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Abbreviations

ACN	acetonitrile
ATCC	American type cultures collection
But	butanol
C	carbon atom
$CDCl_3$	deuterated chloroform
CD_3OD	deuterated methanol
d	doublet
dd	double doublet
DCM	dichloromethane
δ	chemical shift
DEPT	distortionless enhancement by polarization transfer
DQF-COSY	double-quantum filtered correlation spectroscopy
ED50	50% effective dose
eV	electron volt
Fr.	fraction
H	proton
HiResMaldi	high resolution matrix assisted laser desorption/ionizer
HMBC	heteronuclear multiple bond correlation
HPLC	high pressure (performance) liquid chromatography
HSQC	heteronuclear single quantum coherence
Hz	hertz
IC_{50}	50% inhibition concentration
i.v.	intravenous
J	coupling constant
K	kelvin
mg	milligram
µg	microgram
MHz	megahertz
MIC	minimum inhibition concentration
µl	microliter
µM	micromolar
M_r	relative mass
MS	mass spectrometry
m/z	mass-to-charge ratio
NF-κB	nuclear factor κB

ppm	parts per million
ROESY	rotating frame Overhauser enhancement spectroscopy
RP	reversed phase
s	singlet
sp.	species
spp.	species (plural)
ssp.	subspecies
TNF	tumor necrosis factor
TOCSY	total correlation spectroscopy
TLC	thin layer chromatography
VLC	vacuum liquid chromatography

Summary

To date, little ethnobotanical research has been conducted in Mexico's tropical lowlands. Among that which has been undertaken, is that of M. Heinrich working with Mixe communities, and subsequent research in collaboration with O. Sticher in the field of medicinal ethnobotany in rural Mexican communities. These research programs have yielded fruitful results.

In a continuation of this collaboration, we studied the medicinal plants used by the Popoluca of the Sierra Santa Marta in southern Veracruz. The Popoluca are of the Macro-Mayan language stock and culturally related to the Zoque in Chiapas and the Mixe in Oaxaca, and are one of the least studied ethnic groups in Mexico. This research is of particular interest, in that it allows intercultural comparison with the previously studied and culturally related Mixe.

During 16 months of ethnobotanical fieldwork, about 600 medicinal species used by the Popoluca, and approximately 4.500 individual use-reports were documented. Along with the registration and collection of medicinal plants as voucher specimens, information about concepts of diseases and treatment methods were also collected.

The data were analysed using the concept of the "healers' consensus" in order to identify the culturally important medicinal plant species. According to the attributes indicated by the local healers, the medicinal uses of the plants were grouped into 13 illness categories. The sum of each species' attributes were then ordered, by frequency of mention, according to these 13 categories. Dermatological and gastrointestinal ailments, followed by gynaecological and urological complaints were the categories most frequently indicated, reflecting the prevalence of illness and ailment types from which the Popoluca suffer.

The most frequently recorded medicinal plants of the Popoluca are *Hamelia patens* Jacq., used to stop bleeding from wounds, and *Byrsonima crassifolia* (L.) Kunth, used to treat diarrhoea. The high-ranked medicinal species were assessed pharmacologically using published phytochemical and pharmacological data.

In another study, we analysed the smell and taste properties of plants and the influence of these on the selection of medicinal plant species, focusing on the indigenous selection criteria for medicinal plants.

Taste and smell properties are important to humans in everyday life, and we provide evidence for a highly significant association between the organoleptic properties of plants and their usage as a medicine. We further show that

organoleptic properties and the doctrine of signature are excellent guides for selecting or memorising useful plants.

In another study, focusing on a comparison between two ethnopharmacopoeias, we provide evidence for the antiquity of medicinal plant usage by the linguistically related Lowland Mixe and Zoque-Popoluca. These cultures, separated for about 2.000 years, have cognates for vernacular medicinal plant names in common and a statistically significant segment of the medicinal flora is used for similar purposes. These findings support the theory that such knowledge has been inter-culturally transmitted, perhaps since the time of the Olmec "Mother Culture" of Mesoamerica.

Using Moerman's regression analysis method, we determined which ethnomedically used taxa are over-represented in the Popoluca pharmacopoeia (e.g. Asteraceae) and which are underrepresented (e.g. Orchidaceae). Moerman *et al* found high correlations between the holarctic pharmacopoeias and suggest that apart from the relatedness of the northern floras a "global pattern of human knowledge" may account for this. The Popoluca inhabit a region dominated by neotropical flora intermixed with important holarctic elements, and they include considerably fewer neotropical taxa in their pharmacopoeia than one would expect in the absence of historically transmitted knowledge, supporting Moerman's theory. However, as a large number of neotropical elements are nevertheless included in their pharmacopoeia, we conclude that as well as the historically transmitted knowledge about specific taxa, the "global pattern of human knowledge" addressed by Moerman *et al.*, is also based on "common selection criteria".

Finally, we took 54 Popoluca medicinal plants, bioassaying their extracts for cytotoxical and antimicrobial properties. One of these plants, *Mosquitoxylum jamaicense* Krug & Urban (Anacardiacea), was selected for rigorous phytochemical and pharmacological investigation, and using bio-guided isolation we detected nine pure compounds from the apolar and polar extract fractions. These comprised one anacardic acid, three triterpenes, methyl-gallate and four flavonoids. However, structure elucidation by means of one- and two dimensional NMR experiments could not confirm new compounds.

Resumen

Hasta la fecha, han habido pocas investigaciones etnobotánicas en las tierras bajas tropicales de México. Entre ellas, se incluye el trabajo de M. Heinrich con los Mixe, y posteriormente en colaboración con O. Sticher en el campo de la etnobotánica medicinal en comunidades rurales de México, mismos que han tenido resultados muy fructíferos.

A manera de continuar con esta labor, estudiamos las plantas medicinales utilizadas por los Popoluca, de la Sierra Santa Marta del sur de Veracruz. Los Popoluca pertenecen al tronco lingüístico Macro-Maya, son relacionados con los Zoque de Chiapas y los Mixe de Oaxaca, y son una de las étnias menos estudiadas de México. Este trabajo es de particular interés, ya que permite una comparación intercultural con los Mixe.

Durante 16 meses de trabajo de campo, se documentaron alrededor de 600 taxa de plantas medicinales y aproximadamente 4.500 informes de usos. Además de la colecta botánica de plantas medicinales en forma de ejemplares de herbario, se documentó información sobre los conceptos culturales de las enfermedades y las diferentes formas de tratamiento. Se analizaron los datos mediante el concepto de "consenso de curanderos", para identificar aquellas plantas medicinales con mayor importancia cultural. Según las indicaciones mencionadas por los/las curanderos/as, los atributos medicinales de las plantas se agruparon en 13 categorías, por tipo de enfermedad. Todos los atributos indicados por cada especie fueron ordenados, por frecuencia de mención, de acuerdo con dichas categorías. Los trastornos dermatológicos y gastrointestinales fueron las categorías de enfermedad indicados con mayor frecuencia, seguidos por los ginecológicos y urológicos, lo que refleja la predominancia de dichas afectaciones entre los Popoluca.

Las especies medicinales más frecuentemente mencionadas por los Popoluca son *Hamelia patens* Jacq., usada para tratar hemorragias y lesiones, y *Byrsonima crassifolia* (L.) Kunth, usada para controlar la diarrea. Las especies más mencionadas fueron evaluadas mediante el análisis de la información publicada sobre su fitoquímica y farmacología.

En otro estudio, analizamos el olor y el sabor de las plantas, y la influencia que estas propiedades tienen en la selección de plantas medicinales, enfocandose en los criterios de selección utilizados por los indígenas para las plantas medicinales.

El sabor y el olor son importantes para el ser humano en su vida cotidiana, y aportamos evidencia para una asociación altamente significativa entre las propiedades organolépticas de las plantas y su uso medicinal. También mostramos que las propiedades organolépticas y la teoría de la signatura son guías excelentes que faciliten recordar y seleccionar las plantas útiles.

En otro estudio, enfocado a comparar dos etnofarmacopeas, aportamos pruebas que apoyan la teoría de la antigüedad del uso de las plantas medicinales por los lingüísticamente relacionados Mixe (de las tierras bajas) y los Zoque-Popoluca. Estas dos culturas, separadas hace aproximadamente 2.000 años, comparten nombres en común para las mismas plantas, y una proporción estadísticamente significativa de esta flora medicinal es empleada para usos similares. Estos hallazgos apoyan la teoría de la transmisión inter-cultural de este conocimiento, posiblemente desde la época de los Olmecas (considerada como la "Cultura Madre" de Mesoamérica).

Aplicando el método del análisis de regressión de Moerman, determinamos cuáles son los taxa sobre-representados en la farmacopea Popoluca (p.ej. Asteraceae) y cuáles son los taxa sub-representados (p.ej. Orchidaceae). Moerman y colaboradores encontraron importantes correlaciones entre las farmacopeas holárticas, y propusieron que más allá de las relaciones botánicas entre las floras boreales, un "esquema común de conocimiento humano" podria explicarlo.

Los Popoluca habitan una región selvática dominada por taxa neotropical, con presencia de algunos elementos holárticos importantes, pero incluyen un menor número de taxa neotropical en su farmacopea de lo que se hubiera esperado, en ausencia de un conocimiento previo de la etnofarmacopea holártica, transmitido históricamente - lo que parece apoyar la teoría de Moerman *et al.* Sin embargo, dado que un número importante de taxa neotropical sí se incluyen en la farmacopea Popoluca, concluimos que además de los conocimientos sobre taxa específicos transmitidos históricamente, el hipotético "esquema común de conocimiento humano" propuesto por Moerman *et al.*, se basa también en "criterios comunes de selección".

Finalmente, evaluamos los extractos de 54 plantas medicinales utilizados por los Popoluca mediante bioensayos para la detección de propiedades citotóxicas y antibacteriológicas. Seleccionamos una de ellas, *Mosquitoxylum jamaicense* Krug et Urb. (Anacardiacea), para conducir una investigación amplia de su fitoqímica y farmacología. Por medio del aislamiento guiado por bioensayos, pudimos detectar nueve componentes químicos de los extractos apolares y

polares de la especie. Éstos son: un ácido anacárdico, tres triterpenos, methyl-gallate y cuatro flavonoides. Sin embargo, la elucidación de las estructuras químicas por medio de experimentos uni- y bi-dimensionales de RMN no confirmó la presencia de nuevos compuestos químicos.

Zusammenfassung

Bislang wurden im tropischen Tiefland Mexikos relativ wenige ethnobotanische Untersuchungen durchgeführt. Dabei haben Untersuchungen von M. Heinrich bei den Mixe und nachfolgende Projekte in Zusammenarbeit mit der Arbeitsgruppe von O. Sticher auf dem Gebiet der medizinischen Ethnobotanik in ländlichen mexikanischen Gemeinschaften die kulturelle Relevanz von Medizinalpflanzen und deren Potential im Hinblick auf ethnopharmazeutische Untersuchungen aufgezeigt.
In einer Fortsetzung dieser Kollaboration haben wir die Medizinalpflanzen der Popoluca in der "Sierra Santa Marta" im südlichen Veracruz untersucht.
Die Popoluca gehören der Macro-Maya Sprachfamilie (Maya und verwandte Sprachen) an, sind verwandt mit den Zoque in Chiapas und den Mixe in Oaxaca und sind eine der am schlechtest untersuchten Ethnien Mexikos.
Dies liefert unter anderem die spannende Möglichkeit eines interkulturellen Vergleichs mit den zuvor untersuchten Mixe.
Während der 16 Monaten dauernden Feldforschung haben wir 600 medizinisch genutzte Taxa und 4.500 individuelle Verwendungsberichte dokumentiert. Zusammen mit der Registrierung und Dokumentation der Medizinalpflanzen durch das Anlegen von Herbarbelegen wurden Informationen zu Krankheitskonzepten und Behandlungsmethoden aufgezeichnet.
Die Daten wurden mittels des "Heiler Konsens" Konzept analysiert um die kulturell wichtigsten Medizinalpflanzen zu identifizieren. Gemäss den Indikationen, welche von den indigenen Heilern genannt wurden teilte man die medizinischen Verwendungen der Pflanzen in 13 Krankheitskategorien ein. Die Berichte für jede Art wurden in jeder Kategorie aufsummiert um die Arten nach ihrer Anzahl Berichte ordnen zu können.
Dermatologische und gastrointestinale Beschwerden, gefolgt von der Gynäkologie und urologischen Beschwerden waren die Kategorien für welche die meisten Indikationen genannt wurden. Dies reflektiert die Prävalenz der Krankheiten und Beschwerden an denen die Popoluca leiden.

Die am meist genannten Medizinalpflanzen der Popoluca sind *Hamelia patens*, welche verwendet wird um das Bluten einer Wunde zu stoppen und *Byrsonima crassifolia*, die gegen Diarrhö eingesetzt wird. Die meist genannten Medizinalpflanzen wurden pharmakognostisch und phytochemisch, anhand publizierter Daten ausgewertet.

In einer anderen Untersuchung analysierten wir Geschmacks- und Geruchskriterien von Pflanzen und den Einfluss dieser Parameter auf die Selektion von Medizinalpflanzen. Generell untersuchten wir die indigenen Selektionskriterien für Medizinalpflanzen. Für die Menschen sind Geschmacks- und Geruchskriterien der Umwelt wichtig im täglichen Leben und wir konnten zeigen, dass eine hoch signifikante Assoziation zwischen organoleptischen Eigenschaften von Pflanzen und deren Verwendung als Medizin besteht. Zudem konnten wir zeigen, dass organoleptische Eigenschaften und die Signaturenlehre exzellente Richtlinien zur Selektion und als Erinnerungsstütze für medizinisch nutzbare Pflanzen darstellen.

In einer weiteren Studie konzentrierten wir uns auf einen Vergleich der Ethnopharmakopö der Popoluca und jener der Mixe. Dabei erbrachten wir Belege für die historische Tiefe der Medizinalpflanzennutzung dieser linguistisch verwandten Völker. Diese beiden Kulturen, welche sich vor ungefähr 2.000 Jahren trennten, verwenden verwandte Wörter für die Bezeichnung derselben Pflanzen und nutzen einen signifikanten Teil ihrer medizinalen Flora in ähnlicher Weise. Diese Resultate lassen die Übermittlung dieses Wissens seit der Ära der Olmeken (Mutterkultur Mesoamerikas) als sehr wahrscheinlich erscheinen.

Mit Hilfe von Moermans Methode der Regressionsanalyse determinierten wir, welche ethnomedizinisch genutzten Taxa in der Ethnopharmakopöe der Popoluca überrepräsentiert sind (z.B. Asteraceae), respektive untervertreten sind (z.B. Orichidaceae). Moerman et al., welche eine hohe Korrelation zwischen den holarktischen Pharmakopöen feststellten, vermuten, dass nebst der Verwandtschaft der nördlichen Floren ein "globales Muster von humanem Wissen" für dieses Bild verantwortlich ist. Die Popoluca, welche in einem Habitat siedeln, in dem die neotropische Flora dominiert, aber klare holarktische Einflüsse aufweist, schliessen bedeutend weniger neotropische Elemente in ihre Pharmakopöe mit ein als man erwarten würde, wenn nicht historisch tradiertes Wissen ihre Selektion beeinflussen würde. Dieses Ergebnis bestätigt die Theorie von Moerman et al. Da jedoch die neotropische Flora in der Pharmakopöe der Popoluca vertreten ist, glauben wir, dass das von

Moerman et al. vermutete "globale Muster menschlichen Wissens" nebst historisch tradiertem phytomedizinischem Wissen über ein spezifisches Taxon auch auf "gemeinsamen Selektionskriterien" beruht.
Schliesslich wählten wir eine von 54 zuvor auf ihr zytotoxisches und antimikrobielles Potential hin getestete Pflanze für eine gründliche phytochemische und pharmakologische Untersuchung aus. Der apolare und polare Extrakt von *Mosquitoxylum jamaicense*, ein kleiner Baum aus der Familie der Anacardiaceaen wurden bioaktivitätsgeleitet fraktioniert, wobei 9 Substanzen isoliert werden konnten. Wir identifizierten eine Anacardsäure, 3 Triterpene, Methylgallat, und 4 Flavonoide. Jedoch erbrachte die Strukturaufklärung via ein- und zweidimensionaler NMR-Experimente keine neuen Substanzen hervor.

1 Introduction

1.1 Previous studies and objectives

Mexico with its 54 ethnic groups has a great heritage of pre-Hispanic culture and is a nation with a highly developed traditional medicine. The combination of traditional medicine with European medical concepts and resources resulted in a complex cultural wealth (I.N.I 1994; Wolters 1996).
Generally ethnobotanical documentation of medicinal plants in Mexico has a long tradition (Lozoya 1996) and can be traced back to the early colonial period (Frei 1997). However, Bye (1993) states that despite the relatively healthy state of ethnobotanical studies of ethnic groups, Mexico still lacks fundamental national ethnobotanical inventories. Furthermore, Bye (1993) is of the opinion that: "Mexico is an appropriate place to examine the plant-human richness relationships because of the great degree of diversification of cultures and biota in comparison to the rest of the Americas and the world".
Several ethnobotanical studies have already been conducted in cooperation with Mexican institutes by the research groups of M. Heinrich and O. Sticher in the lowlands of Mexico. Heinrich (1989) investigated the ethnobotany of the Lowland Mixe, Frei (1997) conducted her research about the medical ethnobotany of the Isthmus-Sierra Zapotecs, Weimann (2000) focused on the medicinal plants among the Nahuas of the "Sierra de Zongolica" (Veracruz), while Ankli (2000) investigated Yucatec Mayan medicinal plants.
The objective of this study is to investigate the traditional medicine of one of Mexico's 54 ethnic groups: The Sierra Popoluca, located in the southern part of the state of Veracruz. The reasons why we chose the Popoluca for an ethnobotanical investigation are threefold; (i) In contrast to the Mexican highlands, only few ethnobotanical studies in the lowlands have been undertaken, mainly because of the inhospitable conditions (mosquitos, heat, humidity) facing the scientist dealing with field research; (ii) according to anthropologists the Popoluca are one of the least studied ethnic groups of Mexico; (iii) it allows an interesting intercultural comparison of the ethnobotanical and ethnographical data with those of the Lowland Mixe previously investigated by Heinrich (1989) mainly because these two ethnic groups belong to the Macro-Mayan linguistic stock, are not in direct contact for many centuries and live in similar ecological environments.

The first scientific expedition into the area of the Sierra Popoluca was the one conducted by Frans Blom and Oliver La Farge from the Tulane University of Louisiana in 1925. Their goal was to investigate archaeological remains and to describe the languages and the traditions of the indigenous peoples (Blom and La Farge 1926).

The first anthropologist who investigated systematically the Sierra Popoluca was George M. Foster who in 1942 published a comprehensive work about the different aspects of Popolucan life entitled "A Primitive Mexican Economy". Foster (1969) stated that the Sierra Popoluca still are one of the least studied ethnic groups of Mexico. Other ethnographic studies which investigated the Popolucan way of life are "Los Zoque-Popolucas" by Jorge Félix-Báez (1973) and "Etnología del Istmo Veracruzano" by Guido Münch (1994).

Since 1990, the Proyecto Sierra Santa Marta (PSSM) a non-governmental organization which contributes to the conservation and sustainable use of natural resources, as well as promoting equitable socioeconomic development has worked in collaboration with different national and foreign institutions in the Sierra Santa Marta.

Several small ethnobotanical investigations have already been conducted in the Popolucan region. The Instituto Nacional Indigenista (I.N.I.) documented some traditional Popolucan knowledge during their project about the medicinal plants of the different rural Mexican communities. Similarly, diploma theses by Pinzón (1983), Rodiguez (1988) and Rivera (1989) focused on the Popolucan plant use.

However, in none of these works a quantitative approach which would indicate the importance of the different medicinal plants was implemented. Furthermore, none of these investigations included a scientific pharmacological study or subsequent pharmacological screenings and phytochemical investigations.

In our study we intended to sustain traditional medicine by investigating it scientifically and to improve the comprehension of the concepts inherent. Finally, the recording of the traditional knowledge should help to protect at least theoretically a part of it from extinction. According to the results of the pharmacological screenings and further criteria one particularly interesting medicinal plant from the Popoluca's pharmacopoeia was selected for phytochemical investigations. We chose *Mosquitoxylum jamaicense* Krug et Urb., an Anacardiacean species.

The first, ethnobotanical and ethnomedicinal part was supervised by M. Heinrich (The School of Pharmacy, London) and the second phytochemical and ethnopharmacological part by O. Sticher (ETH Zürich).
The ethnobotanic fieldwork took place in the Sierra de Santa Marta from March 1999 to July 2000 (16 months) in the sub-districts of Soteapan and Hueyapan de Ocampo. During this period San Pedro Soteapan was chosen as the logistical base for conducting the field research. For cooperation in the field, first the healer's confidence had to be gained. The ethnobotanical informations was obtained through specific interview techniques (Bernard 1988, Cotton 1996, Martin 1995). "Participant observation" was the basic strategy of the field work which is the maxim for every anthropological and ethnobotanical field study. Participant observation means that the scientist in the field seeks to minimize the feedbacks potentially evoked by his presence (Bernard 1988). The interviews were conducted with healers and other knowledgeable inhabitants, while the central point of the ethnobotanical study was the preparation of the collected medicinal plants for the herbarium in order to allow a subsequent identification.

1.2 The scope of ethnobotany

Ethnobotany, a sub-field of ethnological sciences as well of botanical sciences investigates the relationship between ethnic groups and their herbal environment. This includes plants used as food, medicine, and raw materials for construction and other applications (Farnsworth 1994). As a section of ethnobotany, medical ethnobotany investigates the pharmacopoeia of an ethnic group which is orally transmitted from generation to generation. Ethnopharmacology investigates the pharmacological mechanisms of plants used in traditional medicine by indigenous groups (Farnsworth 1994). Bye (1993) refers to ethnobotany as an interdisciplinary study for which there is no uniformly accepted definition.
There are two major approaches to the investigation of ethnopharmacopoeias; (i) the pharmacological perspective, trying to find potent chemical compounds coupled with financial and sanitary interests and (ii) the cognitive and organoleptic perspective which aims to understand the cultural concept and believes as well as the emic perception and classification of medicinal plants and illnesses.

The World Health Organization (WHO) estimates that about 80% of the worlds population relies on traditional medicine as their primary health-care needs (Akerele 1992). Traditional medicine is of major importance in countries which do not dispose of economic resources to built up a primary health care system (Etkin 1986).

The report of the third meeting of directors of WHO collaborating centers for traditional medicine states: "In many developing countries, traditional medicine is still the only available or affordable health service for the majority of the population. Traditional medicine provides a first-line and basic health service for people living in these areas. The WHO's report on the world drug situation showed that 75 % of the world population living in developing countries consumed only 21 % of the world's pharmaceutical products". It is further argued that "at the same time, expensive pharmaceutical products become a heavy financial burden to many governments of the world" (Ken 1995).

Once, ethnobotany was the major source for pharmaceuticals but in the 20th century antibiotics and advances in molecular pharmacology decreased the importance of pharmacognosy and ethnobotany as tools for new drug discovery (Cox 2000). In the 1970s a renewed interest in the systematic study of indigenous pharmacopoeias and associated medicinal plants arose. This worldwide phenomenon was encouraged by the action of the WHO, which in turn was stimulated by the impact of the "Chinese experience" on the Western medical world at that time (Lozoya 1994). The approach of the Peoples Republic of China, combining traditional and Western knowledge and resources appeared to be a pragmatic solution to the historical problems of sanitation, nutrition and medical assistance (Lozoya 1994). Consequently, ethnobotany has again become an accepted approach in the search for new pharmaceuticals (Balick 1994). In 1985 there were 119 secondary metabolites isolated from higher plants used as drugs on the global market, whereas 75% of these drugs had the same or related uses as the plants from which they were derived (Farnsworth 1994).

Conservative estimations speak of about 250.000 plant species worldwide whereas a new estimate by Bramwell (2002) based on a new method comes close to 422.000 of higher plant species.

So far only a small part of the total world flora has been subjected to phytochemical and pharmacological investigations. Common sense tells us that many more useful drugs remain to be discovered from this source (Farnsworth 1994).

Biodiversity is not uniformly distributed over the planet; generally the tropical regions bear the major proportion of the global diversity. The seven countries with major "megadiversity" are: Brazil, Colombia, Mexico, Congo Democratic Republic, Madagascar, Indonesia and Australia (Challenger 1998). It is important to be aware that biological diversity is an evidence for chemical diversity (Mc Chesney 1996). Mexico bears an enormous botanical diversity. Even if we consider that knowledge about the Mexican flora is incomplete it is considered that the richness of the vascular flora is forth highest worldwide (Challenger 1998). In 1993 at least 21.600 species were described but it is estimated that between 29.000 and 34.000 species occur in Mexico (Challenger 1998).

Cultural diversity in Mexico is high also and placed third in the Western Hemisphere after Brazil and Colombia (Bye et al. 1995). Despite the drastic decline of the indigenous population during the post conquest period Mexico has 8 million native speakers and lately their number is increasing (Bye 1993). From the originally 120 languages (the language is the 1st parameter to define an ethnic group) 54 survived (Bye et al. 1995) and most of these groups still make use of their traditional medicine.

