, 2011; Monteiro et al., 2011; Souto et al., 2011; Lans and Turner, 2011) and Asia (Gaur et al., 2010; Galav et al., 2010; Dilshad et al., 2010; Raziq et al., 2010; Phondani et al., 2010; Ghorbani et al., 2011; Deshmukh et al., 2011; Song and Kim, 2011) are testimony of this growing interest. Some recent works also discuss animals used in veterinary medicine, mainly in Brazil (Barboza et al., 2007; Confessor et al., 2009), and more information on zootherapeutic remedies can be found in Quave et al. (2010) and Benítez (2011).

Although some ethnobotanical information is available for the province of Granada, few works focusing on plants used in veterinary medicine have been published (González-Tejero et al., 1999). Some works on the subject exist for other Iberian regions (Blanco et al., 1999; Agelet and Vallès, 1999; Hualde and Ormazábal, 2002; Bonet and Vallès, 2007; Akerreta et al., 2010; González et al., 2011). A great deal more information can be found in several ethnobotanical books (Villar et al., 1987; Mulet, 1991; Blanco, 1998; Verde et al., 1998; Fajardo et al., 2000; Verde et al., 2000; Parada et al., 2002; Lastra, 2003; Fajardo et al., 2007; Pardo-de-Santayana, 2008; Verde et al., 2008; Carvalho, 2010) and unpublished works (such as Ph.D. or Degree Theses, for example Mesa, 1996; Guzmán, 1997; Fernández-Ocaña, 2000; Aceituno,

* Corresponding author. Tel.: +34 912 115 288; fax: +34 916 168 265.
E-mail address: gbcruz@ugr.es (G. Benítez).

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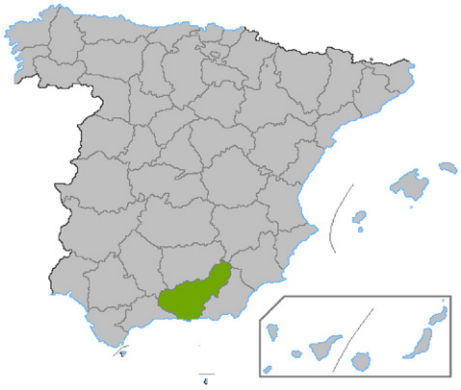


Fig. 1. Study area: Granada Province.

2010). However, in our opinion, more fieldwork needs to be carried out.

We would like to mention some important points regarding our choice of study area. Andalusia, the region of Spain which includes Granada, is a distinctive territory with a high percentage of the population living in rural areas where livelihoods are closely linked to tradition and the environment. This is reflected in a high degree of ethnobiological knowledge in the region. Statistics for the province of Granada (I.E.A.-S.I.M.A., 2009), which covers an area of 12,635 km^2, show an ageing population with somewhat more than 16% of the 907,000 inhabitants over 65 years of age. About 25% of the population lives in the capital, Granada city, but in 96 of its 168 municipalities (57%) the official number of inhabitants is less than 2000. These facts, along with the high ethno- and biodiversity (as mentioned by some authors for the whole Iberian Peninsula; Bonet and Vallès, 2003, and specifically for the province of Granada; Benítez et al., 2010a), make it a suitable region for ethnobiological studies. This paper discusses the plants and animals used in EVPs in the province, and compares them with those used in traditional plant-based human medicine. Observations on some ritual practices are also included.

2. Methodology

2.1. Field studies

The information on ethnoveterinary medicine comes mainly from the first author's Ph.D. fieldwork, currently unpublished (Benítez, 2009), which was carried out between 2003 and 2008 and focuses on the western part of the province of Granada (primary data). It has been supplemented with data from several ethnobotanical studies that were carried out by our research group in the province (Múñoz-Leza, 1989; González-Tejero, 1990) and in the region (González-Tejero et al., 1999, using ethnobotanical survey data from Granada only). Table 1 shows the source of the data and some information pertinent to these studies. The study area for this paper thus encompasses the entire province of Granada (Fig. 1). The information was gathered following the same methods in all the works; through open and semi-structured interviews with local informants (Cotton, 1996; Martin, 2004). Interviews were performed in Spanish with native people in different places such as homes, public places, and pensioners' centres, but most were performed in the countryside, walking with the interviewee in search of the used plants. Most interviews were performed on a one-to-one basis, although a number of group interviews were carried out with good results. We performed a number of preliminary questionnaires in places such as primary schools, adult education centres and pharmacies, through which we acquired information about where to locate informants and conduct interviews. Ethical guidelines of the International Society of Ethnobiology were followed and verbal consent to publish the data was obtained from our informants prior to interviewing. More details on the methodology and the association of emic and ethic cathegories for each condition can be seen in Benítez (2009).

For the main ethnobotanical data used in this paper (Benítez, 2009), 279 people were interviewed in the western part of the province. The age range of interviewees was mainly from 50 to 60 years and the gender distribution was 56% men and 44% women. As expected, data on ethnoveterinary medicine mostly came from elderly people who were involved in the breeding and maintenance of livestock (mostly farmers and shepherds) or who worked in agriculture. In total, 68 people gave information on ethnoveterinary practices, comprising 24% of total informants Most of the informants who provided data on veterinary medicine were men (72%, 49 people), illustrating a deviation of the gender ratio.

In the studies we used as supplementary sources of data, some of which date back more than 20 years (see references above), the data were treated differently from the more recent fieldwork (Benítez, 2009), and information about informants was not included. Furthermore, as information on the number of reports for each ethnoveterninary use was missing in these works, the total number of reports given in this paper comes from Benítez (2009), and relates to the western part of the province (see Benítez et al., 2010b for a map). For the 13 animal conditions which are only found in the other referenced works, data on number of reports are missing. The number of reports in Table 2 should be understood only as an approximation of the most reported plants and conditions for EVPs in the province.

Although scarce, information on the use of animals in veterinary medicine has also been included, all of which comes from Benítez (2009). Mineral remedies are not covered in this paper.

