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Historical and modern medicinal plant uses – the example of the Ch'orti' Maya and Ladinos in Eastern Guatemala

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Abstract

Local empirical knowledge about medicinal properties of plants is the basis for their use as home remedies. Particularly in developing countries such remedies still are an indispensable resource for everyday health care. They form the basis for numerous studies on drugs from natural sources. Like other indigenous groups across the world, the Ch'orti' Maya in Eastern Guatemala are currently experiencing a phase of dramatic cultural change, with their traditional knowledge about plants being in great danger of disappearing. During 17 months of fieldwork, medicinal plant uses were documented using a semi-quantitative approach and analysed using ethnopharmacological methods. The most important groups of illnesses treated with plants were gastrointestinal complaints and illnesses associated with pain and fever. Field data were compared with mostly unpublished historical data collected in the 1930s by the anthropologist Charles Wisdom. This comparison showed that medicinal plant uses that are more consistent over time are also shared by a larger number of people. A literature search on the most frequently mentioned medicinal plants showed that, even for widely used medicinal species, phytochemical and pharmacological data are insufficient for fully understanding their therapeutic profile. Whereas a few examples of potentially dangerous practices were encountered, the limited amount of information available mostly supports local medicinal plant usage.

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Introduction

The immense structural diversity of compounds produced by plants and empirical knowledge about their activity has been an essential inspiration for developing novel medicines used throughout the world. At the same time, this knowledge is the basis for the local preparation of plant remedies, which are still an indispensable resource for everyday health care, particularly in developing countries. Recently, we have seen a number of plant-derived drugs inspired by local or traditional uses bringing about significant improvements in the treatment of various conditions, such as Alzheimer's disease, malaria and AIDS. These include galanthamine (Heinrich & Lee Teoh 2004), artemisinin (Yu & Zhong 2002) and prostratin (Cox 2001).

While a great number of anthropological studies have been conducted in Guatemala, particularly among the Maya of the western highlands, the rich ethnobotanical traditions of that country have been studied in far less detail compared with the indigenous groups in neighbouring Mexico. In such a geographically, biologically and culturally diverse country as Guatemala, the local flora, plant names and uses often vary considerably even over short geographical distances. This is one of the first detailed, modern studies on medicinal plants in this Central American country.

Since the mid-1980s, our group has investigated uses of plant remedies by indigenous groups in Mexico and Tanzania, and in the 1990s we developed a semi-quantitative approach using healers' consensus as a quantitative criterion for assessing the cultural importance of medicinal plants (Heinrich et al 1998a; Schlage et al 2000; Leonti et al 2001). Here, we combine for the first time this (semi-)quantitative approach with a historical perspective. Among the indigenous peoples of Mesoamerica, a change over time has been shown for the Aztecs and their use of medicinal plants, which has been documented in considerable detail from early colonial times on (e.g., Heinrich et al

1998b). For the Maya area, historical records are far more scant. Thus, the existence of a detailed unpublished manuscript by US-American anthropologist Charles Wisdom, documenting plant uses among the Ch'orti' Maya in the 1930s, offers an exceptional opportunity to explore the questions of continuity and change in Mayan medical ethnobotany.

Another important difference relates to the informants we worked with. While in previous studies, healers with specialist status were selected as research participants, this was not appropriate in the Ch'orti' area as specialists' knowledge about healing is in the ritual domain rather than about medicinal plants and their use. The majority of informants are seen as having experience in the treatment of diseases or midwifery by fellow members of their community and do not refer to themselves as healers. Due to the legal stipulations of the Guatemalan authorities who are in charge of issuing permits, but do not represent the indigenous communities and contrary to previous projects, it was not possible to obtain plant material to carry out laboratory studies of some of the species whose phytotherapeutic profile is known insufficiently.

Documentation of local medicinal plant uses is not only of academic interest. Rural people, especially in developing countries, depend on medicinal plants as a vital resource for their everyday health care. While traditional, mainly oral, forms of knowledge transmission are widely breaking down, a need for documentation and transfer into new but culturally appropriate means for dissemination arises.

Background

The Ch'orti' Maya live in Eastern Guatemala and the area near the archaeological site of Copan in Honduras (Figure 1). Isolated from other indigenous communities and surrounded by Ladinos (culturally non-indigenous Spanish-speaking Guatemalans) for centuries, the Ch'orti' have maintained some of their cultural traditions to this day. Although the Ch'orti' still carry out complex agrarian rites showing many parallels with Classic Period ritual practices (Looper 2003; Kufer & Heinrich 2005) and their language is considered particularly close to the lingua franca spoken by Classic Period Maya (Houston et al 2000), they are regarded as an indigenous group that has already lost their culture, both by Ladinos and other Mayan groups in Guatemala (cf. Metz 1998).

The administrative centre of the Ch'orti' area is the lowland town of Jocotán with nearly 4000 mostly Ladino inhabitants and a large Sunday market frequented by Ch'orti' and Ladinos from the hamlets of the larger area, which comprises approximately 100 000 inhabitants. In the municipal towns of Jocotán, Camotán, San Juan Ermita and Olopa, government health centres offer free biomedical health care during normal office hours, including consultations with a doctor and dispensing of some medicines. The nearest government hospital offering free in-patient care is a 45-min bus ride away in the Department capital, Chiquimula. The Dispensario Bethania in Jocotán, a health centre supported by the Belgian Mission, offers health care at moderate prices, with consideration for patient's ability to pay, including consultation with a doctor, dispensing and in-patient care mainly for malnourished children. All towns of the area also have some private clinics and pharmacies. Medicines are often sold in unspecialized shops and drug advice in pharmacies is frequently inappropriate (see also Kroeger et al 2001). Some of the larger hamlets have health posts staffed with a nurse, while most hamlets receive monthly visits by a team consisting of a doctor and a health technician (a nurse specialized in rural health care). Health promoters and traditional midwives resident in the hamlets have some basic biomedical training and are supposed to act as mediators between the government health system and the rural communities.

For the Maya area, only limited information on historical aspects of medicinal plant use is available (Roys 1931; Orellana 1987). In the case of the Ch'orti', a treasure of ethnobotanical information has been lying dormant for seventy years. Cultural anthropologist Charles Wisdom compiled an extensive manuscript on plant use, but only published a tiny fraction of this information in his monograph entitled 'The Chorti Indians of Guatemala'. While it is unfortunate that he did not collect any voucher specimens of the plants whose uses he documented, the manuscript benefits greatly from tentative plant identifications provided by the leading expert on the flora of Guatemala of his time, Paul Standley, based on vernacular names and descriptions. It seems from the data, though, as if Standley was more familiar with local plant names and uses in other parts of Guatemala than in the eastern part.

The integration of local medicinal plant knowledge into primary health care is increasingly recognized as desirable, but still only rarely put into practice. In Guatemala, ASECSA (Asociación de Servicios Comunitarios de Salud) has worked for decades towards an integration of ethnomedical and biomedical knowledge at a local level, often supported by the Catholic church. In the study area in Eastern Guatemala, a local project for the promotion of medicinal plant use was initiated by the Catholic Belgian Mission. As the only existing training centre and source of intellectual support, the ASECSA centre in Chimaltenango (western Guatemala) is ill-equipped to deal with local needs. For example, plant identification is difficult because of the regional variability of plant names.

Methods

Field work was carried out by J. K., from March 2000 to February 2001, between October 2001 and March 2002 and for five weeks in March and April 2003. Permits for research, collecting and export of voucher specimens were obtained from CONAP (Consejo Nacional de Areas Protegidas).

The quantification of ethnobotanical information is a tool to assess the relative cultural importance of individual plant taxa (Phillips 1996). In a semi-quantitative approach, 40 research participants (22 women and 18

Figure 1 Map of the Ch'orti' area. From Metz (1998), reproduced with permission.

men) were asked to list any medicinal plants they knew for treating common ailments (free listing; Alexiades 1996). For every plant species mentioned, the following information was recorded: local plant name in Spanish and, if known, in Ch'orti'; plant part used for medicine; preparation; application; and where to procure the plant material. This method of data collection allows for further analysis according to socio-cultural and botanical parameters, which are outside the scope of this publication. Interviews were conducted by J. K., mostly in Spanish. In interviews with bilingual research participants, the Ch'orti' terms for illnesses, plant parts and mode of preparation were also recorded. In a few cases interviews were carried out in Ch'orti' with the help of bilingual research assistants.

At the end of each interview, the interviewer asked to see all medicinal plants that had been mentioned, where possible. Voucher specimens were collected, as far as possible, in sets of six, and deposited at the herbarium of the Centre for Pharmacognosy and Phytotherapy (The School of Pharmacy, London), UVAL, MSB, BM, and W (acronyms according to Holmgren et al 1990 and updates published in *Taxon*). One specimen of each taxon was deposited at the MENACHOR project in Jocotán, as the basis for a local medicinal plant herbarium. Plants were identified mainly at the Institute for Systematic Botany, University of Munich, and in some cases at the Herbario de Investigaciones of the Universidad del Valle. Plant names follow Balick et al (2000) and Stevens et al (2001). Family classification is used according to Judd et al (2002).

Data recorded in the form of field notes were quantified and analysed according to the following system. Medical uses were grouped into ten use-groups (UGs) or categories of illnesses, largely based on organ systems – gastrointestinal (GI), gynaecological (GY), respiratory (RE), dermatological (DE), urogenital (UC), oral cavity (OD) and ears and eyes (EE). Further categories comprised conditions associated with fever and pain (FP) and illnesses with a psychological or spiritual component (CN). A residual category (OT) included a variety of conditions that were mentioned too infrequently to justify establishing a separate UG (e.g., snake bites and bone fractures). Every plant species used for the treatment of conditions within one UG was counted as one medicinal plant use (MPU). Every MPU mentioned by one research participant was counted as one use-report (UR). Field data were entered into a database using Lotus Approach version 9 for Windows.

For analysis of historical data, a copy of Charles Wisdom's unpublished field notes dealing with ethnobotany was obtained from the Smithsonian Institution National Anthropological Archives (NAA manuscript 4826, pp 774–1006). To allow a comparison of historical and contemporary data, the information in the manuscript was entered into a database using the same categories of UGs and MPUs and the same software as for the analysis of field data.

The distribution of modern and historical MPUs into the ten UGs was compared using a standard Chi-squared test. After exclusion of the residual category, no significant difference in distribution was found between the modern and historical data. (The residual category was over-represented in the historical data, likely due to a significant number of insufficiently specified medical uses in the manuscript.) The hypothesis that there is a link between historical consistency and frequency of plant use was tested using a Chi-squared goodness of fit test: expected frequencies for the null hypothesis were calculated based on the assumption that the frequency of URs for an MPU is independent from its historical use.

The factor of informant consensus F_{ic}

The F_{ic} is a quantitative criterion for the cultural importance of plants and was adapted based on earlier work by Trotter & Logan (1986). It is calculated for each of the use groups according to the following formula:

$$F_{ic} = (N_{ur} - N_t)/(N_{ur} - 1) \quad (1)$$

where N_{ur} is the number of URs in one UG, and N_t is the number of taxa used in this UG.