These two actual facts, the high cultural diversity and the high biodiversity make Mexico an interesting field for ethnobotanical research, promising a high ethnobotanical diversity. It amplifies the field of possible ethnomedicinal investigations because every ethnic group herds its own pharmacopoeia. Ethnobotanical diversity is referred to by Bye (1993) as the sum of the products of taxonomic richness and weighted cultural value. The ethnobotanical richness and diversity is reflected by the circa 5.000 utilized vascular plants recorded so far in Mexico (Bye 1993).

Biodiversity in Mexico is however, as well as in many other countries endangered because of population and economic pressure. Deforestation of the tropical regions in Mexico is mainly due to the expansion of pasture farming and has reached 90 % (Toledo et al. 1995). The tropical Mexican region is inhabited by 23 ethnic groups and the total number of indigenous individuals in tropical Mexico is estimated at about one million, more than the indigenous population of the whole Amazonian basin (Toledo et al. 1995). Though accompanied by biodiversity loss there is a high degree and diversity of tribal knowledge endangered by extinction. The loss of bio-cultural diversity has an enormous influence on the local population (King 1996). Especially traditional medicine, with its occurrence in the myths together with the magic-religious

practices of the healers, and the "real" psycho-social-biological effects makes it a cultural element which can not easily be discarded without major cultural disruption (Messer 1994).
Considering deforestation of the tropical regions of the world, the search for alternative forms of utilization has become a central goal in the investigations on the management of natural resources in recent years (Toledo et al. 1995).
Following the arguments of Balick (1994), King (1996) and Benz et al. (1996) biodiversity can best be protected in combination with the health system.
It was tried to demonstrate the ecological and economic superiority of forestry compared to agriculture, pasture farming or plantations (Toledo et al. 1995). Within this ecologic context ethnobotanic studies got new rights for they have the possibility to underline the importance of biodiversity and point to alternative managements of natural resources. However, to be successful, the economic effect of projects which sustain the alternative management of natural resources must be felt at the local level (Benz et al. 1996). Primarily we consider medicinal plants as a source for improving the public health situation of a people, by selecting plants through detailed analysis which are particularly useful and have defined pharmacological effects. Phytopharmaceuticals constitute a cheap economic alternative compared to the Western medicinal system and the loss of a indigenous pharmacopoeia would increase the dependence on Western culture.

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2 Relevant anthropological, historical and ecological background information

2.1 The Olmec culture

The first sedentary villages in Mesoamerica along the pacific coastal plain from Chiapas to Guatemala radiocarbon-dated to 3.000-2.000 B.C. (Coe 1999) were phasing out the Archaic period on the continent. The Formative period (also called the Pre-classic period) in Mesoamerica was heralded, around 1.800 B.C. with the rise of the Olmec culture in south-eastern Mexico together with the manufacture of ceramics and the cultivation of corn, beans, squash and chili.
The Olmec civilization established its heartland in southern Veracruz and Tabasco (Figure 1) and lasted up to about 300 B.C. This time span of 1.500 years comprises the Early and Middle Formative period which precede the late phase (300 B.C. to 250 A.D.) (Coe 1999).

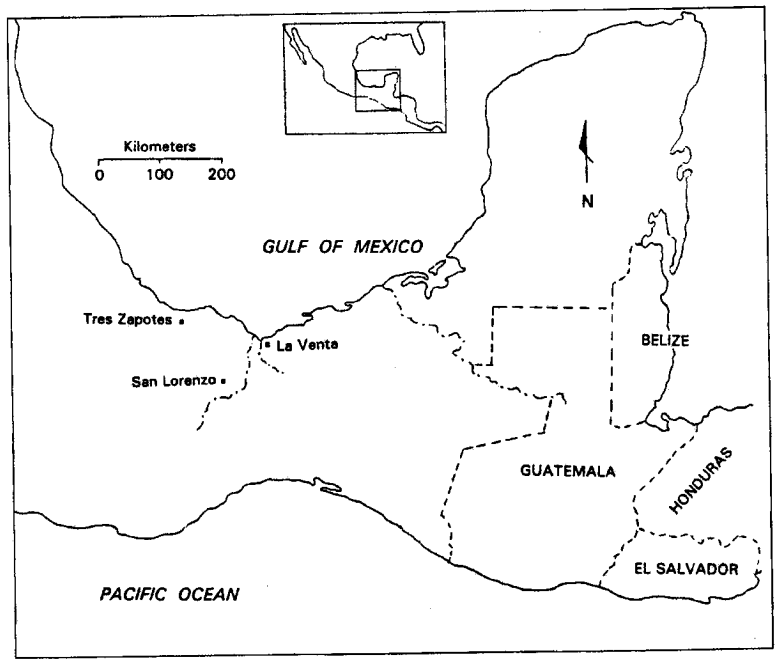

Figure 1. *Southern Mexico and adjacent states. The Olmec heartland at the border of the gulf of Mexico is marked by the three most important archaeological sites: San Lorenzo, La Venta (both in the State of Tabasco) and Tres Zapotes (State of Veracruz) (Map from Arnold 2000).*

In Nahuatl (Aztec) "Olmeca" means "the inhabitants of the rubber region" (De la Fuente 1995). However, it is unknown how the Olmecs called themselves and where they came from (Coe 1994).

A theory derived from the interpretation of the Olmec iconography states that the Olmecs believed that in their cultural beginning a woman cohabited with a jaguar giving rise to a race of were-jaguars (a creature half man, half jaguar) (Coe 1994) (Figure 10). The Olmecs are as well known as the "mother culture" of Mesoamerica because they were the first culture to leave permanent relicts and due to their strong cultural influence on the succeeding cultures. Their art style is the hallmark of their civilization and artifacts can be found from Central Mexico along the pacific coastal plain down to El Salvador and Costa Rica (Coe 1994). The most prominent Olmec relicts, however, were recovered in their cultural heartland. These oldest monuments from pre-Hispanic Mexico include colossal stone heads, altars and massive anthropomorphic and zoomorphic statues. Geological investigations determined that the basalt used to carve most of the monuments found at the archaeological sites of "San Lorenzo" and "La Venta" came from the area of the Los Tuxtlas mountains (Grove 1995).

Very little archaeological information is available about the end of the last period of the Olmec culture (500-300 B.C.) and therefore the demise of the Olmecs is uncertain (Grove 1995). The late Pre-classic period (around 300 B.C. to A.D. 250) after the waning of the Olmec culture has proven to be one of the most perplexing questions facing Mesoamericanists (Stuart 1993). "Tres Zapotes" lying on the north-western foothills of the "Los Tuxtlas" mountain range became an important post-Olmec center and "Laguna de los Cerros", laying on the southern foothills continued as a major center into the Classic period (Grove 1995).

An accidental discovery of a 4-ton carved basalt stela took place at "La Mojarra" (the perch) north-west of the Los Tuxtlas mountain range in 1986 (Stuart 1993). It is considered to be one of the most important monuments ever found in Mesoamerica because of its second century A.D. date, its location, its image and over all the text it bears (Stuart 1993). The origin of the stela could be dated back to 159 A.D. through the interpretation of the long count data (Mesoamerican vigesimal counting system) carved into it (Stuart 1993). The stela depicts an epi-Olmec warlord (Figure 2).

Justeson and Kaufmann (1993) achieved the decipherment of a part of this epi-Olmec script, yielding the earliest currently readable texts of Mesoamerica.

Figure 2. *Drawing from La Mojarra Stela 1 (Justeson and Kaufmann 1993).*

The text is a description of the rise to kingship through several years of warfare and ritual activity of the depicted warrior king. They concluded that the script incised into
the stela represents a pre-proto-Zoquean language and that the script is more closely related to Mayan hieroglyphic writing than to any other Mesoamerican script. Though, the stela was celebrated as a sort of a missing link between the Olmec culture and the literate Classic period civilizations of the Maya (Stuart 1993). The script itself may descent from the Olmec hieroglyphic system but too little of the Olmec script has been recovered to confirm or disprove a connection (Justeson and Kaufmann 1993).

2.2 The Popoluca, Sierra Popoluca or Zoque-Popoluca

Originally, the denomination "Popoluca" was a common noun, not a tribal name. It is a term coined by the pre-Conquest Nahuatl to refer to a number of distinct alien groups that was applied in a deprecating sense meaning as much as "the ones who speak gibberish". In the beginning, ethnologists assumed that the so called ethnic groups were of a common tribe, which had been broken up by invading peoples and therefore been pushed in different directions (Foster 1943). The Sierra Popoluca accepted this designation to describe their own culture but referring to their indigenous language they speak of "Nuntaj¥yi", which probably is their real name. However, Foster (1948) states that the Popoluca use the term "angmati" to refer to their own language which means as much as "word" or "language" but the term "Nuntaj¥yi" seems to be more precise meaning "Popoluca (-language)". Directly translated "Nuntaj¥yi" means "real-rumour", from "nunta" (real) and "j¥yi" (rumour) (compare to: Elson and Gutiérrez 1999). "Soteapan", the name of the capital village of the Popoluca community, harbouring about 4.000 souls is a loan word from Nahuatl as well and finds in the term "Attebet" its original Popoluca appellation.
In southern Veracruz four Popoluca languages are discerned. Foster (1943) classifies them into the "Texistepec", "Oluta", "Sayula" and "Sierra Popoluca". The first three live in villages of the same name, while the Sierra Popoluca, numerically the biggest group of them all, occupy about 25 villages and ranchos scattered over the two municipalities "Soteapan" and "Hueyapan de Ocampo" on the southern and western slopes of the Sierra Santa Marta, a range

of volcanoes between the Lake of Catemaco and the gulf shore in southern Veracruz (Figure 3). Besides the Popoluca, Nahua Indians as well as Zapotec and Mestizo immigrants inhabit the Sierra Santa Marta.

Traditionally, the Popoluca settle on the ridges of the hills which are flanked on both sides by watercourses. Consequently, the villages can only grow on their endings which results in a characteristically serpentine shape and in significant elevation differences between the lower and the upper ends of the villages. The houses are made from wooden shelves or bamboo sticks (*Bambusa* sp.) the traditional thatches made from grass are nowadays substituted by corrugated iron roofs while the floor is generally bare earth. Foster (1966) observes that polygyny is common and that a number of men live with two or three wives or mistresses a phenomenon which he explains by the considerably larger number of girls born. It is said that a Popoluca man can have up to 7 women and polygyny can still be found. The number 7 is the holy number with the Popoluca but probably is a Christian adoption. An average household comprises a separate kitchen and a sleeping or reposing house normally without a latrine. Defecation is undertaken in the "acahual" (secondary vegetation zone) surrounding the village or in the extended "solar" (house garden) and cleaning is performed with a maize cob.

The Popoluca are primarily corn farmers which is reflected in their believe in the maize god "Homshuk", a believe which is now undermined by Christianisation. Traditionally, for a Popoluca, the milpa (corn field) is one of his major life contents. The Popoluca's dishes basically consist of maize (*Zea mays*) and kidney beans (*Phaseolus vulgaris*) like everywhere else in Mexico and Mesoamerica. Maize is always prepared by boiling in a mixture of lime and water, a process called "nixtamal". Cooking the maize kernels with lime enhances the balance of essential amino acids and frees the otherwise unavailable niacin – a member of the vitamin B complex (Coe 1999; Wolters 1996). Untreated maize would develop pellagra and without this technique no settled life in Mesoamerica would have been possible (Coe 1999). The swollen kernels are then ground with a hand stone (mano) on a rectangular quern (metate). The resulting dough can either be toasted on a griddle (formerly made from clay, nowadays a steel plate) in the form of round flat cakes yielding tortillas or can be steamed or boiled enveloped in leaves yielding tamales. The Popoluca use predominately the leaves of *Calathea lutea* "Pob ay" (white leave) for the preparation of tamales.

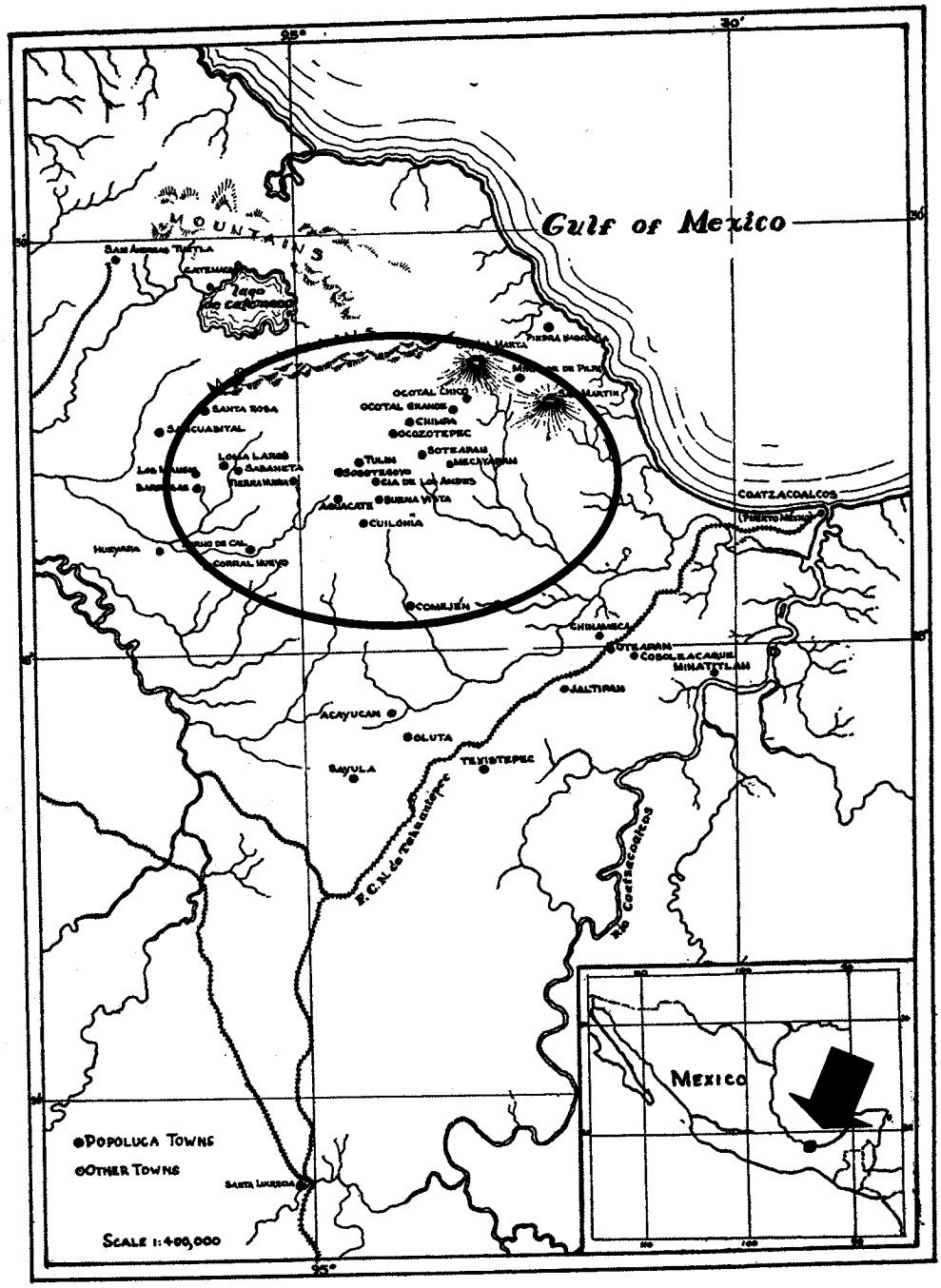

Figure 3. *Sierra de Santa Marta, habitat of the Sierra Popoluca. From Foster (1966).*

Beans are cooked with salt and water, seasoned with the leaves of *Teloxys ambrosioides* (Epazote) and eaten with tortillas.
Apart from animal husbandry of chicken and pigs wild game constitute a source for meat although it became scarce in the past decade.
Accompanied by a dog the Popoluca go hunting game trying to catch armadillo (*Dasypus novemcinctus*), deer (*Odocoileus vigrinianus*), roe deer (*Mazama americana temama*), tepezcuintle (*Agouti paca nelsoni*) or jabalies (*Pecari tajacu crassus*). The skulls of the hunted animals are prepared and preserved in the house of the hunter while the bones are thrown in an arroyo with the idea that the Chanecos (nature-kings) save them (Figure 4). Once the dog who participated the chase dies, the skulls are buried together with the dog. This tradition seems to be a very archaic one and testifies that the Popoluca believe in another world where Chanecos reign and revitalize hunted animals (Báez-Jorge 1973).

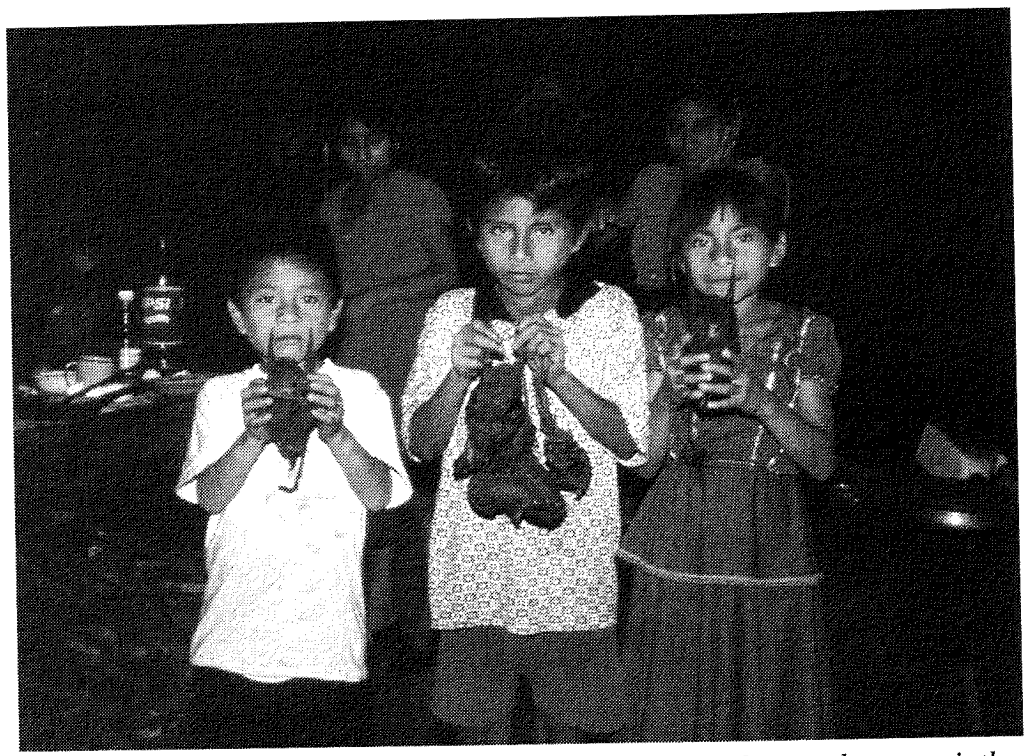

Figure 4. *Popoluca children posing with skulls of roe deer and tepezcuintle, blacked by the smoke of the hearth.*

Foster (1943) states that the Sierra group occupies relatively poor and inaccessible territory, and therefore has remained much less influenced by

European civilization than the populations living in the lowlands. Two historical occurrences in a short chronological sequence influenced Sierra Popoluca life very much and brought a change into the relatively straightforward way of life followed for centuries; the establishing of a coffee plantation in the 1890's and the Mexican Revolution, which in Soteapan started as early as 1906, earlier than anywhere else in the country.
Despite the growing influence of the western civilization the Sierra Popoluca still retain many aspects of their traditional way of life. In most families Popoluca is the first or only language. In school, children are educated bilingually, and Mexican government institutions have programmes to encourage the continuous use of the native language. Although, in schools the main language is Spanish (Rice et al. 1998).
The economic basis of the Popoluca is the production of maize for subsistence and of coffee as a cash crop. Since land is scarce, young men migrate to the Mexican economic centres to work as day labourers in industry and agriculture or in the military.

2.3 The language

Foster (1943) preliminarily compared the four Popoluca languages on a basis of a 116 word vocabulary, including Mixe and Zoque, trying to recognize common roots. He concluded that "Sayula" and "Oluta" are more closely related to Mixe, while the closely related "Texistepec" and "Sierra" are nearer to Zoque. Later, he and several linguists corroborated these conclusions (Figure 5). Considering the geographical proximity of the four Popoluca languages it is surprising that all languages are mutually unintelligible (Foster 1943).
In addition to the common consonants and vowels in Sierra Popoluca, an open [o] written as [¥] is used as the 6th vocal. Furthermore, the language uses glottal stops ['] like in t'un t'un (astringent) or na'a (gum). The Popoluca dictionary compiled by Elson and Gutiérrez (1999) distinguish 46 alphabetic characters whereas the official Popoluca school books discern about half as much (Hernandéz-Cruz 1994 & 1995).
According to a study of the I.N.I. (Instituto Nacional Indigenista) in 1990 in Soteapan, 13% of the population were monolingual, speaking only Popoluca whilst 87% spoke Spanish and Popoluca (I.N.I 1994). The population of the

Popoluca has been variable over the years (Bye 1993). The 11th general census of 1990 resulted in 30.000 Popoluca speakers (I.N.I 1994).
In his 1995 publication, Wichmann designs a family tree, showing the relationship among the Mixe-Zoque languages of Mexico (Figure 5) (with Soteapan Zoque referring to Sierra Popoluca).

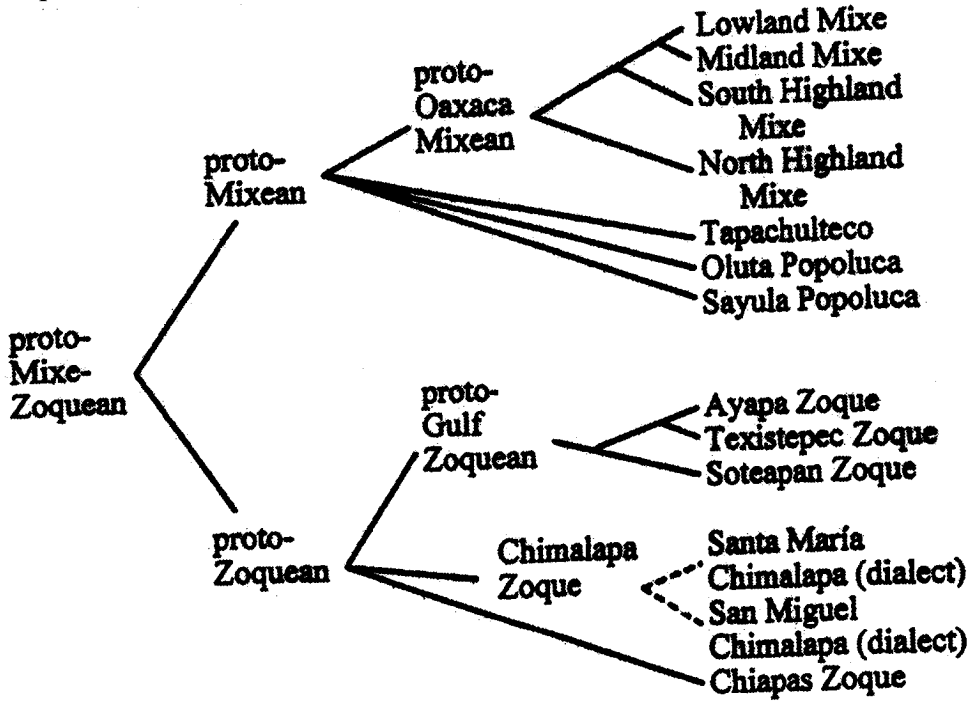

Figure 5. *Mixe-Zoquean family tree (from Wichmann 1995).*

Although it is tempting to associate the Popoluca's ancestors with the Olmec culture, Foster (1969) states that it is unlikely that such a hypotheses ever can be verified. But he supports the assumption that the three cultures, the Mixe, Zoque and the Popoluca once formed a solid block of languages and culture. After the retrogression of the cities of Teotihuacán (ancient Mexico City) and Tula in the 9th century Nahuatl speaking people migrated from the high valley of Mexico into southern Mexico and Central America (Chevalier and Buckles 1995). The last migration of Nahuatl speaking people into southern Veracurz lasted up to 1300 A.D. (Baéz-Jorge 1973). According to this source the Popoluca continuity was broken by Nahuatl speaking invaders, and the Zapotecs separated the Mixe from the Zoque (Foster 1969). The ancestors of the now Nahuatl speaking Pajapan, situated on the foot of the San Martín Pajapan volcano originally spoke a Mixe-Zoquean language but later adopted

the language of the Nahuatl migrants (Chevalier and Buckles 1995 and ref. therein).

Foster has the impression that the Popoluca have always been culturally "less advanced" than their neighbors and therefore have been pushed onto the least desirable terrain in the region. In the fact that in the Popoluca mythology the entrance to the afterworld is marked by a cacao tree he sees a hint for the theory that the Popoluca formerly lived at lower elevations because cacao grows at elevations below the Popoluca settlements (Foster 1969). It is true though, that today the Popoluca don't cultivate cacao very much and that for their sepulture ceremonies they buy the required cacao beans, but I have seen a cacao tree at elevations as high as 600 meters in San Fernando (Soteapan), one of the highest Popoluca villages and appreciated the sweet pulp of the cacao beans in Santa Rosa Loma Larga (250 m.a.s.l) (Figure 6). Nevertheless, it is right that the cacao tree is an element of the humid lowlands. However in 1943, Foster wrote that all evidence indicate, that the Sierra Popluca have been in their present location since long before the Spanish Conquest.