2.2. Data analysis

Primary data regarding the plants, uses and informants were compiled in a database using Microsoft Access v.2007, including cross-reference information on the plants used (scientific and vernacular names, botanical families, ecology, voucher number, parts used and other fields), conditions (pathological group, methods of administration and preparation, number of reports) and informants (gender, age, locality, profession, education). For this paper, we extracted the information on EVPs from the original database (more details in Benítez (2009)) and supplemented it with the data

Table 1
Bibliographical sources of data and information about these studies.

Source	Study area	Study area (km^2)	Type of work	Main subject	PU	AU	Information included
Benítez (2009)	Western Granada province	2041	Ph.D. thesis	Ethnobiology	67	6	U, PU, AF, V, I, R
González-Tejero et al. (1992)	Andalusia	87,268	Review	Ethnoveterinary	22	0	U, PU, AF
González-Tejero (1990)	Granada province	12,531	Ph.D. thesis	Ethnobotany	12	0	U, PU, AF, V
Múñoz-Leza (1989)	Lecrin Valley, Granada	460	Degree thesis	Ethnobotany	11	0	U, PU, AF, V

PU: number of plant uses reported in each work; AU: number of animal uses reported in each work. Information included: U: uses; PU: part used; AF: administration form; V: voucher numbers; I: informant data; R: reports.

Table 2
Plant species used in ethnoveterinary medicine, families, traditional uses, parts used, preparation and administration forms and citations.

Scientific name (voucher number)	Family	Traditional use	Part used	Prep.	Use type	Rep*.	Med.	Source
Adiantum capillus-veneris L. (GDA54094)	Adiantaceae	Birth	Leaves	D	IU	1	x	1, 2, 3, 4
Agave americana L. (GDA53864)	Agavaceae	Wound healing	Leaves	DA	EU	–	x	1,2
		Scabies	Leaves	D	EU	–		3
Alkanna tinctoria (L.) Tausch (GDA53942)	Boraginaceae	Wound healing	Roots	D, MO	IU	1	x	4
Allium cepa L.	Liliaceae	Birth	Bulb	D	IU	3	x	4
Bupleurum gibraltaricum Lam. (GDA54110)	Apiaceae	Wound healing	Leaves	D, MO	EU	4	x	3, 4
Cinnamomum verum J.Presl	Lauraceae	Birth	Fruits	D	IU	2	x	1, 4
Cistus albidus L. (GDA54044)	Cistaceae	Birth	Leaves	D	IU	1		1, 4
Cistus laurifolius L. (GDA54046)	Cistaceae	Birth	Leaves	D	IU	1		4
		Wound healing	Leaves	D	EU	1		4
Cytisus scoparius subsp. *reverchonii* (Degen and Hervier) Rivas Goday and Rivas Mart. (GDA53909)	Fabaceae	Wound healing	Flowering Stems	D	EU	1		4
Dactylis glomerata L. subsp. *hispanica* (Roth.) Nyman (GDA54066)	Poaceae	Eyes	Inflorescence Stems	DA	IU	3		1, 4
Daphne gnidium L. (GDA53805)	Thymelaceae	Birth	Bark	DA	EU-M	12		1, 2, 3, 4
		Diarrhoea	Bark	DA	EU-M	3		3, 4
		Dislocation	Leaves	D	EU	7		2, 4
Digitalis obscura L. (GDA53945)	Scrophulariaceae	Wound healing	Flowering Stems	D, MO	EU	12	x	3
		Toothache	Flowering Stems	D	IU	1		4
Dittrichia viscosa (L.) Greuter (GDA54164)	Asteraceae	Wound healing	Flowering Stems	D	EU	3	x	4
Eryngium campestre L. (GDA54112)	Apiaceae	Dislocation	Roots	DA	EU-M	–	x	1, 2, 3
Eucalyptus globulus Labill.	Myrtaceae	Cold	Leaves	D	IU	–	x	3
Ferula communis L. (GDA54105)	Apiaceae	Dislocation	Stems	DA	EU	2		4
Festuca scariosa (Lag.) Ascherson & Graebner (GDA54048)	Poaceae	Eyes	Inflorescence Stems	DA	IU	1		4
Ficus carica L. (GDA53804)	Moraceae	Flatulence	Stems	DA	IU	1	x	4
Foeniculum vulgare Mill. (GDA54111)	Apiaceae	Wound healing	Whole plant	D	IU	1	x	4
Hyoscyamus albus L. (GDA54123)	Solanaceae	Wound healing	Leaves	D	EU	–	x	2
		Dislocation	Leaves	D	EU	–		3
Juglans regia L.	Juglandaceae	Contraceptive	Leaves	D	IU	1	x	4
Juniperus oxycedrus L. (GDA54020)	Cupressaceae	Birth	Resin	D	IU	2	x	4
		Purgative	Resin	D	IU	3		1, 4
		Uric acid	Resin	D	IU	1		4
		Scabies	Resin, Leaves	DA, D	EU	–		3
Juniperus phoenicea L. (GDA54019)	Cupressaceae	Depurative	Leaves	D	IU	1		4
		Mineral salts	Ash	DA	IU	2		4
Lavandula lanata Boiss. (GDA53906)	Lamiaceae	Cold	Flowering Stems	D,I	IU	–	x	3
Lavandula latifolia Medik. (GDA54312)	Lamiaceae	Cold	Flowering Stems	D,I	IU	–	x	3
Marrubium supinum L. (GDA53899)	Lamiaceae	Cold	Flowering Stems	D	IU	–	x	3
Marrubium vulgare L. (GDA53900)	Lamiaceae	Cold	Flowering Stems	D	IU	–	x	2, 3
Mentha pulegium L. (GDA53895)	Lamiaceae	Birth	Flowering Stems	D	IU	7	x	4
		Fleas	Flowering Stems	D, DA	EU	–		3

Table 2 (*Continued*)