An F_{ic} value close to 1 indicates a high degree of consensus among the interviewees, whereas a low value reflects either a high degree of intracultural variation or that a significant part of the informants' knowledge was not documented. Especially when open-ended questions are used, the collected data are sensitive to memory bias, because there are plant species the research participants will not actively remember, but would recognize if asked a yes/no question. In the following discussion, results from this study will be compared with four studies of indigenous groups in Mexico using a similar methodology (see Leonti et al (2001) for the Popoluca and Heinrich et al (1998a) for the Maya, Nahua and Zapotec, as well as for a more detailed discussion of the F_{ic}). From a methodological perspective, it is important to note that often higher F_{ic} values are found in the larger UGs (among the Maya and Nahua, as well as in this study). This tendency is less pronounced among the Zapotec and Popoluca, where the total number of URs collected was greater. This may indicate that more work is needed for documenting the majority of medicinal plant uses in the area.

Results and Discussion

Ch'orti' medicinal plants – an overview

In interviews with 40 research participants, 2629 individual URs were collected, representing 991 different MPUs and 381 plant taxa (Table 1). The most important UG was gastrointestinal complaints, followed by fever and pain, women's remedies and respiratory diseases. One plant species, *Cnidoscolus longibracteatus* Fdez. Casas & Pizarro, was described as a species new to science (Fernández Casas & Pizarro Domínguez 2004), while several others had not been collected in Guatemala before. The historical data comprised 645 MPUs, representing 321 plant taxa.

Results for each UG will be discussed separately, including ethnobotanical, phytochemical and pharmacological data for some of the most frequently mentioned and therefore culturally most important native species in each group. For each UG, a list of all plant taxa with more than four URs is provided (Tables 2–11). Introduced plants whose therapeutical profile is comparatively well known will not be discussed in further detail, as this information can be found elsewhere (e.g., Hänsel et al 1992–1994; Lewis & Elvin-Lewis 2003; Hänsel & Sticher 2004).

The highest F_{ic} in our study was 0.72 for the FP UG. Similarly high values have been found in the two studies among the Zapotec and Popoluca, whereas the values in this UG were much lower among the Nahua and the Yucatec Maya. The next highest value (0.69) was in the gastrointestinal and women's remedies UGs. In the four other studies, consensus for GI was generally high, with the exception of the Zapotecs, whereas the F_{ic} for women's remedies was low to medium. The F_{ic} for skin problems was low (0.51), as among the Maya and Nahua.

Table 1 Ch'orti' medicinal plants — an overview

	Semi-quantitative data					Comparison historical and own data									
	No. URs	%UR total	F_{IC}	No. MPUs	%PUtotal	CW MPUs	% CW MPU	% mentioned for same UG		% mentioned for other UG		% only non-medical use(s)		% not in MS	
								MPU	URs	MPU	URs	MPU	URs	MPU	URs
Gastrointestinal	520	19.8	0.69	164	16.5	117	18.1	42.7	62.5	42.1	22.7	12.2	11.3	9.1	3.5
Fever & pain	498	18.9	0.72	140	14.1	106	16.4	35.7	54.0	39.3	32.5	10.0	7.4	15	6.0
Women's remedies	488	18.6	0.69	154	15.5	81	12.6	24.0	43.2	40.9	34.6	18.2	11.5	16.8	10.7
Respiratory	278	10.6	0.65	98	9.9	51	7.9	19.4	28.1	54.1	53.2	11.2	10.1	15.3	8.6
Skin	238	9.1	0.51	116	11.7	67	10.4	34.5	49.2	30.2	26.9	13.8	11.0	21.6	13.0
Psychological & spiritual	178	6.8	0.60	74	7.5	35	5.4	20.3	48.3	51.4	32.0	12.2	7.9	16.2	11.8
Oral health	114	4.3	0.51	56	5.7	25	3.9	14.3	28.9	53.6	46.5	19.6	16.7	12.5	7.9
Urogenital	105	4.0	0.39	64	6.5	36	5.6	18.8	30.5	53.1	42.9	10.9	15.2	17.2	11.4
Ears & eyes	90	3.4	0.53	43	4.3	38	5.9	32.6	47.8	44.2	34.4	7.0	10.0	16.3	7.8
Other	120	4.6	NA	82	8.3	89	13.8	28.0	36.7	45.1	45.8	9.8	7.5	17.1	10.0
Total	2629			991		645		29.1	47.1	42.7	34.3	12.8	10.4	15.4	8.2
				381 taxa		321 taxa									

UG, use group; UR, use report; MPU, medicinal plant use; CW, Charles Wisdom; MS, manuscript. The F_{ic} is a quantitative criterion for the cultural importance of plants and was adapted based on earlier work by Trotter & Logan (1986). It is calculated for each of the UGs according to the following formula: $F_{ic} = (N_{ur} - N_t)/(N_{ur} - 1)$, where N_{ur} is the number of URs in one UG, and N_t is the number of taxa used in this UG.

Table 2 Most frequently named plant species for gastrointestinal illnesses

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Chromolaena glaberrima (DC.) R.M. King & H. Rob.	Asteraceae	22	Sa, (Di, Am, Em, Pw, Na)	lv, (ts)	N		venadillo	SUG	imp
Chenopodium ambrosioides L.	Amaranthaceae	16	Pw, Sa, (Di, Em, cramps)	rs, ap, (sd)	N	pasujt	apazote, epazote	SUG	same
Dorstenia drakena L.	Moraceae	15	Di, Sa, Em	rs	N	amtz'ak	contrahierba, corcionera	SUG	same
Psidium guajava L.	Myrtaceae	14	Am, Di, (Vo, Em, Aj)	ts, lv, fr	N	pataj	guayaba	NMU	same
Citrus limon (L.) Burm.	Rutaceae	13	Di, Am, Aj, (cramps, Sa, Na)	fr, lv, ts, (rs)	I		limón	SUG	same
Aristolochia maxima Jacq.	Aristolochiaceae	12	Di, Am, Sa	rs	N	(nojta) wáko	guaco	SUG	same
Bixa orellana L.	Bixaceae	12	Am, (FIS, Aj)	sd (aril)	N	kiwi'	achote, achiote	SUG	same
Mangifera indica L.	Anacardiaceae	11	Am, Di, Vo, Sa	sd, (bk, ts)	I	malak'	mango	SUG	same
Ocimum campechianum Chapm./ *O. basilicum* L./*O. africanum* Lour.	Lamiaceae	11	Em, Di, Ps, flatulence, Sa	lv	N/I		albahaca cimarrona/ albahaca de Castilla	SUG	same
Vernonia sp. (# Kufer 223)	Asteraceae	11	Di, Am, Sa, Vo, Na, Em, Ps	lv	N	ub'i te	suquinay, sucunay	SUG	mis
Allium sativum L.	Alliaceae	10	Pw, Sa, Am, Di, (Aj, Na, Vo, Em)	rs	I		ajús, ajo	SUG	same
Guazuma ulmifolia Lam.	Malvaceae	10	Am, Di, (FIS, Gs)	bk, (ts, fr, ap)	N	ch'ab'ay	caulote	SUG	same
Licania platypus (Hemsl.) Fritsch	Chrysobalanaceae	10	Di, Am, (Vo, Sa)	sd, (bk)	N	jor b'oj	zunso, zunsa	SUG	same
Persea americana Mill.	Lauraceae	10	Sa, Am, Di	sd, (bk, lv)	N	un	aguacate	SUG	same
Oxalis frutescens L. ssp. *angustifolia* (H.B.K.) Lourteig	Oxalidaceae	9	Aj (green Di), Di, Am	ap	N	ajsyan k'opot, pajpaj k'opot	tamarindillo, monte (de) preñiz	OUG	mis
Buddleja americana L.	Buddlejaceae	8	Sa, Aj	lv, (ts)	N	t'oxpe'	salvia (santa), hoja blanca, hoja (de) salve	SUG	imp
Isocarpha oppositifolia (L.) R.Br.	Asteraceae	8	Sa, (Di, Am, Ps, Em)	lv	N	u chikin t'ur	oreja de conejo, hierba de conejo	OUG	mis
Coriandrum sativum L.	Apiaceae	7	Sa, Di, Vo, Aj, Am, Pw	sd	I		culantro (de Castilla)	SUG	same
Punica granatum L.	Lythraceae	7	Am, Di	fr	I		granada	SUG	same
Cocos nucifera L.	Arecaceae	6	Am, (solitaria)	fr	I		coco	SUG	same
*Folk generic 'tamagás'		6	Sa, Di	rs	N		(bejuco) tamagás	OUG	mis

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Lippia graveolens H.B.K.	Verbenaceae	6	Sa, (Aj, stimulate appetite)	lv	N		orégano (de Castilla)	NMU	same
Musa × *sapientum* L.	Musaceae	6	Di, Am, Pw, Sa	fr	I	kene'	guineo, banano	NMU	same
Simaba cedron Planch.	Simaroubaceae	6	Sa, (Ps, Na)	sd	I		cedrón	SUG	imp
Simarouba glauca DC.	Simaroubaceae	6	Ps, Di, Am, Sa	bk, lv, ts	N		aceituno	SUG	same
Anacardium occidentale L.	Anacardiaceae	5	Am	ts, lv	N		marañón	NMU	same
Cissampelos pareira L.	Menispermaceae	5	Di, (Sa)	rs	N		alcotán	SUG	same
Eryngium foetidum L.	Apiaceae	5	Di, Aj, (Pw)	rs, (ap)	N	yujtz' ner via'r	culantro de tripa, c. cimarrón	SUG	imp
Lepidium virginicum L.	Brassicaceae	5	Sa, cramps, Ps, Pw	ap	N		maltuerce	SUG	same
Mentha cf. *crispa* L. (# Kufer 333)	Lamiaceae	5	Sa, Di, Na, Aj	lv	I		hierbabuena	SUG	same
Pimpinella anisum L.	Apiaceae	5	Aj, Sa, Vo, Di, cramps	sd	I		anís (de Castilla)	SUG	same
Abelmoschus moschatus Medik.	Malvaceae	4	Sa, Di	sd	I		algalia, algálico	OUG	imp
Ambrosia cumanensis H.B.K.	Asteraceae	4	Sa	lv, ap	N		altamís	OUG	mis
Cinnamomum verum J.S. Presl	Lauraceae	4	Pw, (Am, Sa, ulcers)	bk	I		canela	SUG	same
Citrus sinensis (L.) Osbeck	Rutaceae	4	Am, Aj, Sa	lv, fr	I		naranja/o	SUG	same
Cucurbita moschata Duch. ex Poir.	Cucurbitaceae	4	Am, Pw	sd, (fr)	N	ch'um	ayote	SUG	mis
Fevillea cordifolia L.	Cucurbitaceae	4	Sa, cramps in children	sd	I		chichimora	SUG	same
Petiveria alliacea L.	Petiveriaceae	4	Sa, Pw, Am, Gs	rs	N		apacin(a)	SUG	imp
Physalis spp. (# Kufer 127, 221, 237)	Solanaceae	4	Pw	fr	N	pe'ych k'opot	tomate de lombriz	NMU	mis
Sinapis sp. (seeds from market)	Brassicaceae	4	Sa, indigestion, cramps	s	I		mostaza	NMU	n
Tagetes filifolia Lag.	Asteraceae	4	Sa, Vo, Di	ap, lv	N		anicillo, anís de monte	SUG	imp
Verbena litoralis H.B.K.	Verbenaceae	4	Sa, Di, Am	lv	N		verbena	OUG	same

Aj, *ajsyan* (green diarrhoea in children); Am, amoebiasis; Di, diarrhoea; Em, *empacho*; FIS, five in the stomach; Gs, gastritis; Na, nausea; Pw, parasitic worms; Ps, *pasmo* (diarrhoea, vomiting and pain); Sa, stomach ache (*dolor de estómago*); Vo, vomiting. *Folk generic tamagás, *Chiococca* cf. *alba* Hitchc. (Rubiaceae, # Kufer 238), *Piper* sp. (Piperaceae, # Kufer 214), indet. (# Kufer 113); ap, aerial parts; bk, bark; fr, fruits; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); sd, seeds; ts, tender shoots & leaves (*cojollos*); Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; n, no botanical identification in the manuscript; same, own data confirm identification in the manuscript.

