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Studies on pharmaceutical ethnobotany in the region of Pallars (Pyrenees, Catalonia, Iberian Peninsula). Part I. General results and new or very rare medicinal plants

Antoni Agelet, Joan Vallès *

Laboratori de Botànica, Facultat de Farmàcia, Universitat de Barcelona. Av. Joan XXIII s/n, 08028 Barcelona, Catalonia, Spain

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Abstract

An ethnobotanical survey was carried out in the region called Pallars — constituted by two districts, Pallars Sobirà and Pallars Jussà — situated in the Central Pyrenees, in North West Catalonia (Iberian Peninsula), with an approximate area of 2530 km^2 and a population of 19 000. We obtained data on 437 plant species used for health care through interviews with 264 people. We detected 867 unreported or uncommon uses corresponding to 272 plant species, 52 of which had never or very rarely been cited as medicinal. To present the most important findings concerning the ethnopharmacology of the area studied, this first part includes the general results and the new or very scarcely reported medicinal vascular plants. Further papers will deal with unreported or very uncommon uses for known medicinal plant species and with medicinal non-vascular plants.

Keywords: Ethnobotany; Quantitative ethnobotany; Pyrenees; Catalonia; Medicinal plants; Folk medicine

1. Introduction

According to Alcorn (1995), the aims of ethnobotany are twofold: to document facts about plant use and management and to describe roles and processes in plant use. These two aims are contextualized by the applied goal of developing new plant-derived products, among which medicines are very relevant (Croom, 1983; Hedberg, 1993). Several authors have remarked that the ethno-directed investigations, i.e. those carried out on the basis of traditional plants uses, are more efficient that the random screening in the search for new drugs (Cox and Balick, 1994; Khafagi and Dewedar, 2000). The different goals require different approaches, and that is why ethnobotany has been defined as a discipline placed in the crossroad between social and natural sciences (Barrau, 1971). Prance (1991) insisted in the interdisciplinary aspect of ethnobotany and in its link with the development of new pharmaceuticals, and the latter aspect is more deeply treated in Chadwick and Marsh (1994). Taking into account the precedent comments, in the last years we are carrying out ethnobotanical studies in different regions of Catalonia (see Bonet et al., 1999, and references therein) with two purposes: (i) to contribute to the knowledge and the preservation of a part of the national cultural heritage; and (ii) to find out new or rare uses of medicinal plants, which could lead to the use of new plant-derived medicines. This kind of research is not rare in Europe, and in particular in the countries of the Iberian Peninsula, although it is not so common as in many less-industrialized countries. In fact ethnobotanical studies in industrialized countries are particularly urgent, because in the last few generations there has been a considerable loss of traditional knowledge about plants, and especially about medicinal uses. On the one hand, rural places have suffered an important depopulation, and, on the other hand, people still living there adopted (at least partly) the so-called 'modern' culture to the detriment of their 'traditional' one, considered inferior, in a process that we can define as acculturation (Ember and Ember, 1997). The list of European and Iberian contributions

* Corresponding author. Fax: +34-9340-35879.
E-mail address: avalles@farmacia.far.ub.es (J. Vallès).

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to ethnobotany — basically pharmaceutical ethnobotany — given in Raja et al. (1997) and Bonet et al. (1999) can be updated with the citation of some recent works, such as Fernández-López et al. (1996) and Agelet (1999), the basis for the present paper), Guarrera (1999), Pieroni (1999, 2000), Fernández-Ocaña (2000) and Ivancheva and Stantcheva (2000).

Our work in the region presently considered was conducted with both above-stated objectives, and this paper mainly presents the first part of the results dealing with the second of those purposes, i.e. the applied research on popular phytotherapy that is relevant for the search for new drugs, on the basis of the conviction that plants from the Mediterranean region have a real medicinal potential. The territory studied (Fig. 1) is constituted by two mountain districts ('comarca', in plural 'comarques', in Catalan) situated in the Pyrenees: el Pallars Jussà (or el Baix Pallars) and el Pallars Sobirà (or l'Alt Pallars); both areas together are known as Pallars and are defined by the river Noguera Pallaresa, which crosses them from North to South. El Pallars Sobirà, a clearly Pyrenean district, with different peaks around 3000 m, has an area of 1376 km^2 and a population of 5050. El Pallars Jussà, basically a Prepyrenean district, with some peaks around 2000 m, has an area of 1290 km^2 and a population of 13 760. The predominating climate is submediterranean, but alpine and subalpine climates characterize the Northern portion of the territory studied, and mediterranean climate is typical of the Southern plains and close Prepyrenean mountains. Rainfall ranges from 600 to 1300 mm/year — snow being a normal phenomenon in many zones and mean temperature oscillates between −3 °C (January) and 24 °C (July). The altitudinal and climatic variation cause a very diverse vegetal landscape. According to Folch et al. (1984), we can find in Pallars the following types of vegetation dominia: (i) mediterranean and submediterranean mountain, with oak (*Quercus faginea*, *Q. pubescens*) and holm-oak (*Q. ilex*) forests and their series; (ii) Central European mountain, with beech (*Fagus sylvatica*) and pine (*Pinus sylvestris*) forests — the former rather scarce; (iii) alpine and subalpine mountain, with meadows and spruce (*Abies alba*) and pine (*P. uncinata*) forests; (ii) riparian vegetation, with herbaceous communities and willow (*Salix purpurea*) and alder (*Alnus glutinosa*) forests.