Scientific name (voucher number)	Family	Traditional use	Part used	Prep.	Use type	Rep*.	Med.	Source
Mentha suaveolens Ehrh. (GDA53894)	Lamiaceae	Fleas	Flowering Stems	D, DA	EU	4	x	1, 4
Nerium oleander L. (GDA53843)	Apocynaceae	Analgesic	Stems	DA	EU-M	1		4
Nicotiana glauca R. C. Graham (GDA54004)	Solanaceae	Wound healing	Leaves	D	EU	1		4
Olea europaea L. var. *europaea*	Oleaceae	Detoxifying	Oil	DA	IU	1	x	4
Paeonia broteroi Boiss. & Reut. (GDA54006)	Paeoniaceae	Wound healing	Bulb	DA	EU	1	x	4
Pallenis spinosa (L.) Cass.	Asteraceae	Wound healing	Flowering Stems	D	EU	1	x	4
Petroselinum crispum (Mill.) A.W. Hill (GDA54108)	Apiaceae	Wound healing	Whole plant	I	EU	1	x	4
Phlomis lychnitis L. (GDA53880)	Lamiaceae	Birth	Flowering Stems	D	IU	1		4
Phlomis purpurea L. (GDA53901)	Lamiaceae	Birth	Flowering Stems	D	IU	9	x	4
		Wound healing	Flowering Stems	D	EU	3		4
Pistacia lentiscus L. (GDA53849)	Anacardiaceae	Distemper	Leaves	DA	EU-M	1		4
Plantago coronopus L. (GDA54031)	Plantaginaceae	Birth	Whole plant	DA	EU-M	1	x	4
Plumbago europaea L. (GDA53860)	Plumbaginaceae	Vermin	Whole plant	M	EU	4	x	4
Quercus rotundifolia Lam. (GDA53814)	Fagaceae	Birth	Bark	D	IU	5	x	4
Retama sphaerocarpa (L.) Boiss. (GDA53934)	Fabaceae	Birth	Bark & Roots	D	IU	2	x	4
		Dislocation	Bark	DA	EU	7		4
		Bone fracture	Bark	DA	EU	2		1, 2, 3, 4
Rhamnus saxatilis Jacq. (GDA54133)	Rhamnaceae	Other	Spines	DA	EU	2		4
Rorippa nasturtium-aquaticum (L.) Hayek (GDA54035)	Brassicaceae	Purgative	Whole plant	DA	IU	1	x	2, 4
Rosmarinus officinalis L. (GDA54003)	Lamiaceae	Birth	Flowering Stems	D	IU	3	x	3, 4
Rubus ulmifolius Schott (GDA53963)	Rosaceae	Birth	Leaves	D	IU	1		4
Ruta angustifolia Pers. (GDA53813)	Rutaceae	Birth	Whole plant	D	IU	2	x	1, 2, 4
Ruta chalepensis L. (GDA19351)	Rutaceae	Scabies	Whole plant	D	EU	–	x	3
Ruta montana (L.) L. (GDA53867)	Rutaceae	Birth	Whole plant	D	IU	7	x	4
Salvia lavandulifolia subsp. *vellerea* (Cuatrec.) Rivas Goday (GDA53896)	Lamiaceae	Other (nutraceutical)	Whole plant	DA	IU	1	x	4
Scirpoides holoschoenus (L.) Sojak (GDA54074)	Scirpaceae	Toothache	Leaves	DA	IU	2	x	4
		Cold	Leaves	DA	IU	2		2, 3, 4
		Diuretic	Leaves	DA	IU	1		4
Sideritis hirsuta L. (GDA54007)	Lamiaceae	Wound healing	Flowering Stems	D, MO	EU	16	x	2, 3, 4
		Birth	Flowering Stems	D	IU	1		4
		Alopecia	Flowering Stems	D	IU	1		4
Stipa lagascae Roem. and Schult. (GDA54058)	Poaceae	Eyes	Inflorescence Stems	DA	IU	1		4
Stipa tenacissima L. (GDA54052)	Poaceae	Analgesic	Inflorescence Stems	DA	EU	3	x	4
		Birth	Leaves	D	IU	3		3, 4
		Eyes	Inflorescence Stems	DA	IU	4		4
		Cold	Leaves	D	IU	2		4
		Distemper	Leaves	DA	EU-M	3		3, 4
Thapsia villosa L. (GDA54101)	Apiaceae	Dislocation	Stems	DA	EU	1	x	4
Thymus mastichina (L.) L. (GDA53890)	Lamiaceae	Wound healing	Flowering Stems	D	EU	2	x	4
Urginea maritima (L.) Baker (GDA54075)	Liliaceae	Alopecia	Bulb	DA	EU	1	x	4
Urtica dioica L. (GDA54315)	Urticaceae	Invigorative	Whole plant	DA	IU	2	x	4
Verbascum thapsus L. (GDA53944)	Scrophulariaceae	Wound healing	Leaves	D	EU	1	x	4
Verbena officinalis L. (GDA53831)	Verbenaceae	Wound healing	Leaves	D	EU	1	x	4

Source: 1. Múñoz-Leza (1989); 2. González-Tejero (1990); 3. González-Tejero et al. (1999); 4. Benítez (2009).

Prep.: preparation form; D: decoction; DA: direct application; MO: medicinal oil; I: infusion. Use type: IU: internal use; EU: external use; M: magico-religious use. Rep*.: number of reports in Benítez (2009) for the western part of the province. Med.: medicinal species also used in human ethnopharmacology (indicated with "x"). Underlined uses are the same for human folk medicine.

from the previous studies for the province. Information on the parts used, the methods of preparation and administration and the animals for which treatments are intended has been included. Ritual practices of disease prevention and the belief system supporting these types of healing practices are discussed below.

