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# ETHNOBOTANY, VOLATILE OILS AND SECRETION TISSUES OF *WERNERIA POPOSA* FROM ARGENTINA

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*ABSTRACT*

*Folk medicines are gaining great importance as information sources on traditional medicinal plants. The aim of this paper is the study of a plant traditionally employed by the Puna inhabitants:* Werneria poposa *Phil. Morphology of its secretory tissue and other histological diagnostic features, as well as the chemical composition of its essential oil, is described. Puna inhabitants use* W. poposa *mainly as an infusion for mountain sickness ("soroche"), stomach and hepatic disorders and cold. It is also used externally as a hot bath or unguent for rheumatic pains or traumas. Secretory tissues are schizogenous ducts in leaves and stems. Thirty-one components were detected in the essential oil by means of GC/MS analysis. Oil was characterized by the presence of high content of β-pinene (21.7%), α-pinene (5.5%), terpinen-4-ol (5.3%), α-terpinene (5.2%), β-phellandrene + 1,8-cineole (4.8%), isopulegol (4.8%) and β-citronellal (4.6%). At the present time,* W. poposa *is consumed as a medicinal plant, mainly in the northwest of Argentina, not being commercialized in the urban centers.*

## INTRODUCTION

Essential oils are responsible for the characteristic scent, odor and flavour of many plants, and are economically important as the basis of natural perfumes, spices and by their extensive use as medicinal plants. The vast majority of these drugs are used in crude form, mainly for the preparation of infusions (Bruneton, 1995). Many aromatic plants are used by the inhabitants of Puna as therapeutical resources; they can recognize them by odor and some morphological features.

Folk medicines are gaining importance as a source of information for traditional medicinal plants (Hostettmann et al., 1995). These drugs are subjected to investigation in the search for new biodynamic compounds with renewed rigor. A common belief is that plant remedies are naturally superior to synthetic drugs and that they are not harmful to human beings (Beier, 1992).

The goal of this paper is to establish traditional and current uses of *W. poposa* by the Puna inhabitants, the morphology of secretory tissue and other histological diagnostic features, as well as the chemical composition of its essential oil.

*Werneria poposa* Phil. (common names: poposa, pupusa [Compositae]) has the following characteristics: fetid, very branchy, cushion forming, sub-shrub, (cojín), 3–5 cm height, stems densely leafy; wide inner woolly leaf sheath. Apical solitary sessile and radial capitulum, campaniform involucral with glabrous oblong phyllary. Dimorphic tubulose hermaphroditic flowers; white ligulate radial flowers and yellow-liliaceus disc flowers. Cylindricous glabrous ribbed achene, white-yellow papus (Fig. 1). It grows in high mountains of South America: South Perú, North Chile and North West Argentina (from Jujuy to Tucuman). 4600–5300 m above sea level. This region is known as Puna (Cabrera, 1978) (Fig. 2).

## MATERIALS AND METHODS

The above ground parts of the plants were collected in Puna with the help of local informants, and the material

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Fig. 1. *W. poposa*. Plant aerial parts.

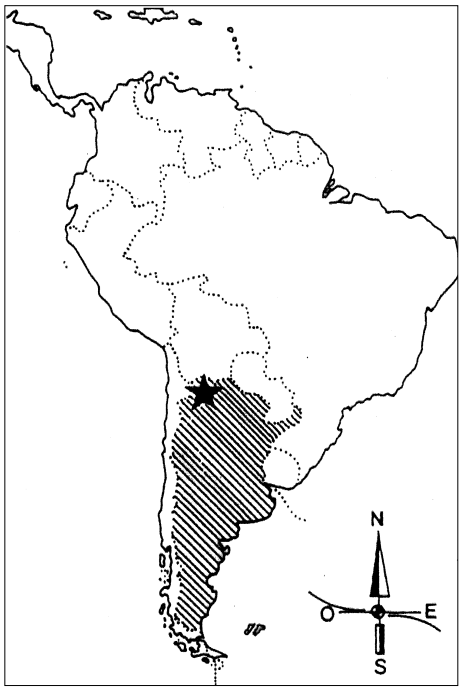


Fig. 2. Puna geographical location.

was also purchased at local markets. The plant was botanically confirmed using available literature (Cabrera, 1978).