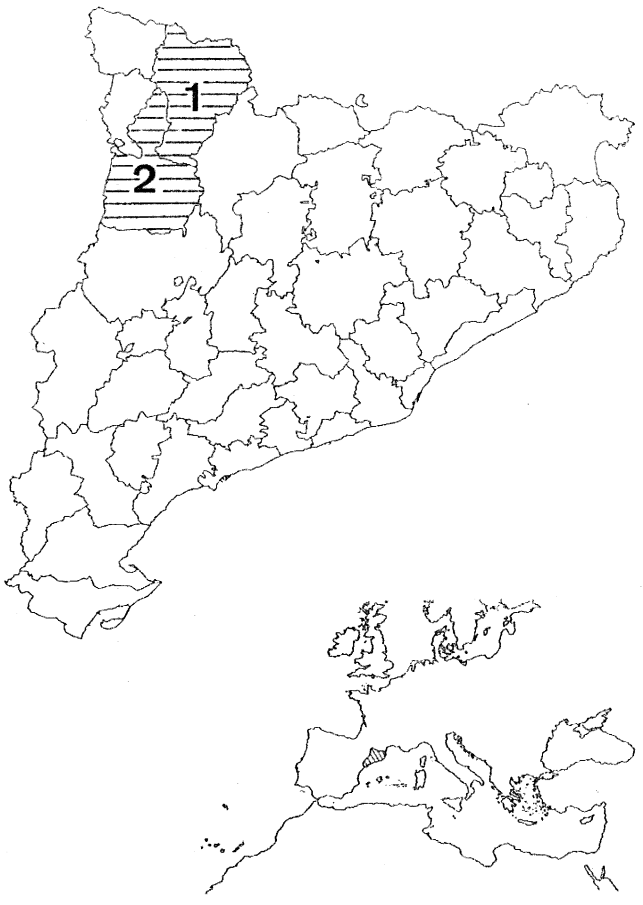

Fig. 1. Location of the areas studied in Europe and in Catalonia (shaded areas: 1, El Pallars Sobirà; 2, El Pallars Jussà).

From the second half of 19th century, a constant decrease in the population has been observed in Pallars, which has reduced from more than 50 000 in 1850 to the present 19 000 (Sabartés, 1993). This process has been particularly dramatic from 1960. People left the region to go to large cities, as Barcelona, Catalonia's capital, and, on the other hand, small settlements or isolated farms (called in Catalan 'mas' or 'masia', in plural 'masos' or 'masies') were abandoned in favor of larger villages. The depopulation has been a current trend in rural areas in the country, especially in the mountains, of which Pallars constitute one of the most-clearest examples. A relative isolation has been added to the problems of people in Pallars, because, until recent times, the communication network (roads, railways) was very deficient. This fact caused that el Pallars Jussà and el Pallars Sobirà are two districts which are rather marginal in the Catalan economy. Both districts belong to the socioeconomical territorial unit called Catalan High Pyrenees (Carreras, 1983), which comprises the main mountain zones in the country. Agriculture and livestock-raising are the basis of Pallars economy, even though tertiary sector and other activities as iron mining and forestry are also relevant.

Different authors contributed to the study of ethnobotany — in the wide sense — in Pallars. Among them, Ramon Violant i Simorra has been particularly active. He was born in Pallars and he studied his region before the great depopulation suffered in this century; his numerous articles, published between 1930 and 1960, have been reedited together (Violant, 1979–1981). We can also cite the works of Griera (1923–1964), Llensa (1946, 1950, 1953, 1959), Font (1948, 1961), Lluís (1967) and Amades (1982). Nevertheless, data concern-

ing popular uses of medicinal plants are scarce and often deficient.

2. Methodology

Information was obtained by the method of the ethnobotanical interview with people without scientific culture, born or having lived most of their lives in the region studied, and usually quite elderly. During our meetings with people, we tried to assess every question linked to the uses of plants by people with health purposes, in persons and animals. We did that through general conversations without a closed questionnaire, asking people to collect plants with us and to show us where and how they stored the plants and how they prepared the remedies; if it was not possible to collect plants with the informants, specimens collected by ourselves in the region were shown to them to confirm the identity of each taxon. We tried to avoid asking direct questions that could bring an implicit answer (like 'do not you use this plant for this purpose?' or 'do not you know this plant by this name?'), so as not to coerce the informants and lessen their spontaneity; we verified that many people are very influenced by those questions and very often tend simply to answer 'yes'. Whenever possible, the conversations were recorded and, once back to the laboratory, transcripted. The field and laboratory work lasted more than five years, during which we performed 155 interviews concerning 264 from 30 to 101-year-old people (mean age, 70 years: 48% women, 52% men). In most cases, there was more than one interview session; the total time of interview recorded is 395 h.

Voucher herbarium specimens of every taxon cited were prepared and deposited in the Herbarium of the Laboratory of Botany, Faculty of Pharmacy, University of Barcelona (BCF). Complete records of the interviews are also kept in this laboratory. Further details of the interviews are given in the Doctoral Thesis of one of the authors (Agelet, 1999). For plant nomenclature, we follow Bolòs et al. (1993). Complete citation, including authorities, of the taxa is given in Table 1, and the first time that they appear in the text for the species not listed in this table.

To establish the originality of our research, we compared our results with an extensive corpus of the most relevant Iberian and European ethnobotanical studies and a wide selection of other papers and treatises covering the uses of medicinal plants all over the world. These studies are the same as those used and cited by Raja et al. (1997) and Bonet et al. (1999), with the addition of Le Floc'h (1983), Schröder et al. (1996), Sezik et al. (1997), Cañigueral et al. (1998) and Selga (1998), with which the literature used to compare the results reaches 77 papers.

3. Results

We established a catalogue of Pallars ethnoflora consisting of 529 species, 437 of which (82.6%) are used in the field of health, 60 (11.34%) have other uses (among which food is the most important) and 32 (6.04%) have only popular names, but no use. The 437 health plants can be grouped in the following way, taking into account that one plant may belong at the same time to more than one group: 410 (93.82%) therapeutic, 94 (21.51%) prophylactic, 40 (9.15%) with magicoreligious use, 12 (2.74%) diagnostic elements, 55 (12.58%) with other uses linked with health; 146 (33.4%) plants are considered noxious or toxic.