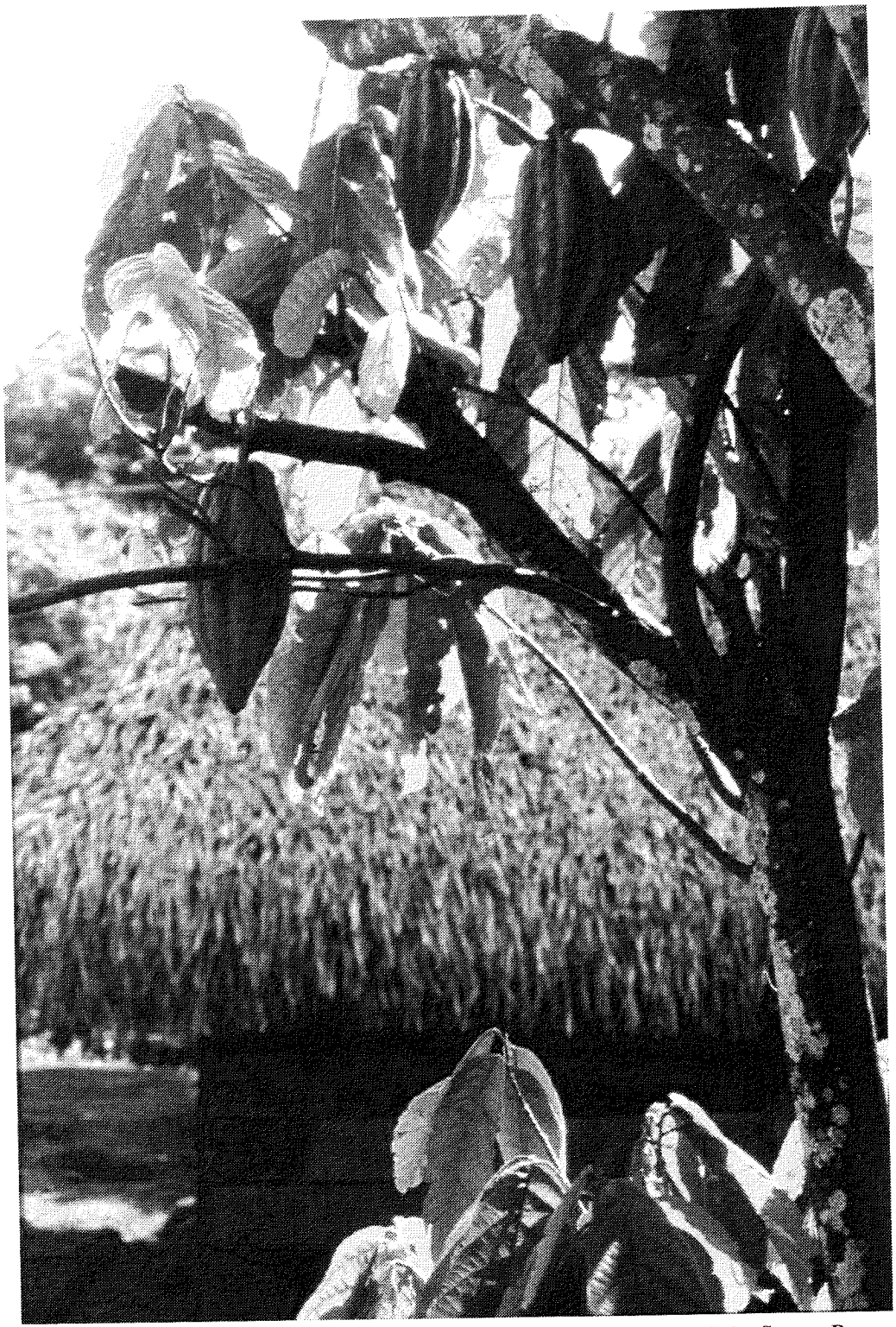

Figure 6. *Popoluca house with cacao tree* (Theobroma cacao) *in Santa Rosa Loma Larga (Hueyapan de Ocampo).*

2.4 Geography and ecology

The volcanoes of the Sierra Santa Marta form the southern foothills of the costal "Sierra de Los Tuxtlas" mountain range. They interrupt the flat monotony of southern Veracruz and extend from the marshy depression of Alvarado and Tlacotalpan to the Isthmus of Tehuantepec near to the region's major harbour of Coatzacoalcos (Figure 3).

The "Sierra de Los Tuxtlas" is the location of the northernmost tropical rainforest of the continent (Dirzo and Garcia 1992). The proximity to the Gulf of Mexico stabilizes the climate and provides the Sierra with a high precipitation which is particularly noteworthy on the north-eastern side of the mountains (Chevalier and Buckles 1995). In a recently published list (Ramirez 1999), 2.700 species were recorded, but there are probably at least 3.000 species growing in the Sierra. The region is inhabited by 102 mammals, about 400 bird species, 160 species of amphibians and reptiles and an extremely high diversity of bats counting with 359 species. Unfortunately, deforestation has brought about 140 species of fauna (mostly birds, reptiles and mammals) at the edge of extinction (Chevalier and Buckles 1995).

This biological diversity belongs to the Central and South American (neotropic) and to the North American (holarctic) floral and faunistic kingdoms which together with the climatic and topographic conditions result in an island of biological diversity uncommon in the world. Between 8 and 13 ecological life zones are distinguished like "rain forest", "cloud forest", "gum oak forest", "pine-oak forest", "oak forest", "savannah" "littoral" and "mangrove" (Chevalier and Buckles 1995 and ref. therein, Ramirez 1999 and ref. therein).

The climate is characterized by an accentuated dry season lasting from April through May. The rains which come in early June slacker somewhat in August and are intense in September and October, an observation differing from the one made by Foster (1966). In November and December the "Nortes", strong winds and rainstorms, bring down the temperature to as low as 5° C. The Sierra Santa Marta provides the cities of Acayucan, Minatitlán and Coatzacoalcos with drinking water (Chevalier and Buckles 1995) encompassing the water demand of at least 300.000 people.

The study area of about 1350 km^2 lies at altitudes between 0 to 1720 m above sea level (m.a.s.l.), whereas the highest situated Popoluca village is Santa Marta, a relatively new aggregation at about 1100 m.a.s.l.

2.5 Agriculture, land use and ecological and economical consequences

Land became scarce as the indigenous population grew probably as a result of better medical assistance, less warlike conflicts and governmental programs which influenced food supply. Since the beginning of the 20th century the population in the Sierra has sextupled. In 1900 the municipalities of Soteapan, Pajapan and Mecayapan had 8200 inhabitants (Blanco 1997). Today, more than 50.000 people live in the Sierra, mainly of indigenous Nahua and Zoque-Popoluca origin (Rice et al. 1998).

In the community of Soteapan, prior to the splitting of the land between the 175 beneficiary men (derechosos) everybody could take uncultivated land and rise his milpa. Now, many farmers have to rent land and have to pay for the firewood they extract form a derechoso's land. The land distribution pattern implicates drastic social and economic disruption but prevents at the same time overuse.

The land owners' title is passed on to the eldest son and a regulation prevents the fragmentation of land holdings by heredity. Normally, the land is all the same shared between the family members. Of course, the land can be sold. During the last years Zapotec and Mestizo immigrants, traditionally better businessmen than the Popoluca, bought a great deal of farmland and converted it into grassland for breeding livestock. This ranching industry is a low-profit economy that occupies extensive tracts of land while creating little employment and few opportunities for sustainable growth (Chevalier and Buckles 1995).

Formerly, bean cultivation was common, too, but nowadays the fewer rainfalls and introduced pests declined bean cultivation drastically. The reduced precipitation and the prolongation of the dry period is probably due to deforestation in the area. Formerly, the corn and the bean plantations were separated by rows of pineapples (*Ananas comosus*) (compare Foster 1966), a plant cultivated very rarely nowadays by the Popoluca as are sugar cane (*Saccharum offiniarum*), cotton (*Gossypium* sp.) and sweet potato (*Ipomoea batatas*).

The milpa is prepared by the slash and burning technique (roza, tumba y quema) and assures good harvest for about four years. Then the land is traditionally left fallow several years to recover during an acahual (weedy climax) period, before it can be transformed anew into a milpa. Nowadays, as the pressure on cultivable land is high the fallow period gets shorter and instead fertilizers are applied.

Generally, diversity of cultivated crop and maize cultivars as well as diversity of spontaneous growing vegetables in the fields have decreased. The loss of wild growing vegetables in the corn field such as *Crotalaria longirostrata* (chipile), *Solanum nigrum* (quelite) *Capsicum* sp. (chili) and *Solanum lycopersicon* (jitomate, tomato) is predominantly due to the application of herbicides, which makes weeding obsolete. Governmental institutions promoted the introduction of herbicides and fertilizers and encouraged their application in order to improve corn production. Edible weeds, condiments (*Porophyllum ruderale,* papaloquelite) medicinal plants and fruits of different kinds abound in traditionally cultivated corn fields. However, only few farmers still rely on the traditional crop growing. The author, being faced with a tremendous diversity of weeds gave up counting plants in the milpa of Pedro Hernandez in Soteapan as he arrived at 100 species (comprising ordinary weeds).

On the other hand the home gardens (solares) show a considerable variety of domesticated and wild fruit plants though mostly trees or treelets such as: a variety of *Musa* spp. cultivars (bananas), *Annona* spp. (soursop) *Tamarindus indica* (tamarind), different mango cultivars (*Mangifera indica*), *Spondias purpurea* (hog-plum), *Carica papaya* (papaya), *Persea americana* (avocado), *Persea schiedeana* (chinini), *Psidium* spp. (guava), *Citrus* spp. (citrus fruits), *Pouteria sapota* (mammee apple) *Cocos nucifera* (coconut), *Byrsonima crassifolia* (nanchi), *Muntingia calabura* (capulín) and *Inga punctata*, among others.

Jamaica pepper (*Pimenta dioica,* Myrtaceae) is cultivated in the understory of the tropical forest and the aromatic seeds sold to external merchants.

Fruits from wild plants are appreciated and gathered too, like: *Chrysobalanus icaco* ("icaco", Chrysobalanaceae), *Rheedia edulis* ("uouo", Clusiaceae), *Diospyros digyna* ("nuu", Ebenaceae), *Conostegia xalapensis* ("chuch jeepe", Melastomataceae), *Hyperbaena mexicana* ("txa cuy", Menispermaceae), *Ardisia compressa* ("tsuk nok nok", Myrsinaceae), *Syzygum jambos* ("pomarosa", Myrtaceae), *Ximenia americana* ("paja pitx cuy", Olacaceae), *Passiflora* spp. (passion fruits, Passifloraceae), *Genipa americana* ("nuk t¥m", Rubiaceae), *Manilkara* spp. ("chicozapote", Sapotaceae), and *Vitis* spp. ("totoloche", Vitaceae). The tubers from *Xanthosoma violaceum* (Araceae) are used as a carbohydrate source as well as the flowers and the stem core of different *Chamaedora* species (Arecaceae).

Generally, vegetables are cultivated rarely in the house gardens which is a result of the free running livestock, such as pigs and chickens which set a prompt end to any cultivation attempts. The few cultivated vegetables are *Sechium edule* (chayote), *Cucurbita* spp. (calabash), *Cnidoscolus chayamansa*, (chaya) and *Opuntia* sp. The green vegetables which were present on the traditionally managed fields and enriched the diet of the Popoluca are not being substituted.
Apart from the extrusion of spontaneously growing vegetables the utilization of herbicides in the milpa increases the problem of soil erosion considerably. The lack of a layer of annual weeds, which would lessen the impact of the raindrops, provide the soil with a protecting mulch cover and stabilize the soil with their physical structure, together with the uneven topography of the terrain favour erosion and soil degradation, one of the main agricultural problems in the sierra (Blanco 1997). As a consequence fertilizers must be applied.

2.6 The time of the Conquest

A soldier joining the expedition of Grijalva in 1518 named Martín was the first to espy the northeastern volcano of the Los Tuxtlas Sierra since then called San Martín in honour of its European discoverer (Báez-Jorge 1973, and references therein). In 1522 *La Villa del Espíritu Santo* was founded just next to the pre-Conquest Nahuatl-speaking Coatzacoalcos (Báez-Jorge 1973).
A report from 1580 mentions that the area extending from the southern slopes of the San Martín Pajapan volcano towards the Coatzacoalcos river was the most populated of the region. Cacao was used as money identical to the monetary system of the Mayan communities. Tributes from the village population to the corresponding *Casique* apart from cacao beans could be contributed as well with cotton, maize, wild birds, copper axes and small quantities of gold. Between 1522 and 1580 the population of the Coatzacoalcos region counting with about 76 villages declined from 50.000 to 3.000 due to excessive demands for tributes from the Spaniards and because of epidemic diseases like measles and chickenpox (Chevalier and Buckles 1995 and ref. therein, Báez-Jorge 1973 and ref. therein).

2.7 "Soteapan en 1856" by Andres Iglesias, one of the first reports on the Popoluca community

A cutout of the report by Andres Iglesias, first published in a newspaper of Veracruz in 1850, reedited in 1856 and re-reedited 1973 by "Una Institución de Cultura " as the Colección Suma Veracruzana, Serie Antropología México D.F.

...conserving their language, the vulgar superstitions of their grandfathers, superstitions which could not have been destroyed by the frequent commerce they were forced to have with those they call "gente de razón" (rationale people) *nor by the judicious and persuasive insistent requests of the good willed priests who served in the village.*
Soteapan is a village of a grim and obscure aspect, being situated on a rough and bumpy surface, whose versants are cut by deep canyons; because the apathy of its children leaves the weeds grow in the streets and on the places, and because their ramshackle huts made from clay and straw, with which they cover even the soil to relieve the excessive cold of the winter, are far too low constructed, separated from each other and distributed without order; even though, these ungrateful impressions are easily replaced by others of delicious delight, if, averting the eyes from the village, one contemplates the lovely landscape of its surroundings and the infinite undulating hills which are encircling the village, painted in an endless green and of varying pictures of the plantations; the solitary barracks of the indios on the cliffy slopes or on top of the hills merging with the region of the clouds. (pp.: 4-5 Iglesias 1856).
Even if it is assumed because of their wild appearance, for their brusque manners, for their grossly language and for their always dirty cloth, they would share the barbarous character with the nomadic tribes of the north, a view which one might confirm considering their use of the arrow and the custom to have the face inserted, if one can describe it like that in a forest of hair, which is only cut in the front down to the eyebrows in a square shape; if one has contact with them one will recognize the mistake, and see that they actually care about some of the vice which disturb the spirit and violate the character, like immoderateness and drunkenness, they further are innocent, enemies of robbery, faithful to their obligations and so hospitable that they feel vital pleasure if a "persona de razón" accommodates in their houses or visits them. (pp.: 9-10, Iglesias 1856).

The woman, who is in the perception of a poet, the most perfect and lovely opus of the creation, is in the feeling of the "Soteapeños" a mortified being, a furniture, something which can be useful for something, but which is possible to sell, abandon, rent or exchange for another, like merchandise. And indeed she is useful, though she does the domestic works, helps her husband in the field, and even ends up being his transport animal, assumed that she bears on her shoulders the products of the harvest from the corn field to the hut and from there as far as to Acayucan, Chinameca or Minatitlán, which are the villages where the Soteapeños sell their spare fruits.
Its true that the woman enjoys some pleasures, if one considers that getting drunk in company with her husband is a pleasure, or convening to scandalous orgies, where shamelessness is manifested without cover; but even though, she is not less unhappy or reduced. She finds herself in all circumstances like compelled to undergo the caprice of her tyrant, and if she doesn't she exposes herself to be beaten up without remorse or to die through the blade of a machete. Such is the sad and humbling condition of the women in the villages which, like Soteapan, live immersed in the obscurity, without seeing even a gleam of the splendorous lights of civilization. (pp.: 11-12, Iglesias 1856).

Although Iglesias makes no connection in this context the following lines are not surprising:

The insensibility in respect to life in Soteapan comes to such a level, that the indios, particularly the women, driven by a slight reason, strangulate themselves with the abdominal belt. (p.: 25, Iglesias 1856).

Although the exposed is an evidence for the fact that the Soteapeños regard death with the same disrespect as life, they don't cease the tradition of their curanderos to whose science they apply to in case of dangerous illnesses. The curanderos are nobody else than the sorcerers. If an indio moans under the burden of a strong suffering he thinks to be spellbound, frightened with "air" or cramps and calls for one of those in order to be treated. The reputed Hippocrates examines the patient with the manner of a physician and seeking the inspiration in the nauseating tepache (fermented beverage made from water, corn and sugar cane) *is disposed to cure. When the illness is confined to a part of the body, actually thinking that the "air" is the causative agent they sting without mercy the determined region with a big needle or cauterize it with*

a glowing iron to form a bad wound, intending to let the air out; and if because of the symptoms he recognizes that the origin of the illness has another cause he runs into the forest, recollects diverse medicinal herbs and applies the herbs internally or externally and sends some alleviating superstitions to the "big master": and if they (the herbs and the prayers) don't bring relief the sorcerer who has exhausted his knowledge, bends the neck in consideration of the absurd creed of fatality and retrieves himself, not without declaring the patients proximate and inevitable death. (pp.: 26-27, Iglesias 1856).
(Translated by M. Leonti 2002).

2.8 San Pedro Soteapan, cradle of the Mexican Revolution

As an absolute ruler of Mexico for 35 years, Porfirio Díaz served as a president from 1876-80 and from 1884-1911, the time span known as the "Porfiriato". In his early political career he distinguished himself as a strong right arm of the liberal cause. Later, during his presidency when he opened up the country to foreign capital he defended in every circumstance the power and interests of foreign investors and the great land owners. Diaz was so eager to attract foreign capital that he adopted the odious policy of paying foreign employees more than Mexicans for the same work, which was the reason for the bloody strike, ruthlessly suppressed at the Cananea Mining Company in Sonora 1906. The Porfiriato induced the legislation called "Ley de los baldiós" declaring all lands without formal title properties of the state (Chevalier and Buckles 1995). Companies were given the right to appropriate the lands if they promoted subsequent colonization. A next legislation called 'Ley sobre la subdivisión de la propriedad territorial' gave way to the possibility to divide collective lands into private property (Chevalier and Buckles 1995).
Regarding southern Veracruz the best agrarian land was acquired by the father-in-law of Porfirio Díaz, Romero Rubio de Diaz, who later sold it to the U.S. Pearson and Brothers Company (DPTGE 1945). The territory included most of the communal lands of Soteapan and Mecayapan (Chevalier and Buckles 1995). As a consequence, many peasants lost their land resulting in a pressure on Popoluca agriculture land. The charismatic General Hilario C. Salas from Oaxaca and his forces planned a rebellion and went to organize themselves in the Sierra of Soteapan. The rebels joined forces with Popoluca peasants and together they considered to attack simultaneously the city centers of

Coatzacolacos, Minatitlán and Acayucan on the 30th September of 1906 in order to sow confusion within the governmental elements. Because of drunkenness and disunity the attacks on Coatzacoalcos and Minatitlán failed but Hilario C. Salas with his troop managed to take over the Municipal plaza of Acayucan. However, a ricochet injured him and he saw himself constrained to take off back to the Sierra. Before the governmental forces were trailing the revolutionaries with the task to combat them, Salas was healed in Ocotal Chico. Salas won the battle against the governmental troops and the prisoners were incarcerated in the church of Soteapan. The federal government was upset and all military forces in the south of Veracruz were getting the order to fight the revolution originated in Soteapan. Salas was forced to choose the guerilla tactic because his forces were in an inferior position. At that time in the northern states the Liberal Mexican Party was founded which sympathized with the revolutionaries and collected financial support. Hilario C. Salas was shot in an ambush at "Arroyo Verde" (Green river) between Buena Vista and Ocozotepec in February 1914 (all information from DPTGE 1945).

The uprising in the Sierra Popoluca precedes the official beginning of the Mexican revolution (November 1910) by about four years. Without any doubt to the people fighting together with general Hilario C. Salas appertains the honour to have operated as the vanguard of the Mexican revolution. In the years of revolution Soteapan was burned down three times (Foster 1966). Foster notes in his reports (1966) that the Popoluca are not openly hostile but adopt a policy of passive resistance to all strangers what he considers as a "healthy distrust to all outsiders". However, Iglesias (1856) describes the Popoluca as a very hospitable people. Therefore Foster (1966) makes the occurrences during the time span of the Mexican revolution responsible for the "new" attitude.

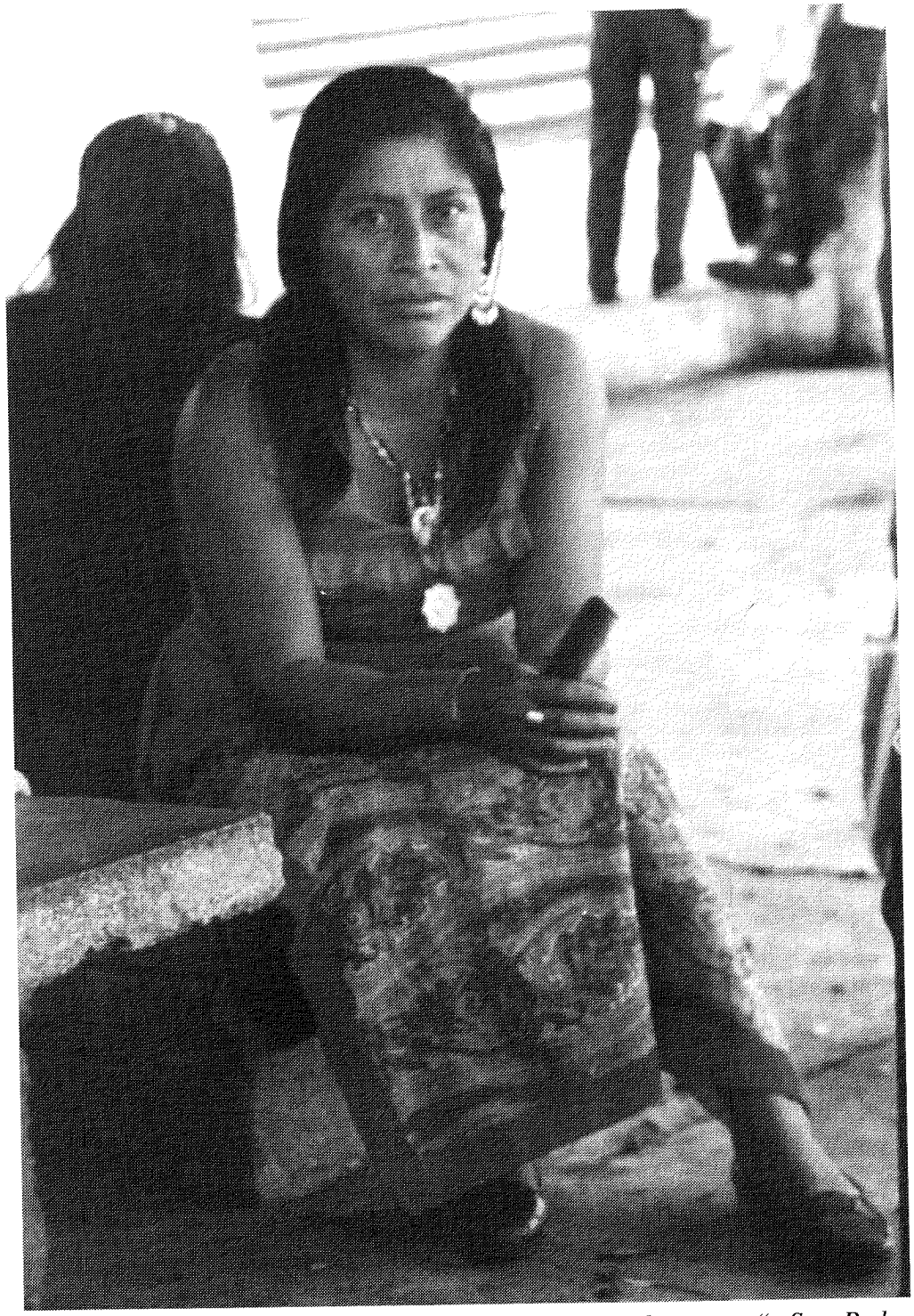

Figure 7. *Popoluca woman with "modern traditional costume", San Pedro Soteapan (Soteapan).*

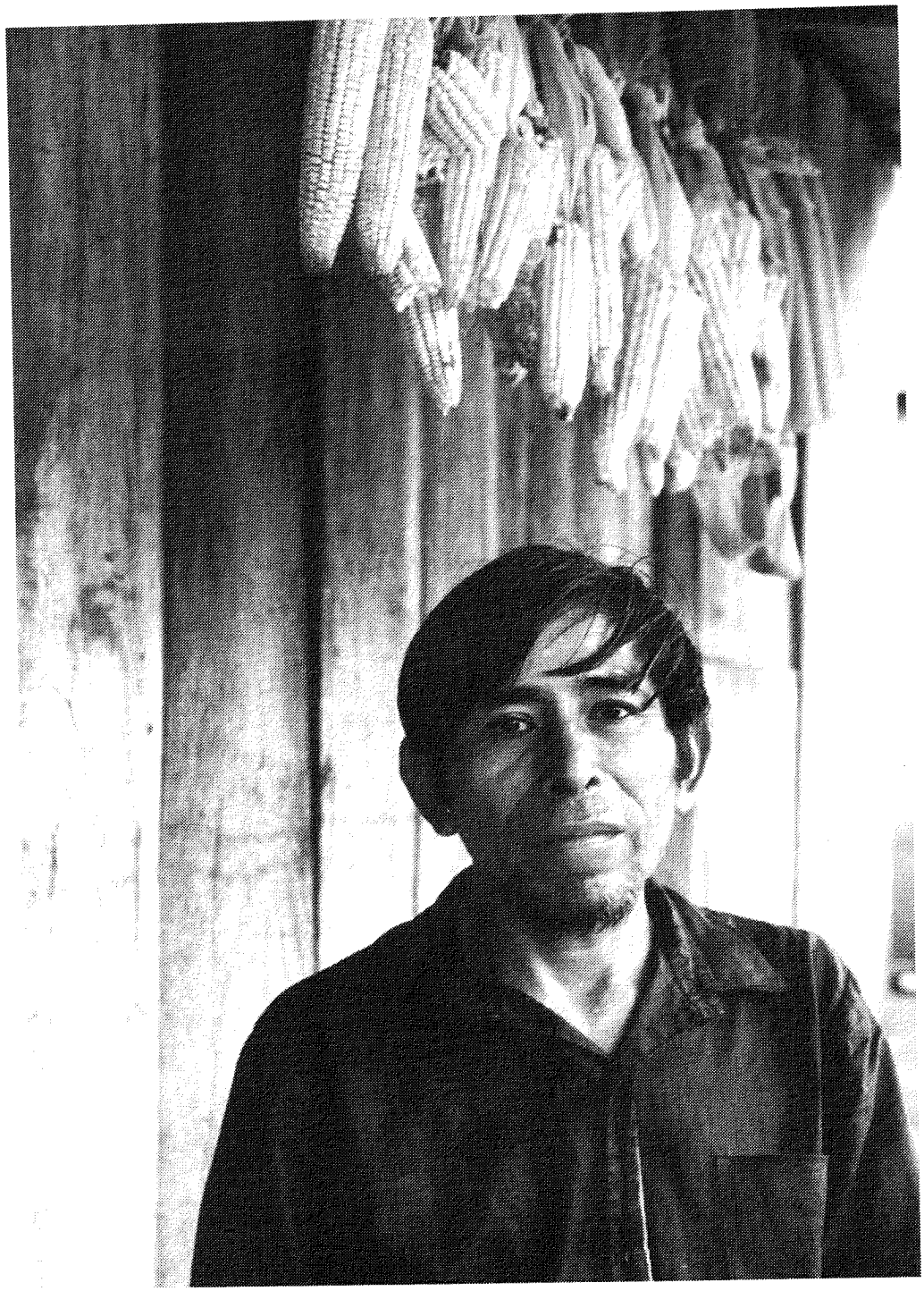

Figure 8. *Erasmo Lopez Cruz under the drip of his house in Buena Vista (Soteapan).* "The Popoluca is a solemn man. He is not given to joking and horseplay. He does not gamble, and he knows no form of group play or competition. Except for church music he does not sing, and the only dance in

which he ever takes part is the typical Veracruz *huapango*, which is listlessly executed. The Popoluca drinks but rarely, for it interferes with his productive efficiency, and he looks with disdain on the frequently drunken neighboring Mexicanos. His pleasure comes from hard work, from the knowledge that his milpa is good, that his family will have plenty to eat and that enough will be left over to buy a few luxury items. In his rare idle moments he hardly knows what to do with himself" (Foster 1945, p.: 180).