A voucher specimen was deposited at the Museo de La Plata herbarium and at the Laboratorio de Etnobotanica y Botánica Aplicada (LEBA) herbarium No. 9, L. Abella.

The area was surveyed four times between 1995 and 1997, in different seasons, to perform ethnobotanical studies. Data were obtained from native informants who were healers, faith healers, ordinary villagers and market traders. The information was collected by means of direct observation, participating observation interviews and tape recordings.

Samples were hydrated in water during 24 h for histological studies, performed with a light microscope (LM). Sections were performed with frozen microtome Microm HM 340 E and also with a manual one. Oxidant agents $H_2O_2$ (100 vol) and NaClO were used to clear the sections. In order to detect terpenoids histochemically, the $SbCl_3/HClO_4$ reagent, that generates a red colour, was used (Mace et al., 1976).

Scanning electron microscope (SEM) was also used. Fragments of the leaves and stems were Critical Point dried. The samples were previously fixed with FAA (formaline + anhydrous acetic acid + anhydrous ethanol) for four days, and then successively washed in ethanol, 50, 70 and 100%.

The secretion tissue was described; in addition, other histological characters were studied which could be useful as diagnostic features to identify fragmented, powdered or destroyed samples.

Air-dried plant material was hydrodistilled in an all glass Clevenger-type apparatus to isolate volatile constituents. The oil was dried over anhydrous sodium sulphate and stored at 4°C in the dark.

Analytical GC was performed on a Varian 3300 gas chromatograph equipped with a silicone DB-1 capillary column (30 m × 0.25 mm, film thickness 0.25 μm) using nitrogen at a 1.5 ml/min flow rate as carrier gas. Injections were made by the split mode, and column temperature programmed from 80 to 225°C at 4°C/min. Injector temperature was 250°C, and a FID detector at 300°C was used. Injection volume was 0.1 μl for all samples. GC/MS analysis was carried out on a Hewlett Packard 5890 gas chromatograph equipped with a silicone SE-30 capillary column (20 m × 0.2 mm) at a carrier gas flow rate of 1.5 ml/min. Temperature was programmed from 70 to 210°C at 4°C/min and the injector temperature was 250°C. The chromatograph was coupled to a HP 5971 A mass selective detector (70 eV). All constituents were identified by comparing their Kováts retention indices with those of authentic standards available in the author's laboratory. The latter were compared with those stored in the spectrometer database using the commercial NBS54K.L and WILEY.L built-in libraries and with those reported in the literature (Libey, 1991; Adams, 1995).

## RESULTS AND DISCUSSION

*W. poposa* is widely used as a therapeutic resource in Puna. The most common method of preparation is as infusion: less than a handful of leaves and stems in a

cup of tea (250 ml of boiling water) are used for "soroche" (mountain sickness). It is also used as a digestive and for hepatic colics, cough, cold and bronchitis, and as a food condiment for pneumonia convalescents. Former reports dealing with some of these uses in the North West of Argentina (Palma, 1973; Perez De Nucci, 1988; Martinez & Pochettino, 1992) were confirmed in the present study.

External use is also very common, as a hot bath, mainly for the feet, or associated with *Artemisia copa* ("copa-copa") for rheumatic pains (Palma, 1973).

Bibliographic references mention its use in the preparation of unguents (powdered plant mixed with hen fat) to treat rheumatic and traumatic pains, and also as a local antiinflamatory (Meyer, 1943; Zardini, 1984). The use of the root in pleurisy has been reported in one case (Debelmas, 1975).