The complete catalogue of the ethnoflora of the areas studied is given in Agelet (1999). We are presenting in this paper the general results of the work concerning pharmaceutical ethnobotany as well as the information about plants unreported to date as medicinal. Further articles will deal with the unreported uses of plants already known as medicinal and with the non-vascular medicinal plants used in the territories studied. Table 1 reports the 38 vascular plant species for which we did not find in the literature any medicinal use; they are grouped by families in alphabetical order. Following the reliability criterion of Le Grand and Wondergem (1987) and Johns et al. (1990), the unreported medicinal plants with uses cited by at least three independent informants are indicated by an asterisk (*).

With the 410 therapeutic species the informants prepare 3438 medicines — 136 of which are considered of very high efficacy — that cover 193 therapeutic groups. Most reported therapeutic activities were: against infections and infestations (19.92%), among which plants used against cold, and antibacterian and antihelminthic species are predominating; against digestive pathologies (14.52%), particularly diarrhea and colics; against traumatisms (13.44%), including wounds and contusions. The 94 prophylactic species are reported in 161 medicines used to prevent mainly infections and infestations (59.02%), and circulatory (16.09%), digestive (7.8%) and respiratory (6.82%) troubles. Most of the plants reported as toxic (85.62%) are also used as medicinal with all the necessary precautions. Almost all the taxa used with magicoreligious purposes have also normal therapeutic or prophylactic uses; *Carlina acanthifolia* All. and *S. viminialis* L. are the only taxa strictly linked to magicoreligious practices. Most of the remedies prepared with medicinal plants are used in human medicine (72.11%); the remaining are used in veterinary medicine (25.47%) or in both human and veterinary medicine (2.3%).

The predominating botanical families are Asteraceae (10.98%), Rosaceae (6.86%), Lamiaceae (6.4%%), Fabaceae (6.4%), Poaceae (4.11%), Liliaceae (3.43%), Apiaceae (3.43%) and Solanaceae (2.29%). The species

Table 1
Vascular plant species used in folk phytotherapy in Pallars and previously unreported or very scarcely cited as medicinal or toxic

Scientific name (voucher specimen)	Local Catalan name	Part used	Popular use	Preparation	Administration	Type of use (Peters, 1987)	Frequency of citation
Apiaceae							
Chaerophyllum aureum L. (BCF 40775)	Sabuda	Aerial part	Tympanitic in animals	Direct ingestion	Oral	Toxic (may be lethal)	1
Chaerophyllum temulum L. (BCF 37505)	Cicuta	Aerial part	Resolutive	Embrocation	Topical	Curative	1
Eryngium bourgattii Gouan (BCF 38247)	Panical blau	Aerial part	Gastric antialgic	Tisane	Oral	Symptomatic	1
	Card blau	Inflorescence bracts	Antiseptic in animals	Direct use	Topical	Curative	1
Asteraceae							
Achillea chamaemelifolia Pourr. (BCF 37237)	Setge	Floral top	Anticatarrhal in colds associated with hypertension or fever	Tisane	Oral	Symptomatic	1
			Vulnerary	Pomade	Topical	Curative	1
Artemisia alba Turra. (BCF 38333)	Botja	Aerial part	Renal antialgic	Oil lotion	Topical	Symptomatic	1
	Botja per als ronyons		Digestive	Tisane	Oral	Palliative	1
Centaurea alba L. (BCF 38324)	Braçadera	Aerial part	Hypoglycemiant	Tisane	Oral	Palliative	1
Inula helvetica Weber (BCF 37882, 37883)*	Àrnica	Flower head	Antialgic	Lotion, embrocation	Topical	Pallative	1
	Àrnica borda		Antialgic/anti-inflammatory	Embrocation		Pallative, symptomatic	3
			Bone reinforcing	Lotion		Pallative	1
			Vulnerary	Embrocation		Curative	1
Staehelina dubia L. (BCF 38016)	Botja blava	Aerial part	Antihypertensive	Tisane	Oral	Palliative	1
Brassicaceae							
Cardamine pyrenaica (Loefl.) O. Kunze (BCF 39730)	Greixos	Leaf	Digestive/gastrointestinal antiseptic	Poultice	Topical	Palliative, curative	1
Caryophyllaceae							
Telephium imperati L. (BCF 38213)	Herba felera	Aerial part	Anticholagogue in animals	Wine maceration	Oral	Pallative	1
			Hepatoprotector	Tisane			1
Clusiaceae							
Hypericum maculatum Crantz (BCF 37566)	Herba de cop	Aerial part	Analgesic/anti-inflammatory	Lotion	Topical	Pallative and symptomatic	1
			Antihypertensive	Tisane	Oral	Pallative	1
		Floral tops	Anti-inflammatory	Lotion or embrocation	Topical		1

Table 1 (*Continued*)