2.9 Historical and cultural relations between the Olmecs, the Maya and the Mixe-Zoque Popoluca

The first tradition mentioning the Olmec culture probably is a Nahuatl (Aztec) poem recorded after the Conquest. The poem speaks of a legendary land which had a government for a long time called "Tamonchan" located on the eastern sea long before the founding of Teotihuacán (ancient Mexico City) (Coe 1994). The most fascinating about this poem is that "Tamonchan" is not Nahuatl but Mayan meaning "Land of Rain or Mist" (Coe 1994). The fact that a Mayan word is used in an Aztec poem leads to the suggestion that the pre-Conquest Maya themselves were the transmitters of this knowledge. If the Maya would have spoken of their own culture they would have hardly used the term "Tamonchan". Lacking plausible alternatives one gets the impression that the described land was contemporaneous to an earlier stage of Mayan culture and that this government very likely refers to the one of the Olmec state.
The ancient Maya were at least partially contemporaneous with the Olmecs. During the Middle Formative period the earliest Maya villages were founded in the lowlands. At that time the Maya's realm to the north-west (Yucatan peninsula and Chiapas) bordered to the Olmec's land. Coe (1999) states that the Olmec influence which at that time was present throughout Mesoamerica is not detectable in the Mayan domain and believes this to be due to the lack of interest by the Olmecs. Although, in the meantime he admits that many cultures were dependant on the Olmec's achievements including the Maya.
The most revolutionary intellectual inventions of the Formative period was the "Long Count calendar" and the hieroglyphic script. Both inventions have been ascribed to the Maya culture. However, the earliest appearance (36 B.C.) of a incised date comes from a monument outside the Maya area and led to a rethinking among many scholars which are now willing to ascribe the Long

Count calendar to a Mixe-Zoquean provenience (Coe 1999). Therefore it seems that the calendar as well as the writing (due to the decipherment of the Stela 1 hieroglyphs) spread from a Mixe-Zoquean center to the Mayan civilization (Coe 1999).

According to Coe (1994) there was nothing egalitarian about the Olmec culture and the violent mutilation of the stone heads testify that San Lorenzo as well as La Venta were destroyed by revolution or invasion.

The transportation of the stone sculptures from the Los Tuxtlas mountain range to the political centers of San Lorenzo and La Venta did cost a lot of energy and its imaginable that subdued and conquered tribes were employed as slaves; or that the commonality respectively the peasants had to make their contribution to the ruling aristocrat class as free laborers.

The strong influence of the Olmec culture on their neighbors and subsequent cultures together with their obviously very warlike and imperialistic behavior (the colossal stone heads are interpreted as the portraits of their rulers; text on the stela) the scenario of cultural expansion can be best hypothesized for the Olmec's history.

Figure 9. *Relief detail of a Mayan pyramid in Palenque, symbolizing the rise and fall of cultures (Palenque, Chiapas).*

According to Greenberg (1987) the Maya, Mixe, Zoque and the Popoluca belong to the Penutian language stock, a widespread linguistic family that extends from British Columbia across California down to Honduras. In an under-classification Mixe and Zoque is referred to as Macro-Mayan (Hasler 1958) and Brown and Witkowski (1979) demonstrate regular sound correspondence in Mayan and Zoquen and prove a genetical relation of the two language families. "Mayan" itself encompasses a number of closely related but mutually unintelligible languages, obviously a result of a long period of internal divergence (Coe 1999).

All seventeen Middle American Penutian groups included in the study of Larysse and Wilbert (1999) are Diego allele positive giving this linguistic classification a common genetical background (regarding this trait).

The 31 tested Zoque persons have an average of 12% Diego allele and 54 Mixe individuals come up with exactly the same average (Table 1). This leads to the conclusion that the proto-Mixe-Zoque culture at the time of divergence into the proto-Mixe and proto-Zoque linage had the allele distributed at about 12% as well and that both strains didn't mix notably with other tribes (of different allele distribution). I assume that the Sierra Popoluca share this marker at about 12% as well but unfortunately no data are available because the studies didn't include them.

The different Maya groups tested show a great diversity of Diego allele frequencies. Even within the same Maya groups high differences exist. The Tzeltal data are coherent and show a relatively low frequency. The two population segments tested showed 5% (111 persons tested) and 3.5% (133 persons tested). Within the different Guatemaltecan Quiche (Cakchiquel) groups the average values oscillate between 4% and 17% (Table 1). However, it has to be remarked that higher sample sizes result in more reliable data and that some sample sizes are definitely too low to be of significance.

During this time of new cultural technologies which caused an increase of the population density (comparable to the Neolithic age in Europe and the fertile crescent) gene drift is not likely to have produced such heterogeneity concerning Diego allele frequency because gene drift has a notably effect only in demographic bottle-neck situations (Cavalli-Sforza 1996).

The heterogeneity within the Maya groups may be due to the following reasons: (i) after the split of a Maya core culture the different subgroups mixed with other tribes; (ii) an early Maya core culture conquered or affiliated neighboring cultures without mixing their genes but passing on their language

and cultural traits; (iii) both phenomena occurred. Cavalli-Sforza (1996) refers to the first two possible cultural expansions as "demic" (expansion of a people bringing along new technologies and mixing genes) and "cultural" (the passing on of new technologies to other peoples without mixing genes) respectively. However, with the available data no clear suggestion can be made regarding the expansion of the Maya culture.

Table 1. *Frequency of phenotype and genotype of Diego blood group system within the Mixe, Zoque and different Mayan groups (taken from Larysse and Wilbert 1999).*

Origin	No. tested	Phenotypes Di (a+)	Di (a-)	Genotypes Di^a	Di^b
Mexican					
Mixe-Zoque:					
Zoque	31	22.58	77.42	0.1201	0.8799
Mixe	31	22.58	77.42	0.1201	0.8799
Mixe	54	22.22	77.78	0.1181	0.8819
Maya:					
Chol	15	26.67	73.33	0.1436	0.8564
Chol	54	12.96	87.04	0.0670	0.9330
Itza	67	25.37	74.63	0.1361	0.8639
Lacandon	61	16.67	83.33	0.0871	0.9129
Lacandon	33	33.33	66.67	0.1835	0.8165
Tzeltal	111	9.91	90.09	0.0508	0.9492
Tzeltal	133	6.77	93.29	0.0344	0.9656
Tzotzil	86	15.12	84.88	0.0787	0.9213
Tzotzil	80	18.75	81.25	0.0986	0.9014
Chontal	89	19.10	80.90	0.1006	0.8994
Guatemalan					
Maya:					
Quiche (Cakchiquel)	5	0.00	100.0	0.0000	1.0000
Quiche (Cakchiquel)	150	8.67	91.33	0.0443	0.9557
Quiche (Cakchiquel)	409	22.74	77.26	0.1210	0.8790
Quiche (Cakchiquel)	323	9.29	90.71	0.0476	0.9524
Quiche (Cakchiquel)	46	17.39	82.61	0.0911	0.9089
Quiche (Cakchiquel)	80	31.25	68.75	0.1708	0.8292
Quiche (Tzutujil)	130	20.00	80.00	0.1056	0.8944
Quiche (Tzutujil)	95	11.58	88.42	0.0597	0.9403
Chol (Chorti)	30	50.00	50.00	0.2929	0.7071
Pocoman (Kekchi)	122	5.74	94.26	0.0291	0.9709
Pocoman (Kekchi)	80	21.25	78.75	0.1126	0.8874
Maya	120	30.00	70.00	0.1633	0.8367
Mam	116	10.34	89.66	0.0531	0.9469
Mam	70	32.86	67.14	0.1806	0.8194
Belizean					
Maya	230	8.70	91.30	0.0445	0.9555
Maya (Kekchi)	117	6.84	93.16	0.0348	0.9652

Even though, while it is generally assumed that there are few parts in the world where such a good congruence and homogeneity of language and culture exists (Coe 1999) the genetic marker seems to suggest a heterogeneous base or/and development of the Mayan culture.
Wanting to investigate a possible connection of the Zoque-Popoluca with the ancient Olmec culture it is useful to know when the Zoque and the Mixe lineage split up.
The deciphered epi-Olmec hieroglyphic writings dated to 160 A.D. (Justeson and Kaufmann 1993) and assigned to an early form of Zoque implicate that the Mixe and Zoque have been separated prior to this date. The decline of the Olmec culture ended 300 B.C., though about 500 prior to the manufacture of the stela when the Mixe and Zoque linage was obviously already split up. Additional glottochronological data from Morales (1971) result in a separation of a minimal of 2100 years between Zoque (Mezcalapa) and Mixe (Totontepec) fitting astonishingly well, regarding the scientific discussions about the reliability of this linguistic method with the archaeological dating of the stela. On the other hand Morales' (1971) finding that the Mixe and the Sierra Popoluca split 1530 years ago is surprising. For the separation between Zoque and Sierra Popoluca he calculates a minimum of 1490 years. However, its not possible to equate the last period of the Olmec civilization with the splitting of a proto-Mixe-Zoquean culture.
Nowadays the southern foothills of the Los Tuxtlas mountains, the source of the basalt used by the Olmecs is the homeland of the Sierra Popoluca. The Popoluca share many aspects of cultural life and cosmovision with the Maya, Mixe, Zoque, and the other indigenous groups in the region. The similarities can be detected in interesting singular and striking examples. The Popoluca word for vagina "cang" is the same as for the jaguar which is intriguing considering the Olmec's believe in their feline parentage (see page 21).
Foster (1945) detects striking similarities between the legend of "Homshuk" and "Popol Vuh" the creation myth of Maya civilization. Foster (1945) states that "certain events related in the Popol Vuh suggest that the elements which compose Popoluca folklore were in part drawn from Maya sources, or from sources common to the two areas.

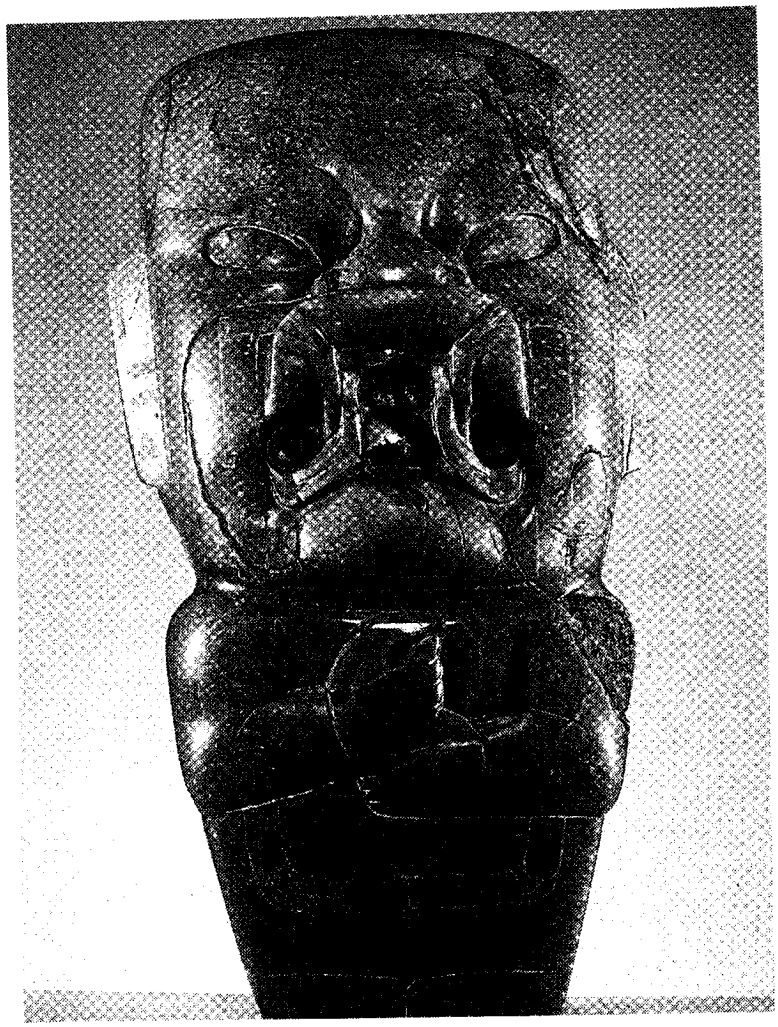

Figure 10. *Olmec jade effigy of a were-jaguar baby, Middle Pre-classic period (from Coe 1994).*

The Yucatec and Lacandon Maya utilize *Lonchocarpus violaceus* bark to strengthen "balche" (Rätsch 1998), a traditional intoxicating mead while the Popolucas use the root of *Lonchocarpus acuminatus* (N¥ts cuy - Armadillo tree) to strengthen "tepache" (fermented beverage made from water, corn and sugar cane, traditionally their only inebriating agent).
Other examples of a similar use of the biotic environment is the Mayas' and Popoluca's utilization of *Plumeria rubra* for amatory attraction and the Ceiba tree (*Ceiba* sp.) which is mythical with the Maya, the Mixe and the Popoluca and used to indicate the center of a village. Of course its impossible to tell

whether cultural similarities have their cause in a common cultural past, later exchange or congruent cultural development.
Anyhow, for a better understanding of Mesoamerican history the relationship between the Olmec and the ancient Mayan culture coexisting for many centuries seems to be a key subject.
One can only speculate why the once trend-setting Olmec, epi-Olmec or proto Mixe-Zoquean groups have lost their influence and cultural power. Further it is very astonishing that the Popoluca, evidently belonging to the descendants of a highly developed culture are now living marginalized on the least desired terrain of the region ignorant of the Long Count calendar not to mention an indigenous script and referred to by anthropologists as the culturally less advanced group in the area (cf. Foster 1943).

2.10 The Diego blood group system and the Mongoloid realm. By Miguel Larysse and Johannes Wilbert 1999

Summary of the publication with focus on Mexico and the Isthmic zone.

Based on the presence of an antigene and an antibody, a blood factor was described 1954 being responsible for a hemolytic disease of a new born in Venezuela. The antigenic protein was called Diego in memory of the child dying form erythroblastosis, the consequence of the antibody formation by his mother. First, it was considered to be a blood factor due to mutation in the particular family, rather than being an antigene distributed rarely in the population. Later, after testing random donors in Venezuela it became clear that it is a matter of a low-incidence blood factor suggesting a correlation with physical features of Native American ancestry. In succession, a series of additional studies were conducted which verified the hypothesis.
Thus the Diego factor was attributable to Native American ancestry. In the following all over the Americas indigenous groups were tested and later on, data of peoples from the whole world were incorporated in the project. The world-wide research established the corresponding genes' presence in Asiatic Mongoloids and finally became recognized as a Mongoloid character fitting well with the generally considered Asiatic origin and Mongoloid descent of the American aboriginals. Surprisingly, the investigation revealed that some Native American groups were lacking the Diego-allele indicating that the allele was not of universal indigenous American distribution. This led to the suggestion

that the indigenous Americans were of diverse genetic stocks and possibly of different spacial and temporal origins reflecting different waves of immigration. This consideration fitted with phenotypical peculiarities of several indigenous groups, archaeological relicts and linguistic research (Greenberg 1987), which led to the assumption of three major immigration waves. According to the possible transgression of the Beringian street regarding sea-level fluctuations they assume that about 40.000 B.P. pre-Mongoloid eastern Asians entered the New World, followed by Paleo-Mongoloids around 30.000 B.P. and finally by the Diego allele positive Neo-Mongoloids at about 9.000 B.P.

The average Diego allele frequency in America aboriginals increases from North America (2%), through Middle America (including Mexico) (5%), to South America (9%), implicating that these last invaders headed more or less straight southwards. South American samples often show higher Diego allele frequencies, reaching up to 49 %.

Based on the presumptions they suggest that the vanguard of the late arriving Diego allele positive Neo-Mongoloid intruders advanced through the Central American isthmus by about 7.000 B.P.; though about 3.000 years prior to the beginning of the Mesoamerican Formative period with the first agricultural villages and resulting demographic changes. Permanent agricultural villages established between Guatemala and Colombia (a region occupied by Diego negative peoples) by 1.000 - 500 B.P. were impeding any further advancements of Neo-Mongoloid migrants through the isthmic zone.

3 Some Popoluca legends and myths

3.1 Jem Xunujti - El Gatito Encantado - The Enchanted Kitten

Legend told by: Don Leopoldo Martínez Lazaro, Santa Rosa Loma Larga, Hueyapan de Ocampo 1999.

This mythical animal is a catlike creature and has its main habitat near waterfalls in the undisturbed forest (Figure 11). The Xunujti is one of the several guardians of morality and social life of the Popoluca community. The master of the Xunujti is the old witch "Chichiman". The Xunujti can overcome a person only in the forest, the realm of the Chanecos. Over all hunting men must be very careful in respect to the presence of a Xunujti. Previous social behaviour to a hunting event encompasses a period of abstinent life regarding sexual relations. Especially endangered persons are hunters who shortly before a hunting session had sex with a lover and and/or paid her off with meat from a hunted animal. The Xunujti smells the humans and detects whether a person had sexual contact recently and whether he has lovers or not.

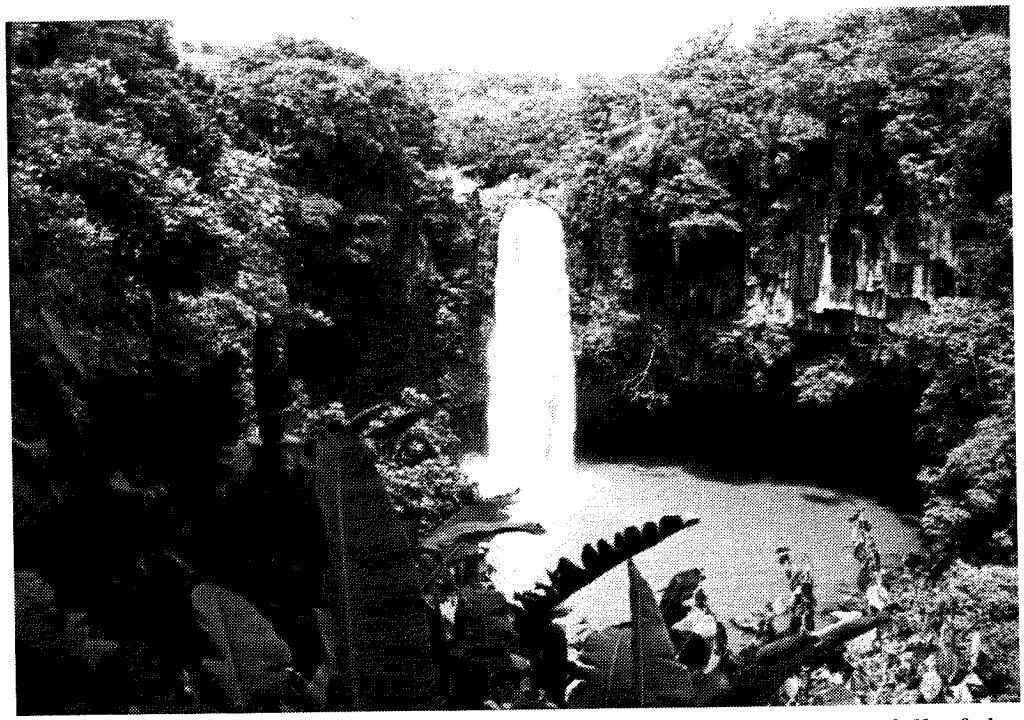

Figure 11. *Habitat of the Xunujti; the vegetation around the waterfall of the river Huazuntlán, Soteapan.*

The sound of a meowing Xunujti at night brings fear over a group of hunters. In this case they have time to decide to go back all together or to make a divining session through which the wrongdoer can be revealed. The procedure comprises the burning of old tortilla pieces and the interpretation of the firelight. Caught off guard the Xunujti begins to orbit his prey. The first signs of decay is the pouring nose of the wrongdoer, while the Xunujti grows bigger with every meowing. Finally under the growing meowing of the Xunujti the wrongdoer melts away and turns into a pit of an atole-like (corn-cream) liquid. He is then licked up by the now jaguar ("tigre") sized Xunujti.
Fighting against the Xunujti is useless because the animal, while cut with the machete into pieces multiplicates itself. The best method to fool the Xunujti is to wash oneself thoroughly with soap after sexual practices.
Nowadays the Xunujti is quite a rare species (but probably not due to increasing morality (comment by the author)).

3.2 Jem Lubujti - El Lobo u el Burrito Encantado - The Enchanted Donkey

This animal has the morphology of a donkey and produces a similar sound. His main habitat is around waterfalls and rivers, similar to the habitat of the Xunujti. If a person finds himself opposite to a Lubujti, the Lubujti by agitating his ears provokes that the person passes out. His master is "The Giant".

3.3 Jem Zeje - El Carpintero - The Wise Bird

This bird, which really exists is called the "wise bird". Its whistles are signaling that a person or a group of persons are in danger (maybe by a luring Xunujti) and should return to the village.

3.4 Jem Junxuts - The Hunshuts

This mythical creature looks like a human child but his feet are reverted and he wears a hole in his hollow head. He feeds on human brains (probably because he aint got any) and overwhelms a human being by jumping onto him and

fixing himself to the umbilicus. Then he drills a hole into the human head and sucks the brain. Furthermore, he feeds on "nanchi" (fruits from *Byrsonima crassifolia*) and sweet water shrimps which he picks out of the bow nets deposited in the arroyos by shrimp fishers. The only thing which can be used to defend oneself against the Hunshuts is a crumble of wax. "Junxuts" means "dead rubber" and derives from: "Juñi" (rubber) and "tsuts" (dead).

3.5 Jem Pak Muutxi

They say that the Pak muutxi is a sorcerer in the shape of a big hog who roams the villages at night in order to do evil. "Pak" means "bone" and "muutxi" means "to cannonate" and it is said that one can hear a sound similar to the one emitted while something is eating bones when a "Pak muutxi" is near. From a killed "Pak muutxi" the following day only a banana leaf is left.