At the present time, *W. poposa* is consumed as a medicinal plant, mainly in the northwest of Argentina, not being commercialized in urban centers.

Secretory tissues are schizogenous ducts which go through leaves and stems (Figs. 3, 4, 5); their diameter

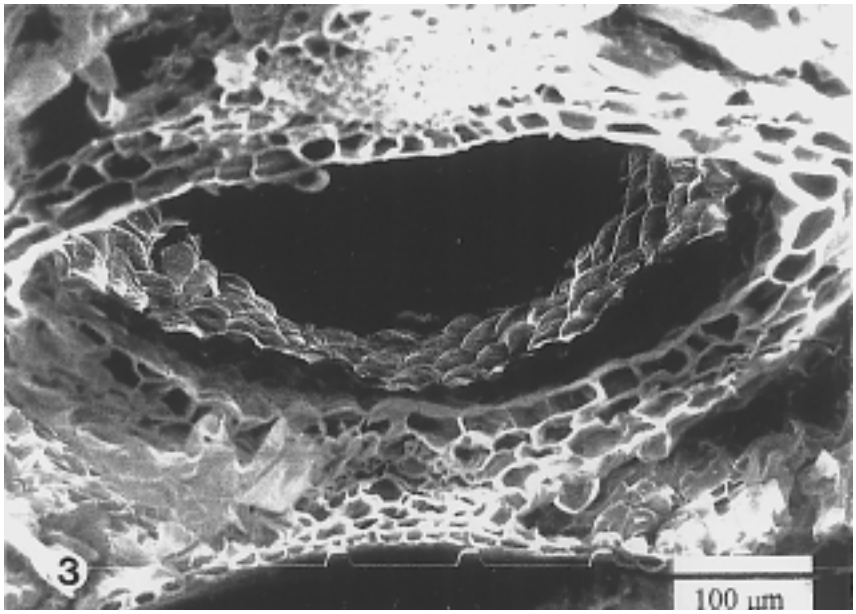


Fig. 3. Leaf schizogenous duct critical point dry.

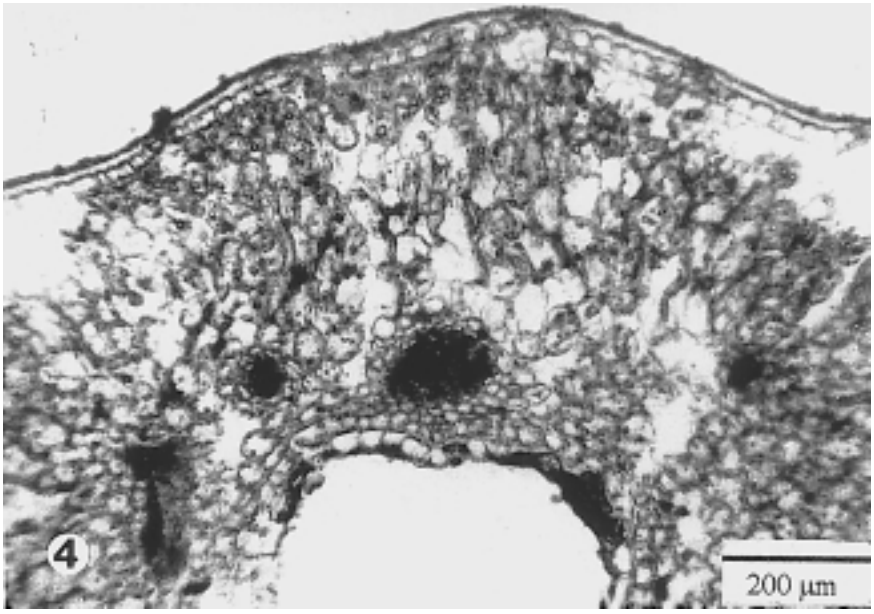


Fig. 4. Cross section leaf (LM).