Table 3 Most frequently named plant species for fever and pain

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Tecoma stans (L.) H.B.K.	Bignoniaceae	29	Fv, Ma, (dengue, Ha, MC, arthritis)	lv, (ts)	N	ch'aj te'	chacté, chayté, flor amarilla, chinche	SUG	same
Citrus limon (L.) Burm.	Rutaceae	26	Fv, Ha, MC, (exhaustion)	fr, (fl)	I		limón	SUG	same
Neurolaena lobata (L.) R. Br. ex Cass.	Asteraceae	25	Fv, Ma, (Ha, MC)	lv, (ts)	N	ch'ajch'aj k'opot	tres puntas	SUG	same
Mikania micrantha H.B.K.	Asteraceae	23	Fv, Has	ap, lv	N		tabardillo/a	SUG	mis
Coffea arabica L.	Rubiaceae	18	Ha, Fv	sd, lv, ts	I		café	NMU	same
Bursera simaruba (L.) Sarg.	Burseraceae	15	Fv, MC	bk, (fr)	N	chakajr	(palo de) jiote/ fiote, palo chino	OUG	same
Matricaria recutita L.	Asteraceae	15	Fl, Ha, (Fv, Sw, Ba)	ap, (lv)	I		manzanilla	SUG	mis
Justicia spicigera Schltdl.	Acanthaceae	12	Fv, (MC, Ha)	lv, (ts, ap)	N		tinta	SUG	same
Tridax procumbens L.	Asteraceae	11	Fv, Fl, Ha, (Ba, Sw, Br)	ap	N	wakax k'opot	hierba del toro	SUG	same
Cucurbita moschata Duch. ex Poir.	Cucurbitaceae	9	Fv, MC	sd	N	ch'um	ayote	OUG	mis
Ruta chalepensis L.	Rutaceae	9	Fv, Ha, Ba, Ma, Fl, backache, Ai	ap, ts, lv	I	tujyan ixik	ruda (macho)	OUG	same
Sansevieria hyacinthoides L.) Druce	Ruscaceae	9	Fv, Ha, (Ma, MC)	lv	N		curarina	SUG	mis
Passiflora foetida L.	Passifloraceae	8	Fl, (Ha, Ba, Fv, Sw)	ap	N	pa'ch'em, julusyon k'opot	(monte) flución, monte preñiz	SUG	imp
Verbena litoralis H.B.K.	Verbenaceae	8	Fv, (Ha, Ma)	lv, ap	N		verbena	SUG	same
Aloe vera (L.) Burm.f.	Asphodelaceae	7	Fv, Sw, (Ha, Ba, Br, mumps)	lv	I	tujtuj sukchij	sábila	OUG	same
Buddleja americana L.	Buddlejaceae	7	Fv, Ha, Fl, Ba	lv, (ts)	N	t'oxpe'	salvia (santa), hoja blanca, (hoja de) salve	SUG	imp
Citrus sinensis (L.) Osbeck	Rutaceae	7	Fl, Fv, Br, Ai, Ha	lv, (fr, sd)	I		naranja/o	OUG	same
Pluchea symphytifolia (Mill.) Gillis	Asteraceae	7	Ha, (Fv, dizziness, rheumatism)	lv, ts	N	musik witzir	ciguapate	SUG	imp
Asteraceae (# Kufer 154 & 395)	Asteraceae	6	Fv, Ba, Fl, Sw because of "cold"	ts, lv	N		corrimiento, currimiento	ABS	n
Erythrina sp. (# Kufer 165)	Fabaceae	6	Fv, MC	bk	N	mo'te'	pito	OUG	same

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Gliricidia sepium (Jacq.) Steud.	Fabaceae	6	Ha, Fv, (MC)	lv, bk	N	k'an te	cacao de nance, madre cacao, canté	OUG	same
Hyptis verticillata Jacq.	Lamiaceae	6	Fv, (Ba, Ai)	lv, ts, ap	N		canelón, verbena canelón, verbena	SUG	same
Melia azedarach L.	Meliaceae	6	Fv, Ha	lv, (ts)	I		paraiso, paraise	OUG	same
Tradescantia zebrina Bosse	Commelinaceae	6	Fv, (MC)	ap, lv	N	ak'ach k'opot	hierba de pollo, sangre de pollo, pata de pollo	SUG	mis
Ambrosia cumanensis H.B.K.	Asteraceae	5	Ai, pain, fatigue, muscle pain	lv, ap	N		altamís	SUG	mis
Cassia fistula L.	Fabaceae	5	Fv, MC	fr	I		cañafistula (de mercado), cañafístola, caña de fuiste	SUG	same
Jatropha curcas L.	Euphorbiaceae	5	Fv, (MC, Sw)	bk	N	sakirte'	piñón	OUG	same
Acourtia nudicaulis (A. Gray) B.L. Turner	Asteraceae	4	Ha, Br, pain, Ai, Sw	rs	N		valeriana (roja), valeriana de cerro	OUG	mis
Hordeum vulgare L.	Poaceae	4	Fv	grains	I		cebada	SUG	same
Nicotiana tabacum L.	Solanaceae	4	backache, pain in legs (jolchan?), Ha, Sw	lv (dried, cigar)	N	k'ujtz	tabaco, puro	OUG	same
Senna occidentalis (L.) Link	Fabaceae	4	Fv, MC	lv, ap	N	b'u'r k'opot	frijolillo (negro)	SUG	imp
Sinapis sp. (seeds from market)	Brassicaceae	4	Fv, Ha, Ai	sd	I		mostaza	NMU	n
Spondias cf. *radlkoferi* Donn. Smith	Anacardiaceae	4	MC	bk	N	pare'	jocote clavo/ macho/agrio/ acido/cimarrón	OUG	same
Tamarindus indica L.	Fabaceae	4	MC	fr (aril)	I		tamarindo	SUG	same
Yucca guatemalensis Baker	Agavaceae	4	Fv, cramps, exhaustion	ts		sit'a'	izote	SUG	same

Ai, aire; Ba, body aches; Br, bruises; (golpes); Fl, flución (dizziness and headache); Fv, fever; Ha, headache; MC, measles/chickenpox; Sw, swellings; ap, aerial parts; bk, bark; fl, flowers; fr, fruits; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); sd, seeds; ts, tender shoots & leaves (*cojollos*); Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; n, no botanical identification in the manuscript; same, own data confirm identification in the manuscript.

Table 4 Most frequently named plant species for women's remedies

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Pluchea symphytifolia (Mill.) Gillis	Asteraceae	21	Ch, Rf, Ms, Fc, Az	rs, lv, ts	N	musik witzir	ciguapate	SUG	imp
Matricaria recutita L.	Asteraceae	20	Pt, Ep, Ch, Az, Rf, (Tc)	ap, (lv)	I		manzanilla	SUG	mis
Chenopodium ambrosioides L.	Amaranthaceae	19	Ch, Rf, Ms, pain	rs, ap	N	pasujt	apazote, epazote	SUG	same
Cecropia peltata L.	Moraceae	18	Pt, Ep, (Ch)	ts, (lv)	N	chojb'	guarum(b)o	SUG	imp
Tagetes lucida Cav.	Asteraceae	16	Ch, Pt, Rf, Az	ap	N		pericón	SUG	imp
Citrus limon (L.) Burm.	Rutaceae	14	Ch, Rf, Ms, Az	rs, (fl, bk, fr)	I		limón	OUG	same
Lavandula officinalis L.	Lamiaceae	13	Ch, (Pt, Az, Rb)	fl, ap	I		lucema, alhucema	SUG	mis
Lantana camara L.	Verbenaceae	12	Ch, (Rf, Ms)	rs, (lv, ap)	N		cinco negritos	OUG	same
Lippia graveolens H.B.K.	Verbenaceae	11	Pt, Ch, Rf, pain, Az, Tc	v	N		orégano (de Castilla)	NMU	same
Solanum torvum Sw. (*S. lanceolatum* Sessé & Moc.)	Solanaceae	11	Ch, Rf	rs, (lv)	N		riega plata, riega platos	SUG	imp
Erythrina sp. (# Kufer 165)	Fabaceae	10	Pt, Ch, Vb, delayed Ms	bk, (sd)	N	mo'te'	pito	SUG	same
Rosmarinus officinalis L.	Lamiaceae	10	Ch, Pt, Az, Ms	ap, ts, lv	I		romero	OUG	same
Piper nigrum L.	Piperaceae	9	Ch, Cr, Rf	fr	I	ich pimyénta	pimienta de chile, pimiento Castilla	ABS	n
Piper tuberculatum Jacq.	Piperaceae	9	Ch, Ms, Fc, Rf	rs, (fl, lv, bk)	N	kordonsíyu	cordoncillo	OUG	imp
Dioscorea sp. (# Kufer 208)	Dioscoreaceae	8	Ch, Rf	rs	N		cuculmeca	OUG	same
Pimenta dioica (L.) Merr.	Myrtaceae	8	Ch, Rf, Mc, Az	fr	N		pimienta gorda	SUG	same
Buddleja americana L.	Buddlejaceae	7	Ch, Ms, Az, If	lv, (ts, fl)	N	t'oxpe'	salvia (santa), hoja blanca, (hoja de) salve	SUG	imp
Pimpinella anisum L.	Apiaceae	7	Ch, Az, Rb	sd	I		anís, anís de Castilla	SUG	same
Acourtia nudicaulis (A. Gray) B.L. Turner	Asteraceae	6	Ch, Rf, Ms	rs, (ap)	N		valeriana roja, valeriana de cerro	OUG	mis
Porophyllum punctatum (Mill.) S.F. Blake	Asteraceae	6	Fc, Ch	rs	N		guapillo	NMU	mis
Acacia farnesiana (L.) Willd.	Fabaceae	5	Ch, Rf, Vb, Fc	rs, bk	N	sub'in	espino blanco, nco macho	SUG	same