We followed Adjanohoun et al. (1989) to classify the conditions into several pathological groups, as in previous works by our research group (González-Tejero et al., 1999). Some categories were simplified due to the low number of conditions included. The distribution of conditions within the different pathological groups is the following (some infections, states or supplements used in livestock management in relation to health have been included in this classification):

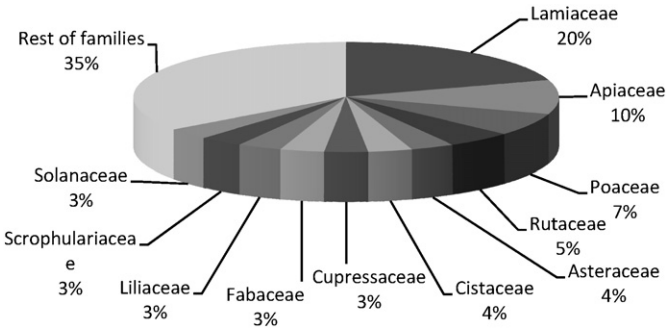
- *Digestive system:* Plants used to treat digestive disorders such us diarrhoea or flatulence as well as those used as purgatives or for toothache.
- *Respiratory system:* Plants and animal resources used as catarrh remedies for colds.
- *Birth and post-birth:* Includes contraceptive plants and those used as abortifacients or birth coadjutants to encourage the expulsion of the placenta (this use is referred to as "birth" in the tables).
- *Kidney:* Plants with a diuretic effect or those used to control the level of uric acid.
- *Infectious and parasitic diseases:* Plants used for vermin, parasites, to treat infestations of fleas or scabies, for infectious diseases such as distemper, and animals used in the ritual prevention of some bacterial infections.
- *Traumatic lesions and poisoning:* Resources used for the treatment of wounds, bone fractures and dislocations.
- *Metabolism and other diseases:* Plants used as analgesics, general depuratives, invigoratives, detoxicants or whose ashes are used as mineral salt supplements for some animals. This group also includes alopecia and "other conditions", indicated as such in the tables.
- *Eyes:* Plants for the treatment of the ailment known as "nube" (literally, "cloud"), a type of keratoconjunctivitis characterised by the appearance of a white membrane over the eye that impairs vision (González-Martín, 2009).

The comparison of plants used in veterinary and human medicine is derived from the same ethnobotanical works (Múñoz-Leza, 1989; González-Tejero, 1990; Benítez, 2009 and its ethnopharmacological synthesis, Benítez et al., 2010b). For the autochthonous flora, voucher specimens were collected and added to the GDA Herbarium of the University of Granada. Botanical names and families follow Castroviejo et al. (1986–2010) and Tutin et al. (1964–1980). Vouchers were collected for the animal species, but they were not included in any official Andalusian institution due to spatial and conservation limitations and no voucher numbers are given here. For proper identification, we were assisted by a specialist from the Zoological Department of the University of Granada.

3. Results

3.1. Plants used

Data on plants used comes from a number of ethnobiological or ethnobotanical surveys in the province, but mostly from the western region (Benítez, 2009); we consider the latter to be "primary data". Nearly 60% of the total uses presented here were collected in that particular study (67 of the 112 total reports; see Table 1). Moreover, 50 of the 82 uses included in Table 2 (60% of total uses) have not been previously documented for the province. The work of González-Tejero et al. (1992) comprises 20% of the total data, mainly from previous surveys and unpublished fieldnotes.



Graph 1. Distribution of botanical families.

Information for a total of 60 plant species was compiled, with an associated total of 82 ethnoveterinary uses (Table 2). The plants are used to treat 24 different health problems, grouped into 8 categories in this study. An ethnoveterinary use is understood here as one specific part of a specific plant or animal used in the treatment of a particular livestock condition. Animals treated are mainly sheep, goats, pigs and cows, which are the most common livestock in the region: in 2009 there were approximately 453,000 sheep, 196,000 pigs, 182,000 goats, 17,000 cows in the province (I.E.A., 2009). Treatments for poultry, horses and dogs have also been collected.

The 60 plant species we report here constitute a relatively high number when compared to studies for other territories: 9 species are employed in EVPs in Campoo, Cantabria (Pardo-de-Santayana, 2008), 23 species in Caurel, Galicia (Blanco et al., 1999), 36 species in Navarra (Akerreta et al., 2010), 46 in the Sierra Norte, Madrid (Aceituno, 2010), 84 in the Arribes del Duero, Castilla-León (González et al., 2011) and 89 in Montseny, Catalonia (Bonet and Vallès, 2007).

The species belong to 31 botanical families, the most important in species number being Lamiaceae, Apiaceae, Poaceae and Rutaceae (Graph 1). The family Lamiaceae is the most important in human ethnopharmacology (González-Tejero et al., 1992; Benítez et al., 2010b) and ranks third in species number in the region (Blanca et al., 2009), so it is not surprising that it ranks highest in this study. The family Apiaceae also appears frequently in the first positions in a number of ethnobotanical studies (Pieroni et al., 2006; Bonet and Vallès, 2007). Particularly interesting is the extensive use of Rutaceae in ethnoveterinary medicine, accounting for 35.5% of all species in the family, including three of the genus *Ruta*. The same can be said for the frequent employment of Poaceae species. The family Poaceae does not normally rank highly in terms of species richness in ethonoveterinary studies (for example, Pieroni et al., 2006; Akerreta et al., 2010) or in statistical approximations for ethnobotanical data (Moerman, 1996; Weckerle et al., 2001), despite being one of the most diversified families in the Iberian flora and the fourth worldwide (Stevens, 2001). As mentioned in Section 3.3, the position of the family in this study is mainly due to the unspecific use of several species to treat a certain eye condition.

Although data for the number of reports are not representative of the whole study area, a brief analysis of the data from Benítez (2009) should be included. In total, 187 reports (or "use-reports" according to Tardío and Pardo-de-Santayana, 2008) were collected from interviewees in the western part of the province. The species with the highest number of reports are *Daphne gnidium* (22 reports), *Sideritis hirsuta* (18), *Stipa tenacissima* (15) and *Digitalis obscura* (13), all of which are used for more than one purpose. It is interesting to note that *Daphne gnidium* is a common species found in the clearings of Holm oak woodlands. Despite

being rarely used in human ethnomedicine, this plant (locally called "torvizco") is well known by local people for its veterinary use. The other plants mentioned above, especially *Sideritis* and *Digitalis*, are widely employed for different human conditions, with a high degree of similarity between human and veterinary uses.