3.6 El Brazofuerte - The Anteater

Story told by: Don Cristobal Hernandez Garcia, Buena Vista, Soteapan 1999.

The anteater bears enormous strength in his arms, his literal hunger for ants makes him crush the hollow stems of *Cecropia obtusifolia*, to get access to the ants living in the cavities.
If an anteater feels disturbed by a person he is said to grab the human at the wrists and throw him to the ground. The anteater then, according to the accounts, introduces his slim tongue through the nose of the person and tears the brain out. With this act the anteater steals the person's force and incorporates it. Bold men are said to seek the fight with the anteater on purpose to gain its forces. The challenger carves two swords from the wood of *Heliocarpus* sp. One is for the anteater with the other one he defends himself.
The thumbnail of the anteater is used as an amulet for babies with the idea that the amulet will make them strong.

3.7 Hunting

Previous to a hunting session the hound gets fumigated with "Nanchi mokxi" (fungus afflicted twig of *Byrsonima crassifolia*) and is told by his boss which animal is intended to be hunt. In the special case of an armadillo hunting the dog gets fumigated with residuals of an armadillo nest. The direction of the smoke from burning incense indicates where the wild game is most likely to be found.

3.8 Jem Pixtyiñ - La Ceiba - The Ceiba tree (*Ceiba pentandra*)

Legend told by: Don Leopoldo Martínez Lazaro, Santa Rosa Loma Larga, Hueyapan de Ocampo 1999.

Ceiba pentandra and other *Ceiba* species are mythical trees with the Maya the Mixe and the Popoluca. It seems that this tall growing giant has a long tradition in this cultural alliance and maybe was as well of major importance with the ancient Olmecs.
A sturdy body and a well established belly represent a status symbol in the Popoluca culture. A skinny person with the request to gain weight is told to embrace a young Ceiba tree while saying the adequate prayer. Later, when the tree has achieved the extension of the desired size of the person the tree must be cut down. Should the concerned person omit the chopping of the tree the person will grow to the trees' size and finally explode.

3.9 Sierra Santa Marta, Los Tuxtlas - refuge of the "Rayos" (thunderbolts), the weather-making agents

Story told by: Doña Teresa Reyes Martínez, Santa Rosa Loma Larga, Hueyapan de Ocampo 1999.

The Rayos of Guatemala are "historical" enemies and envious of the Los Tuxtals region because the corn grows better here. These Guatemaltecan Rayos are confederated with the "Rayo of the black Horse". This Rayo comes every year in the months of July and August from the costal region of Coatzacoalcos to the Los Tuxtlas region. His arrival is announced by the snickering of his horse. The Rayo of the black horse is red and comes without any clouds. When

he gets off the horse he brings heavy winds and cloudbursts in order to destroy the young corn plants. The rayo works together with the white spiritual turtles who are trying to dig a channel from the seaside into the Sierra with the same goal. But the "Centellos Rayos" (spirits of defunct men who unify with the thunderbolts) of Soteapan, together with the "Centellos Rayos" of Oaxaca fight against these bad spirits from Guatemala. The Centellos of Soteapan have their base in a waterfall near the "Banana mountain" (Cerro Platano) in the subdistrict of Soteapan.
The Guatemaltecan want to inundate the Sierra because they are envidious, mean and poor. That's why their land is called "Guate" - "mala" ("Guate" - "bad") (old pan-Mexican "joke" (the author)).

3.10 El nacimiento de Homshuk, dios del Mais y su viaje por San Pedro Roma - The birth of Homshuk, the Maize god and his journey to San Pedro Roma

Myth told by: Don Miguel Garcia Ramirez, La Estribera, Soteapan 2000.

Konk¥jtsay Woyayi the spiritual father of Homshuk was flying in the shape of a crane at the seaside trying to find a woman when his attention was caught by a group of white pigeons harvesting cotton. Konk¥jtsay Woyayi sequestered a pigeon covering it with the cotton. He adopted the pigeon as his wife. She was called Semakun Mooya. When the mother of Semakun Mooya realized that her daughter was kidnapped she called the sparrow hawk and ordered him to bring back her daughter. When he found Semakun Mooya the sparrow hawk chopped off her head and brought it to her mother. Her mother carved a doll from the wood of Achiote (*Bixa orellana*) and as soon as she stuck the head to the dolls trunk Semakun Mooya resurged. Konk¥jtsay Woyayi on the other side took a gourd, put it at the place of Semakun Mooya's head, while the calabash transformed itself in the pigeons head and revitalized Semakun Mooya.
Later a thunderbolt killed Konk¥jtsay Woyayi and when Semakun Mooya gave light to her son Homshuk she saw no chance to raise her child alone. That's why she threw Homshuk away.
Then the story continues with Homshuk's childhood and his heroic deeds already published in many publications (e.g. Foster 1945). At the end Homshuk tired of his work and falling into oblivion wanted to retire himself in San Pedro Roma. He asked the bloomed turtle "Mooy Tuqui" if she would give him a ride

to the other side of the sea. Unfortunately the turtle at that time had its carapace broken and needed first to be cured. So Homshuk called for the rabbit who treated the turtle's carapace with its own faeces. Homshuk asked the rabbit what he desired in response. The rabbit said: I want antlers. The rabbit, as he got his antlers went into the woods playing where he encountered a deer. The deer was enchanted by the rabbit's antlers and asked the rabbit if he could borrow them for a while. The rabbit lent the antlers to the deer who in turn never showed up again to bring back the antlers. The frustrated rabbit went to look for Homshuk and reclaimed his antlers. The rabbit, being told that no more antlers were available asked Homshuk to tear his ears. "Stand in the sun and look at your shadow while I tear your ears and tell me how long you want them to be" ordered Homshuk the rabbit. This is why nowadays the rabbit has long ears.
Finally Homshuk took off on the turtle's carapace to San Pedro Roma. When they arrived on the other side of the sea Homshuk found the soil to be very cold. "This is ice" the turtle explained. Homshuk continued his journey to Roma on foot while the turtle swam back into the middle of the ocean. Now Homshuk lives in San Pedro Roma. Homshuk appreciates it very much if the people narrate his stories and remember him.

3.11 Discussion and conclusion

There exist many more Popoluca legends and myths (see Foster 1945) providing the virtual playground for further mythical creatures. The explanatory elements in the stories is very typical of Popoluca folklore (Foster 1945).
In order to get indications for a future nature conservation policy Faust (1992) investigated the perception of the Coconuco and Yanacona Indians in Colombia regarding their ecological environments and the local resources. In an attempt to better understand the indigenous relations, constrictions and taboos connected to the different ecological environments he drew a "mythical map" of the environment where the different supernatural beings are plotted. This could be done as well with the mythical world of the Popoluca and would in some cases provide astonishing similarities.
The Popoluca believe that the dwarf-like Chanecos who are the "masters of all game" dwell inside the mountains. These Chanecos can shut up all deer (which

is the most prestigious game) during the night inside their mountain kingdom and let them out the next morning; the deer are their cattle (Foster 1945). The Chanecos have in their power to grant luck to the hunters or to withhold it (Foster 1945).

The Coconuco and the Yanacona believe in the "Jucas" which on the one hand is a quality inherent in wildlife and on the other the master of all wild animals and wild plants and phenomena of nature like rain, wind and thunder (Faust 1992). The indigenous say that the "Jucas" keeps the deer in hollow mountains called "urcus" like the humans keep sheep. The deer is the pet of the "Jucas" and it is up to the "Jucas" to free the game or to hide it (Faust 1992).

If these striking similarities in cosmovision are pure coincidence or based on an ancient cultural exchange, or are due to the common perception of the human mind is difficult to tell. The cave depictions of animals and animal chases from the Paleolithic age may reflect a similar perception and imagination of those remote cultures.

As Foster mentions, due to their remote settlements (1945) the Popoluca were less influenced by Western civilization as were other indigenous cultures in Mexico. As a whole the acculturation process was milder and proceeding in a more gradual way compared to the cultures settled in the surrounding lowlands. Traditional elements within the old cultural framework slowly disappeared as new ones were introduced without greatly altering the original mental and material orientation (Foster 1945).

The continuing use of the Popoluca language is the most powerful argument to show that these people have not given up their cultural roots. The incorporation of Spanish terms for which no Popoluca expressions exist (e.g. numbers, modern Spanish expressions) in their colloquial language is just the prove that their cultural identity is not broken but vital and dynamic.

The fact that Popoluca legends and myths are still being told is another aspect which underlines the liveliness of their culture. More than the fact that the stories are still narrated weighs the fact that they are being modified and carried on as exemplifies the last sequence of the legend of "Homshuk". In a metaphorical way the story tells how the once most honored Popoluca deity was virtually incorporated into the Christian pantheon of oblivion (St. Peters Dome) which name appropriately has the same saint's prefix as Soteapan. Though, this part of the legend demonstrates very lucidly that the Popoluca are aware of the processes altering their culture and their way of life.

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4 Ethnomedical syndromes

4.1 Chanecos, anjeeki, z¥yi - Chanecos, espanto, susto - Nature kings, sudden fright, shock

Chanecos can not be equated with gods or something alike. The Chanecos are the spiritual guardians and owners of the places which they colonize. Basically they are dwarf-like kings of nature. They live in family gangs (grand grandfather, grandmother, mother and father, children...) and inhabit all imaginable places like the house, the drip, the street, the house garden...every locality harbors its Chaneco family. The most powerful Chaneco families however are those living around waterfalls and the ones living inside the mountains, the so called Rayo-chanecos.
The black Chaneco is the meanest one but at the same time he is the guardian of the Popoluca (mestizos have white Chanecos) and is called San Pedro. He prevents Soteapan from being inundated (in collaboration with the Rayos).
According to the Popoluca, illness may have different causes. For example incurring the displeasure of the "Chanecos" can result in "espanto" *(anjeeki)* or "susto" *(z¥yi)*. Disregarding the social and cultural norms of behaviour may cause this displeasure. The disease does not need to hit the guilty person; if parents have strong arguments, "espanto" or "susto" will most likely hit their 'weaker' children. Furthermore, the symptoms of espanto can manifest themselves days or several weeks after the causative happening.
"Espanto" or "susto" means fright or shock and is an illness associated with soul-loss, still commonly diagnosed by Popoluca healers. Hence the base of this phenomenon is the people's understanding that a person is composed of a body and an immaterial essence which can partially or totally get lost (Rubel et al. 1984). It is believed that the patient, wittingly or not has disturbed the spirit guardians of the earth, river, ponds, forest or collectivity of animals, birds or fish (Rubel et al. 1984). According to Foster (1951) "a sudden shock, an unexpected encounter with supernatural beings, a fall, or ... fear of death from purely natural causes" can cause "espanto". The "Chanecos" are thought to be the responsible agents by provoking these accidents and then capturing a part of the victims' soul and keeping it locked up. Based on a cross-cultural study Rubel et al. (1984) summarise the symptoms of espanto and susto from restlessness during sleep, listlessness, being debilitated and depressed and being indifferent to food, to dress and to personal hygiene.

If a person is suffering from "espanto" or "susto" the frightened person needs to be cleansed. During a cleansing ritual (limpia) the lost soul is reclaimed by the "ensalmador" (soul-loss expert). With a piece of incense the ensalmador sweeps the patient's body and cleans it. Repetitively the incense is driven from the shoulder to the wrist passing over the inner arm side trying to pull the palpitation (of the cardiovascular system) from the inner elbow side (a sign of "espanto") to the wrist. During this ceremony the soul-loss expert seeks to normalize and relax the relation between the patient and the Chaneco by repetitively invoking the Chanecos and reciting prayers.

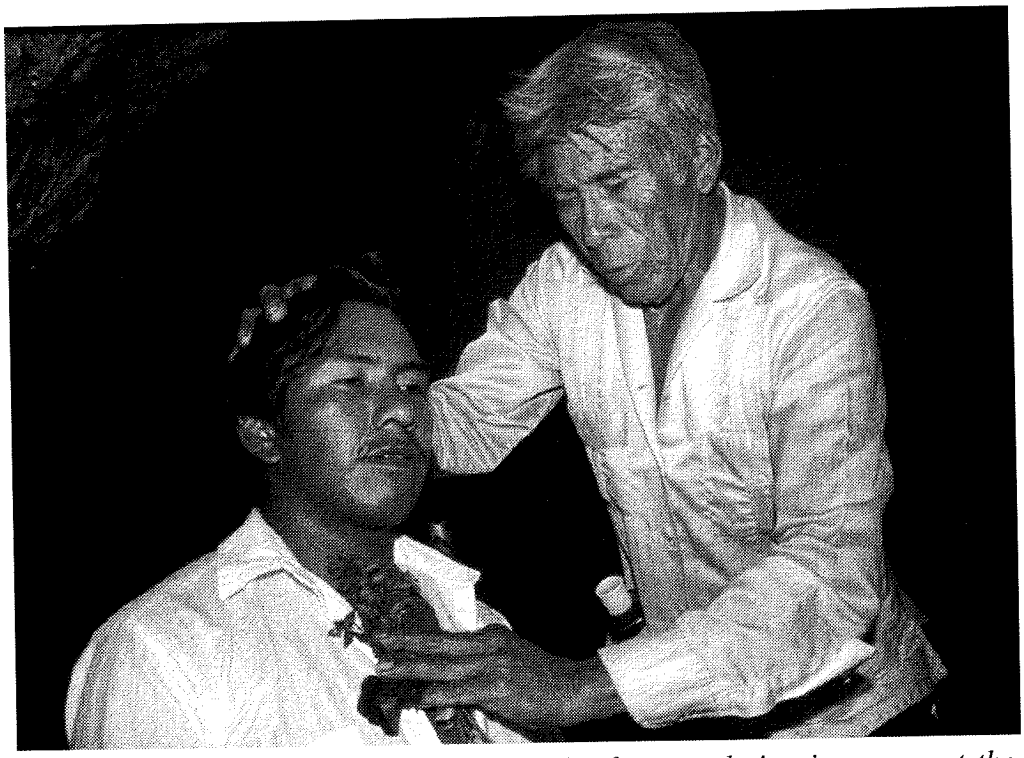

Figure 12. *Cleansing ritual with basil and a fragrant lotion in a cave at the "Laguna encantada" San Andres Tuxtlas.*

A person who had an accident e.g. while working in the milpa or in the wood is taken during his convalescence to an arroyo at night and is cleansed with different wild herbs and water of the arroyo. Closer family members attend the cleansing ceremony and thereafter a roasted chicken and firewater is served. The idea behind this social act is to eat together with the Chanecos, which are thought to participate in the meal in order to relax any remnant strains.

Though, the chicken and the firewater are not sacrificed but used in a social context in order to live together ("convivir") with the Chanecos.
Babies, as their soul is tender and new, are often disturbed by interferences with Chanecos and gremlins. As a result the baby cries consistently. After a fumigation ceremony the baby is brought to a road or path junction where it is laid down. Another person then picks the baby up and leaves the place running by choosing a different path while the other person fumigates the junction. The idea behind this ritual is to confuse the gremlins and the Chanecos and make them loose the trace.
The phenomenon of the cleansing ceremony is of pan-Mexican distribution. Limpias are applied also in contexts where the patient is not explicitly frightened. A sick person is always cleansed before the treatment with a herbal remedy and a person who is psychologically exhausted (because of thinking too much about a problem) gets a limpia too.
Principally during the treatment bad spirits and the "heat" of an illness are sucked out and sent away. A raw egg is driven over the body with the function to take up the heat. This can be detected by investigating whether the egg white is "cooked" (got white) after breaking the egg into a glass of water. Different plants together with a fragrant, alcohol based lotion are used to cleanse the body. Basil (*Ocimum basilicum*) is the most frequently used plant in this context (Figure 12).

4.2 Tsog¥y - Engaño (de la mujer) - Deceiving (of the woman)

This ethnomedical syndrome probably comprises several illnesses; malaria, dengue and tuberculosis amongst others. To be disastrously enamoured and having the desperate wish to make love with the desired person provokes "engaño". Especially men are said to be afflicted by this complex disease, because they are very keen (after all they are Veracruzanians). The fright (susto) and the shame of being caught in action by a third person can be another cause of "engaño". A heavy fever (love fever) with shivering overcomes the person, accompanied by headaches, aching kidneys and hiccup. Further symptoms are shrunken sexual organs, which turn inside the body cavity. There are said to exist three forms of "engaño": The short lasting (one week) red and black forms and the longer lasting (up to one year) white form. All forms can have a deadly end.

Figure 13. *Altar used in cleansing ceremonies by Don Apolinar in Benito Juarez (Soteapan) showing Maria surrounded by a crew of catholic saints.*

Figure 14. *Phallus and vagina symbols made from stone, clay and wood, and tortoise shell, deer horn and penis bones from* Nasua narica *to treat "engaño".*

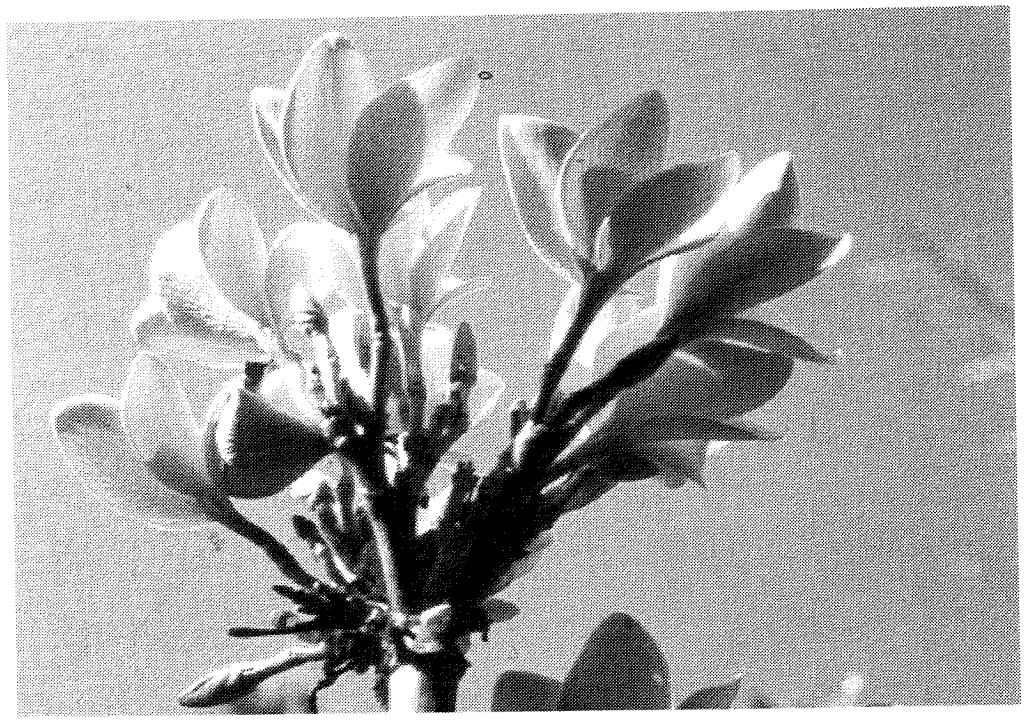

Figure 15. *Inflorescence of the frangipani tree* (Plumeria rubra) *to treat "engaño".*

The red form's main symptom is fever and with the black form the skin gets dark. The white form provokes complications with the respiratory system and "exhausts" the person.
Children can be attacked by "engaño" as well; the illness provoked by either part of the parents can encroach the weaker child. As the illness is thought to be caused by psychological reasons the curing can not be achieved through allopathic medicine neither through herbal remedies allone. The curing procedure therefore is more complex. The physical part: Water, recollected from seven different sources in the early morning hours, seven flowers of *Plumeria rubra* (frangipani tree) (Figure 15), seven exemplars of old Mexican pesos, the powder of the penis bone of the tejón (*Nasua narica*), the powder of deer horn, powder of tortoise shell and the powder of phallus and vagina symbols carved from stone, wood and clay (Figure 14) are brought together. This mixture is used as a body shower while some drags are administered orally.
The psychological part: The healer seeks to reveal which person is responsible for the patient's situation. If the patient states the name of the adored person the subject of lust is sent for and is asked to mark a cross with its saliva on the patient's forehead.

4.3 Tunu m¥ñi - Latido - Palpitating umbilicus

Latido *(tunu m¥ñi)* is a very common clinical picture with the Popoluca. People suffering from *tunu m¥ñi* are always undernourished and lack of appetite. The umbilicus or an organ underneath the umbilicus palpitates and hurts.
This ethnomedical syndrome can probably be equated with the Maya's *Me' winik*, described by Berlin et al. (1993). They state that: Women in general and individuals who are thin and undernourished are especially susceptible...the palpitating mass may move around mid-abdomen...secondary symptoms...include weakness, lethargy and loss of appetite (Berlin et al. 1993). They found the biomedical equivalence of *Me' winik* to be gallbladder diseases caused primarily by gallstones (Berlin et al. 1993). Heinrich (1994) reports for the Mixe an illness called *jo'ot x¥h¥* for which the key sign is the more noticeable pulsation of the abdominal artery and which he describes as spasmic movements of the belly with cough. This Mixean illness seems to be closely related to the Popoluca's *tunu m¥ñi* and the Maya's *Me' winik*.

The Popoluca treat *tunu m¥ñi* with a decoction of aromatic and/or bitter herbs (*Tagetes* sp., *Ruta* sp., *Zingiber* sp. *Porophyllum* sp., *Calea ternifolia*) in order to regain appetite and to combat the pain.
However, Werner (1996) describes latido as the palpitation of the aorta at the stomach entrance. He states that this palpitation can be felt if somebody is very emaciated and undernourished. In both interpretations (Berlin at al. 1993 & Werner 1996) latido leads to undernourishment or is its cause, but curiously the location of the palpitation is different.

4.4 Tsocoicopoia, j¥xi - Pensamientos, desesperación - Melancholy

Maybe because of strong arguments a person feels sad. The person feels the will to leave the place (village), the baggage is ready but at the end the person does not have the strenght to leave. *Tsocoy* means "liver" (the place of the soul), *copoia* means "to go". *Tsocoicopoia* (liver/soul wants to go) is treated with a decoction of different *Phyllanthus* species.

5 Traditional Popoluca illness and ailment terms

5.1 Dermatologic afflictions

-J¥p puka – J¥p (mouth), puka (putrid): Infection of the mouth or/and teeth.

-K¥ kujuki – K¥ (hand), kujuki (?): Infection under the fingernail and of the fingernail itself.

-Masan: Erysipelas.

-Miktanchina: The infected skin area swells and gets red; subsequently a watery liquid leaks from the infected area.

-Mok jipxi – Mok (corn), jipxi (burned): The skin is infected and provokes a burning ache. The infection is thought to result from the accidental destroying of maize cobs during the harvest procedure when by mistake and simply overlooking maize cobs get burned with the harvest litter.

-Tapu: Wart.

-Tsuts tsabats masan – Tsuts (dead), tsabats (red), masan (erysipelas): Most aggressive form of erysipelas.

-W¥yi: Fungal infection causing white circles ("jiotes").

-Xiui: Furuncle with pus.

5.2 Gastrointestinal disorders

-¥¥txi: Vomiting.

-Cojipxi: Heartburn.

-N¥pin tyín – N¥pin (blood), tyín (faeces): Dysentery with blood in the feces.

-*Paji:* Diarrhea.

-*Pun¥ktyín* – Pun¥k (pus), tyín (faeces): Dysentery with mucus and/or pus.

-*Puu sawa* – Puu (belly), sawa (wind): Flatulence.

-*Tunu m¥ñi* – Tunu (umbilicus), m¥ñi (~palpitates): compare to p. 65.

5.3 Women's medicine

-*Esmeyi:* Hemorrhage.

-*N¥pin cacuy* – N¥pin (blood), cacuy (disease): Hemorrhage.

5.4 Fever

-*Jawan:* Fever.

-*Kobak toya* – Kobak (head), toya (pain): Headache.

-*Penaxi / Mahei piji* – Majeiwin (thunderbolt), piji (fever): In the Sierra occur many tempests. Persons who get hit by a lightning will suffer from the thunderbolt's fever. The body and the bones ache and sometimes the patients have cramps while the fingernails get violet.

-*Piji:* Fever.

-*Piji angjumi* – Piji (fever), angjumi (?): Fever of the tsog¥y.

-*Tsuts piji / Piji cacuy* – Tsuts (dead), piji (fever), cacuy (disease): The so called fever of the dead or of the defunct; If a mother of a newborn passes by a house where recently a person has died, she gets encroached with the "heat" of the dead person and will subsequently transmit this "heat" to her newborn. The baby will get fever and diarrhea while the mother will have

problems to produce milk for the baby. The baby and her mother need to be cleansed and to be fumigated with incense.

5.5 Cultural syndromes

-Anjeeki: Sudden fright, shock, compare to page 60.

-J¥xi: Thinking about problems, compare to page 66.

-Ixcuy piji – Ixcuy (eye), piji (fever): This comes from a very strong glance obtained for example by a person who is in love. "Ixcuy piji" causes headache which begins at the temples. Mostly infants get affected by this sort of illness. If a person who is not part of the closer family gets close to a baby or an infant he is told to hold the baby in his arms and is asked to mark a cross with its own saliva on the baby's forehead in order to prevent "Ixcuy piji".