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Cinnamomum verum J.S. Presl	Lauraceae	5	Ch, Rf	bk	I		canela	OUG	same
Citrus sinensis (L.) Osbeck	Rutaceae	5	Az, Ch, Pt	lv, (fl)	I		naranja, naranjo	OUG	same
Phlebodium pseudoaureum (Cav.) Lellinger	Polypodiaceae	5	Ch, Rf	rs	N	lorom, u kab' mis	calaguala	SUG	same
Rauvolfia tetraphylla L.	Apocynaceae	5	Rf, Ch, Vb, If	rs	N	sisar k'opot	chalchupa	SUG	imp
Agave cf. *sisalana* Perrine (# Kufer 359)	Agavaceae	4	Pt, Ch, Rf, Fc	ts, ro	N	sukchij	maguey	SUG	same
Aristolochia maxima Jacq.	Aristolochiaceae	4	Ch, Rf	rs	N	(nojta) wáko	guaco	SUG	same
Calyptocarpus wendlandii Sch. Bip.	Asteraceae	4	Gl, (Ch)	ap	N		cabeza de zompopo, espina de gallina	ABS	n
Cochlospermum vitifolium (Willd.) Spreng.	Bixaceae	4	Pt, Ep, (Ch)	bk, fl, ts	N	t'uyuy, mujrur te'	tecomasuchi(te)	SUG	x
*Folk generic 'tamagás'		4	Ch, If	rs	N		(bejuco) tamagás	OUG	mis
Hymenaea courbaril L.	Fabaceae	4	Ch, Pt, Vb		N	pakay	guapinol	OUG	same
Mentha cf. *crispa* L. (# Kufer 179 & 333)	Lamiaceae	4	Ch, Mc, Tc	lv, ap	I		hierbabuena	SUG	same
Ocimum campechianum Chapm./*O. basilicum* L./ *O. africanum* Lour.	Lamiaceae	4	Ch, Cr	ap	N/I		albahaca cimarrona/ albahaca de Castilla	OUG	same
Persea americana Mill.	Lauraceae	4	Fc, Rf, delayed Ms, If	sd, (bk, lv)	N	un	aguacate	OUG	same
Petiveria alliacea L.	Petiveriaceae	4	Ch, Vb, Ep	rs	N		apacina, apacín, epacina	SUG	imp
Psidium cf. *Popenoei* Standl. (# Kufer 418)	Myrtaceae	4	Ch, Rf, Fc, Rb	rs	N	ixim pataj	rayana, guayaba arrayán	OUG	mis
Zingiber officinale Roscoe	Zingiberaceae	4	Rf, Ch, Tc	rs	I		jenjirbe, jengibre	OUG	same

Az, *azahar*; Ch, after childbirth; Cr; *ciria*/*cirra*; Ep, expel placenta; Fc, fertility treatment or contraception; Gl, galactagogue; If, infection; Ms, menstruation; Mc, after miscarriage; Pt, parturient; Rb, reconstitute blood; Rf, *resfrio* (cold); Tc, tumour or cyst (according to doctor's diagnosis); Vb, vaginal bleeding; ap, aerial parts; bk, bark; fl, flowers; fr, fruits; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); sd, seeds; ts, tender shoots & leaves (*cojollos*); ro, fleshy centre of rosette; Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; ABS, no mention in manuscript; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; n, no botanical identification in the manuscript; same, own data confirm identification in the manuscript.

Table 5 Most frequently named plant species for respiratory illnesses

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Eucalyptus sp. (# Kufer 45)	Myrtaceae	14	Co, Wc, (pneumonia)	lv, (ts)	I		eucalito	OUG	same
Yucca guatemalensis Baker	Agavaceae	14	Co, Wc, As	ts	N	sit'a'	izote	SUG	same
Lippia dulcis Trev.	Verbenaceae	13	Co, As	ap, (ts, lv)	N		orozus	SUG	same
Citrus limon (L.) Burm.	Rutaceae	11	Co, As, Gr, Wc	fr (juice), (ts, lv)	I		limón	SUG	same
Cymbopogon citratus (DC.) Stapf	Poaceae	11	Co, Wc, Gr	lv, (fleshy base)	I		te de limón, zacate limón	OUG	same
Allium sativum L.	Alliaceae	9	Co, Sb, (Wc, sinusitis, asthma, Gr)	rs	I		ajús, ajo	OUG	same
Citrus sinensis (L.) Osbeck	Rutaceae	9	Co, Wc, As, Gr	lv, (fr, bk)	I		naranja/o	OUG	same
Bougainvillea x buttiana Holttum & Standley	Nyctaginaceae	8	Co, As, Gr, asthma	fl	I		bugambilia, bombilia, napoleon	SUG	mis
Psidium guajava L.	Myrtaceae	8	Co, Wc, As	ts, lv	N	pataj	guayaba	NMU	same
Persea americana Mill.	Lauraceae	7	Co, Wc, As	ts, sd	N	un	aguacate	OUG	same
Cinnamomum verum J.S. Presl	Lauraceae	6	Co, (Gr)	bk	I		canela	OUG	same
Matricaria recutita L.	Asteraceae	6	Co, Wc, As, Gr	ap, (lv)	I		manzanilla	SUG	mis
Mentha cf. *crispa* L. (# Kufer 179 & 333)	Lamiaceae	6	Co, Sb	lv, ts	I		hierbabuena	OUG	same
Pinus oocarpa Schiede	Pinaceae	6	Co	resin, ts	N	tajte'	pino	OUG	same
Tecoma stans (L.) H.B.K.	Bignoniaceae	6	Co, Wc, Gr, prevent Sb	lv, (ts)	N	ch'aj te'	chacté, chayté, chinche	OUG	same
Acacia farnesiana (L.) Willd.	Fabaceae	4	Co, As, Sb	bk, ts, ap	N	sub'in	espino blanco	OUG	same
Allium cepa L.	Alliaceae	4	Co, Wc, asthma	rs	I		cebolla	SUG	same
Asteraceae (# Kufer 154 & 395)	Asteraceae	4	Co, Wc, As	ts	N		corrimiento, currimiento	ABS	n
Buddleja americana L.	Buddlejaceae	4	Co, As, Sb	lv	N	t'oxpe'	salvia (santa), hoja blanca, (hoja de) salve	OUG	imp
Coffea arabica L.	Rubiaceae	4	Co, Wc, Gr, As	sd, lv, ts	I		café	NMU	same
Crescentia alata H.B.K.	Bignoniaceae	4	Co	bk, fl	N	tzimaj	morro	SUG	same
Mangifera indica L.	Anacardiaceae	4	Co, Wc, As	lv, ts, sd	I	malak'	mango	OUG	same
Ruta chalepensis L.	Rutaceae	4	Sb, Co	ap, ts, lv	I	tujyan ixik	ruda	OUG	same
Terminalia catappa L.	Combretaceae	4	Co, As	seed (oil)	I		almendro	OUG	same
Thymus vulgaris L.	Lamiaceae	4	Co	ap	I		tomillo	ABS	n

As, *ansia* (asthma?); Co, cough; Gr, cold or flu (*gripe*); Sb, *sajbuk*; Wc, whooping cough; ap, aerial parts; bk, bark; fl, flowers; fr, fruits; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); sd, seeds; ts, tender shoots & leaves (*cojollos*); Or, geographical origin; N, native; I, introduced; SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; ABS, no mention in manuscript; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; mis, botanical misinterpretation in the manuscript; n, no botanical identification in the manuscript; same, own data confirm identification in the manuscript.

Table 6 Most frequently named plant species for skin problems

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Alvaradoa amorphoides Liebm. ssp. *amorphoides*	Picramniaceae	18	It, Se, Bo	lv	N	chi'karar te', plumajíya	plumajillo/a	SUG	same
Chenopodium ambrosioides L.	Amaranthaceae	16	iWn, Aj, It, Se, Af	ap, lv	N	pasujt	apazote, epazote	SUG	same
Gliricidia sepium (Jacq.) Steud.	Fabaceae	9	It, Se	lv, (ts, bk)	N	k'an te	cacao de nance, madre cacao	SUG	same
Aloe vera (L.) Burm.f.	Asphodelaceae	8	Bo, Wn, It, burns	lv	I	tujtuj sukchij	sábila	SUG	same
Citrus limon (L.) Burm.	Rutaceae	8	Aj, Wn, It, headlice	fr, lv, ts	I		limón	SUG	same
Agave cf. *sisalana* Perrine (# Kufer 359)	Agavaceae	5	Wn, (It)	leaf sap	N	sukchij	maguey	OUG	same
Allium cepa L.	Alliaceae	5	Wn, (tinea)	rs	I		cebolla	OUG	same
Karwinskia calderoni Standl.	Rhamnaceae	5	Wn, Se, It	lv	N	ixim te'	guiliguiste	SUG	same
Tecoma stans (L.) H.B.K.	Bignoniaceae	5	It, Bo	lv	N	ch'aj te'	chacté, chayté, flor amarilla, chinche	OUG	same
Ficus sp. (Kufer 288)	Moraceae	4	Bo, Wn, larvae in skin	sap	N	jun, ma'n0jun, chu jun (te')	amate (grande), amate orejón	OUG	same
Solanum americanum Mill	Solanaceae	4	iWn, tinea	ap, lv	N	majk'ui	(hierba de) mora, quilete (de mora), macuy	OUG	same

Af, athlete's foot; Aj, *ajsyan* (wound infected by pregnant woman); Bo, boils; Wn, wounds; iWn, infected wounds; It, itching; Se, skin eruptions; ap, aerial parts; bk, bark; fr, fruits; lv, leaves; Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; same, own data confirm identification in the manuscript.

Table 7 Most frequently named plant species for illnesses with a psychological or spiritual component

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CWBotID
Buddleja americana L.	Buddlejaceae	19	Tx, Nv, Dp, Es, Ee, Rc, Wc	lv, (ts)	N	t'oxpe'	salvia (santa), hoja blanca, (hoja de) salve	SUG	imp
Ruta chalepensis L.	Rutaceae	18	Ee, (Rc, Tx, Es, Nv, Wc, Dp)	ap, ts, lv	I	tujyan ixik	ruda	SUG	same
Allium sativum L.	Alliaceae	9	Ee, Ij, Rc, Wc	rs	I		ajús, ajo	OUG	same
Citrus sinensis (L.) Osbeck	Rutaceae	7	Tx, Dp, (Ij, Es, Ep)	lv, (ts, bk)	I		naranja/o	SUG	same
Citrus limon (L.) Burm.	Rutaceae	6	Ee, Rc, Ij, Es, Nv, Dp	lv	I		limón	SUG	same
Nicotiana tabacum L.	Solanaceae	6	Ee, Es, Rc, crying baby, Wc	lv	N	k'ujtz	tabaco, puro	SUG	same
Acourtia nudicaulis (A. Gray) B.L. Turner	Asteraceae	5	Nv, Tx, Is	rs	N		valeriana (roja), valeriana de cerro	SUG	mis
Acacia hindsii Benth.	Fabaceae	4	Hh, Wc, Ep	ants in hollow spines	N	ixcanal	cacho de buey, cachito de toro, ixcanal	ABS	n
Artemisia ludoviciana ssp. *mexicana* (Willd. ex Spreng.) D.D.Keck.	Asteraceae	4	Ee, Ij, Is, Dp	lv, ap	N		(hoja) incienso, hierba (de) incienso, esencia	SUG	mis
Erythrina sp. (# Kufer 165)	Fabaceae	4	Is, tranquilizer, (Ep)	bk, fl, ts	N	mo'te'	pito	SUG	same
Sinapis sp. (seeds from market)	Brassicaceae	4	Wc, Rc, Es, Ij	sd	I		mostaza	NMU	n
Tagetes erecta L.	Asteraceae	4	Ij, (Es, idiocy)	ap	N	sampwer	flor de muerto	OUG	mis

Dp, depression; Ee, evil eye; Ep, epilepsy; Es, *espanto* (fright); Hh, henpecked husband syndrome; Ij, *ijillo* (emanation from corpse); Is, insomnia; Nv, nervios; Rc, ritual cleansing; Tx, *toxpe* (anger); Wc, witchcraft; ap, aerial parts; bk, bark; fl, flowers; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); sd, seeds; ts, tender shoots & leaves (*cojollos*); ahs, ants in hollow spines; Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; ABS, no mention in manuscript CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; n, no botanical identification in the manuscript; same, own data confirm identification in the manuscript.