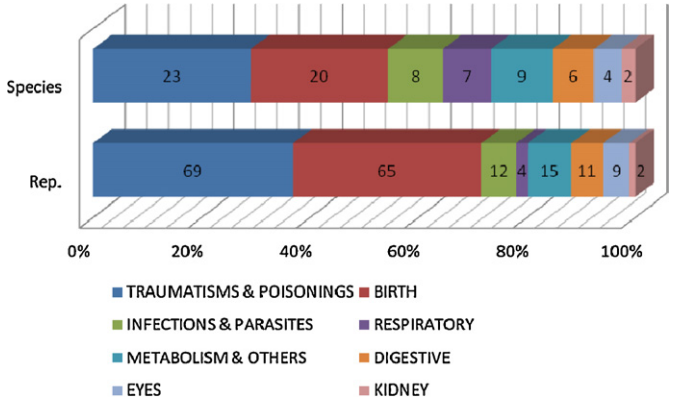
The resources are collected mainly from their natural environment, as most are autochthonous plants in the area (88%, included in Table 2 with the voucher numbers). *Agave americana* and *Nicotiana glauca*, which are naturalized plants, are also collected from the wild. Other species are cultivated, for example, *Olea europaea* var. *europaea, Juglans regia* or *Eucalyptus globulus*, while *Allium cepa* and especially *Cinnamomum verum* are purchased in local markets. Veterinary medicine shows a high degree of specialization regarding the uses traditionally associated with each plant: 78% are used to treat just one particular condition, with only 13 species used to treat more than one. However, there are well-known plants that are used in a versatile way, such as the four most reported species previously mentioned, and *Retama sphaerocarpa* and *Juniperus oxycedrus* (both the plant and the "miera", or distilled resin) for example.

3.2. Animals used

Six animal resources have also been employed in EVPs in the region. They are included in Table 3 with the vernacular names, ethnoveterinary uses, methods of preparation and administration and number of reports. The source of this data is Benítez (2009). With the inclusion of these animal resources, we can state that EVPs in Granada involve 66 species for 88 veterinary uses.

The most important animal use involves the skins of several snake species belonging to the genera *Elaphe* and *Coluber,* as well as *Malpolon monspessulanus* (family Colubridae). These are used for colds mainly in horses, donkeys and mules. The snakeskin is given to the animals directly (normally inside a piece of bread) or mixed in a decoction with plants that are also used for colds. Another currently valid ethnoveterinary practice involving animal resources is the external application of a medicinal oil used to heal wounds, which is prepared with many *Berberomeloe majalis* specimens macerated in olive oil. This species, an insect of the family Meloidae, is known to contain a caustic terpenoid, cantharidin, which has a number of applications (Bologna et al., 2008). Snakeskins and *Berberomeloe* oil are also applied for the same conditions in both human and ethnoveterinary medicine. Finally we should mention the ancient ritual use of toads of the species *Bufo bufo* and *Bufo calamita* (family Bufonidae) in the prevention of a pig disease called locally "the red pig disease", which is caused by a bacterial infection of *Erysiopelotrix rhusiopathiae*. The toad was hung alive from the pigsty roof until it died and was then replaced with another, in the belief that this would repel the disease.

Although the use of animals for medicinal purposes in some parts of the province of Granada has been reviewed (Benítez, 2011), most are involved in treating human conditions. Only the 6 animal resources mentioned here are used in EVPs in the region. While these practices are not strange in some territories such as Brazil (Confessor et al., 2009), the use of animals to heal animals in Europe seems to be rare, and few references have been found (for example, 11 animals have been used in EVPs in the Cantabrian region of Campoo; Pardo-de-Santayana, 2008). In our study area, only 9% of the total number of species and 4.4% of total reports for the western part of the province refer to animals (10 reports), which indicates that the use of plants is much more important and frequent in the treatment of animal conditions in the region. However, we agree with Quave et al. (2010) that the study of medicinal animals has often been neglected when compared with medicinal plant research.



Graph 2. Distribution of number of plant species and number of reports (in Benítez (2009); for the western part of the province) for each pathological group. Rep.: reports.

3.3. Conditions

Information on 24 different diseases was collected, which was categorised into 8 groups following the classification outlined in Section 2.2.

Graph 2 shows the number of plant species in each pathological group for the whole province and the number of reports for the western region only (not extrapolated for the whole province). From the graph it can be seen that the category "traumatic lesions and poisoning" includes the highest number of species and received most reports, mainly due to the high number of wound healing plants. "Wound healing" (or epulotic) is the second most frequently reported cure (50 reports; 64 reports for plants related to birth), and wound healing plants are certainly most frequently used in Andalusian farming today. This is probably due to various factors: wound related conditions are generally mild ones that do not need specialized treatment or veterinary assistance; the conditions occur frequently; a high diversity of plant resources can be used; and most plants can also be used for humans.

Twenty-three different plants can be employed for traumatic lesions and poisoning (25 uses), with *Sideritis hirsuta*, *Digitalis obscura* and *Bupleurum gibraltaricum* being the most common ones. The first of these, locally known as "zahareña", is generally mixed with one of the other two species, both called "crujia", in a concentrated decoction applied externally. Sometimes the remedy is prepared by frying both plants in olive oil at a low temperature and then filtering the oil for storage. This mixture is generally applied to large and deep wounds, and it was frequently reported that if a single species is applied (normally *Sideritis hirsuta*), the healing is so fast that wounds may close and heal only externally, the inner zone remaining unhealed with the subsequent risk of internal infection. Adding "crujía" to the mixture means that the healing is not only slower and safer (occurring deep down first and then superficially), but that the stinging sensation that usually comes with healing is reduced, preventing possible self-inflicted injuries by the animal scratching the area.