-Tsocoicopoia – Tsocoy (liver), copoia (wants to go): Melancholy, thinking about problems, compare to page 66.

-Tsog¥i: Deceiving (of the women), compare to page 62.

-Z¥yi: Sudden fright, shock, compare to page 60.

5.6 Respiratory ailments

-J¥k sukxi: Whooping cough.

-Sukxi: Cough.

5.7 Skeleto-muscular disorders

-Kiñi: Arthritis, rheumatism.

-M¥a toya / K¥ m¥a – M¥a (deer), toya (pain), k¥ (hand): Pain of the wrist.

5.8 Urogenital complaints

-Tsem pagak – Tsem (urine), pagak (cold): Pain while urinating, urine without blood.

-Tsem n¥pin – Tsem (urine), n¥pin (blood): Pain while urinating, urine with blood.

5.9 Ophtalmologic complaints

-Uks¥: Conjuctivitis.

5.10 Venomous animals

-Chipuki: Brown caterpillar with nettle hairs. Getting in contact with the nettle hairs burns similar to a strong ant's bite but after a while the lymph nodes begin to ache considerably.

-Pop tsukiñ – Pop (white), tsukiñ (caterpillar): White caterpillar with nettle hairs. Getting in contact with the nettle hairs burns similar to a strong ant's bite but after a while the lymph nodes begin to ache considerably.

-Tsumi: Rattlesnake

5.11 Various ailments

-Utsaga: Pain underneath the ribs, probably referring to the milt.

6 The treatment of "Masan" (erysipelas): An example

In the Popolucan community dermatologic conditions form the largest illness category with the most plant species and use-reports assigned to. The Popoluca demonstrate to be very virtuous in curing and treating dermatologic conditions. On the other hand they consider themselves not to be very skillful in the treatment of skeleto-muscular ailments and therefore for the treatment of bruises and fractions they rather frequent the specialists of their Nahuatl speaking neighbours. Distinct treatment methods are used to cure the diverse cutaneous ailments like infections by microorganisms, badly healing wounds, pimples, hemorrhoids and rashes. A specific treatment method is used in the curing of an infected slowly healing wound. The wound is carefully cleaned with the vapor of a plant decoction and a subsequent washing with this decoction. This treatment often has to be repeated over weeks and is therefore very labor-intensive. It seems that the selection of the plants to be applied was of less importance than the chosen treatment method itself. The medical staff of the local governmental health-care institutions SSA (Secretaría de Salud y Asistencia) and the IMSS (Instituto Mexicano del Seguro Social) is often overemployed and has not the leisure and patience to treat such conditions. The medical work of the Popoluca healers therefore constitutes an important health service to their community.

Mycosis and erysipelas (infections with *Streptococcus* spp.) are treated with a cataplasm of ground leaves sometimes with additives. In the following photo series (Figures 16-19) the preparation of a cataplasm against erysipelas is demonstrated containing leaves of *Phoradendron quadrangulare* (Loranthaceae) and sour tortilla (corn) dough. Whether the low pH level has an influence on the success of the treatment is open to speculation.

Figure 16. *With the "metate" (rectangular volcanic stone plate) and the "mano" (tubular stone, used for grinding) leaves of* Phoradendron quadrangulare *(Loranthaceae) and sour tortilla dough are ground to a smooth paste.*

Figure 17. *The paste is transferred on* Piper auritum *(Piperaceae) leaves.*

Figure 18. *The cataplasm is carefully applied to the infected area of the skin.*

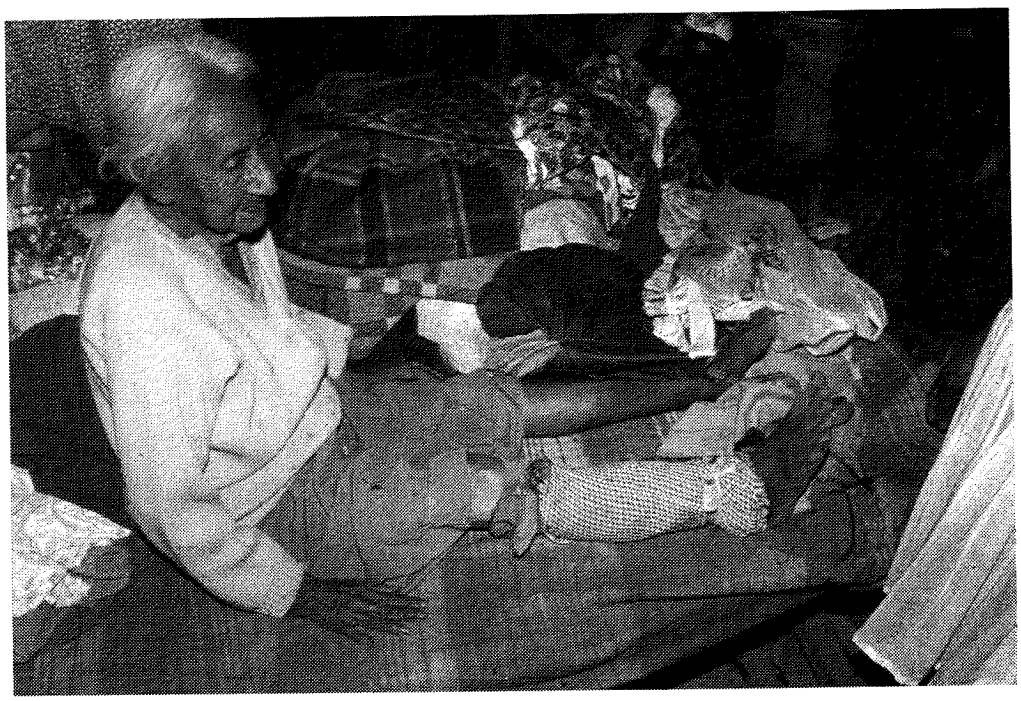

Figure 19. *The cataplasm is covered with a cotton towel.*

7 Animals and fungi in traditional medicine

The advantage of the plant kingdom in contrast to the animal kingdom as a source for medicine is obvious: Plants don't move and thus are easy to root up, are storable in a dried form, often are relatively appetizing and have a broad range of chemical diversity with distinct pharmacological properties. Nonetheless the Popoluca include animals or parts of animals in their pharmacopoeia.

One of the most prominent examples are toads form the genus *Bufo* used to treat erysipelas (infection with *Streptococcus* spp.). During the treatment the vivid toad is kept at the hind legs and is then swept over the infected area. It is said that during the application the toad takes up the heat of the ailment and later dies from it.

Toads have their skin impregnated with bactericidal compounds to protect their always humid surface from being infected (Habermehl 1987). It is very likely that during the treatment procedure the antimicrobial compounds containing dermal mucus of the toad gets in contact with the infected area and is responsible for subsequent curing. The application of toads against this kind of dermal infections can therefore be a treatment with an empirical pharmacological basis.

To dry fresh wounds, the spores of the fungal genera *Geastrum* and *Lycoperdon* (both Gastromycetes) are applied.

Scorpions macerated in alcohol are used to treat rheumatism while the fat of the iguana (*Iguana iguana*) is used to cure mumps. "Nang cuy" in Popoluca or "Aji" in Spanish refer to a ratite insect which is bred on *Spondias mombin* trees by some healers. This insect, belonging to the order of the Hemiptera (true bugs) is ground and the obtained cream is used to treat menstrual problems and dermal infections.

The carapace of the Armadillo is used to treat asthma, applicated in form of a decoction. A famous aphrodisiac utensil is the penis bone of the "tejón" (*Nasua narica*) a mammal of the Procyonidae family (order of the Carnivora). Finally, the nest of the hummingbird is used as an amulet in order to attract the attention of a lover.

8 Toxic plants

The assessment of the Popolucan pharmacopoeia according to published phytochemical data resulted in the identification of several plants which possess potential toxic properties and risks. The genus *Phytolacca* used by the Popoluca to treat erysipelas is known to contain mitogenic lectines (Frohne and Jensen 1998).

The Popolucan pharmacopoeia contains six *Aristolochia* species which applications are mostly indicated as an orally applied decoction used to treat stomach-ache, vomiting and snake bites. The systemic use of *Aristolochia* species, known to contain aristolochic acids is very problematic because of severe mutagenic and cancerogenic risks (Hänsel, Sticher and Steinegger 1999).

Especially the Fabaceae s.str. used by the Popoluca contain many toxic genera and species like *Canavalia* (lectines), *Ormosia* (quinolizidine alkaloids), *Erythrina* spp. (isoquinoline alkaloids), *Crotalaria sagittalis* (pyrrolizidine alkaloids). *Mucuna pruriens* seeds, containing L-DOPA and hallucinogenic tryptamines, are ground, toasted and used as a coffee surrogate which is typical for rural regions in Guatemala and Mexico (Buckles et al. 1998).

The main constituent of *Piper auritum* leaves used in the kitchen as a spice is the cancerogenic safrole and thus may constitute a health risk if consumed excessively.

The leaves of *Lantana camara* (Verbenaceae) known to contain the toxic triterpene acids lantadene A (hepatotoxic) and lantadene B (Seawright and Hrdlicka 1977) are used by the Popoluca in a decoction to treat cough.

The fruit pulp of the Bignoniaceaen species *Crescentia cujete* is sometimes indicated for the treatment of cough, haematoma and anemia although it contains cyanhydric acid and can produce severe diarrhoea and is suspected to be cancerogenic (Roth and Lindorf 2002).

The Crotonoideae are famous for their co-carcinogenic phorbol esters (Frohne and Jensen 1998). Only recently Murillo et al. (2001) have isolated a phorbol ester form the frequently used *Croton draco* while for the other four *Croton* species in use with the Popoluca no clear assertion regarding phorbol esters can be made. Bracken fern (*Pteridium aquilinum*), which leaves are occasionally indicated as a remedy against cough in form of a decoction is known to contain the carcinogenic glucoside ptaquiloside. Furthermore, it has been discovered by Alonso-Amelot (1996) that if the weed is eaten by grazing cattle the compound

is passed into milk. Bracken fern is widely distributed in the Sierra Santa Marta and to reduce health risks by intoxicated milk or its products bracken fern should be eliminated on pasture.
At least the use of *Aristolochia* species should be discouraged and the Mexican health authorities ought to launch appropriate programmes.

9 Folk taxonomic aspects

A first step in understanding the cultural perception of a culture's vegetal world can be achieved by understanding the naming and significance of plants (Bye 1993). Very often the plant names bear the endings *cuy* (tree) *ay* (leaf/herb) or, to a lesser extent *tsay* (vine) which distinguish the different life forms. An example of the Popolucan pharmacopoeia is *Cissampelos pareira* L. In Popolucan the plant is called "*Tyiñi woyo*" which means "round feces" and describes in a vivid way that the plant (root) is used to treat diarrhea.

Other examples of indigenous plant names which directly refer to a medicinal application are the *Masan ay* (leaves of erysipelas). There are several plants called *Masan ay* all of which are used to treat erysipelas: *Neea psychotrioides* (Nyctaginaceae), *Phytolacca rivinoides* and *Rivina humilis* (Phytolaccaceae), *Talinum paniculatum*, (Portulacaceae), *Hoffmannia nicotianifolia*, *Psychotria hebeclada* and *Psychotria nervosa* (Rubiaceae).

The number of lexemes (vocabulary unit) for folk generic names increases with the importance of a plant which means that plants with more significant utility have a higher tendency to be lexically diversified (Bye 1993).

Hamelia patens is an important medicinal plant with the Popoluca and has three designations which frequently are used: *Chochod'ay* (apparently a cognate), *Cang chocho* (meaning: chocho of the vagina, referring to the use in woman's medicine) and Cuma ay (referring to its application during the cooking of Cuma, which are the seeds of *Acrocomia mexicana* (Arecaceae).

In Popolucaan folk taxonomy all species of the genus *Piper* except *P. auritum* (*Aycuyo*) are called *Tooso* probably due to the fact that they are optically difficult to distinguish.

Plants which have restricted uses often bear names which refer to the world of the animals or gremlins. Examples are: *M¥a nanchiñ*; the nanchiñ (edible fruit of *Byrsonima crassifolia*) of the deer, or *Uuts tuj cuy*; the monkeys' rifle, or *Makti mooya*; the Gremlins' flower. In case of ginger (*Zingiber officinale*) they realte to the introduction via the Spaniards: *Kaxtxan ñiwi*; Castilian chilli.

Plants introduced by the Spaniards mostly retained their Spanish name although in a slightly aberrant form. Ninfa (*Catharanthus roseus*) became *Ninfax*, Mango (*Mangifera indica*) became *Manku* and Café (*Coffea arabica*) became *Capel*.

10 List of informants

List of healers, midwives and other informants who contributed their knowledge to this investigation. The age of the informants ranges between 22 and 85 years.

Municipality of Soteapan	
Benito Juarez	
- Don Apolinar	Herbalist, Soul-loss expert
- Celestino Hernandez Santiago	Herbalist, Sorcerer
- Marta Garcia Lopez	Midwife, Herbalist
- Don Rodolfo Ramirez Cruz	Herbalist
- Teofila Lopez Cruz	Midwife, Herbalist
Buena Vista	
- Aliberta	Midwife
- Chucho Gutierrez Cruz	Herbalist
- Don Cristobal Hernandez Garcia	Herbalist
- Erasmo Lopez Cruz	Herbalist, Soul-loss expert
- "Tacho" Anastasio Cervantes Ramirez	Snakebite specialist
La Estribera	
- Don Miguel Garcia Ramirez	Herbalist
- Sofia Nolasco Cruz	Midwife
- Benito Lopez Garcia	Herbalist
Mazumiapan chico	
-Don Donaciano Gutierrez Gutierrez	Informant
-Maria Aries Hernandez	Midwife
Ocotal Chico	
- Doña Fernanda	Midwife, Herbalist
- Mama de Emeterio	Informant
- Prumencio Gonzalez Santiago	Herbalist
Ocozotepec	
- Don Marcelino Cervantes Aries	Herbalist
- Don Paulino Ramirez	Herbalist, Soul-loss expert
- Don Teodulo Gutierrez Ramirez	Soul-loss expert, Herbalist
- Doña Teofila	Midwife
San Fernando	
- Agripina Mateo Marquez	Midwife
- Don Bartolo Ramirez Rodriguez	Herbalist
- Don Simon Dominguez	Herbalist
- Doña 'Incognita'	Herbalist
- Doña Rosalia	Midwife
- Emiliano	Herbalist
- Fermín	Herbalist
- Lucio Marquez Cruz	Herbalist
- Ramon(a)	Herbalist
San Pedro Soteapan	
"La Abuelita"	Midwife
Asunción (Chong)	Informant
Baldomero Santiago Pascual	Herbalist
Carlos Sagrero Cervantes	Informant
Comandate municipal	Snake-bite specialist
Cristina Rodriguez Arismedi	Soul-loss expert, midwife

Don Esteban Ramirez	Herbalist
Doña Adelaida Arismendi	Midwife
Doña Apolonia	Soul-loss expert
Doña Modesta Pascual Perez	Midwife
Doña Pascuala Ramirez Marquez	Herbalist
Eloio	Herbalist, Sorcerer
Eulojia Hernandez Ramirez	Midwife, Herbalist
Feliciano Hernandez Hernandez	Informant
Gabino Juarez	Herbalist
Igiño	Herbalist
Melecio Hernandez Ramirez	Herbalist
Octavia Marquez	Midwife, Herbalist
Pedro Gonzalez	Informant
Pedro Hernandez	Herbalist
Pedro Marquez	Herbalist, Sorcerer
Quirino y familia	Herbalist
Teofilo	Herbalist
Municipality of Hueyapan de Ocampo	
Santa Rosa Loma Larga	
Andres	Informant
Crescencio Cruz Gutierrez	Herbalist
Don Cipiriano (Cipi)	Herbalist
Don Enrique Lazaro	Herbalist
Don Inez Lazaro	Herbalist
Don Leopoldo Martinez Lazaro	Herbalist
Doña Marcelina Pascual Lopez	Herbalist
Doña Mariquita (Maria Garcia)	Midwife, Herbalist
Epitacia Lopez Pascual	Midwife, Herbalist
Gabino Cruz Hernandez	Snakebite specialist, Herbalist
Hermenegilda Pascual Martinez	Midwife, Herbalist
Maria Dolores Gutierrez Garcia	Herbalist
Marina	Midwife, Herbalist
Sixto Pascual Martinez	Herbalist
Teresa Reyes Martinez	Midwife, Herbalist
Sabaneta	
Alejandro Pascual Ramirez	Informant
Mujer de Mauricio	Midwife
Samaria	
Chano Cruz	Herbalist, Snakebite specialist
Loma del Tigre	
Clemente Hernandez Lopez	Herbalist, Snakebite specialist

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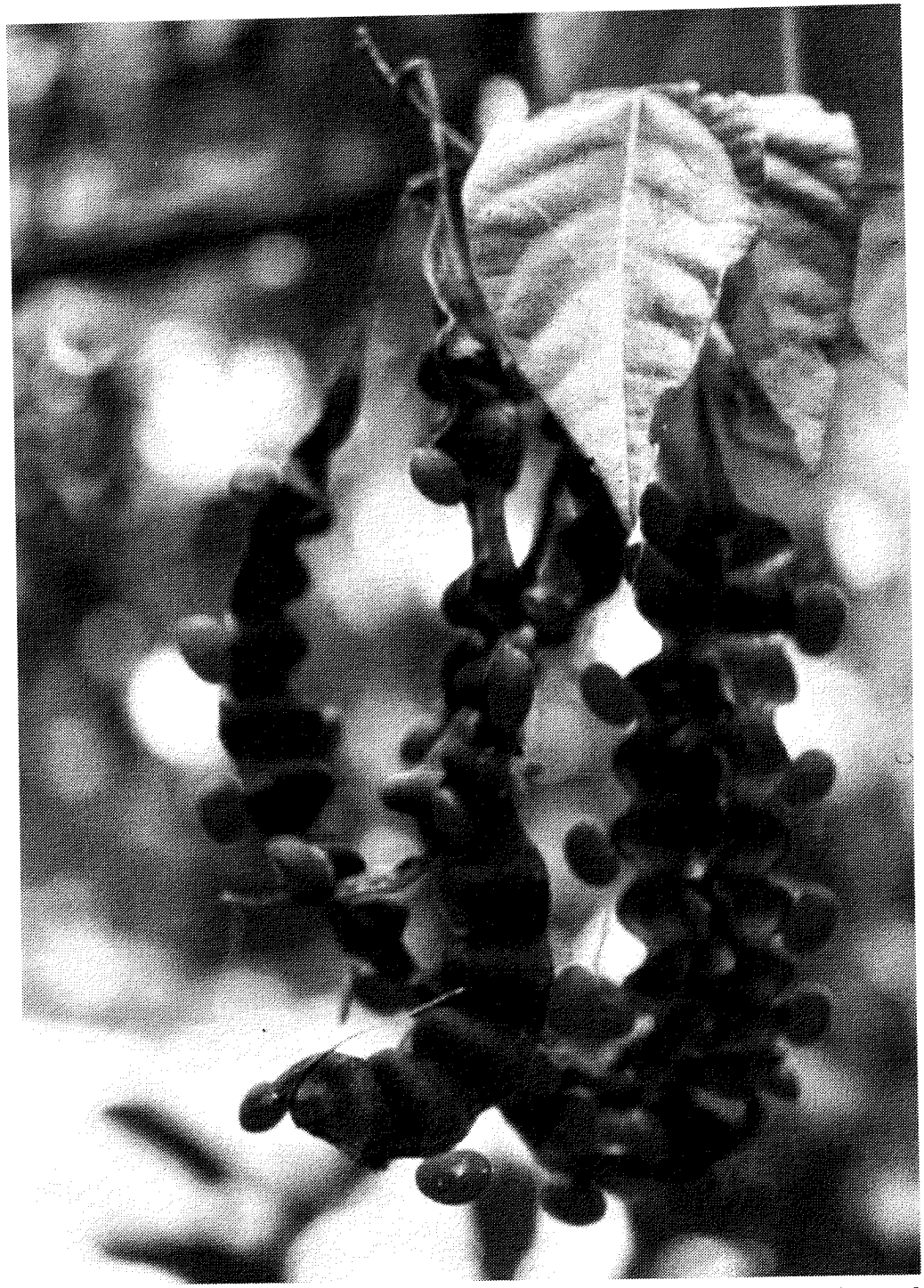

Figure 20. *Seeds of* Erythrina americana, *(n¥tung tsen tsen) are used in form of amulets for good luck.*

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Ethnopharmacology of the Popoluca, Mexico: An Evaluation

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Abstract

Medicinal plants are an essential part of indigenous pharmaceutical systems. We studied the medicinal plants used by the Popoluca of the Sierra Santa Marta (Eastern Mexico). The study is part of a series on the ethnopharmacology of various Macro-Mayan groups. During 16 months of ethnobotanical fieldwork 614 taxa used medicinally and 4488 individual use-reports were documented. The data are analysed using the concept of the "healers' consensus" in order to identify culturally important medicinal plants. The medicinal uses of the plants were grouped into 13 illness categories. The responses for each species were summarized for each of the categories, and were ordered by frequency of mention. The most frequently recorded medicinal plants of the Popoluca are *Hamelia patens*, used to stop bleeding from wounds, and *Byrsonima crassifolia*, used against diarrhoea. The high-ranked medicinal species were assessed pharmacognostically using published phytochemical and pharmacological data.

Popoluca medicinal uses were fairly consistent with published data on active ingredients, for those plants for which such data exist. However, data is still lacking for many other species. Toxicological studies are particularly scarce. This study will be used as a basis for subsequent studies on the pharmacology and phytochemistry of medicinal plant species.

Resumen

Plantas medicinales son una parte integral de sistemas farmacéuticos indígenas. Nosotros estudiamos las plantas medicinales usadas por los Popoluca en el oriente de México. Este grupo habla un idioma Macro-Maya y vive en las laderas meridionales y occidentales del la Sierra Santa Marta, una cadena de volcanes cerca de la costa del Golfo de México. El estudio forma parte de una serie de investigaciones sobre la etnofarmacología de varios grupos de Mayas. Esta cultura está cambiando rápidamente, como muchas otras culturas indígenas.

El estudio se llevó a cabo de Marzo de 1999 a Julio de 2000. Documentamos 614 especies de plantas medicinales y 4488 reportes individuales de usos. Se analizan los datos utilizando el concepto de "consenso de curanderos" para identificar aquellas plantas medicinales con importancia cultural. Los usos medicinales de las plantas se agruparon en 13 categorías de enfermedades. El número de reportes por especie y categoría se resumieron, y se ordenaron por frecuencia de mención. Las especies medicinales más mencionadas por los Popoluca fueron *Hamelia patens*, usada para frenar el sangrado de heridas, y *Byrsonima crassifolia*, usada contra la diarrea. Se evalúan las especies más mencionadas a través de información publicada sobre la fitoquímica y la farmacología.

Los usos medicinales de los Popoluca eran razonablemente consistentes con los datos publicados sobre los ingredientes activos, para aquellas especies que cuentan con datos publicados. Pero todavía faltan datos para numerosos taxa. Estudios toxicológicos son especialmente escasos. Este estudio será la base para estudios posteriores sobre la farmacología y la fitoquímica de las especies usadas como remedio por los Popoluca.

Introduction

Natural product research is often based on ethnobotanical information and many of the drugs used today were developed from medicinal plants used in indigenous societies. Even more importantly, the study of these resources in order to contribute to better health care in marginalized areas is becoming a central task of modern ethnopharmacological research (Heinrich 2000, Heinrich and Gibbons 2001). While it is generally assumed that medicinal plants used in indigenous cultures have beneficial health effects, little empirical evidence is available which corroborates this idea. One of the first of these attempts focused on Aztec medicinal plants and showed that a large proportion of the plants used in this historic culture had the effects the Aztecs ascribed to them (Ortiz de Montellano 1975). Our own group has contributed to this field through several studies on Mexican and Tanzanian cultures (e.g. Ankli et al 1999, Heinrich et al 1998, Schlage et al 1999). A major part of the ethnopharmaceutical research in recent years has been directed towards a better understanding of the pharmacological effects of individual medicinal plants. Phytochemical studies on medicinal plants are relatively abundant. This study focuses on the medicinal plant usage by one Mexican Indian group - its "ethnopharmacopoeia". Also in view of the rapid change, which indigenous cultures all over the world are undergoing, the documentation of this knowledge and its detailed ethnopharmaceutical study is urgent.

The diversity of medicinal plants is very high in a country like Mexico, in which more than 50 indigenous languages are spoken and which is very well known for its biological diversity (Challenger 1998). There are about 30.000 species of higher plants in the country (Toledo and Ordóñez 1993, cited in Challenger 1998). Each region has different local plant resources and from these a basic group of phytotherapeutics is selected (Aguilar et al 1994, Argueta et al 1994, Heinrich et al 1998). The gathering and use of *local* resources is still an important aspect of the phytotherapeutic traditions in many regions of Mexico.

Recently we have developed a method, which allows a stratification of indigenous uses of (medicinal) plants and a comparison of these data on a cross-cultural basis (Heinrich et al 1998, Ankli et al 1999). The number of use-reports, i.e. the number of times a species is reported for a certain use by healers in the community, serves as an estimation of a specie's ethnobotanical importance.