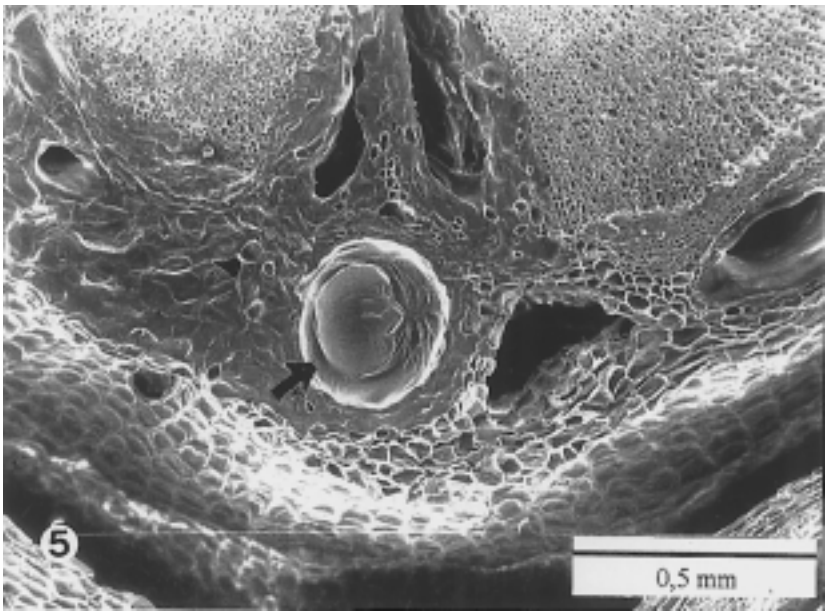


Fig. 5. Stem schizogenous duct. Essential oil filling in the cavity (arrow).

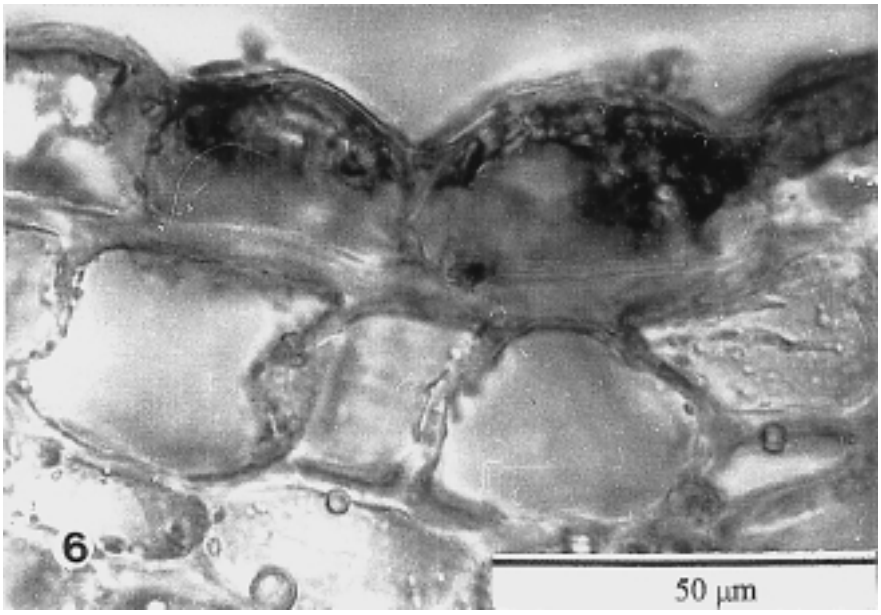


Fig. 6. Epithelial secretory cells (LM).

is uniform (350–400 μm) and they are internally coated with thin-walled epithelial secretory cells (Fig. 6). Positive terpenoid histochemical reactions were detected in all the tests performed on these tissues or in secretion products.

Volatile oils are pressurized within the ducts, and a slight traumatism produced in the plant immediately releases the essential oil. Poposa is a very aromatic smelling plant.