It is noteworthy that twelve of the 25 uses for traumatic lesions and poisoning (11 plant species) and one animal resource: *Berberomeloe* oil (cf. Table 3) are also employed for the same conditions in human medicine (underlined in Table 2). The other plants reported in this category are used less frequently, usually as substitutes for reputed plants that are not always available. There are also 6 species used specifically for dislocations (the third most reported condition; 17 reports), and one species used for bone fractures; *Retama sphaerocarpa,* a plant also used in human medicine for both fractures and dislocations in eastern Andalusia (Casana, 1993; Martínez-Lirola et al., 1997; Benítez, 2009).

Table 3
Animal species used in ethnoveterinary medicine, classes, vernacular names, traditional uses, parts used, preparation and administration forms and number of reports.

Scientific name	Class	Vernacular name	Traditional use	Part used	Preparation, administration	Rep.
Berberomeloe majalis (Linnaeus, 1758)	Insecta	Curica, aceitera	Wound healing	Exudate	Medicinal oil in external use	2
Bufo bufo (Linnaeus 1758)	Amphibia	Sapo	Infection prevention	Whole animal	Direct application, ritual use	1
Bufo calamita (Laurenti 1768)	Amphibia	Sapo	Infection prevention	Whole animal	Direct application, ritual use	1
Malpolon monspessulanus (Hermann, 1804)	Reptilia	Bicha, culebra	Against Colds	Snakeskin	Direct application or decoction, internal use	2
Elaphe Wagler, 1833	Reptilia	Bicha, culebra	Against Colds	Snakeskin	Direct application or decoction, internal use	2
Coluber Linnaeus 1758	Reptilia	Bicha, culebra	Against Colds	Snakeskin	Direct application or decoction, internal use	2

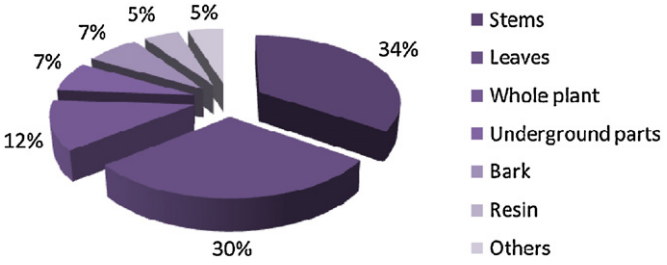
Rep.: reports. Underlined uses are the same for human folk medicine.

It has been said that reproductive efficiency is the primary factor affecting the productivity of livestock (Dilshad et al., 2008). In our study area, plants used in relation to reproductive conditions form the second largest group both in species richness and in number of reports. The species reported include mainly abortive and oxytocic plants (19 species, 64 reports) used to stimulate uterine contractions and expulsion of the placenta after birth. The most commonly used plants are *Stipa tenacissima*, *Ruta montana, Ruta angustifolia, Cinnamomum verum* (administered orally in concentrated decoctions) and *Daphne gnidium*, which is used in a ritual practice. *Mentha pulegium* is also widely employed, but more as a preventive of post-partum infections than as an abortifacient. Of the 19 species in this category, 8 are also used in the treatment of similar human conditions related to births, especially as abortifacients or preventatives of post-partum infection. One species is used as a contraceptive for pigs (*Juglans regia*).

The category for metabolic disorders and other diseases, the third largest in number of species, includes plants used as analgesics and for other less important uses, such as fortifying the body in general, as depuratives, and for alopecia. We highlight the peculiar use of *Juniperus phoenicea* ashes to increase the level of mineral salt in the diet of goats and sheep by simply adding the ashes to the feed. The leaves of *Salvia lavandulifolia* are considered nutraceutical. One informant argued that, from his extensive experience observing animal behaviour, livestock eat the leaves in greater quantities when they are suffering from an illness for self-medication reasons. The spines of *Rhamnus saxatilis* have been used as needles to extract venom from animals bitten by snakes or spiders, by puncturing the animal with the spine and then pressing the bitten area. It is also important to mention the extensive use of olive oil as a detoxifying agent, whereby the animal is simply forced to drink large quantities after a possible poisoning.

Infectious and parasitic diseases affecting livestock have been grouped together to follow the same classification used in other studies by our group (see references in Section 1). This group is the fourth largest (8 plants, 12 reports) and mainly includes plant treatments for fleas and scabies, distemper in dogs and, to a lesser extent, internal parasites. The ritual use of some toads to prevent bacterial infection should also be mentioned here.

Seven plant species are used to treat respiratory disorders (usually reported as colds), mainly from the Lamiaceae family (4 species). This family is extensively used in human herbal medicine for the treatment of respiratory disorders. Of the plants reported in this study, all but *Stipa tenacissima* and *Marrubium supinum* are also used in humans (according to the previously cited ethnobotanical works for the province). The number of reports for respiratory disorders was surprisingly low (only 4), due to the lack of reports in the previous works, and the inclusion of several species used for this condition that did not have report numbers (see Table 2). Five of the seven species used for colds are also used for colds in humans, so it is likely that shepherds and farmers use these plants indifferently. Three animal resources are also used for respiratory disorders: the skins of the three previously mentioned snake species, which are sometimes also employed in the treatment of human colds.



Graph 3. Parts of the plant used.

Another 6 plant species are used for digestive disorders such as diarrhoea, flatulence, as laxatives or for mouth diseases. In this group, most of the species used are not the same as those used to treat digestive disorders in humans. For the western part of the province this is the pathological group with the greatest number of species available for use in human ethnomedicine (Benítez et al., 2010b). The only species that coincide are those used for toothache (*Digitalis obscura* and *Scirpoides holoschoenus*), which can probably be interpreted as an example of extrapolation from ethnoveterinary practices to human folk medicine.

In the treatment of the aforementioned eye condition called "nube" (the condition which ranks fourth in number of reports: 9 in total), four species of plants with hollow stems are used, all of which belong to the family Poaceae. The method used to remove the membrane from the eye is to cut the inflorescence stem the same length as the space between the cavernous sinuses of the mouth and the eye. It is then carefully inserted between these two areas in order to facilitate drainage of the infection and the membrane to the mouth. This mechanical use, usually associated with the plant known as "esparto", *Stipa tenacissima* (the technique is locally known as "espartinar") and reported here for three other Poaceae species, can probably be associated with more species of the same family. For example, a similar indication was recorded in Catalonia for *Brachypodium phoenicoides* (L.) Roem. & Schultes (Bonet and Vallès, 2007).