Table 8 Most frequently named plant species for ailments of ears and eyes

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CW BotID
Mentha cf. *crispa* L. (# Kufer 179 & 333)	Lamiaceae	8	Ea	ap, lv, ts	I		hierbabuena	SUG	same
Ocimum campechianum Chapm./ *O. basilicum* L./ *O. africanum* Lour.	Lamiaceae	8	Cj, (Ea)	sd, (lv)	N/I		albahaca cimarrona/ albahaca de Castilla	SUG	same
Bromelia karatas L.	Bromeliaceae	7	Ea	lv, ts	N	tzetze'	muta, piñuela/o	NMU	same
Senna occidentalis (L.) Link	Fabaceae	5	Cj	lv, ap	N	b'u'r k'opot	frijolillo (negro)	SUG	imp
Tagetes erecta L.	Asteraceae	5	Cj, (Ea)	ap, lv	N	sampwer	flor de muerto	SUG	mis
Yucca guatemalensis Baker	Agavaceae	5	Ea	ts	N	sit'a'	izote	OUG	same
Vitis tiliifolia Humb. & Bonpl. ex Roem. & Schult.	Vitaceae	4	Cj	sap	N	chuyur ch'a'n	(bejuco de) uva	SUG	same

Cj, conjunctivitis/eye inflammation; Ea, earache; ap, aerial parts; bk, bark; lv, leaves; sd, seeds; ts, tender shoots & leaves (*cojollos*); Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; same, own data confirm identification in the manuscript.

Table 9 Most frequently named plant species for urogenital complaints

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CW BotID
Equisetum myriochaetum Schltdl. & Cham.	Equisetaceae	9	Kd, Ub/Ui	ap	N	u nej chij	cola de caballo	NMU	imp
Citrus limon (L.) Burm.	Rutaceae	6	Ui	fr	I		limón	SUG	same
Zea mays L.	Poaceae	6	Ui, (Ub, Kd)	silk (styli)	N	ixim, nar	maíz	SUG	same
Bursera simaruba (L.) Sarg.	Burseraceae	5	Kd, Ui, Bs	bk, (fr)	N	chakajr	(palo de) jiote/fiote, palo chino	SUG	same
Hymenaea courbaril L.	Fabaceae	5	Kd	bk	N	pakay	guapinol	OUG	same

Bs, bladder stones; Kd, kidney problems; Ub, urinary blockage; Ui, urinary infection; ap, aerial parts; bk, bark; fr, fruits; SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; Or, geographical origin; N, native; I, introduced; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; same, own data confirm identification in the manuscript.

Preparation and application of remedies

The two most common forms of preparing a medicine are decoctions and cold macerations. The latter is locally called *horchata* and commonly made by grinding the fresh plant material on the grinding stone normally used for maize. The use of *horchatas* is strongly discouraged not only by biomedical health-care providers (who often oppose any kind of herbal medicine) but also by those involved in projects trying to promote the use of herbal medicine, because of concerns about microbial contamination. People making these recommendations are usually unaware of particular indigenous motives for choosing this mode of preparation, such as the concept that remedies for feverish illnesses must not be boiled because this would reverse their so-called cool character, or that an entire rue plant (*Ruta chalepensis*) would die if a sprig of it was boiled. A way of enhancing the power of a cool remedy is to leave it outside overnight in an open dish so that it will collect the morning dew (*sereno*; the process is called *aserenado*). Herbal

Table 10 Most frequently named plant species for oral health problems

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CW BotID
Jatropha curcas L.	Euphorbiaceae	9	Ms, (Ta)	sap (from bk)	N	sakirte'	piñón	SUG	same
Lysiloma sp. (# Kufer 258)	Fabaceae	9	Ta, Oh	bk, (rs)	N	yaj	quebracho	SUG	mis
Byrsonima crassifolia (L.) H.B.K.	Malpighiaceae	7	Ta, Oh	bk	N	chi'	nance (ágrio)	OUG	imp
Matricaria recutita L.	Asteraceae	6	Ta	ap, (lv)	I		manzanilla	SUG	mis
Pinus oocarpa Schiede	Pinaceae	6	Ta	resin, ts	N	tajte'	pino (de ocote)	OUG	same
Nicotiana tabacum L.	Solanaceae	4	Ta	lv	N	k'ujtz	tabaco, puro	OUG	same
Quercus sp. (# Kufer 254)	Fagaceae	4	Ta, Oh	bk	N	ch'oror	roble	NMU	same

Ms, mouth sores; Oh, oral hygiene & prevention; Ta, toothache; ap, aerial parts; bk, bark; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); ts, tender shoots & leaves (*cojollos*); Or, geographical origin; N, native; I, introduced; SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; imp, identification in the manuscript less detailed than in this study; mis, botanical misinterpretation in the manuscript; same, own data confirm identification in the manuscript.

Table 11 Most frequently named plant species in the residual category

Scientific plant name	Family	No. URs	Main uses	Plant parts	Or	Ch'orti' name	Spanish name	Hist. comp.	CW BotID
Citrus limon (L.) Burm.	Rutaceae	7	Sn, (antidote)	fr	I		limón	SUG	same
Allium sativum L.	Alliaceae	6	Cv, (nose bleeding, Al), mumps	rs, (ap)	I		ajús, ajo	OUG	same
Tridax procumbens L.	Asteraceae	6	An	ap	N	wakax k' opot	hierba del toro	SUG	same
Aloe vera (L.) Burm.f.	Asphodelaceae	4	Lc	lv	I	tujtuj sukchij	sábila	SUG	same
Pedilanthus tithymaloides (L.) Poit.	Euphorbiaceae	4	Bf	ap	N		pie de niño	OUG	same
Sansevieria hyacinthoides (L.) Druce	Ruscaceae	4	Sn	lv	I		curarina	SUG	mis

Al, alcoholism; An, anaemia (to refresh the blood); Bf, bone fractures; Cv, cardiovascular problems; Lc, liver complaints (incl. hepatitis); Sn, snakebite; ap, aerial parts; fr, fruits; lv, leaves; rs, roots and other subterranean plant parts (tuber, rhizome, corm, bulb); Or, geographical origin; N, native; I, introduced; N/I, native and introduced (folk generics consisting of several botanical species); SUG, same use group; NMU, no record of medicinal use; OUG, used for treating conditions of a different use group; CWBotID, botanical identification in Charles Wisdom's unpublished manuscript; mis, botanical misinterpretation in the manuscript; same, own data confirm identification in the manuscript.

infusions (*apagado*) are sometimes prepared, especially from tender plant parts like young leaves, which do not require lengthy boiling to achieve a good extraction. For local application, parchments (*parche*, *cataplasma*) are prepared. Powders prepared from dried and toasted plant leaves and used to dry up open sores are another preparation form discouraged by outsiders. An interesting form of application are *confortes* (sometimes called *infortes*), small tortilla-shaped cakes that are applied externally onto particularly important parts of the body, especially the navel, often also on the temples, pulses and soles of the feet. They are mostly used when the patient has difficulties ingesting remedies via the oral route, and contain medicinal plants or nutritious substances like egg for, as Charles Wisdom described it, magical injection of sustenance (Wisdom 1952).

Comparison between contemporary and historical medicinal plant uses

Of all contemporary (c)MPUs, 29.1% overlapped with the historical data (i.e. the same plant taxa were mentioned in Wisdom's manuscript as being used for treating conditions in the same UG (SUG)). A further 42.7% of cMPUs referred to plant species that are recorded in the manuscript as medicinals, but for treating conditions of a different UG (OUG). 12.8% of all cMPUs referred to plants with an entry in the manuscript, but no record for medicinal use (NMU), while the plant species of 15.4% of cMPUs have no entries in the manuscript (ABS). Interestingly, though perhaps not surprisingly, the MPUs that were more consistent over time were also mentioned more frequently

(i.e. culturally more important): of all URs 47.1% were referring to plants already recorded by Wisdom for the treatment of the same groups of illnesses (SUG), while these represented only 29.1% of the cMPUs. The connection between frequency and historical consistency showed a very high level of statistical significance.

Gastrointestinal illnesses

The 520 URs (19.8%) in this group referred to 164 plant taxa (16.5% of all MPUs). As in most other parts of Guatemala diarrhoea is very common and a serious cause of morbidity especially in children (Heuveline & Goldman 2000). A particular form of diarrhoea in children is locally called *ajsyan* (Ch'orti') or *preñiz* (Spanish) and is said to occur when a breast-feeding mother eats food prepared by a pregnant woman. The nursing infant contracts the disease via the milk. *Ajsyan* is distinguished from ordinary diarrhoea by the green colour of the faeces. An ethnomedical concept associated with green diarrhoea in children has also been reported for other Mayan groups (e.g., Berlin & Berlin 1996; Ankli et al 1999a).

Amoebiasis is distinguished from other gastrointestinal infections by its clinical symptoms ("we want to go to the toilet but nothing happens"), hence the local Spanish name *pujo*. There is a further distinction into red (bloody) and white (mucous) *pujo*. Intestinal worms are common especially among children. *Ascaris* infections are most frequent, while *Oxyuris* (pinworms) and tapeworm are mentioned only occasionally.

Empacho is an illness concept of Spanish origin with a wide distribution in Latin America (Weller et al 1993). In Eastern Guatemala, it has some aspects in common with gastritis and some local people consider it to be the same illness. It is said to be caused by missing a meal at the normal time or eating without appetite, which causes food to get stuck on the stomach wall. When it later becomes unstuck, this causes local injury and pain. Treatment of *empacho* typically involves ingestion of the food that caused the *empacho* in carbonized form. There was no evidence for the dangerous practice of using lead-based remedies to treat this illness, as has been reported from some parts of Mexico (Baer et al 1989).

Remedies for gastrointestinal problems are normally prepared as a decoction or tea and taken orally. Several fruit trees yield important botanical drugs used for this purpose: guava (*Psidium guajava*), lime (*Citrus limon*), mango (*Mangifera indica*) and zunso (*Licania platypus*). Often the preferred plant part is the seed, while the bark is considered second choice, but in other cases the (unripe) fruit is used. Most of the important species in this UG are native to the neotropics and all of the important species were already recorded by Charles Wisdom. Only for a few species (e.g. *P. guayava*) did he report a different, or no, medicinal use.

The most popular plant is *Chromolaena glaberrima* (Table 2) commonly used for gastrointestinal pain (locally called *dolor de estómago*) and diarrhoea. Charles Wisdom did not provide a botanical identification for the species he recorded as *venadillo*, for which he also reported uses in the treatment of gastrointestinal pain. Similar uses are known from Honduras and the Sierra de las Minas in Guatemala (House et al 1995; Orellana Ayala 1998). Apart from some sesquiterpene lactones, very limited phytochemical information is available about the species and the subgenus as a whole (Ahmed et al 1985, 1986).