In addition to the secretory tissues, the main histological diagnostic features are the abundant whip-like trichomes present in the leaf sheath, with two basal cells and a very long apical (1–1.5 mm), twisted, thick wall cell (Fig. 7). The leaf sheath is very woolly; these leaf sheath hairs are characteristic of other Compositae whose apical cells are not as long and thick as in *W. poposa* (Metcalfe & Chalk, 1979).

Other features are the deep stomata and a thick waxy layer of the aerial parts, characteristic of xerophytic plants (Fig. 8) (Ancibor, 1980).

The components of the oil, the percentage by weight of each constituent and their Kováts indices are

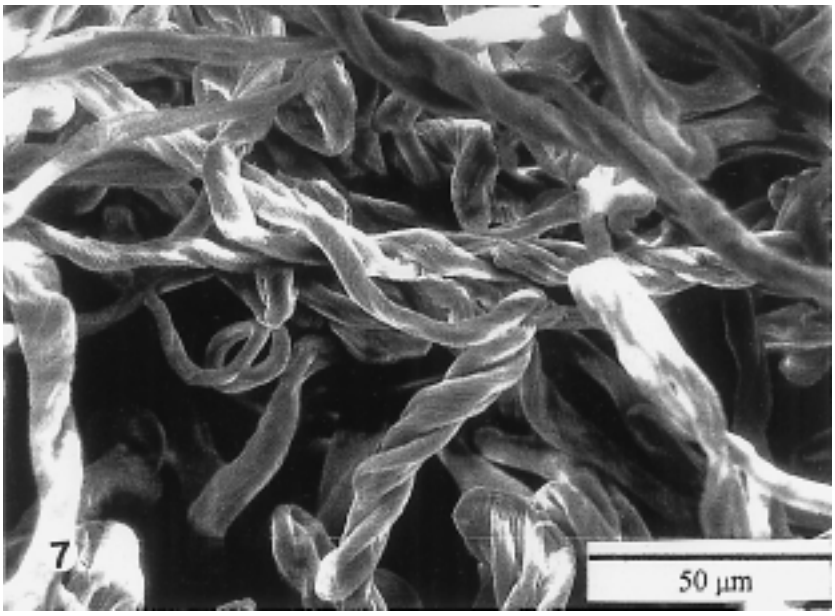


Fig. 7. Leaf sheath trichomes.

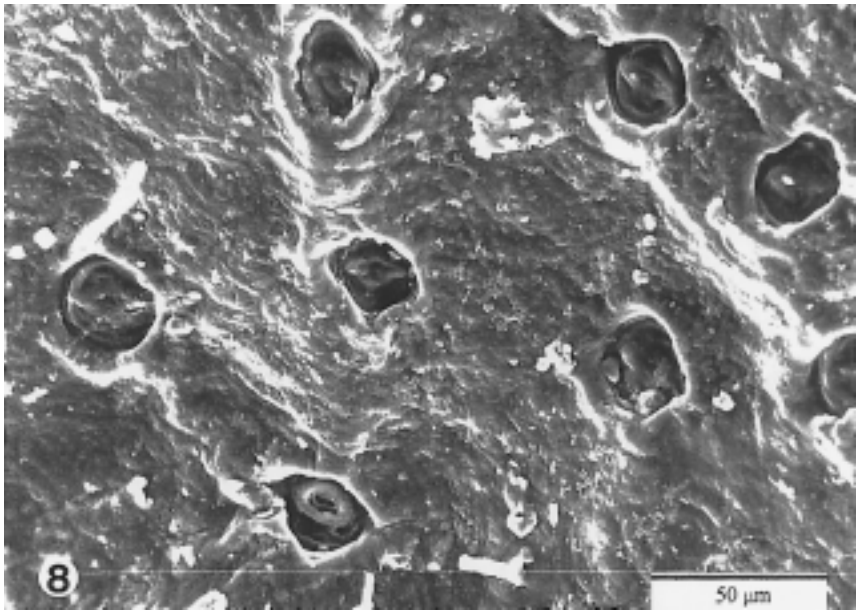


Fig. 8. Leaf upper surface, deep stomate and waxy layer.

summarized in Table 1. The components are arranged in the order of GC elution from the silicone columns. The yield of essential oil was about 1% based on dried weight.