The last pathological group relates to kidneys, and includes two plant species to cure kidney disease.

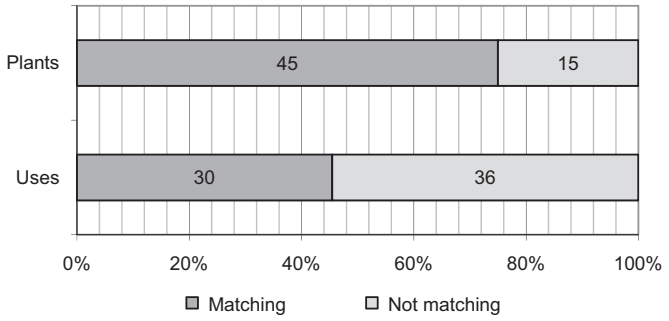
3.4. Parts of the plants used, preparation, ritual practices

The distribution of the plant parts used is shown in Graph 3. The use of different stems can be highlighted, most frequently flowering stems (including flowers and leaves) but also the inflorescence stems of the Poaceae. There is also an extensive use of leaves, which coincides with human medicinal treatments: after flowers, leaves are the second most important group of plant parts used in humans; cf. Benítez et al. (2010b). One of the differences between human and veterinary medicine is that for human treatments people tend to select the plant parts with more care, separating flowers from stems, while for ethnoveterinary uses they tend to employ the entire aereal part or the flowering stems, including stems and

leaves, rather than selecting only flowers. Besides stems and leaves, the whole plant, underground parts and bark are also important in EVPs. In a few cases the oil, distilled resin, ash and spines are used. It should be noted that the frequent use of stems and leaves in our study area contrasts with the parts used in other territories. Stems and leaves are a renewable source and their collection does not result in the death of the plant. In South Africa, for example, a higher percentage of bark, roots and other underground parts are used (Zschocke et al., 2000), mainly from slow-growing trees, with bark and roots comprising 54% and bulbs and whole plants 28% of parts used for the Zulu (Mander, 1997). Conservation problems due to ethnobotanical collection may be less important when the collected part of the plant is renewable, and studies on the substitution of plant parts (e.g. Zschocke et al., 2000; Katerere and Eloff, 2008) are not needed in Granada to preserve the natural populations of the medicinal plants.

Regarding the way in which remedies are administered, oral and topical administrations are almost equal in proportion, with a slightly higher percentage for oral administration (53.6%). It is not surprising that the main form of preparation is decoction, followed to a lesser extent by infusions. Infusions are the most frequently used method of preparation and administration in human ethnopharmacology for the same area. Preparation of plants by maceration in water is reported only once, and frying in oil for external application is reported on only three occasions. As previously mentioned for the plant parts used, an important difference between human and veterinary medicine in our study area as regards forms of preparation and administration seems to be that the remedy is not as carefully prepared when it is destined for an animal. The decoction is a generalized one and less carefully selected plant parts are used, which are normally boiled for a long time. For human treatments people tend to be more thorough, preparing many aromatic plants as infusions, and adding only the flowering shoots or the aerial parts without the stems.

It should be highlighted that in seven cases (8% of total uses) the ethnoveterinary use is considered "magico-religious" or "superstitious", i.e., remedies not explained on the basis of the pharmaceutical properties of the plant or animal but rather on an intense faith in the fulfilment of its mission (Benítez et al., 2010b). In some of these applications, as has been mentioned in previous works (González-Tejero et al., 1999, illustrated with an example from *Eryngium campestre* L. and its use against lameness), the idea is to transfer the ailment from the animal to the plant, with the animal recovering as the plant dies. Such practices are still widespread and involve not only plants but also animals, for example, the previously mentioned use of toads. In this case, before the toad died, the bacterial infection would supposedly be transferred from the pig to the toad. Another example is the well-known use of *Daphne gnidium* bark to make necklaces that are tied to the neck (or sometimes to the abdomen) of sheep and goats in order to facilitate the expulsion of the placenta after birth (this is a fairly widespread use in southern Spain, see graphical abstract for an illustration). The same method is used by other farmers against diarrhoea in animals, and is practised in certain villages of the Murcia region (Obón and Rivera, 1991). The ritual use of this plant seems to be ancient and quite extensive. A similar method has been described in the Italian region of Calabria for the treatment of papillomas (Passalacqua et al., 2006). The stems of *Nerium oleander* are also known to have been used in a healing ritual for digestive disorders, in which crosses were made on the animal's belly while a healing prayer, unknown to us, was recited. The use of plants as amulets for pets is also occasionally practised today, not only as a preventative for certain conditions, but also for the treatment of distemper in dogs (leaves of *Stipa tenacissima*). One example is to hang bags filled with leaves of *Pistacia lentiscus* or *Stipa tenacissima* around the neck of the animal. A less common method is to place a whole specimen of *Plantago coronopus* in a bag and hang it around the neck of a goat to prevent complications while giving birth.



Graph 4. Proportion of matching and non-matching plants and their uses in veterinary and human traditional medicine.

3.5. Relation to human medicine

It should be noted that 75% of the 60 plant species reported in this study are also used in human medicine (Graph 4). For these 45 plants, 45% of uses are applied to treat similar diseases, demonstrating a high degree of convergence between traditional veterinary and human medicines, two disciplines which mutually enrich one another (Pieroni et al., 2006). As can be seen in Table 3, for animal resources this percentage is even higher: 4 of the 6 animal uses reported (66%) are also employed to treat humans.

As regards pathological groups, the category "respiratory conditions" shows most similarities between plants used in both veterinary and human herbal medicine. For the group "traumatisms and poisonings" half of the species used in veterinary medicine are also employed for similar human affections. However, for the treatment of infections and parasites, as well as kidney and eye conditions, none of the plants included in this paper are used to treat humans. This may be because these conditions are more common in animals (or are exclusive to them, such as the eye condition described as "nube"), or because better remedies for humans are known (probably the case for kidney diseases).