Scientific name (voucher specimen)	Local Catalan name	Part used	Popular use	Preparation	Administration	Type of use (Peters, 1987)	Frequency of citation
			Hepatic anti-inflammatory	Tisane	Oral		1
Crassulaceae							
Sedum dasyphyllum L. (BCF 38238, 38953)	Pa de moixó	Aerial part	Antialgic/anti-inflammatory	Poultice	Topical	Palliative and symptomatic	1
		Leaf	Purgative	Potion	Oral	Curative	1
Sedum rupestre L. (BCF 38202)	Pa de moixó Fideus bords	Aerial part	Ocular antiseptic	Poultice	Topical	Curative	1
Cupressaceae							
Cupressus macrocarpa Hartweg (BCF 38025)	Xiprer	Strobile	Acaricide in animals	Lotion	Topical	Curative	1
Dipsacaceae							
Cephalaria leucantha (L.) Roem. Et Schultes (BCF 39738)	Escabiosa	Floriferous stem	Digestive	Tisane	Oral	Palliative	1
Scabiosa columbaria L. (BCF 37503)*	Escabiosa	Floriferous stem, floral top	Anticatarrhal	Tisane	Oral	Symptomatic	1
			Antidermatosic	Tisane, lotion	Topical, oral		2
			Antiexematose			Curative	2
			Antiinfluenza	Tisane	Oral	Symptomatic	1
			Antipyretic				1
			Buccopharyngeal antiseptic			Curative	1
			For measles				
			Antihypertensive			Palliative	1
Fabaceae							
Medicago minima (L.) L. (BCF 39213)	Miligó bordisc	Young aerial part	Tympanitic in animals	Direct ingestion	Oral	Toxic (may be lethal)	1
Fagaceae							
Quercus × *cerrioides* Willk. and Costa. (BCF 37886, 38020)	Roure	Roasted fruit	Antidiarrhoeal	Tisane	Oral	Curative	2
Lamiaceae							
Sideritis montana L. (BCF 39211)	–	Aerial part	Anticephalalgic	Tisane	Oral	Symptomatic	2
Liliaceae							
Merendera montana (L.) Lange (BCF 40417)	Safrà bord	Flower	Abortive in animals	Direct ingestion	Oral	Toxic	1

Table 1 (*Continued*)

Scientific name (voucher specimen)	Local Catalan name	Part used	Popular use	Preparation	Administration	Type of use (Peters, 1987)	Frequency of citation
Pinaceae							
Pinus mugo Turra subsp. *uncinata* (Ramond ex DC. in Lam. Et DC.) Domin (BCF 38203)*	Pi negre	Inflorescence /trunk/strobile	Antiasthmatic	Tisane	Oral	Symptomatic	5
		Inflorescence /leaf/strobile	Anticatarrhal				20
		Inflorescence	Antidiarrhoeal			Pallative	1
		Rotten wood	Antieritematose	Direct application	Topical	Curative	1
		Inflorescence	Blood depurative	Tisane	Oral	Palliative	1
			Antihypertensive				3
		Branch/leaf	Salutiferous/reconstitutive	Direct ingestion			6
		Burnt trunk and branch	Vulnerary	Embrocation	Topical	Curative and prophylactic	2
		Cortical parenchyma	Vulnerary/haemostatic	Poultice		Curative	4
Plantaginaceae							
Plantago subulata L. (BCF 38029)*	Herba de set sagnies	Aerial part	Antipelohemic	Tisane	Oral	Palliative	1
			Weakening			Toxic	1
		Aerial part /leaves	Antihypertensive			Palliative	5
Poaceae							
Elymus pungens (Pers.) Melderis (BCF 38659)	Embriaga	Fruit	Narcotic in animals	Direct ingestion	Oral	Toxic	1
Festuca paniculata (L.) Schinz et Thell. (BCF 40412)	Sudorn	Plant in fruit	Salutiferous	Direct ingestion	Oral	Food medicine	1
Polypodiaceae							
Asplenium fontanum (L.) Bernh. In Schard. (BCF 39210)	–	Frond	Antivariolose in pigs	Tisane	Oral	Palliative	1
Primulaceae							
Lysimachia ephemerum L. (BCF 38643)	Herba melsera	Forgotton by the informant	Spleen anti-inflammatory in animals	Forgotten by the informant	Forgotten by the informant	Forgotten by the informant	1
Ranunculaceae							
Consolida ajacis (L.) Schur. (BCF 38201)	–	Aerial part	Pediculicide	Embrocation	Topical	Curative	1

Table 1 (*Continued*)

Scientific name (voucher specimen)	Local Catalan name	Part used	Popular use	Preparation	Administration	Type of use (Peters, 1987)	Frequency of citation
Rosaceae							
Rosa agrestis Savi (BCF 38023)	Gavarrera	Fruit	Antitoxic (for insect and myriapod bites)	Embrocation	Topical	Symptomatic	1
			Vulnerary			Curative	1
Rosa arvensis Huds. (BCF 38280, 38313, 38314)	Barsa	Flower	Antihaemorrhoidal	Lotion	Topical	Palliative	1
	Roser bord			Ointment			
			Vulnerary	Lotion	Topical	Curative	1
			Laxative in newborns	Tisane	Oral	Palliative	1
		Young stem buds	Antimycotic	Collutorium	Topical	Curative	1
			Buccopharyngeal antiseptic				
			Oxytocic	Suspension	Oral		1
Rosa canina L. × *Rosa gallica* L. (BCF 39709, 39710, 39711)*	Roser blanc	Flower	Ocular antiseptic	Collyrium	Topical	Curative	3
Rosa sicula Tratt. (BCF 37502)	Gavarrera	Gall	Haemostatic in epistaxis Antihypertensive	Tisane	Oral	Palliative	1
Rubus saxatilis L. (BCF 38293, 38294)	Barsa	Young stem buds	Buccopharyngeal antiseptic	Tisane /collutorium	Oral/topical	Curative	1
Saxifragaceae							
Ribes alpinum L. (BCF 38395, 38396)	Pinsonera	Fruit	Laxative	Direct ingestion	Oral	Toxic	1
Scrophulariaceae							
Linaria spuria (L.) Mill. (BCF 38311)	Arenària	Aerial part	Diuretic	Tisane	Oral	Palliative	1
Rhinanthus mediterraneus (Sterneck) Senn. (BCF 37938)*	Forrollada	Aerial part	Oxytocic	Enema or tisane	Anal or oral	Curative	14
Scrophularia alpestris Gay ex Benth in DC. (BCF 39733, 39734)	Setge	Young leaf	Resolutive	Direct application	Topical	Curative	1
Veronica austriaca L. (BCF 37923)	–	Aerial part	Anticephalalgic	Tisane	Oral	Symptomatic	1
Violaceae							
Viola × *wittrockiana* Gams. (BCF 39221)	–	Flower	Ocular antiseptic	Collyrium	Topical	Curative	1

Plants with uses reported by three or more independent informants are marked with an asterisk (*).