The oil was characterized by the presence of a high content of β-pinene (21.8%); other important components were found to be α-pinene (5.5%), terpinen-4-ol (5.3%), α-terpinene (5.2%), β-phellandrene + 1.8- cineole (4.8%), isopulegol (4.8%) and β-citronellal (4.6%).

The α- and β-pinenes produce an increase of blood flow in the skin and in the mucous membranes; this explains its external use for rheumatic pains and as infusion for digestive problems. This monoterpene is also a well know antiseptic (Duke, 1991). Terpenes are found in the leaves of some desert plants and are the cause of allelopathic effects (Harbone, 1977).

There are no records about intoxications caused by the use of poposa, though it is widely consumed by people. Evidently the Puna inhabitants know about the dose to be used for various health problems.

Table 1. Major components found in *W. poposa* essential oil.

| Component | % | $t_R$ | I |
|---|---|---|---|
| 1.- α-thujene | 1.9 | 3.4 | 928 |
| 2.- α-pinene | 5.5 | 3.4 | 928 |
| 3.- camphene | 0.4 | 3.6 | 941 |
| 4.- sabinene | 2.0 | 3.9 | 968 |
| 5.- β-pinene | 21.8 | 3.9 | 968 |
| 6.- myrcene | 0.3 | 4.2 | 984 |
| 7.- α-phellandrene | 0.5 | 4.3 | 995 |
| 8.- α-terpinene | 5.2 | 4.5 | 1005 |
| 9.- p-cymene | 2.4 | 4.7 | 1017 |
| 10.- β-phellandrene+1,8-cineole | 4.8 | 4.7 | 1017 |
| 11.- cis-ocimene | 1.2 | 5.1 | 1033 |
| 12.- Isopenthyl-n-butirate | 1.2 | 5.2 | 1039 |
| 13.- γ-terpinene | 1.8 | 5.2 | 1041 |
| 14.- cis-linalool oxide | 0.2 | 5.5 | 1054 |
| 15.- terpinolene | 0.7 | 5.8 | 1071 |
| 16.- linalool | 2.2 | 5.9 | 1078 |
| 17.- isopulegol | 4.8 | 7.0 | 1123 |
| 18.- citronellal | 1.3 | 7.3 | 1134 |
| 19.- iso-isopulegol | 0.5 | 7.4 | 1141 |
| 20.- terpinen-4–ol | 5.3 | 7.7 | 1152 |
| 21.- α-terpineol | 2.1 | 8.2 | 1164 |
| 22.- β-citronellol | 4.6 | 9.0 | 1202 |
| 23.- neral | 2.6 | 9.9 | 1222 |
| 24.- geraniol | 0.3 | 9.9 | 1235 |
| 25.- geranial | 2.8 | 10.1 | 1250 |
| 26.- α-copaene | 0.2 | 13.6 | 1363 |
| 27.- aromadendrene | t | 15.6 | 1425 |
| 28.- γ-muurolene | 0.3 | 16.5 | 1456 |
| 29.- α-muurolene | 0.1 | 17.1 | 1478 |
| 30.- γ-cadinene | 0.8 | 17.6 | 1493 |
| 31.- δ- cadinene | 2.9 | 17.9 | 1501 |
| 32.- β-eudesmol | 1.9 | 21.5 | 1623 |

%: percentage by weight percentage in the oil mixture $t_R$ : retention time (min). I: Kováts retention index. (t): components found as traces (< 0.1%).

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