As recent papers on the use of plants and animals in human ethnomedicine for Granada are restricted to the western part of the province, we can compare the total reports regarding ethnoveterinary knowledge for the same area (187 reports, from Benítez, 2009) with the 2113 total reports for human ethnomedicine, including 1963 for plants (Benítez et al., 2010b) and 150 for animals (Benítez, 2011). The relatively high percentage of reports for EVPs (8.8%) shows that this discipline is not as unknown as might be initially expected for a European territory.

3.6. Prevention of illnesses in general

We agree with Huffman (2003) and Pieroni et al. (2006) that one of the evolutionary pathways in ethnoveterinary practices has been the observation of self-medication in animals by shepherds and farmers. Although the list of forage and pasture species within the region is too large to present here (included in Benítez (2009) for the western part of the province), some of the plants are used by animals to heal themselves. This self-healing occurs when an animal suffering from a particular affection consciously selects particular plants for food, with the aim of obtaining a certain health benefit. For example, in some areas of Granada it is believed that when cattle eat *Salvia lavandulifolia* they are doing so in order to achieve a health benefit. There are also cases in which species are given as food to animals for certain non-medicinal benefits, such as to increase the number of eggs in hens (for example, *Sonchus oleraceus* L., *Rorippa nasturtium-aquaticum*, *Urtica* spp. and *Papaver*

rhoeas L.). At least one plant, *Urtica dioica* (a common species in the area), is also employed for the same purpose in Tuscany, Italy (Uncini Manganelli et al., 2001). Some plants are also used in the direct treatment of scabies and fleas (see Table 1) whereas other species, such as *Daphne gnidium*, *Ulmus minor* L., *Juglans regia*, *Mentha pulegium* and *Ononis natrix* L., are hung in barnyards to repel biting and stringing insects.

4. Concluding remarks

The use of plants in veterinary medicine in the province of Granada involves a large number of species (60 in total). Most are also commonly used in human medicine. These plants, most of which are autochthonous and gathered from natural populations, are used to treat 24 different diseases, mostly minor ailments. There are a small number of reports of animal resources being used to heal animal conditions (6 ethnoveterinary uses) which represent some of the first reports of using animals to heal animals in the Iberian range (see Pardo-de-Santayana (2008) and Quave et al. (2010) for some previous examples).

It is important to highlight that 25% of the plants included in this study are used exclusively in animal healthcare are not used in human ethnomedicine in Granada, whereas in other territories all the plants used in both human and veterinary medicine are the same (for example, in Navarra; Akerreta et al., 2010). Despite this, the convergence between both branches of medicine in our study area has been discussed, and for the shared species, nearly half the uses for ethnoveterinary medicine are similar to those for human medicine.

It should be noted that some of the reported plants which are not used in human medicine are toxic or mildly toxic, a fact which may support the lack of use. Of these 15 plants, at least 4 contain known toxic principles: *Cytisus scoparius* (alkaloid sparteine; Bruneton, 2001a), *Daphne gnidium* (daphnetoxine in the bark, a diterpene derivate; Bruneton, 2001a), *Nerium oleander* (cardiotonic heterosides; Bruneton, 2001a) and *Nicotiana glauca* (anabasine, a pyridine alkaloid, Furer et al., 2011). Others may contain some toxic compounds but more study of their chemistry is required, particularly in terms of toxicity. For example, *Festuca scariosa* may contain pyrrolizidine alkaloids like other plants of the genera (*Festuca arundinacea* Schreb.; Koulman et al., 2008) or phytoalexines (like *Festuca argentina* (Speg.) Parodi; Casabuono and Pomilio, 1997). While *Juniperus phoenicea* is not highly toxic, other species of the genera are considered to be (*J. sabina* L., whose essential oil contains sabinene and sabinile acetate, with embriotoxic properties; Bruneton, 2001b). Others, such as *Rhamnus saxatilis* (some species of the genera are widely known for their antraquinones) or *Rubus ulmifolius* (also contains antraquinones; Flamini et al., 2002) may have a narrow therapeutic range.

It is not surprising that for some of the most common animal conditions there are a high number of possible plant species that can be used. However, there are also some common conditions that are treated with only one or two species, a fact which may illustrate a loss of ethnopharmacological knowledge. For example, a bone fracture is a common condition for which only *Retama sphaerocarpa* is currently used, probably because shepherds also use it for different bone and muscle conditions). According to our informants, its use in human medicine is probably an extension of its use in ethnoveterinary practices. In the group for digestive conditions, frequent affections such as diarrhoea and flatulence could be treated with more plants in the past (only one species recorded for each, with a low number of reports). The same can be said for several indications in the group for metabolic alterations: plants used for their invigorative, depurative or detoxifying properties and for the plants used as contraceptives (only one species recorded for each). In our opinion, these must have been better known in the past.

This progressive loss is further exacerbated by the fact that, unlike other territories such us Pakistan or Uganda (Dilshad et al., 2008; Gradé et al., 2009), only some of the reported remedies are widely used today. In some cases, our informants reported that, compared with the past, less plant resources are being used now and with less frequency, mainly due to the higher government sanitary control and the better access to synthetic drugs, manifested in an increased voluntary use of synthetic drugs. We are currently witnessing a general change in the pattern of livestock management in Spain in this respect. Recently, in a European context, it has been estimated that 5393 tons of antibiotics, 194 tons of antiparasitics and 221 tons of other veterinary drugs are used per year to treat alimentary and metabolism disorders (Kools et al., 2008).

It has been said that ethnoveterinary practices can be regarded as sustainable veterinary medicine (Lin et al., 2003). However, in our study area, many farmers are afraid of using traditional medicine for more serious conditions due to government sanitary control, which sometimes imposes the use of synthetic drugs. We believe that more pharmacological and ethnoveterinary studies must be carried out to improve our understanding of traditional practices.

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