As in other Latin American countries (e.g. Morton 1981), American wormseed, locally called *apazote* (*Chenopodium ambrosioides*), is used to eliminate gastrointestinal worms. The essential oil of this plant contains ascaridol as its main anthelmintic principle and was commercially produced until some decades ago. Ascaridol has toxic side effects and cases of poisoning, though probably due to overdose, contributed to the phasing out of this product. A recent study showed that ascaridol-free infusions of the plant possessed anthelmintic properties without the kind of toxicity associated with ascaridol. This indicates that the traditional usage of a decoction of this plant, which is also used as a food flavouring, is very likely to be safe (MacDonald et al 2004). Another indicator for judicious use of this species is that local people usually avoid plant material with a high proportion of seeds, which contain the highest concentrations of ascaridol. Since another study found genotoxic effects in the aqueous extract, further studies are needed (Gadano et al 2002). As the plant has a very wide geographical distribution and human selection for different purposes may have occurred over a long period in different places, it is also highly likely that chemical races exist.

Dorstenia drakena and the closely related species *D. contrajerva* have widespread use for the treatment of gastrointestinal problems. The latter species showed very promising activity against *Helicobacter pylori* (Ankli et al 2002). Tender leaves and fruits of *Psidium guajava* are widely used for gastrointestinal illnesses and have shown antimicrobial and spasmolytic activity (e.g., Lozoya et al 2002).

Aristolochia maxima is commonly used for gastrointestinal pain. The internal use of *Aristolochia* species is widespread in Mexico and Central America. This is a cause for serious concern, as a common characteristic of this genus is the presence of aristolochic acids, which are known to have clinically and toxicologically well documented carcinogenic and nephrotoxic effects (Muniz Martinez et al 2002). As these dangerous side effects occur years after the use of the herbal product, the cause of these side effects is difficult to establish without bioscientific and statistical methods.

Fever and pain

Compared with previous studies in Mexico (Heinrich et al 1998a; Leonti et al 2001), this UG is of particular importance in Eastern Guatemala (18.9% of all URs and 14.1% of all MPUs). Fever and pain seem to have been even more important historically, as 16.4% of all MPUs in Charles Wisdom's manuscript fall into this UG. Indeed,

malaria was endemic in the area and a major killer, to the extent that its gradual reduction and, finally, near-eradication in the first half of the 20th century contributed significantly to the dramatic increase in population (Scrimshaw & Tejada 1970; Maxwell 1975). Today, cases of malaria in Eastern Guatemala are rare and mainly occur among migrant workers. Many of the remedies formerly used for malaria are now recommended for dengue fever, which is becoming increasingly frequent in Guatemala (Klassen et al 2004).

Infections associated with fever, especially viral infections, have been shown to cause alterations of the oxidant–antioxidant system (Klassen et al 2004). The use of citrus juice and other sour-tasting ingredients for the preparation of refreshing drinks provides the body with a good supply of vitamin C, while the pleasant taste of home-made lemonade and similar drinks encourage the patient to drink plenty. Of particular interest is the use of squash seeds (*Cucurbita moschata*) for the preparation of a refreshing drink, particularly recommended for measles. Vitamin E is an important antioxidant. A fat-soluble vitamin, it is much more likely than water-soluble vitamin C to be missing in the diet during episodes of feverish illness when patients suffer from poor appetite.

Measles and chickenpox are often not clearly distinguished, and in addition, the Spanish term for smallpox, *viruela*, is sometimes used erroneously for these conditions. Especially measles used to be a serious threat and has caused many fatalities until only one generation ago. However, in recent years, most children in the more accessible hamlets have received vaccinations and both illnesses have become less frequent.

Flución is a concept of Spanish origin. Headache and dizziness are the main symptoms and said to be caused by sudden exposure to cold, especially cold water, when the body is overheated by strenuous physical activity, exposure to the sun, or both. To avoid *flución*, it is recommended that one sits down in the shade and rests for some minutes before drinking or washing. *Aire*, literally air, is a pain that can occur in many parts of the body. *Aire* close to the surface of the body is typically caused by blunt injuries (*golpes*), which are said to weaken the body at the affected spot so that air enters and causes pain. Apart from herbal remedies, the most important traditional treatment for this condition consists in applying *ventosas* – a method producing a vacuum with a small gourd or glass, similar to cupping, but without the drawing of blood. Swellings (*hinchazón*) are often said to be caused in a similar way to *flución* (i.e. by a sudden cold shock to a part of the overheated body, e.g., by walking barefoot on the cold earth floor of the house, or by excessive cold or heat). Swellings in children are frequently caused by kwashiorkor (protein deficiency). While elephantiasis is today practically unknown in the Ch'orti' area, it was frequent at least until the 1930s (Wisdom 1940), and Charles Wisdom's manuscript mentions five plant remedies explicitly for treating elephantiasis besides a further ten for unspecified swellings. Remedies for swellings are mostly applied locally as poultices or with a gentle massage. Swellings supposedly caused by cold are also treated with a steam bath, using a large bowl and a blanket. The traditional sweat-house (*tuj* or *temascal*), popular in highland Guatemala, is unknown in Eastern Guatemala.

With the exception of swellings, which are classified as cold diseases because of the accumulation of liquid in the affected tissue, the ailments in this UG are regarded as hot and often referred to as fire. Therefore, cool remedies have to be applied (*cosas frescas*). This means that remedies are not boiled, and cool plants are preferred. A sour taste is indicative of a cool nature, as are a mucilaginous/viscous consistency (*liga*) and diuretic action. However, the quality that was most frequently mentioned spontaneously was bitter taste, although bitterness is not generally associated with coolness. In this case, the plants were simply considered cool because they showed antipyretic action and bitterness was mentioned as their most outstanding characteristic. Indeed, many of the most important remedies in this UG do have a strong bitter taste (e.g., *Tecoma stans*, *Neurolaena lobata*, *Mikania micrantha*, *Justicia spicigera* and *Tridax procumbens*).

For fever and headache, a rather large amount of *horchata* (cold maceration) is prepared. Only a small part is taken internally, while the rest is used for a head bath. The solid remains of the plants used in preparation are sometimes applied as poultices to the temples, the palms of the hands and the soles of the feet.

Mikania micrantha has become a pantropical weed causing serious concern because of its invasiveness. However, in Eastern Guatemala it is native and only moderately abundant. Its local name, *tabardillo*, is a traditional Castilian term for exanthematic typhus, which later came to be used to describe epidemic diseases characterised by fever (Orellana 1987). The plant is used for dengue fever in the Sierra de las Minas, Guatemala (Orellana Ayala 1998), contains sesquiterpene lactones (Wei et al 2004) and has antimicrobial effects (Lentz et al 1998). Charles Wisdom reported the same use for this plant, but the scientific name given in his manuscript is for a species from a different plant family.

Tecoma stans and *Neurolaena lobata* are both specifically recommended for very high fever (i.e. for malaria and increasingly for dengue fever). They were both reported by Charles Wisdom for the same UG. Alkaloids from *T. stans* have been isolated and tested for hypoglycaemic activity (Costantino et al 2003), but its potential as an antimalarial, febrifuge and anti-inflammatory drug remains little known. *N. lobata* contains pyrrolizidine alkaloids (Passreiter 1998) and sesquiterpene lactones (Passreiter et al 1995). Use of both species to treat feverish illnesses has also been documented by other researchers in adjacent areas (e.g. Orellana Ayala 1998).

Tridax procumbens has in-vivo immunomodulatory effects (Tiwari et al 2004) and is used particularly for fever associated with headache and dizziness (*flución*). Its use for headaches in Eastern Guatemala has been documented previously (Ronquillo 1988).

Charles Wisdom reported no medical uses for coffee, although in the 1930s it was already cultivated in the area and commonly used as a beverage. It is likely that the

medical uses of coffee only became established among the Ch'orti' later on when they had collected enough local empirical evidence.

Women's remedies

The 488 URs (18.6%) in this group refer to 154 plant taxa (15.5% of plant uses). The vast majority of remedies in this category are simply called hot remedies (*remedios calientes*) and may be used in different situations. During childbirth, a decoction is typically given in the later stages of labour to ensure a healthy and timely delivery. After childbirth, the woman (called *criandera* at this stage) has to follow a certain *dieta*, a regimen which includes more than dietary restrictions. A decoction of hot remedies is taken for three days as the only liquid. Afterwards, some women still drink preparations of some of these plants (for 20 or 40 days), but usually composed of fewer species. A similar *dieta* is taken by menstruating women, on the first three days or throughout when menstruation is longer. Disregard of the *dieta* regime after childbirth, or during menstruation, is said to cause a condition called *resfriado*, which can be cured by application of the same hot remedies. Taboos of the *dieta* regime include everything considered cold (all greasy, sour and sometimes also green foods), such as pork, avocado, citrus and other sour fruits, raw vegetables, bathing, washing and drinking cold water, and exposing the body to cold air. Symptoms of *resfriado* are sterility and a prolonged and painful menstruation. Infections of the female reproductive organs with all the accompanying symptoms, such as pain and vaginal discharge, are also mainly explained as a consequence of *resfriado*. As this condition is considered a consequence of ignorance and carelessness rather than of immoral behaviour, there are no taboos associated with knowledge about its treatment, and research participants belonging to both genders readily shared knowledge of this kind. It was frequently explained that after birth, a stone forms in the woman's abdomen (stomach), which has to be washed away by frequent drinking of hot remedies. Another expression frequently employed was cleaning (or clearing) the stomach after birth (*limpiar el estomago después del parto*). A serious case of *resfriado* or failure to apply hot remedies after birth may result in *ciria* or *cirra*, considered to be a kind of false pregnancy, characterised by cessation of menstrual periods without previous sexual intercourse. A ball or animal is formed from the woman's own blood and the condition progresses apparently like a normal pregnancy. It is supposed to be fatal if untreated, and the *ciria* should be expelled, at the latest, after three or four months.

There are only a few other women's remedies with more specific indications: delay in the last phase of labour and particularly retention of the placenta is treated with either of two plants, *Cecropia peltata* and, less frequently, *Diphysa americana*, or the soot (*xoj* in Ch'orti', *tizne* in Spanish), which forms in traditional Maya houses on the wooden beams over the hearth. Both plants were reported by some people to be used for the same problem in cows, and one informant actually reported having given this remedy to his wife in desperation because he knew it to be effective in animals. *C. peltata* is used to expel the placenta in Honduras (Ticktin & Dalle 2005). The related species *C. obtusifolia* showed anti-inflammatory, analgesic and central depressor effects and low toxicity in-vivo (Perez-Guerrero et al 2001). Another category of women's remedies overlaps to a large extent with food: many galactagogues are foods considered to be good for nursing mothers, but also eaten by other people, such as *Cnidoscolus chayamansa* or sweet potato leaves (*Ipomoea batatas*). This overlap between the categories of food and medicine is very likely to have caused some underreporting.

While *resfrio* supposedly may lead to female sterility, it has never been recommended that this condition should be induced deliberately as a means of family planning because it is regarded as a serious illness. Family planning is a very delicate issue in Eastern Guatemala and besides a widespread lack of understanding about methods of contraception, active rejection of the concept, particularly of mechanical and hormonal methods, by various groups of the population has been documented in recent years (Metz 2001). These conditions limited the possibilities for asking directly about plants used as contraceptives. However, for most people it was culturally acceptable to talk about methods for increasing the time between pregnancies (*espaciar los embarazos*).