Table 2
Comparison of results of ethnobotanical studies in Pallars and in other Mediterranean territories

Region	Extension (km^2)	Population	Flora[a]	MP[b]	MP (km^2)	MP/Inhabitant	NI[c]	MP/I[d]	EI[e]	U/C[f]
Pallars[g]	2530	18 800	1500	437	0.142	2.32×10^{-2}	264	1.7	29.1	49.2
Huesca[h]	15 671	222 000	2500	553	0.035	2.48×10^{-3}	–	–	22	50
Castelló[i]	6679	385 823	2128	365	0.055	9.46×10^{-4}	150	2.3	17.2	–
Granada[j]	12 531	761 734	–	241	0.019	3.16×10^{-4}	–	–	–	–
Cabo de Gata[k]	800	20 000	1000	253	0.316	1.26×10^{-2}	153	1.7	25.3	–
Cerdanya[l]	1086	23 000	1600	234	0.215	1.02×10^{-2}	155	1.5	15	30.4
Vall del Tenes[m]	260	17 969	–	150	0.577	8.35×10^{-3}	28	5.4	–	70.8
Cyprus[n]	9251	639 000	1900	379	0.041	5.93×10^{-4}	–	–	–	19.9
Tunisia[o]	15 4520	790 0000	2000	553	0.004	7×10^{-5}	130	4.3	27.7	27.7
Israel-Palestine[p]	20 700	448 6600	–	150	0.007	3.34×10^{-5}	100	1.5	–	–
Córdoba[q]	13 718	724 000	1641	145	0.01	2×10^{-4}	106	1.4	8.8	–
Sierra de Cazorla[r]	2143	72 423	1933	344	0.161	4.7×10^{-4}	183	1.9	17.8	88.8
Caurel[s]	260	2400	800	223	0.86	9.29×10^{-2}	45	4.9	27.9	–
Segarra[t]	646	17 040	–	92	0.142	5.39×10^{-3}	29	3.2	–	52.6
Alt Empordà[u]	178	41 300	1650	149	0.837	3.61×10^{-3}	46	3.2	11	93
Guilleries[v]	594	18 880	1100	158	0.266	2.32×10^{-2}	27	5.9	20	87

[a] Approximative number of species of vascular plants in the territory, when available.
[b] Number of medicinal plants cites.
[c] Number of informants.
[d] Number of medicinal plants cited per informant.
[e] Ethnobotanicity index (Portères, 1970).
[f] Utilization index (Muntané, 1991; Bonet et al., 1999).
[g] Agelet (1999), present study.
[h] Villar et al. (1992).
[i] Mulet (1990).
[j] González-Tejero (1989).
[k] Martínez (1993) and Martínez et al. (1996, 1997).
[l] Muntané (1991).
[m] Bonet (1991) and Bonet et al. (1992).
[n] Arnold-Apostolides (1991).
[o] Le Floc'h (1983) and Boukef (1986).
[p] Friedman et al. (1986) and Palevitch et al. (1986).
[q] Casana (1993) and Galán (1993).
[r] Fernández-Ocaña (2000).
[s] Blanco (1996).
[t] Raja (1995) and Raja et al. (1997).
[u] Parada (1997) and Bonet et al. (1999).
[v] Selga (1998) and Bonet et al. (1999).

more collected and used by the informants are *Agrimonia eupatoria* L., *Hypericum perforatum* L., *Lilium candidum* L., *Lavandula angustifolia* Mill., *Valeriana officinalis* L., *Carum carvi* L., *Ramonda myconi* (L.) Reichenb., *Asperula cynanchica* L., *Mentha spicata* L., *Rosa* × *centifolia* L., *Salvia officinalis* L., *P. sylvestris* L., *Hyssopus officinalis* L., *Achillea millefolium* L., *Rosmarinus officinalis* L., *Jasonia saxatilis* (Lam.) Guss., *Gentiana lutea* L., *G. burseri* Lap., *Juglans regia* L., *Matricaria recutita* L., *Tanacetum parthenium* (L.) Schultz Bip., *Tilia platyphyllos* Scop., *Sambucus nigra* L. and *Thymus vulgaris* L.

Complete aerial parts of the plants are largely most used for medicinal purposes (37.3% in plants used separately and 39.11% in plant mixtures). Other commonly used parts are, in decreasing order, flowers (including floral summits and flowering heads, 15.75 and 13.28%), fruits (including seeds, 13.92 and 14.26%), leaves and foliar structures (13.65 and 12.73%), stems and cauline structures (8.09 and 7.49%), and roots (5.3 and 4.85%). The most common pharmaceutical forms are for oral administration (tisane prepared by infusion, decoction or maceration, 33.71%) and for dermatological application (poultice, 13.14%).

4. Discussion and conclusions

4.1. Quantitative ethnobotany

Table 2 presents a comparison of some quantitative data in Pallars and in other Mediterranean territories that have been investigated with the same methodology. Pallars is the region in which a higher number of

informants have been interviewed: 264, only followed by figures around 150 in three other Iberian zones (Mulet, 1990; Muntané, 1991; Martínez, 1993). The number of medicinal plants reported (447) is also very high, comparable to those from Tunisia (553 counting those cited by Le Floc'h, 1983 and Boukef, 1986) and Huesca (553, Villar et al., 1992). Apart from these general figures, we will discuss now some indices linked to the ethnobotanical richness and the persistence of popular knowledge about plants in the zone studied, in agreement with the idea that quantification is a good tool — although not the only one — for evaluating data in ethnobotanical studies (Johns et al., 1990; Mesa-Jiménez, 1996; Phillips, 1996).