In this study we report on the medicinal plants used by the Popoluca (also called NuntajÏy) in the southern part of the Mexican state of Veracruz. The ethnobotany of this group was of particular interest for us, as we had previously studied the medicinal plant use of the Mixe (or Ayuk), a linguistically closely related group in the subtropical lowlands of the state of Oaxaca. Both groups inhabit regions in the humid part of the "Istmo de Tehuantepec" and the adjoining low altitude foothills of the mountain ranges of southern and central Mexico. We document and analyse the use of important medicinal plants of the Popoluca. Published phytochemical and pharmacological data are used to evaluate the plants. Also, we look at the Popoluca's rationale for using these plants.

Background and Methods

General ethnobotanical background

The Popoluca live on the southern and western slopes of the Sierra Santa Marta, a range of volcanoes between the Lake of Catemaco and the gulf shore. These volcanoes form the southern foothills of the "Sierra de Los Tuxtlas" mountain range, a region particularly well known for its biodiversity because the holarctic and neotropical floristic kingdoms overlap here. In a recently published list (Ramirez 1999), 2.700 species were recorded, but there are probably at least 3.000 species growing in the Sierra (Chevalier and Buckles 1995 and references therein).

The study area of about 1350 km^2 lies at altitudes between 0 to 1720 m above sea level. The influence of the more humid climate of the Mexican gulf is particularly noteworthy on the northeastern side of the mountains. Important vegetation zones include the tropical montane cloud forest, the tropical rain forest and a semi-dry oak forest. The latter region was selected by the Popoluca for constructing their settlements.

According to Foster (1969), the Popoluca were (and still are) one of the least studied ethnic groups of Mexico. The word Popoluca is an Aztec defamatory term for barbarians (those who speak gibberish), but the name is now commonly used to designate this ethnic group. The language is closely related to Mixe (previously studied ethnobotanically by Heinrich 1989) and Zoque and belongs to the Macro-Mayan stock. Other dialects of Popoluca were formerly

spoken in the Isthmus of Tehuantepec around Acayucan. The northern part of the Isthmus of Tehuantepec also was the home of the Olmecs (1500-300 BC) one of the first cultures in Mesoamerica, which has left permanent monuments and artefacts, and influenced many of the subsequent cultures in Mesoamerica (Báez-Jorge 1973).
About 30.000 Popoluca live in the Sierra de Santa Marta, which is also inhabited by Nahua as well as Zapotec and Mestizo immigrants. The cultural centre is San Pedro Soteapan (Attebet), founded before the conquest, which today has approximately 4.000 inhabitants. Despite the growing influence of the western civilization the Sierra Popoluca still retain many aspects of their traditional way of life. In most families Popoluca is the first or only language. In school, children are educated bilingually, and Mexican government institutions have programmes to encourage the continuous use of the native language.
The economic basis of the Popoluca is the production of maize for subsistence and of coffee as a cash crop. Since land is scarce, young men migrate to the Mexican economic centres to work as day labourers in industry and agriculture or in the military.

Health and healing

The illness profile is typical for such a poor rural area in the tropics. Gastrointestinal illnesses are particularly frequent (especially diarrhoea and dysentery), as well as infectious and inflammatory afflictions of the skin. The dermatological complaints are usually not life-threatening, but diarrhoea still is a cause of death, especially among children. Amoebiasis provoked by *Entamoeba histolytica* is endemic. Fever caused by infections of all kind is frequent. According to the local governmental health-care institution "Secretaría de Salud y Asistencia" (SSA), the last cases of malaria and dengue, which are transmitted by mosquitoes, were recorded in 1996. Snakebites were a frequent life-threatening problem, but the number of cases has dropped in recent years, because of the intensifying agricultural practises. Also, snakebites are now better controlled by antisera. Diabetes type II is becoming a serious health problem of the indigenous population. A diet low in fibre and rich in simple carbohydrates, and generally insufficient nutrition, are the main causes.
Western forms of medical treatment (biomedicine) are provided by

The specialists in traditional medicine were asked first about their experiences as healers and about themselves. Next, during an excursion to the surroundings, mostly fields, the specialist showed the plants he knew and used for his pharmaceutical preparations. It was left to the informant to choose the itinerary because he knew best where to find the plants he was willing to show. Subsequently, in a more structured interview, the specialist was asked about the use(s), preparation, application of the plants gathered, as well as about his concepts about healing. The Popoluca words were transcribed according Hernández-Cruz (1994 and 1995) and the "Diccionario Popoluca de la Sierra Veracruz" (Elson and Gutiérrez 1999).

Our database consists of 4488 use-reports on 614 plant species, contributed by 72 informants. These include 27 women and 45 men aged between 22 and 85. Herbalists (curanderos, hierbateros, Tsoy¥yk¥win), midwives (parteras), experts of the skeleto-muscular system (hueseros), soul-loss experts (ensalmadores) and snakebite specialists (culebreros) were the seven groups of informants. However, the borders between these different groups were fluent. About 50 informants were interviewed at least twice. If required additional interviews were conducted in order to assure that all relevant information from the respective healer was obtained.

In order to analyse the cultural importance of an individual species and for a later cross-cultural comparison the reports obtained were separated into 13 categories of use, grouping the illnesses into relatively well-defined ethnomedical categories (Table 1). The number of use-reports for every species in such a category were ordered in a ranked list, showing species with the largest number of positive responses at the top (cf. Tables 2 - 11). A species may be listed in more than one category and for the same number of positive responses the species are arranged alphabetically first by family, second by genus.

- The SSA ("Secretaría de Salud y Asistencia") and the IMSS ("Instituto Mexicano del Seguro Social"), two governmental health-care institutions which provide free treatment and medication in Soteapan and in outlying communities, respectively.
- Private medical doctors in the cities of Acayucan, Minatitlan and Coatzacoalcos, which can be reached by a bus ride of more than two hours are relatively expensive by local standards.
- Small grocery stores, which give "advice" on the use of pharmaceuticals and sell these in small quantities (usually as individual tablets).

MEXFAM, a governmental institution that promotes reproductive health, collaborates with local midwives, and gives advice on family planning. The midwives prescribe birth control pills at low cost.

Herbal treatment is of major importance, due to the unreliability in the supply of pharmaceuticals and its high costs compared with local earnings. Local pharmaceutical practise uses both empirical and symbolic forms of treatment. Symbolic forms of treatment are beyond the scope of this paper. They include praying to the various saints and traditional deities, as well as ritual cleansing ceremonies called "limpias". Healers are consulted if the illness is perceived to be untreatable by the SSA, if the centre of the SSA is closed or if no medicine is available through it. Many Popoluca also distrust the SSA because of previous experiences and prefer the treatment offered by the Popoluca healers.

The type of treatment a patient seeks depends on his/her cultural self-identification, the social and economic conditions, education, and the kind of ailment. According to the Popoluca, illness may have different causes. For example, inter-familiar tensions, strained relations in general and incurring the displeasure of the "Chanecos" (dwarf-like kings of nature dwelling inside the mountains) may bring disease into the family. Disregarding the social and cultural norms of behaviour may cause this displeasure. The disease does not need to hit the guilty person. For example, if parents have strong arguments, the illness will most likely hit their "weaker" children.

"Espanto" or fright is an illness associated with soul-loss and still commonly diagnosed by Popoluca healers. According to Foster (1951) "a sudden shock, an unexpected encounter with supernatural beings, a fall, or ... fear of death from purely natural causes" can cause espanto. Again the "Chanecos" are thought to be the responsible agents by provoking these accidents and then capturing a part of the victims' soul and keeping it locked up.

Witchcraft, too, plays an important role in the cultural consciousness and is thought to be a cause of chronic illnesses. Brujos (witches) are thought to be instructed by an envious person to "inject" objects into a person's body and the person consequently falls ill. Thermal dichotomy (hot / cold) plays a role in the dietary customs and in medicine. The medicine must have opposing thermal properties. During the dry period diarrhoea and dysentery are more frequent, as the cysts of the causative organisms are transported onto food with dust. Thus it is considered to be a hot disease, which in turn needs cold medicine. Being surprised by a sudden cloudburst while working in the milpa may be a reason for getting skeleto-muscular rheumatic pains. Lightning are considered to cause heating of the body. This diagnosis is frequently made during the rainy season in many cases where fever (perceived as a "hot disease") is the main symptom. After parturition women are not allowed to eat cold foods such as pork meat, iguana and molluscs. The same products are said to be possible agents to provoke congestion of the stomach.

Methods

The data presented in this paper were collected in the sub-districts (municipios) of Soteapan and Hueyapan de Ocampo in southern Veracruz from March 1999 to July 2000. Fieldwork was conducted during 16 months and focused on collecting information on the medicinal plant use and general ethnographical (background) data as well as on the preparation of dried herbarium specimens and the collection of samples for further analysis. The research was conducted with the permit No. DOO. 02.-1750 obtained from the Instituto Nacional de Ecología, Secretaría de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP). Complete sets of voucher specimens (Leonti 1-599) were deposited at the National Mexican Herbarium MEXU (UNAM, México, D.F.), the Herbarium-Hortorium of the Colegio de Postgraduados de Chapingo CHAPA (Texcoco), IMSS-M (Instituto Mexicano del Seguro Social, México, D.F.), Instituto de Ecología (Xalapa), the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, Univ. London and the ETH Zurich (CH). Identification was largely conducted at MEXU and the Colegio de Postgraduados de Chapingo, in many cases with the help of specialists from these institutions.

Table 1. Quantitative ethnobotanical analysis of the 13 groups of medical uses

Group of medical use	**F_{ic}**	**Ur[1]**	**%Use-reports**	**Taxa[2]**	**%Taxa**	**%leaf/aerial part**	**%root/tuber**	**%bark**
Diseases of the skin	0.69	973	21.7	303	49.3	70.4	4.7	14.7
Gastrointestinal disorders	0.70	830	18.5	251	40.9	32.7	27.7	26.3
Gynaecology	0.62	566	12.6	218	35.5	21.7	16.6	32.6
Fever and headache	0.71	381	8.5	112	18.2	84.0	4.7	4.4
Urological problems	0.55	345	7.7	157	25.6	34.4	34.7	20.1
Venomous animals	0.54	260	5.8	121	19.7	51.5	17.1	22.7
Culture bound syndromes	0.47	240	5.4	127	20.7	62.6	2.3	7.9
Respiratory complaints	0.64	219	4.9	79	12.9	52.5	8.4	8.8
Skeleto-muscular disorders	0.52	211	4.7	101	16.4	61.5	12.7	23.5
Problems of the ear	0.54	71	1.6	33	5.4	91.5	1.4	0
Problems of the eye	0.45	53	1.2	29	4.7	42.0	4.0	0
Toothache	0.40	53	1.2	32	5.2	20.8	30.2	7.5
Others	n.a.	286	6.4	150	24.4	n.a.	n.a.	n.a.

[1]total 4488 use-reports, [2]total 614 taxa, F_{ic} = Factor of Informant Consensus, n.a. – not applicable, $\%Ur_{tot.}$ = Percentage of use-reports contributed to the total amount of use-reports by the respective illness category, Taxa = Total amount of plant species contributing to the use-reports of the respective illness category, %Taxa = Percentage of the plant species reported for an illness category in respect to the total amount of reported plants species, %leaf/aerial part = Percentage of use-reports for the respective illness category which indicate leaves or aerial parts, %root/tuber = Percentage of use-reports for the respective illness category which indicate roots or tubers, %bark = Percentage of use-reports for the respective illness category which indicate barks.

Table 2. Diseases of the skin

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Hamelia patens Jacq.	Rubiaceae	Leaf	Bleeding wounds	32	(3.3)	Chochoday / Cuma ay / Cangchocho	Coyolillo
Croton draco Schltdl.	Euphorbiaceae	Latex	Oral infection, dermal infection	26	(2.7)	N¥pin cuy	Sangregado
Tithonia diversifolia (Hemsl.) A. Gray	Asteraceae	Leaf	Scabies, wounds	24	(2.5)	Tam chich	Arnica
Solanum sp. *(S. rudepannum* Dunal / *S. torvum* Sw.*)*	Solanaceae	Leaf	Wounds, haemorrhoids	18	(1.8)	Muutsei cuy	Berenjena
Senna pendula (Humb. et Bonpl. ex Willd.) H. S. Irwin et Barneby	Caesalpiniaceae	Leaf	Erysipelas, abscess	17	(1.7)	M¥k stogay	
Heliocarpus americanus L.	Tiliaceae	Bark	Abscess, wounds	15	(1.5)	Panats	Jonote
Momordica charantia L.	Cucurbitaceae	Leaf	Scabies, pustules	14	(1.4)	Kundiamor	Cundiamor
Piper sp.	Piperaceae	Leaf	Infected wounds, gangrene, erysipelas	14	(1.4)	Tooso	
Psychotria hebeclada DC.	Rubiaceae	Leaf	Erysipelas	14	(1.4)	Masan ay	Hoja morada
Jatropha curcas L.	Euphorbiaceae	Sap	Oral infection	12	(1.2)	Cuyukum	Piñon
Phytolacca rivinoides Kunth & C. D. Bouché	Phytolaccaceae	Leaf	Erysipelas	12	(1.2)	Masan ay	
Citrus limon (L.) Burm. f.	Rutaceae	Leaf	Erysipelas	11	(1.1)	Apitx cuy	Limón
Aloe sp.	Liliaceae	Leaf	Erysipelas	11	(1.1)		Sabila
Maytenus belizensis Standl.	Celastraceae	Bark	Wounds	10	(1.0)	Niui cuy	Retamo
Rivina humilis L.	Phytolaccaceae	Leaf	Erysipelas	10	(1.0)	Masan ay	
Inga punctata Willd.	Mimosaceae	Bark	Infected wounds	9	(0.9)	Inki	Acotope,Vainilla

Table 2. (continued)

Lippia dulcis Trevir.	Verbenaceae	Leaf	Gingivitis	9	(0.9)	Cana ay	Hierba dulce
Loxothysanus sinuatus (Less.) B. L. Rob.	Asteraceae	Leaf	Mycosis	9	(0.9)	W¥y¥ ay	
Dorstenia contrajerva L.	Moraceae	Leaf	Dermal infection	9	(0.9)	Nak ay	Cresta de gallo
Piper amalago L.	Piperaceae	Leaf	Infected wounds, gangrene, erysipelas	9	(0.9)	Tooso	
Calea ternifolia Kunth = *zacatechichi* Schltdl.	Asteraceae	Leaf	Scabies, dermal infection	8	(0.8)	Tam juñi	Jaral
Buddleia americana L.	Loganiaceae	Leaf	Dermal infection	8	(0.8)	Xiapun ay	Teposan
Psychotria panamensis Standl.	Rubiaceae	Leaf	Abscess	8	(0.8)	Tsus pitx cuy	
Pinus oocarpa Schiede ex Schltdl.	Pinaceae	Resin	Wounds	7	(0.7)	Tyiñcuy	Ocote
Cordia spinescens L.	Boraginaceae	Leaf	Erysipelas	7	(0.7)	Y¥k yom tsay	Vara negra
Cecropia obtusifolia Bertol.	Cecropiaceae	Leaf	White spots	7	(0.7)	Mats	Chancarro
Byrsonima crassifolia (L.) Kunth	Malpighiaceae	Bark	Wounds	7	(0.7)	Nanchiñ	Nanchi
Gouania polygama (Jacq.) Urb.	Rhamnaceae	Leaf	Dermal infection	7	(0.7)	Xiapun tsay	Jaboncillo
Vitis tiliifolia Humb. et Bonpl. Ex Roem. Et Schult.	Vitaceae	Leaf	Dermal infection	7	(0.7)	Y¥k ty¥m tsay	Agras
Philodendron hederaceum (Jacq.) Schott	Araceae	Juice	Erysipelas	7	(0.7)	Pasmuj ay	
Odontonema callistachyum (Schltdl. Et Cham.) Kuntze	Acanthaceae	Leaf	Erysipelas, abscess	6	(0.6)	Naktam ay	
Tabernaemontana alba Mill.	Apocynaceae	Latex	Warts	6	(0.6)	Naa cuy	Huevo de venado
Heliotropium indicum L.	Boraginaceae	Leaf	Dermal infection	6	(0.6)	Tunok kiñi	Cola de alacrán
Senna multijuga subsp. *Doylei* (Britton et Rose) H. S. Irwin et Barneby	Caesalpiniaceae	Bark	Wounds	6	(0.6)	Uaxiñ	Palo santiago

Table 2. (continued)

Baccharis trinervis Pers.	Asteraceae	Leaf	Dermal infection, wounds	6	(0.6)	Tsay mayorga	
Calea longipedicellata B. L. Rob. et Greenm.	Asteraceae	Leaf	Dermal infection	6	(0.6)	Añi mutx ay	
Conyza sp. (*C. bonariensis* (L.) Cronquist / *C. canadensis* (L.) Cronquist)	Asteraceae	Leaf	Dermal infection	6	(0.6)	Jok poy	
Diospyros digyna Jacq.	Ebenaceae	Bark	Mycosis	6	(0.6)	Nuu	Zapote negro
Chaetocalyx brasiliensis (Vogel) Benth.	Fabaceae	Leaf	Abscess	6	(0.6)	M¥kstogay tsay	
Miconia albicans (Sw.) Triana	Melastomataceae	Leaf	Gingivitis, oral infection	6	(0.6)	Pak tesua	
Cedrela odorata L.	Meliaceae	Bark	Infected wounds	6	(0.6)	Acuy	Cedro
Bocconia frutescens L.	Papaveraceae	Leaf	Scabies, lice, pustules, mycosis	6	(0.6)		Llora sangre
Pothomorphe umbellata (L.) Miq.	Piperaceae	Leaf	Dermal infection, infected wounds	6	(0.6)	Aycuyo cimarrón	Bella dona
Psychotria tenuifolia Sw.	Rubiaceae	Root	Infected wounds	6	(0.6)	Tam txix¥k	Simonillo
Pouteria sapota (Jacq.) H. E. Moore et Stearn	Sapotaceae	Seed	Dermal infection	6	(0.6)	Kuxamñi	Mamey
Solanum nigrum L.	Solanaceae	Leaf	Erysipelas	6	(0.6)	Ts¥p¥	
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	Leaf	Dermal infection	6	(0.6)	Chi tiuts	Verbena
Xanthosoma robustum Schott	Araceae	Leaf	Dermal infection	6	(0.6)	Pix ay	
Lasiacis ruscifolia (Kunth) Hitchc.	Poaceae	Leaf	Dermal infection	6	(0.6)	K¥kujuki ay	Carisso

Total number of species is 303; total use-reports is 973. The species listed represent 49% of all reported uses in this category. P.p.u. = Plant part used, Ur = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

A more detailed analysis of the published phytochemical and pharmacological information was conducted for species with more than 15 use-reports, the only exceptions being "fever and headache" and the smallest groups: "fractures, bruises, general body pain and rheumatic disorders" as well as problems of the ear, eye and toothache for which a lower number had to be chosen. This selection was required in order to concentrate the analysis on the ethnopharmaceutically important species. In order to get data on published phytochemical and pharmacological information on the species literature searches were performed using the databases Medline, Chemical Abstracts, Biological Abstracts, EMBASE: Drugs and Pharmacology and Current contents / Life sciences. Plants of European origin, which are well studied, are not discussed (see Table 4) since such information can be found in readily available textbooks (Haensel, Sticher and Steinegger 1999).

The consistency of the use-reports within a category can be evaluated numerically using the Factor of Informant Consensus F_{ic} (see Trotter and Logan 1986). It gives the relationship between the "number of use-reports in each category (n_{ur}) minus the number of taxa used (n_t)" and the "number of use-reports in each category minus 1". Thus, the F_{ic} is determined as follows:

$$\mathbf{F_{ic} = (n_{ur} - n_t)/(n_{ur} - 1)}$$

A value close to 1 indicates a high intra-cultural consensus (most healers use the same species for the same illnesses; Heinrich et al 1998). A value near zero indicates a high variation in the use of species. Plant selection thus may be more at random, as no plant is very effective, or there is little intra-cultural exchange of medical plant knowledge.

Results and Discussion

Different disease groups show different levels of cultural consensus, diverse healing strategies as well as different preferences for the plant parts used. F_{ic} was highest (0.71) in the category of fever and headache. This is contrary to the results of previous studies with other ethnic groups, where gastrointestinal illnesses generally had the highest F_{ic}. 18% of all species and 8.5% of all use-reports are included in this category. As in the previous studies diseases of the skin (0.69) and gastrointestinal disorders (0.70) showed a high F_{ic} as well.

Culture bound syndromes (0.47); problems of the eye (0.47) and toothache (0.40) have relatively low values of F_{ic} (see Table 1).
Leaves and aerial parts are the plant parts used most commonly, followed by bark, root / tuber and the seed. Latex, plant saps, fruits and flowers are less frequently used. Leaves and aerial parts are the parts most frequently used (77%) in categories of illnesses where topical applications are frequent (dermatological diseases, fever and headache). In illness categories that are usually treated with ingested preparations (gastrointestinal disorders, gynaecology and urological complaints) bark and root drugs are more common (52.4%), while leaf and aerial parts account for only 34% of the reports (see Table 1). In the following the individual indigenous groups of use are discussed.

Diseases of the skin

In the hot and humid lowlands of Mexico infectious and inflammatory diseases of the skin, caused by bacteria and fungi, are frequent. Erysipelas (infections with *Streptococcus* spp.) and infections of wounds caused by accidents while cultivating the milpa (maize field) are particularly important. Scabies is very common, due to the low quality of the water. Half of all recorded medicinal species (49%) are used to treat dermatological disorders, and about one fifth (981) of the use-reports fall into this group (Table 2). The ethnobotanical importance of this group has already been documented with other indigenous groups and Fic is relatively high (0.69). Dermatological complaints are treated topically with a washing, cataplasm or dried plant powder. Contrary to previous studies, the Popoluca have a well-defined set of three plants, which are used widely for specific illnesses in the group "diseases of the skin". For example, fresh leaf sap from *Hamelia patens* is applied to stop the bleeding of a wound. The closing of the wound is accelerated by dried leaf powder of *Solanum torvum* / *S. rudepannum* or the slimy bark extract of *Heliocarpus* species.
Hamelia patens is a species widely distributed in the neotropics. It is noteworthy that this rubiaceous species is one of the most important medicinal taxa of the Popoluca, while, for example, the Mixe do not use it. As pointed out by Moerman et al (1999), the Rubiaceae are unusual, as some ethnic groups use them frequently, while others hardly ever employ species of this family as a

medicine. It remains to be elucidated why this is the case. Antibacterial activity from *Hamelia patens* was reported by Jimenez Misas et al (1979). The aerial parts contain flavanone glycosides, narirutin and rosmarinic acid (Aquino et al 1990, Mahmood et al 1993). Furthermore, the alkaloids isopteropodine (Ripperger 1977) and ephedrine (Chaudhuri and Thakur 1991) were isolated.

Little published information is available on *Croton draco* with respect to its usage for oral and dermal infections. However, an American phytopharmaceutical company studied it in detail but its development was stopped some years ago. Hernandez and Delgado (1992) reported sitosterol, stigmasterol, a mixture of polyprenols and a previously isolated clerodane-type diterpene.

Tithonia diversifolia is a now pan-tropically distributed noxious weed, which is relatively well studied phytochemically and pharmacologically. The use of this species for scabies and for washing wounds can presumably be explained by the presence of sesquiterpene lactones, which are potent inhibitors of the transcription factor NF-KappaB (Bork et al 1997) and have antibacterial effects.

The leaves of *Solanum torvum* contain the sapogenins chlorogenine and neochlorogenine (Doepke et al 1975) while the extract has antibacterial activity against gram-negative and gram-positive species (Ajaiyeoba 1998). The ethanolic crude extract of the leaves of the closely related *Solanum diflorum* showed strong inhibitory activity on NF-KappaB activation in EMSA shift experiments at 100 μg/ml. Phaeophorbide A isolated from this species showed a dose dependent inhibitory effect and inhibited the PMA induced activation of NF-KappaB down to a concentration of 2μg/ml (Heinrich et al 2001). The physiological relevance of this data remains to be ascertained.

Ground leaves of *Senna pendula* are used for treating abscesses. The bark of *Heliocarpus americanus* is used by both the Mixe and the Popoluca for treating wounds. There are no studies on the phytochemistry of these two species but it seems likely that with *H. americanus* the large amount of polysaccharides present contribute to the effect.

Gastrointestinal disorders

Diarrhoea, dysentery, vomiting and stomach-ache are treated systemically with infusions, but flatulence is treated topically. The remedy for diarrhoea and dysentery is almost always astringent (bark and root), with the exception of *Cissampelos pareira* root, which is bitter. Stomach-ache and vomiting, however, are treated with aromatic and bitter herbs. 41% of all species contribute to the use-reports of this group, which accounts for 18.5% of all reports and consequently has a relatively high F_{ic} (0.70) (Table 3).

The bark of *Byrsonima crassifolia* is commonly used in the treatment of diarrhoea. It is widely used for this purpose in Mexico and is rich in tannins, as are many other species used in Mexico for this purpose (Heinrich 1998). Tannins of the proanthocyanidin type were reported by Geiss et al (1995). However, some of the compounds reported were also shown to have *in vitro* spasmogenic activity (Bejar and Malone 1993). The extract possesses antibacterial activity against *Staphylococcus* spp., *Salmonella typhi* and other pathogenic bacteria (Martinez-Vazquez et al 1999).