Pluchea symphytifolia is widely used during and after childbirth (e.g., Ankli et al 1999a; Leonti 2001). It contains caffeoylquinic acids, which have shown some in-vitro antibacterial and anthelmintic properties (Scholz et al 1994), thus it may have a prophylactic effect against infections.

Charles Wisdom already mentioned the use of *Chenopodium ambrosioides* for 3 days after delivery (Wisdom 1940). The plant was also mentioned as a remedy for menstrual problems in the colonial period (Fuentes y Guzmán 1969; López Austin 1972, both cited in Orellana 1987).

Respiratory problems

The 278 URs (10.6%) in this group represent 98 plant taxa (9.9% of plant uses). As in other parts of Guatemala, respiratory problems are frequent among children (Heuveline & Goldman 2000) and opportunistic respiratory infections can be a particularly serious, indeed lethal, threat to children after survival of an acute crisis of malnutrition. Besides cough as a symptom of the common cold, whooping cough was reported frequently. Large temperature differences and dust in the dry season, cold and humid climate in the hamlets situated at higher elevations and smoke from the fireplace in traditional Maya houses without a chimney all contribute to susceptibility towards infections of the respiratory tract. Also in this category is a condition referred to as *sajbuk* (Ch'orti'), a persistent and very dangerous cough distinguished from other forms of cough by it causing the mouth to foam like soap. It is said to affect mainly children when they become exposed to the heat of suppressed or illicit sexual energies.

Tender shoots of *Yucca guatemalensis* are among the most frequently mentioned remedies for cough. The genus *Yucca* contains steroidal saponins, and thus may have an expectorant effect, but little else is known about its phytochemistry and pharmacological activity. *Lippia dulcis* is another important native remedy in this UG (cf. Pascual et al 2001). However, most of the major remedies in this UG are introduced from abroad (e.g. *Eucalyptus* leaves, lemongrass (*Cymbopogon citratus*), lime juice (*Citrus limon*), garlic (*Allium sativum*) and orange leaves (*Citrus sinensis*)). *Bougainvillea x buttiana*, a widely cultivated ornamental plant, is frequently used for respiratory problems in Guatemala, Honduras and Mexico (e.g. Dieseldorff 1977; House et al 1995; Frei et al 1998a). An antiviral protein was isolated from the roots of *B. glabra* (Balasaraswathi et al 1998) and the pigments of the showy bracts have been studied intensely (e.g., Heuer et al 1994), but little else is known about the phytochemistry of the genus.

Cough remedies are usually prepared as a decoction or tea. Many of the plants in this UG are aromatic (e.g., *Eucalyptus* sp., *Lippia dulcis* and *Cymbopogon citrates*). Often, plant oil or animal fat (from chicken or any of a wide variety of wild animals) are added during the preparation, probably to extract essential oils from the plants.

In Charles Wisdom's manuscript, respiratory illnesses account for a lower percentage of MPUs than they do among our field data. While this difference is not statistically significant, it is striking that many of the most frequently mentioned species in this group were reported by Charles Wisdom as medicinal plants, but only for the treatment of illnesses in other UGs (e.g., eucalyptus, lemongrass, garlic, orange and guava leaves, as well as avocado seeds and leaves). This may be due to the fact that remedies for respiratory illnesses are mostly used by mothers and other female relatives to treat children, hence knowledge about them is a predominantly female domain, and thus may have been less accessible to Charles Wisdom as a male researcher.

Skin problems

The 238 URs in this group represent 116 plant taxa (11.7% of plant uses). The percentage of use reports in this category (9.1%) is much smaller than in other studies (Weimann & Heinrich 1997; Frei et al 1998a; Ankli et al 1999a; Leonti et al 2001). Methodological factors may contribute to this to some extent: some conditions included in this UG in other studies have been allocated to other UGs (e.g., mouth sores and gingivitis, OD; snake bites, OT; swellings and bruises, FP) because this better reflected the local classification. Also, the predominant use of free listing rather than guided walks favours established herbal remedies with a vernacular plant name, while remedies for certain skin problems such as cuts and other wounds are often used for first aid and characterized by a high degree of experimentation. On the other hand, the extremely low number of URs for skin problems is unlikely to be due to methodology alone. Other reasons may be that machete wounds acquired during fights under the influence of alcohol are socially stigmatized, and the tradition of applying leaf powders to dry up open sores has been strongly discouraged by government health programmes because of concerns about increasing the risk of wound infection instead of minimizing it. The percentage of MPUs in this UG is equally low among the historical data collected by Charles Wisdom (in fact, even lower, but the difference is not statistically significant), making it unlikely that the low number of species found in this UG is due to methodology or factors such as the gender of the researcher.

Cuts and other injuries contracted while working in the maize fields are frequent health problems. Under the conditions of poor hygiene in rural Guatemala, it is crucial to control wound infections. As in other parts of Latin America, the term cancer refers to infected and slow-healing wounds rather than to skin cancer. Boils are usually considered too trivial to undertake the journey to see a doctor. Instead, they are opened by the application of latex from a range of plants such as *Ficus* sp., which bring boils to a head. Skin infections causing an itching or burning sensation can be caused by a wide range of organisms, including insects, fungi and bacteria. Scabies, chiggers, ringworm, athlete's foot and erysipelas are common in the area, as is tinea, a skin infection that causes no pain or itching but rather disfiguring irregularities in skin pigmentation.

Plants for dermatological conditions overlap to a considerable extent with plants used for cosmetic purposes. As in the case of food and medicine, it is often not possible to draw a line between medical and non-medical uses, especially when preventive effects are involved, as is the case with plants used for personal hygiene, which may also prevent skin infections. Under-reporting is certainly high for these, because many research participants did not consider them remedies in the strict sense and the way questions were phrased (in terms of remedies for skin problems) favoured plants for treating skin problems once they occurred rather than for preventing them. Almost all of the most frequently mentioned species in the DE category have some property that disqualifies them for daily use – some are too irritating (e.g., *Alvaradoa amorphoides* and *Agave* sp.), while *Aloe vera*, commonly used in industrially processed cosmetics, has an unpleasant smell when the fresh plant is used. None of the plants commonly used for washing body and hair was mentioned more than three times (i.e. frequently enough to be reported here) although they were very widely used.

Alvaradoa amorphoides, mentioned by nearly half of all research participants, is mainly used for treating itching skin conditions. Many informants warned that this remedy had to be used very carefully as in some patients it may cause additional skin irritation rather than relief, while others regarded the initial burning sensation it causes as a sign of its efficacy. Alvaradoins, compounds showing many structural similarities with bitter and purgative C-glycosides (aloins) of the genus *Aloe*, have been found in *Alvaradoa jamaicensis* (Harding et al 1999). Otherwise, little is known about the phytochemistry of the genus *Alvaradoa*, which is closely related to *Picramnia*, a genus with important medicinal species.

Both genera were previously regarded as belonging to Simaroubaceae but have been placed into a separate family, Picramniaceae, partly on the basis of phytochemical criteria such as the absence of quassinoids, bioactive compounds typical for Simaroubaceae (Jacobs 2003).

Chenopodium ambrosioides (see also above under Gastrointestinal illnesses and Women's remedies) is used in many parts of Guatemala for the treatment of infected wounds and infections of the female reproductive organs (e.g. Ronquillo 1988; Ayala Lemus 1999).

Gliricidia sepium leaves are widely used for skin problems and other complaints (Ronquillo 1988; House et al 1995; Orellana Ayala 1998). Since the tree can easily be grown from cuttings, it is also used as living fence-posts. The flowers are sometimes eaten and the plant is used as a natural insecticide. Despite these multiple and interesting uses, its phytochemistry and pharmacology have not been studied in great detail and most of the published information is relatively old. The bark contains 12a-hydroxyrotenoids (Rastrelli et al 1999). As a widespread plant frequently used in empirical phytotherapy, it would be a good candidate for laboratory-based studies.

Illnesses with a psychological or spiritual component

The 178 URs (6.8%) in this group refer to 72 plant taxa (7.5% of plant uses). In this category we discuss conditions with an important psychological or spiritual component. Some of these, such as insomnia, are recognized universally, while concepts for others are limited to a certain cultural–geographic area. While some conditions in the other use groups are also referred to, and explained in culture-specific terms (*sajbuk* in RE, *empacho* in GI, *resfrio* in GY, *aire* in FP and *ajsyan* (*preñiz*) in GI and DE), illnesses with a spiritual dimension are inherently more closely tied to the cultural idiosyncrasies of the sufferer and will therefore be discussed using the local terminology and emic concepts.

A largely underestimated and misunderstood part of ethnomedical traditions is the use of plants as culturally appropriate, powerful symbols, able to evoke a strong 'meaning response', commonly called placebo effect. The expression placebo has negative connotations and specifically in an ethnopharmacological context it is often misleading. Also, there is mounting evidence that this effect is in fact part of a much more complex phenomenon. Therefore, the term meaning response is used here (see Moerman & Jonas 2002 for a detailed discussion). Symbolic plant applications, such as passing a bundle of aromatic herbs externally over the patient's body for ritual cleansing, will presumably evoke a meaning response, resulting in effects such as immunostimulation or pain relief. On the other hand, the healing effects of many forms of biomedical treatment, such as injections and surgery, are in part also due to the meaning response. It is crucial to remember that in a poor country like Guatemala these forms of biomedical treatment are often applied inappropriately, resulting especially in iatrogenic infections, and put patients at considerable risk (Reeler 2000).

Espanto or *susto* is a concept widespread in the Americas, and involves the loss or imprisonment of a part of the soul or spirit, caused by a sudden fright (Weller et al 2002). Common explanations in the Ch'orti' area include stumbling and falling (especially children), falling from a tree and fear of drowning when swimming in a river. Allegedly, the sufferer has been seized (*agarrado*) by a supernatural entity. For curing an *espanto*, it is essential to find out who has seized the patient, so that this specific being can be forced, tricked or persuaded to release the victim. Usually, *espanto* cannot be cured with plants but requires the expertise of a spiritual healer, locally called *chucurero*, an expression derived from the Ch'orti' word for 'to seize'. However, some ritual plants are essential for the healer's work, especially tobacco, which is used for divination, and copal incense for ritual cleansing.

A concept similar to espanto is *t'oxpe'* (Ch'orti'), often translated as *cólera* or *enojo* (anger) or with a phrase like 'when somebody is very angry'. Local people very rarely referred to this concept as *bilis*, or biliousness, a term originally used for an ethnomedical concept of European origin supposedly caused by an excessive amount of bile with choleric, angry behaviour as the main symptom. Six entries in Charles Wisdom's manuscript on ethnobotany mention biliousness as one of the conditions for which the respective plants are used. While the European concept of biliousness is inextricably linked to humoral theory, Ch'orti' informants never explained *t'oxpe'* in humoral terms, but instead used an explanatory model remarkably similar to contemporary psychological theories: *t'oxpe'* occurs mainly when a person becomes a victim of an insult or aggressive behaviour and bottles up the resulting resentment. Over time, the sufferer develops symptoms of depression or post-traumatic stress disorder. While few other illnesses in this UG are treated with orally ingested herbal remedies, the main therapy for *t'oxpe'* consists of a drinking a cold maceration of *Buddleja americana* and bathing the head with it. The Ch'orti' name for this plant is *t'oxpe'*, like the illness it is used for. *T'oxpe'* has much in common with *nervios* (Baer et al 2003), but in the study area the two concepts are clearly distinguished and *nervios*, which seems to be less important as a concept, may be a recent introduction.