Different parameters are used to evaluate the ethnobotanical richness. A first approach can be done by the ratios of medicinal plants/km^2 and medicinal plants/inhabitant; in Table 2 we can observe that those from Pallars are in the second half of the ranking, but these indices are not significantly different between one region and another, and they are affected by methodological questions (particularly the prospective intensity expressed in number of informants). The ethnobotanicity index (Portères, 1970), consisting of the ratio between the useful plants and the total flora, expressed as a percentage, is much more precise. This index has in Pallars the highest value among the areas in which the flora is reasonably well known: 29.1, meaning that almost one-third of the plant species growing in the territory are used; this value is close to those obtained in Caurel mountains (27.9%; Blanco, 1996), Tunisia (27.7; Le Floc'h, 1983; Boukef, 1986) and the Gata cape region (25.3%; Martínez, 1993). The ethnophytonymy index (Bonet et al., 1999), defined as the ratio between the number of plant species with popular names and the total number of plants of the flora in one region, is a good complement to the precedent one, because naming the plants is one of the first human activities concerning nature, and names are the last elements of knowledge linked to plants to disappear in case of cultural erosion, the uses being much weaker. The higher the number of taxa with popular phytonyms, the better plant knowledge and use is conserved in the region. The different names used for a same plant, which can vary with every dialect of a language, are not considered in this index; they are rather indicators for linguistic richness. This index is quite higher in Pallars (0.35) than in the other zones for which it can be calculated (Guilleries, 0.19, Bonet et al., 1999; Castelló, 0.18, Mulet, 1991; Samo, 1995; Alt Empordà, 0.11, Bonet et al., 1999); this indicates a rather high level of conservation of plant knowledge in the area studied in the present paper.

The utilization index (proposed by Muntané, 1991, and amended by Bonet et al., 1999) is also useful to appraise the persistence of plant uses; it is the ratio between the mean number of medicinal and aromatic plants used (U, for use) and cited and claimed to be useful (C, for citation) by the informants. The U/C value is only moderately high in Pallars (49.2%), comparable to those calculated for Segarra (52.6%; Raja et al., 1997) and Huesca (50%; Villar et al., 1992), but very far from those reported for other territories such as l'Alt Empordà (93%) and les Guilleries (87%) (Bonet et al., 1999). The reported figure indicates that roughly half of plant species referred to by the informants are really used at present. If we add to this that some species were mentioned only by one person and for 32 of them our informants were able to report only the popular names, we can conclude that there is an evidence of loss of knowledge of plant use. This is only one of the effects of the acculturation process occurred in rural areas: most of young people migrate — at least temporarily — and do not feel very concerned by plant use, which is basically conserved by elder generations. This process have been particularly strong in mountain zones as Pallars (Prat et al., 1991a,b; Sabartés, 1993). The immediate conclusion — that applies to most of European countries — is that it is urgent to gather information on folk uses of plants, especially since some of the new uses reported were for plants cited only by one informant.

The number of unreported or uncommon uses which we found (867, see below, epigraph on new uses, and Table 1), is very high and indicates a high degree of ethnobotanical novelty for Pallars. In the Mediterranean territories studied for which this parameter is reported, it is only higher in Castelló (1856; Mulet, 1991). The NRU/P index, ratio between the number of unreported uses and the total number of plants cited (Muntané, 1991) is 1.9 in Pallars, not very far from that reported for another Pyrenean area (Cerdanya, 2.3, Muntané, 1991). Other values of this index are 0.57 in L'Alt Empordà and 0.48 in Les Guilleries (Bonet et al., 1999), 0.08 in Segarra (Raja et al., 1997), 0.23 in river Tenes valley (Bonet et al., 1992), and 5.08 in Castelló province (Mulet, 1991). The figure obtained in Pallars can be considered particularly high because recent study of nearby regions increased the documentation on folk-medicinal uses of the plants in the country and also because in almost all the studies cited the volume of literature consulted to compare and establish new uses was much smaller (less than 20 references) than in the present study — and in Bonet et al. (1999) — (around 80 references).

4.2. Predominant families and species

The members of just four botanical families (Asteraceae, Lamiaceae, Fabaceae and Rosaceae) mentioned by the informants represent approximately one-third of the total number of plants cited in Pallars. The situa-

tion is similar in other areas in which ethnobotanical studies have been carried out with the same method as ours in the Mediterranean area (Bonet et al., 1999 and references therein). These four families are among the five most common ones in almost all the territories (Fabaceae in all territories and the other three in all the territories but one); the fifth most common family is Apiaceae in more than half of regions and Poaceae in Pallars. Bonet et al. (1999) stated that it is normal that these families predominate, because they are well represented in Mediterranean flora and contain some very common plants, and, as confirmed by Johns et al. (1990), the more common a plant (family or species) is in an area, the greater is the probability of its popular use. We can add to this argument that some families, as Fabaceae, Rosaceae and Poaceae, include many species with a large distribution area, because they can grow in quite different ecological conditions, particularly in dry or poor soils. There is, in addition, a socioecological reason: a high number of the species of the predominant families are favored by human activity (those living in ruderal, nitrophilous or arvensic communities) or cultivated for food, medicinal or ornamental purposes; we remarked a tendency to use preferentially those plants growing near human settlements (Agelet et al., 1990), in agreement with the statements of Bellakhdar et al. (1987) for Morocco and González-Tejero (1989) in Granada.

Fourteen species were cited in more than 50% of the interviews; among them, *Thymus vulgaris* L., *Sambucus nigra* L. and *Juglans regia* L. were reported in more than 75% of cases (as well as *Olea europaea* L. and *Vitis vinifera* L., for the products — oil and alcohol — obtained from them). *S. nigra*, *T. vulgaris* — and other species such as *R. officinalis* L. and *M. recutita* L. — are also among the most cited in many other regions (Muntané, 1994; Bonet, 1993; Raja et al., 1997; Bonet et al., 1999). Some differential species, particularly predominant in Pallars popular medicine, are *Aconitum napellus* L., *Amelanchier ovalis* Medic., *Ballota nigra* L., *Genista balansae* (Boiss.) Rouy, *Helleborus foetidus* L., *Juniperus phoenicea* L., *Malva neglecta* Wallr., *Meum athamanticum* Jacq., *Rosa canina* L., *Trifolium alpinum* L. and *Verbascum pulverulentum* Vill.