Nerves (*nervios*) is a concept widespread in Latin America and the Mediterranean (Baer et al 2003). In Eastern Guatemala, it is associated with insomnia, nervous tension and psychological stress in general. Several food plants well known for their soporific properties (in particular *Erythrina* sp. and *Crotalaria longirostrata*) are recommended as evening meals. More recently, an extract from *Acourtia nudicaulis*, prepared by the MENACHOR programme, has become a very popular remedy for nervous tension and insomnia. Very little information about ethnomedical uses of this and related species of the genus *Acourtia* (previously included in *Perezia*) is available in the literature: The only source mentioning medical uses of the same species is a Guatemalan MSc dissertation (Orellana Ayala 1998), while other species are used in Mexico as laxatives, for kidney ailments and for diabetes (Linares & Bye 1987; Gupta 1995). *Valeriana* roots are

one of the most frequently sold herbal remedies in Guatemalan markets, although the botanical identity of the plant material is often not clear. Other species known as *Valeriana* in the study area are *Chaptalia nutans* from the same botanical tribe and *Vetiveria zizanoides* (Poaceae), while in other parts of Guatemala the name *Valeriana* is also applied to *Eupatorium pycnocephalum* Less., Asteraceae (Ayala Lemus 1999) and to native species of *valeriana*, Valerianaceae (e.g. Nicolas 1999). In Honduras, *Dyssodia montana* (Benth.) Gray is called *valeriana* (House et al 1995).

In Eastern Guatemala and Honduras, *hijillo* (*ijillo*, *ejillo*) is a noxious odour or emanation from a corpse, which is conceptually different from the spirit of a dead person (Santamaria 1942). *Hijillo* may affect people attending a funeral, particularly those who wash the corpse, and is transmittable via the clothes worn at the funeral, which become impregnated with it. It usually only affects people in a weakened or delicate state, such as children and sick people, but also healthy adults if they go to the funeral with fear. As *hijillo* is a kind of bad smell, it can be neutralized with other strong smells. A standard procedure at the end of indigenous funerals is the *sahumerio*. This consists of passing through the smoke of a fire made with green pine and cypress boughs, marigolds (*Tagetes erecta*), garlic, citrus leaves, copal resin and other aromatic plants. As the *sahumerio* is a preventive measure, the plants used for it are usually not mentioned as medicinal species and may therefore be under-reported.

Evil eye, a concept of Old World origin still alive in most Mediterranean countries, and which has caught on all over Latin America, is commonly treated with rue (*Ruta chalepensis*), introduced from the Mediterranean, like the concept of evil eye itself.

Epilepsy is locally called *mal de corazón* (literal translation, heart illness). Most people in the study area stated that this condition cannot be cured with plants. However, it was formerly believed to be caused by witchcraft or exposure to an eclipse and some people still consider this a possibility. This implies that treatment by a spiritual healer may be required, including treatment with plants commonly used for spiritual protection and cleansing, as discussed above.

Health problems of the oral cavity

The 114 URs (4.3%) in this group represent 56 plant taxa (5.7% of plant uses). This category includes remedies for toothache, preparations to treat inflammation and sores in the mouth, and antibacterial decoctions used as a preventive mouthwash. Toothache remedies are mainly used to make a decayed tooth fall out without pain. There is some local controversy about some of these remedies, as they are suspected to make healthy teeth fall out as well. While these radical remedies may seem crude to outsiders enjoying easy access to a dentist, they are for many poor people in rural areas the only option to remove a decayed tooth with its roots and thus to prevent a painful and dangerous abscess in the jaw (cf. Nations & Nuto 2002). The most important remedy for mouth sores, *Jatropha curcas*, is widely used in Mexico and Central America for this condition (e.g., Leonti et al 2001). A decoction of *Lysiloma* sp. bark is used both as a remedy and for the prevention of tooth decay. Chamomile (*Matricaria recutita*) and pine (*Pinus oocarpa*), two plants with antibacterial and anti-inflammatory properties, are frequently mentioned, as is the bark of various species of oak (*Quercus* spp.), which has astringent qualities.

Urogenital problems

Only 105 URs (4%), representing 64 plant taxa (6.5% of plant uses) fall into this category. This may be because most local people did not clearly distinguish between STDs (particularly in men) and infections of the urogenital tract resulting from other causes. Whereas genitourinary infections in women (classified under women's remedies) are attributed to *resfrio* (i.e. to ignorance and carelessness, but not to immoral behaviour), this is often not the case with men. As a consequence, remedies for these conditions may have been under-reported. The two most frequently mentioned remedies, aerial parts of a horsetail (*Equisetum myriochaetum*) and maize silk (*Zea mays*), are both well-known diuretics, whereas lemon juice may counteract infections of the urinary tract by lowering the pH of the urine.

While it may at first sight seem likely that local people were particularly reluctant to share information about this group of complaints because of gender issues, the proportion of MPUs in this category in Charles Wisdom's manuscript is still lower (no statistically significant difference). It is also interesting that horsetail (*Equisetum myriochaetum*), the most frequently mentioned plant in this category, is mentioned in the manuscript but not as a medicinal species.

Ears and eyes

The 90 URs (3.4%) in this group represent 43 plant taxa (4.3% of plant uses). Infections of the ear and eye have become less frequent with recent improvements in sanitation, especially in the hamlets closer to the towns. However, dust and smoke in the dry, windy season and the hot, humid climate of the rainy season still cause a large number of infections of the sensory organs. For the treatment of earache, tender plant shoots are heated on the griddle (*comal*) until they release their sap, which is squeezed, while warm, into the ear (cf. Leonti et al 2001). Important plants for earache are two native species of *Bromelia*, which are also used for fencing (*B. karatas* and *B. pinguin*) and *Yucca guatemalensis*, as well as the introduced mint (*Mentha* cf. *crispa* L.). Inflammatory diseases of the eye are treated with eyewashes made from goldenshower senna (*Senna occidentalis*) and Mexican marigold (*Tagetes erecta*). The latter plant is also used to prepare eye drops by sun distillation: the fresh herb is placed into a plastic bag and exposed to the sun, so that the transpired aromatic liquid collects in the bag. The plant is also used for eye irritation in Honduras (House et al 1995). In clinical trials, the ethanolic extract reduced

inflammation and pain in patients suffering from paraketosis (Khan & Evans 1996; Khan et al 1996). Another eye-drop remedy is the liquid produced by *Vitis tiliifolia* stems when they are cut. The same use has been reported from other parts of Guatemala (Wauchope 1948; Mellen 1974). A particularly noteworthy form of treatment consists of placing a seed of basil (either the native *Ocimum campechianum* or one of the introduced species, *O. basilicum* and *O. africanum*) into the eye. The polysaccharides of the seed coat form a mucilaginous layer, which is said to cleanse the eye. This practice has also been reported from other indigenous groups in Mesoamerica (e.g., Ankli et al 1999a).

Residual category

Important medicinal uses in this UG with 120 URs (4.6%) and 82 plant taxa (8.3% of plant uses) are antidotes to snakebite, general tonics to cleanse and strengthen the blood, cardiovascular problems, diabetes, bone fractures, liver complaints and alcoholism. All 7 URs of lime (*Citrus limon)* in the residual category were for poisonous snake bites. The number of URs for bites is very low in comparison with other ethnobotanical studies (e.g. Ankli et al 1999a, b) and, apart from lime juice, only *Sansevieria hyacinthoides* and tobacco (*Nicotiana tabacum*) were mentioned more than once. Of the twelve species mentioned mostly by Ladinos as tonics to refresh or help the blood, only *Tridax procumbens* was mentioned more than once. Charles Wisdom reported a higher number of plant species used for this purpose, but comparison is difficult in this case because in his manuscript, the distinction between general tonics and remedies taken after childbirth (classified under GY) to cleanse and restore the blood is often not clear.

Selection criteria for medicinal plants

Indigenous people use a set of criteria to select a limited number of plant species for medicinal use from the much larger number of species available in their environment. The hot–cold classification is of great importance in Latin America, allegedly derived from the Hippocratic system of four humours and brought to Latin America by Spanish conquerors and settlers (Foster 1994). However, binary oppositions are also a central principle of religious thought among the Maya and other indigenous Mesoamericans, thus there is no reason why such a basic principle as the hot–cold dichotomy should not have been in use in pre-contact times. The UGs in which the hot–cold classification is most important are FP and GY (see the respective sections, above).

Chemosensory properties have been recognized only relatively recently as important criteria in medicinal plant selection (Brett & Heinrich 1998; Frei et al 1998b; Weimann & Heinrich 1998; Ankli et al 1999b; Leonti et al 2002). It is clear from the limited (qualitative) data on the Ch'orti' that the taste and smell of herbal remedies play an important role for the selection of medicinal plants, particularly in the use groups FP, GI, RE and CN. Since this topic has already been studied in some detail, it was not followed up in greater depth.

Symbolism, often referred to as doctrine of signatures, is another important selection criterion. For example, red plant parts such as annatto seeds (*Bixa orellana*), which have a bright red arillus, are added to herbal mixtures for treating bloody diarrhoea. Rather than strictly a criterion for selection, similarities in appearance or structure between the medicinal plant and the disease or the affected organ may be used as mnemonic aids in a culture where until recently no written information was readily available. The meaning response evoked by plants is also important and has been shown particularly effective for the treatment of illnesses with a psychological component.

Conclusions

Contrary to the widespread perception as an indigenous group that has already lost their own culture, the Ch'orti' Maya in Eastern Guatemala today continue to use a complex body of empirical and symbolic knowledge about medicinal plants. A comparison with data recorded 70 years earlier shows that those medicinal plant uses that are more consistent in time are also shared by a larger number of local people, and consequently seem to be of greater cultural importance. This finding underlines the usefulness of a (semi-)quantitative approach to the study of medicinal plant uses by indigenous groups. Our research not only includes a historical dimension, but also, just as importantly, it highlights the potential pitfalls of ethnobotanical approaches not based on a sound field botanical methodology.

Selection of plant species and their preparation and application are largely based on sound empirical knowledge of the plants and their healing properties. While the safety and efficacy of many locally used botanical drugs cannot be fully assessed due to a lack of phytochemical and pharmacological studies, there are very few examples of medical plant uses known to be dangerous. The most notable is the internal application of *Aristolochia* species, which may cause irreversible damage and are used for the treatment of common conditions where safer alternatives exist. The bioscientific data available for the most frequently mentioned native medicinal plants summarized in this study highlights that the therapeutic profile of even the most widely used species, such as *Chenopodium ambrosioides*, remains poorly understood, calling for phytochemical and pharmacological studies.

A synthesis of traditional knowledge and laboratory-based evidence is the most promising approach towards understanding the potential of medicinal plants. By returning the collected information to the research participants and their communities in culturally appropriate forms, we can contribute to the safe and efficacious usage of phytomedicines and drugs from natural sources at a local level. Thus, this study also highlights the need for applied multidisciplinary investigations of medicinal plant uses in the context of local needs and the tasks pharmacognosy and allied disciplines face in this context.

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