4.3. Drug preparation methods

The predominance of tisanes, mostly made by pouring hot water on plant material or by boiling plant material in water (Gugliada, 1992), for oral ingestion and poultices for topical application agrees with what is common in other neighboring regions (Mulet, 1990; Muntané, 1991, 1994; Bonet 1991, 1993; Bonet et al., 1992, 1999; Raja et al., 1997). As in many of these works, we also noted the difficulty of clearly distinguishing between infusion and decoction from the data given by the informants concerning tisane preparation; and that a very high number of excipients are used for poultice preparation. It is worth mentioning that decoction is the preferred method for tisane preparation in elder people, who believe that the longer the drug is in contact with water the higher is the efficacy of the remedy. On the contrary, young people prefer infusions, because they are influenced by the current practices in bars and restaurants, where herbal tisanes are always prepared with this method; infusion is also presently recommended for modern — packed — aqueous phytotherapeutic preparations (Duraffourd et al., 1983; Penso, 1987; Gugliada, 1992).

As in different Iberian (Ballester et al., 1989; Benito, 1998; Bonet et al., 1999) and European (Moe et al., 1995) areas, we found a number of home-made liquors, prepared by maceration in alcohol (usually anis or brandy). One kind of liquor elaborated with many different plant species is very common in Pallars. It is called 'ratafia' — in plural 'ratafies' — drunk alone or with desserts, and claimed to be digestive — as in other parts of Catalonia (Bonet et al., 1999; Vallès et al., 2000) — and also useful in gynecological troubles. Nut (*Juglans regia* L.) pericarp is a basic ingredient of these liquors, which often contain also some aromatic plants and spices, usually also cited by the informants as good for gastrointestinal problems. We collected 13 'ratafia' recipes, elaborated with 64 plant species; many informants talked about 'ratafia', but refused to give the recipe, because it is a 'familiar secret' only transmitted from fathers to sons.

4.4. Drug activities

The main therapeutic groups for internal use in Pallars popular phytotherapy are anticatarrhal, antihypertensive, antiseptic, antialgic and digestive. For external use, dermatological phytomedicines are predominant. Traumatic affections and osteoartropathies (mostly in animals) are also often treated. This fact agrees with the situation in other Mediterranean territories ethnobotanically studied (Mulet, 1991; Muntané, 1991; Bonet et al., 1992, 1999; Raja et al., 1997). Many plants are used as prophylactic, for the same above stated purposes, and also in nutritional troubles and in problems linked to pregnancy, labor and puerperium. Following Casassas et al. (1990) classification, most of Pallars folk theraphy and prophylaxis is pharmacological, and other ways, as food or aversion therapy, appear at low rates. In Pallars, a great number of plant remedies are palliative or symptomatic, according to Peters (1987) classification. This is consistent with the statement of Reuter (1991), and with the findings of Bonet et al. (1999), that traditional phytopharmaceutical products are basically used against mild and chronic diseases; this is not contradictory with the possibility of treat-

ment of serious illnesses and with the relevant role of folk phytotherapy in the search for new medicines (Chadwick and Marsh, 1994).

4.5. Beliefs and symbols in Pallars ethnopharmacology

As in other Catalonian regions (Bonet et al., 1992, 1999; Raja et al., 1997) — and probably in all rural cultures — the use of medicinal plants in the areas studied is frequently highly ritualized, i.e. associated with different kind of beliefs or with magical or religious practices. Prayers are often associated with the use of herbal remedies, as Martí (1989) pointed out. The parts of the plants used or the period of administration of medicines are regulated by some numbers (basically 7, 9, and other odd numbers); as an example, 109 of 410 (26.6%) plant species claimed as medicinal in Pallars are administrated in the so-called 'novenes', periods of nine days (nine days taking the medicine and nine days without it, or nine days increasing and nine days decreasing the doses, or other similar models). This agrees with the statements of Peris and Stübing (1993), Gavilanes (1995) and Bonet et al. (1999). Signs and symbols are very common in folk phytotherapy, as stated by Font (1961), Stuart et al. (1981), Liuetaghi (1991), Arnold-Apostolides (1991) and Oriol (1994). We collected many information about the relationship between, on the one hand, plant form, color, organoleptic properties, growing conditions or other characteristics, and, on the other hand, pharmacological activity. The correlation between plant names and medicinal activities can be illustrated with numerous plant names from Pallars allusive to their uses, such as 'herba de l'hemorràgia' ('haemorrhage herb', *Equisetum arvense* L., antihaemorrhagic), 'herba del ronyó' ('kidney herb', *Lepidium latifolium* L., renal antilithiasic), 'herba de pulmonies' and 'herba de la diarrea' ('pneumonia herb', 'diarrhea herb', *Coris monspeliensis* L., antipneumonic and antidiarrhoeal), 'herba pulmonera' ('lung herb', *Artemisia vulgaris* L., antipneumonic), 'herba del sucre' ('sugar herb', *Centaurea aspera* L., hypoglycemiant), 'herba de les berrugues' ('wart herb', *Chelidonium majus* L., antiverrucose), and 'herba de la pressió' ('pressure herb', *Asplenium trichomanes* L., antihypertensive).

4.6. New or very rarely reported medicinal plants

As stated above, new or rare medicinal plant uses found in our prospections reach the figure of 867, very high in comparison with the results from other areas. It is particularly remarkable that they include 103 uses belonging to 52 new or very scarcely reported medicinal plant species; among them, vascular plants are reported in Table 1, and in further articles (Agelet and Vallès, in preparation) we will consider the new uses of already-known medicinal plants and those of non-vascular plants. Taxa with uses cited by three or more informants are remarked by an asterisk (*) in Table 1, as those that could preferably be candidates to phytochemical or pharmacological investigations. In addition to the data presented in Table 1, some other prominent species are discussed below.

A number of species are characterized by a very large range of uses. Five among them are particularly remarkable for their versatility: *Thymus vulgaris* (50 medicinal uses), *Juglans regia* (49), *Rosmarinus officinalis* (37), *Gentiana lutea* L. (36), *Salvia officinalis* L. (33) and *Sambucus nigra* (33). Most of them are also very much used in other Pyrenean territories as Cerdanya (Muntané, 1994). In addition, we verified that these species have also a high number of uses in other fields, such as food and timber.

Some of the taxa reported in Table 2, new or very scarcely cited medicinal plants, have the same uses as other species of the same genus; this is the case for *Achillea chamaemelifolia*, *Centaurea alba*, *Eryngium bourgatii*, *Galium pumilum*, *Hypericum maculatum* and *Inula helvetica*, among others. On the contrary, for some species, such as *Cardamine pyrenaica*, *Cephalaria leucantha*, *Chaerophyllum temulum*, *Linaria spuria*, *Rhinanthus mediterraneus*, *Plantago subulata*, *Scabiosa columbaria*, *Scrophularia alpestris*, *Staehelina dubia* and *Telephium imperati*, we did not find any close relative with the same medicinal virtues. These species are probably good candidates for phytochemical and pharmacological studies in order to confirm the activities claimed.

A strong anticephalalgic activity is attributed to *Sideritis montana* (2 independent informants) and *S. hyssopifolia* L. (6). We did not find any previous report on medicinal uses for the former species, whereas the latter is only cited in a few Pyrenean regions (Villar et al., 1992; Muntané, 1994). *Lilium pyrenaicum* Gouan, a Pyrenean endemic alpine geophyte, is largely used in Pallars — together with another species of the same genus, *L. martagon* L. — as resolutive; this medicinal use has been reported to now only by Villar et al. (1992) in Central Pyrenees. These medicinal plants, very rarely cited, would also deserve further investigations.

Twenty species are claimed to be antiverrucose, most of which are used topically. The internal use of *Leuzea conifera* (L.) DC. in Lam. et DC., *Ramonda myconi* and *Rubia peregrina* L. is remarkable and could be interpreted as a possible antitumor activity. Mulet (1990, 1991) gives the same information for *Leuzea conifera* and different authors reported antitumor activity for different Rubiaceae (Spjut and Perdue, 1976; Erichsen-Brown, 1989; Arnold-Apostolides, 1991). Spjut and Perdue (1976) found a possible correlation between antihelmintic and antitumor activities, and in Pallars the number of antihelmintic plants is rather high (42). We believe that it will be worth carrying out investiga-

tions in some Pallars plants in order to confirm, or not, antitumor activity.

4.7. Medicinal plant use versus conservation

The Mediterranean basin is considered as one of the biodiversity hotspots for conservation priorities (Myers et al., 2000). In this region — to which Pallars belongs — as in other parts of the world, a conflict may be established between plant use and conservation. Some plant species may suffer a high collection pressure with medicinal purposes, as has been remarked in different countries (Ayensu, 1983; Akerele et al., 1991; Seoane et al., 1991; Lange, 1998; Sheldon et al., 1998; Kala, 2000; Lyke, 2000); this can be seen as a symptom of a certain degree of incompatibility between plant-based medicine and biodiversity conservation. Several plants that are very appreciated and used as medicinal in the territory studied — such as *Ramonda myconi* and *Gentiana lutea* — are in this situation. Even though some of these and other commonly used species are preserved theoretically by different types of legal protection, they continue to be collected from the wild. If further studies advise uses larger than present popular ones, some kind of culture must be established, as it happens with *Gentiana lutea*, already cultivated in France (Desmarest and Derchue, 1988). In this case, an additional problem exists: we verified that people in Pallars — and probably all over the Pyrenees — use identically and without distinction *G. lutea* and *G. burseri* Lap., so that the latter — much rarer than the former — can be also endangered. Furthermore, as stated by Sheldon et al. (1998), cultivation may be difficult or not economically profitable, and therefore harvesting from wild populations may be inevitable. In these cases there must be some regulations that make collection sustainable, and, as suggested by Kala (2000) rare or endangered medicinal plants should be priority objects of conservation and management plans.

Another aspect of the conservation problem deals with the depletion of genetic resources linked to socioeconomic changes. As Etkin (1998) stated, in the areas suffering such changes the loss of both plants and knowledge on plant use and management is more apparent. Pallars offers good examples of this situation. In a study about a particular agroecosystem, the homegarden, we calculated that slightly more than 50% of the medicinal plant species cultivated and used in the 1960s have now disappeared from the homegardens or have fallen into disuse (Agelet et al., 1990). Some medicinal plants, as *Gentiana lutea*, *Achillea millefolium* L. and *Carum carvi* L. are declining clearly in meadows in which traditional exploitation methods (periodical mowing) is being abandoned. We agree with Díaz (1998) and Etkin (1998) that local paradigms of plant management increase biodiversity, promote conservation, and we believe that one of the main present reasons for ethnobotanical studies in industrialized countries is to inventory the plant knowledge not only in order to search for new drugs or food, but also with the purpose of preserving the biodiversity by conserving the local uses and practices. In Pallars and other depopulated Pyrenean regions, for instance, the retrieval of small-scale (familiar) medicinal plant cultivation in homegardens and other spaces (such as marginal lands, not able for agricultural works) is still possible, and would be a positive step in the direction of the above stated ideas.

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