Annona reticulata is not discussed here since the leaves are generally used externally in massages for "ventazon" (flatulence). *Cissampelos pareira* is rich in cytotoxic benzylisoquinoline alkaloids and exhibits antispasmodic action (Morita et al 1993). *Teloxys ambrosioides* is another well-known and widely used Mexican medicinal plant also used as a spice. Its main use with the Popoluca is for "expelling intestinal worms" (especially *Ascaris* spp.). The species has well documented, but relatively weak ascaricidal properties. Its usage has been under discussion for some years because of alleged side effects (Hegnauer 1964). The high essential oil content in *Tagetes lucida* (aerial parts) is characterized by estragole, methyleugenol and anethole (Bicchi et al 1997). The coumarine- and flavonoid-rich aqueous extract has an inhibitory effect on smooth muscle tissue *in vitro* (Jayme et al 1998). This effect, and the essential oil, could be the basis for the therapy against stomach-ache. This therapy could well be a safe and very appropriate one. Further research on the species' pharmacological properties and its active constituents would be very important. Six *Aristolochia* species are used against stomach-ache and colics. The systemic use of *Aristolochia* species, known to contain aristolochic acids is a very problematic one because of severe toxicological risks. Its reduction products are highly mutagenic and cancerogenic (Haensel, Sticher and Steinegger 1999). The use of these species should be discouraged and the

Mexican health authorities ought to launch appropriate programmes. The analgesic and spasmolytic effect could be due to the essential oil (Waller et al 1990, Sagrero-Nieves et al 1994). The root of *Waltheria indica* is employed for diarrhoea with "moco" (white mucus) but no phytochemical or pharmacological information on the root is available.

Gynaecology

Thirty-six percent (218) of all species and 13% (566) of all use-reports relate to women's medicine, showing a moderate F_{ic} of 0.62 (Table 4). The preparations are taken as infusions against menstrual complaints and haemorrhage, for accelerating parturition and as an anti-conceptive. Anti-abortion medicine is taken as a tea and applied topically as a cataplasm. After delivery the woman takes a hot hipbath in order to calm down the inflammation. The mixtures used as a tea for regulating the menstrual cycle always contain red coloured plant parts. If the uterus is inflamed or dislocated a hipbath in a decoction of astringent barks is considered appropriate. Two of the most widely used species (*Matricaria recutita* and *Rosmarinus officinalis*) are of European origin and are well known phytochemically. Both are generally considered to be safe.
Seeds and bark of *Ormosia isthmensis* are used for menstrual problems and as an anti-fertility agent. The genus is known to be rich in quinolizidine alkaloids and both sparteine and lupanine have been reported from its seeds (Ricker et al 1999). Sparteine is cardioactive and has oxytocic effects causing a moderate increase in the tone and strength of the uterus contraction (Bruneton 1999), which may explains its use as an antifertility agent. The juice of fresh leaves of *Tradescantia spathacea* showed *in vitro* a stimulant activity on mouse uterine tissue (Weniger et al 1982), which may have some bearing on the Popoluca's use in the treatment of menstrual cramps and haemorrhage.

Table 3. Gastrointestinal disorders

Plant species	**Family**	**P.p.u.**	**Main use(s)**	**Ur.**	**%**	**Popoluca name**	**Spanish name**
Byrsonima crassifolia (L.) Kunth	Malpighiaceae	Bark	Diarrhoea	22	(2.6)	Nanchiñ	Nanchi
Annona reticulata L.	Annonaceae	Leaf	Flatulence	21	(2.5)	Jon yatyi	Anona
Cissampelos pareira L.	Menispermaceae	Root	Dysentery	21	(2.5)	Tyiñi woyo	Redondillo
Chenopodium ambrosioides L.	Chenopodiaceae	Leaf	Parasites	17	(2.0)	Epazut	Epazote
Tagetes lucida Cav.	Asteraceae	Herb	Stomach-ache	17	(2.0)		Pericón
Aristolochia sp. (*A. ovalifolia* Duch. / *A. asclepiadifolia* Brandegee)	Aristolochiaceae	Root	Stomach-ache, Vomiting	16	(1.9)	Guaco	Guaco
Waltheria indica L.	Sterculiaceae	Root	Dysentery	15	(1.8)	Pun¥g ay	
Quercus oleoides Schltdl. et Cham.	Fagaceae	Bark	Diarrhoea	14	(1.7)	Pop soj	Encino
Pimenta dioica (L.) Merr.	Myrtaceae	Seed, leaf	Stomach-ache, air in the stomach, vomiting	14	(1.7)	Uk suk	Patololote
Mentha sp.	Lamiaceae	Leaf	Stomach-ache, vomiting	13	(1.6)		Menta
Psidium aff. *salutare* (Kunth) O. Berg	Myrtaceae	Root, leaf	Diarrhoea, dysentery	13	(1.6)		Itamo real
Punica granatum L.	Punicaceae	Fruit skin	Diarrhoea	13	(1.6)		Granada
Ruta sp.	Rutaceae	Leaf	Stomach-ache	13	(1.6)		Ruda
Zingiber officinale Roscoe	Zingiberaceae	Root	Stomach-ache	12	(1.4)	Kaxtxan ñiui	Genjible
Persea americana Mill.	Lauraceae	Seed	Gastritis	11	(1.3)	Cuy ty¥m	Aguacate
Psidium guajava L.	Myrtaceae	Bark	Diarrhoea	11	(1.3)	Patan	Guajava dulce
Calea ternifolia Kunth = *C. zacatechichi* Schltdl.	Asteraceae	Leaf	Stomach-ache	10	(1.2)	Tam juñi	Jaral

Table 3. (continued)

Croton schiedeanus Schltdl.	Euphorbiaceae	Bark	Stomach-ache, flatulence	9	(1.1)	Tam cuy	Cascarilla
Psidium guineense Sw.	Myrtaceae	Bark, root	Diarrhoea	9	(1.1)	Copa patan	Guajaba sabanera
Coccoloba barbadensis Jacq.	Polygonaceae	Bark	Diarrhoea	9	(1.1)	Pakum	Uvero
Chamaecrista flexuosa (L.) Greene var. flexuosa	Caesalpiniaceae	Root	Diarrhoea	8	(1.0)	Copa uaxiñ	Ortiga
Porophyllum ruderale (Jacq.) Cass.	Asteraceae	Leaf	Stomach-ache	8	(1.0)	Comunk¥ ts¥p¥	Papaloquelite
Croton repens Schltdl.	Euphorbiaceae	Root	Diarrhoea	8	(1.0)	Copa n¥pin cuy / Soj kobak / Soj muk	
Spondias purpurea L.	Anacardiaceae	Bark	Diarrhoea, hepatitis	7	(0.8)		Conduria
Anethum graveolens L.	Apiaceae	Seed	Stomach-ache	7	(0.8)		Neldo
Artemisia ludoviciana Nutt.	Asteraceae	Leaf	Stomach-ache, parasites	7	(0.8)	Poma ay	Estafiate
Cinnamomum verum J. Presl.	Lauraceae	Bark	Stomach-ache	7	(0.8)		Canela
Malvaviscus arboreus Cav.	Malvaceae	Leaf	Diarrhoea	7	(0.8)	Xoun pocuy	Rompe olla
Psychotria tenuifolia Sw.	Rubiaceae	Root	Diarrhoea	7	(0.8)	Tam txix¥k	Simonillo
Vitis tiliifolia Humb. et Bonpl. Ex Roem et Schult.	Vitaceae	Sap	Diarrhoea	7	(0.8)	Y¥k ty¥m tsay	Agras
Ruellia sp.	Acanthaceae	Root	Diarrhoea	6	(0.7)		
Maytenus belizensis Standl.	Celastraceae	Bark	Diarrhoea	6	(0.7)	Niui cuy	Retamo
Matricaria recutita L.	Asteraceae	Herb	Stomach-ache	6	(0.7)		Manzanilla
Hyptis verticillata Jacq.	Lamiaceae	Herb	Flatulence	6	(0.7)	Tsutsbet cuy	Hierba San Martín

Table 3. (continued)

Talauma mexicana (DC.) G. Don	Magnoliaceae	Seed	Gastritis	6	(0.7)	Mooyniakcuy	
Eugenia capuli (Schltdl. et Cham.) O. Berg	Myrtaceae	Bark	Diarrhoea	6	(0.7)	Cheks patan, Pop pet cuy	
Allium sativum L.	Liliaceae	Bulb	Flatulence, parasites, stomach-ache	6	(0.7)		Ajo
Musa sp.	Musaceae	Sap	Diarrhoea, dysentery	6	(0.7)	Joko samñi	Platano
Cocos nucifera L.	Arecaceae	Root	Diarrhoea	6	(0.7)		Coco

Total number of species is 251; total use-reports is 830. The species listed represent 49% of all reported uses in this category. P.p.u. = Plant part used, Ur = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 4. Gynaecology

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Ormosia isthmensis Standl.	Fabaceae	Bark, Seed	Hemorrhage, contraceptive	24	(4.2)	May cuy	Coral
Matricaria recutita L.	Asteraceae	Herb	Childbirth	16	(2.8)		Manzanilla
Rosmarinus officinalis L.	Lamiaceae	Leaf	Childbirth	15	(2.6)		Romero
Tradescantia spathacea Sw.	Commelinaceae	Leaf	Hemorrhage	15	(2.6)		Maguey morado
Rhynchosia pyramidalis (Lam.) Urb.	Fabaceae	Seed	Hemorrhage, contraceptive	12	(2.1)	Sinchu ixcuy	Ojo de picho
Desmodium incanum DC.	Fabaceae	Whole plant	Anti-abortive	11	(1.9)	T¥ pitx nang tsang	Cadillo rojo
Wimmeria bartlettii Lundell	Celastraceae	Bark	Menstrual problems	9	(1.6)		Canserina
Byrsonima crassifolia (L.) Kunth	Malpighiaceae	Bark	Inflamed uterus	8	(1.4)	Nanchiñ	Nanchi
Miconia argentea (Sw.) DC.	Melastomataceae	Leaf	Childbirth	8	(1.4)	Tesua	Tescuate
Hamelia patens Jacq.	Rubiaceae	Root	Inflamed uterus	8	(1.4)	Chochoday / Cuma ay / Cangchocho	Coyolillo
Sickingia mexicana Bullock	Rubiaceae	Bark	Hemorrhage	8	(1.4)		Nazareno rojo
Ruta sp.	Rutaceae	Leaf	Childbirth	8	(1.4)		Ruda
Quercus oleoides Schltdl. Et Cham.	Fagaceae	Bark	Inflamed uterus, hemorrhage	7	(1.2)	Pop soj	Encino
Zebrina pendula Schinzl.	Commelinaceae	Leaf	Hemorrhage	7	(1.2)	Tsabats uixpin	Hierba del pollo
Gomphrena globosa L.	Amaranthaceae	Flower	Hemorrhage	6	(1.1)	J¥pak mooya	
Mosquitoxylum jamaicense Krug et Urb.	Anacardiaceae	Bark	Hemorrhage	6	(1.1)	Se´mpe	Cedro nogal

Table 4. (continued)

Epiphyllum crenatum (Lindl.) Don	Cactaceae	Leaf	Anti-abortive	6	(1.1)		
Pluchea symphytifolia (Mill.) Gillis	Asteraceae	Leaf	Hemorrhage	6	(1.1)		Salvia
Pimenta dioica (L.) Merr.	Myrtaceae	Seed, leaf	Inflamed uterus	6	(1.1)	Uk suk	Patololote
Pouteria sapota (Jacq.) H. E. Moore et Stearn	Sapotaceae	Seed, bark	Uterine descent	6	(1.1)	Kuxamñi	Mamey
Guazuma ulmifolia Lam.	Sterculiaceae	Bark	Expulse placenta	6	(1.1)	¥k¥	Guazimo
Helicteres guazumifolia Kunth	Sterculiaceae	Fruit	Determine sex of unborn	6	(1.1)	Piniaka	

Total number of species is 218; total use-reports is 566. The species listed represent 36% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Uses in illnesses associated with fever and headache

This group has the highest F_{ic} (0.71) because it contains only 18% (112) of all species and 8.5% (381) of all use-reports (Table 5). According to the Popoluca, fever and headache are symptoms of the same disease (fever normally "causes" headache) and are therefore treated in the same way. Fever as a symptom is mainly treated with a shower bath using a maceration of different fresh or "cold" leaves, supposed to cool the body. Remarkably, leaves and herbs account for 84% of the plant parts used. The concept lying beneath this application is the humoral system with its hot / cold dichotomy. Because of the external application of most plants we do not discuss these species in detail, the only exception being the root bark of *Securidaca diversifolia* used systemically in form of a cold maceration. Cmelik and Ley (1984) isolated the known analgesic methyl salicylate from the root bark of its African relative *S. longipedunculata*, while Olajide and Makinde (1998) showed an analgesic activity of the extract with mice *in vivo*.

Urological problems

In this group 26% (157) of all species and 8% (345) of all reports are included, showing a relatively low F_{ic} (0.55) (Table 6). Urological complaints like renal calculus, gonorrhoea and pain while urinating is commonly treated with a tea or maceration. Root / tuber (35%) or leaf / aerial part (34%) are generally used. Sour drugs are preferred for the treatment of these conditions. Vaginal infections are treated with vaginal douches using a decoction prepared from astringent barks. Flavonol diglycosides, several other flavonoids (Da Silva et al 2000) and a steroidal saponin (Lin 1996) have been isolated from species of *Costus*. The genus *Anthurium* is known for its methylated flavones. However, there are no data validating the indigenous use. Chemically it is the most diverse genus within the Araceae (Williams et al 1981). No information is available on the root constituents of *Anthurium schlechtendalii*.

Plants to counteract bites of venomous animals

Twenty percent (121) of all species are employed against the effects of poisonous animals, while only 6% (260) of the use-reports are assigned to this group, resulting in a relatively low F_{ic} of 0.54 (Table 7). Snakebites are treated both systemically and topically. A steam bath with the vapour of boiling herbs is thought to extract the venom from the body. Cleaning the wound with yellow bark decoctions of *Cochlospermum vitifolium* and *Diphysa americana* (both with a yellow colour like snake venom) is said to act as an antidote. Fresh *C. vitifolium* leaves are chewed in cases of the poisoning by the black widow spider and caterpillar hairs. *Cochlospermum* spp. (rhizome) are reported to have antimalarial activity (Presber et al 1991, Benoit et al 1995) but the phytochemistry of the leaves and the cortex is poorly investigated. The toxicological risks associated with the use of *Aristolochia* species (in this case *A. ovalifolia* and *asclepiadifolia*) taken orally as an antidote has already been discussed.

Culture bound syndromes

In this group of plants we found a low consensus (F_{ic} = 0.47). This appears to be typical for this group of illnesses since we found a similar situation in other cultures (see Heinrich et al 1998). Many species are recorded (21%, 127), but with relatively few use-reports (5.4%, 240) (Table 8). The ritual aspects of treatment are more important than empirical ones. Most plants in this group are employed in ritual cleansing ceremonies ("limpias"). Their discussion is beyond the scope of this paper. The rituals used in the treatment of such disorders seem to be of greater relevance than the use of a specific species. *Phyllanthus* species are the only exception. They are given orally to treat "tsocoicopoya" (sadness). Diverse medical uses of the genus are known from ethnobotanical studies. A multitude of pharmacological effects of members of this genus, especially of *P. niruri* have been reported and a large number of compounds are known, such as the antihepatotoxic compounds phyllanthin, hypophyllanthin and triacontanal (Sayamasundar et al 1985). No pharmacological information substantiating the indigenous use is available.

Table 5. Fever and headache

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Gliricidia sepium (Jacq.) Steud.	Fabaceae	Leaf	Fever, headache	41	(10.7)	Paaki	Cocuite
Bursera simaruba (L.) Sarg.	Burseraceae	Leaf	Fever, headache	37	(9.7)	Ts¥k	Palo mulato
Spondias purpurea L.	Anacardiaceae	Leaf	Fever, headache	23	(6.0)		Conduria
Justicia spicigera Schltdl.	Acanthaceae	Leaf	Fever, headache	19	(5.0)	Chich	Pote de la tiñadora; Añil
Clerodendron ligustrinum (Jacq.) E. Br.	Verbenaceae	Leaf	Fever, headache	19	(5.0)	Muts	Moste
Tamarindus indica L.	Caesalpiniaceae	Leaf	Fever, headache, measles, chickenpox	18	(4.7)		Tamarindo
Securidaca diversifolia (L.) S. F. Blake	Polygalaceae	Root	Fever	14	(3.7)	Kipats ay	Balsamillo
Cestrum nocturnum L.	Solanaceae	Leaf	Fever, headache	13	(3.4)	Mok xoxay	Huele noche
Mecardonia procumbens (Mill.) Small	Scrophulariaceae	Leaf	Fever	11	(2.9)		Chotete
Ocimum basilicum L.	Lamiaceae	Herb	Fever, headache	10	(2.6)		Albahaca
Rosa sp.	Rosaceae	Flower	Fever, headache	8	(2.1)		Rosa concha
Bryophyllum pinnatum (Lam.) Oken	Crassulaceae	Leaf	Fever, headache	7	(1.8)		Maravilla
Iresine diffusa Humb. et Bonpl. ex Willd.	Amaranthaceae	Leaf	Fever, headache	6	(1.6)	Tsus tunuk koso	Tlan cuaya
Sambucus mexicana C. Presl ex DC.	Caprifoliaceae	Leaf	Fever, headache	6	(1.6)		Sauco
Melia azedarach L.	Meliaceae	Leaf	Fever, headache	6	(1.6)		Tarai

Total number of species is 112; total use-reports is 381. The species listed represent 62% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 6. Urological problems

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Costus sp. *(C. pictus* D. Don / *C. pulverulentus* C. Persl*)*	Zingiberaceae	Stalk, root	Pain while urinate, gonorrhoea	23	(6.6)	Chimpa tutu	Caña agria
Anthurium schlechtendalii Kunth	Araceae	Root	Renal calculus, renal pain	17	(4.9)	Tsa ay	Raiz de piedra
Begonia heracleifolia Schltdl. et Cham.	Begoniaceae	Stalk	Pain while urinate, renal pain	14	(4.0)	Leon k¥, Katxu kanapoki	Mano de leon, Caña agria
Smilax domingensis Willd.	Smilacaceae	Tuber	Gonorrhoea, renal pain	13	(3.8)	Mom	Axquiote; Guatotole
Arthrostemma ciliatum Pav. ex D. Don	Melastomataceae	Herb	Pain while urinate	12	(3.5)	Katxu kanapoki	Caña agria quadrata
Byrsonima crassifolia (L.) Kunth	Malpighiaceae	Bark	Vaginal infection	9	(2.6)	Nanchiñ	Nanchi
Cnidoscolus liebmannii (Müll. Arg) Lundell	Euphorbiaceae	Root	Vaginal infection	6	(1.7)	Kenuk	Chichicastle
Quercus oleoides Schltdl. et Cham.	Fagaceae	Bark	Vaginal infection	6	(1.7)	Pop soj	Encino
Tradescantia spathacea Sw.	Commelinaceae	Leaf	Pain while urinate, renal pain	6	(1.7)		Maguey morado

Total number of species is 157; total use-reports is 345. The species listed represent 31% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 7. Plants to counteract bites of venomous animals

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spnish name
Cochlospermum vitifolium (Willd.) Spreng.	Cochlospermaceae	Leaf	Snake bite, Black widow, caterpillar hair irritation	18	(6.9)	Puts cuy	Pongolote
Aristolochia sp. (*A. ovalifolia* Duch / *A. asclepiadifolia* Brandegee)	Aristolochiaceae	Vine, root	Snake bite	18	(6.9)	Guaco	Guaco
Muntingia calabura L.	Elaeocarpaceae	Bark	Black widow	14	(5.4)	Capuli	Capulin
Cissampelos pareira L.	Menispermaceae	Root	Snake bite	8	(3.1)	Tyiñi woyo	Redondillo
Diphysa americana (Mill.) M. Sousa	Fabaceae	Bark	Snake bite	6	(2.3)	Tsus cuy	Chipile
Simaba cedron Planch.	Simarubaceae	Seed	Snake bite	6	(2.3)		Cedrón

Total number of species is 121; total use-reports is 260. The species listed represent 27% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 8. Culture-bound syndromes

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Phyllanthus spp. (*P. niruri* L. & *Phyllanthus* sp.)	Euphorbiaceae	Herb	Sadness	19	(7.9)	Antuñik¥ ay	
Amphitecna tuxtlensis A. H. Gentry	Bignoniaceae	Fruit	Wood ghost	9	(3.7)	Makti jeepe	Jicara del duende
Hyptis verticillata Jacq.	Lamiaceae	Herb	Bad spirits, heat of death	9	(3.7)	Tsutsbet cuy	Hierba San Martín
Mimosa pudica L.	Mimosaceae	Whole plant	Crying child, insomnia	9	(3.7)	Mong mong ay	Dormilona
Cecropia obtusifolia Bertol.	Cecropiaceae	Leaf	Bad spirits	8	(3.3)	Mats	Chancarro
Plumeria rubra L.	Apocynaceae	Flower	Love in vain, shame, loveheat	7	(2.9)	Puutx mooya	
Ocimum basilicum L.	Lamiaceae	Herb	Bad spirits	6	(2.5)		Albahaca
Biophytum dendroides (Kunth) DC.	Oxalidaceae	Whole plant	Sadness	6	(2.5)	Coco ay	Palmita
Polygala paniculata L.	Polygalaceae	Whole plant	Crying child	6	(2.5)	Ueji ay	

Total number of species is 127; total use-reports is 240. The species listed represent 33% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 9. Respiratory complaints

Plant species	Family	P.p.u.	Main use(s)	Ur.	%	Popoluca name	Spanish name
Bougainvillea sp.	Nyctaginaceae	Flower	Cough, pertussis, asthma	12	(5.4)		Bugambilia
Eucalyptus sp.	Myrtaceae	Leaf	Cough	11	(5.0)		Eucalipto
Pityrogramma calomelanos (L.) Link	Adiantaceae	Leaf	Cough, pertussis	10	(4.5)	Y¥k chimal	
Hibiscus rosa-sinensis L.	Malvaceae	Flower	Cough	10	(4.5)		Tulipan
Artemisia ludoviciana Nutt.	Asteraceae	Leaf	Cough	9	(4.1)	Poma ay	Estafiate
Gnaphalium attenuatum DC.	Asteraceae	Leaf	Cough	8	(3.6)	Poma ay cimarrón	Gordolobo
Cinnamomum verum J. Presl.	Lauraceae	Bark	Cough	7	(3.2)		Canela
Allium sativum L.	Liliaceae	Bulb	Cough	7	(3.2)		Ajo
Calea ternifolia Kunth = *C. zacatechichi* Schltdl.	Asteraceae	Leaf	Cough	6	(2.7)	Tam juñi	Jaral
Citrus aurantium L.	Rutaceae	Fruit skin, leaf	Cough	6	(2.7)	Tsootso	Naranja
Lantana camara L.	Verbenaceae	Leaf	Cough	6	(2.7)	Kanmuk	Cinco negritos

Total number of species is 79; total use-reports is 219. The species listed represent 42% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 10. Skeleto-muscular disorders

Plant species	**Family**	**P.p.u.**	**Main use(s)**	**Ur.**	**%**	**Popoluca name**	**Spanish name**
Cedrela odorata L.	Meliaceae	Bark	Bruise, effusion of blood	13	(6.1)	Acuy	Cedro
Tithonia diversifolia (Hemsl.) A. Gray	Asteraceae	Leaf	Rheumatism, bruise, body pain	6	(2.8)	Tam chich	Arnica
Dioscorea floribunda M. Martens et Galeotti	Dioscoreaceae	Root	Rheumatism, bruise	6	(2.8)	Puutx naaku	Barbasco amarillo

Total number of species is 101; total use-reports is 211. The species listed represent 12% of all reported uses in this category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Table 11. Species used for problems of the ear, problems of the eye and against toothache

Plant species	**Family**	**P.p.u.**	**Main use(s)**	**Ur.**	**%**	**Popoluca name**	**Spanish name**
a) Problems of the ear							
Plectranthus amboinicus (Lour.) Spreng	Lamiaceae	Leaf	Earache	12	(16.9)		Oregano
Vernonia deppeana Less.	Asteraceae	Leaf	Earache	11	(15.5)	Ux cuy	
b) Problems of the eye							
Croton repens Schltdl.	Euphorbiaceae	Sap	Retina complication	7	(13.2)	Copa n¥pin cuy / Soj kobak / Soj muk	
c) Toothache							
Acmella radicans (Jacq.) R. K. Jansen	Asteraceae	Root, leaf	Toothache	9	(16.4)	Niui sotyi	
Solanum sp. (S. rudepannum Dunal / *S. torvum* Sw.*)*	Solanaceae	Root	Toothache	6	(10.9)	Muutsei cuy	Berenjena

Total number of species is: a) 33, b) 29, c) 32; total use-reports is: a) 71, b) 53, c) 53. The species listed represent a) 32%, b) 13%, c) 28% of all reported uses in the respective category. P.p.u. = Plant part used, Ur. = Use-reports, % = Percentage of use-reports contributed to the group of illness from the respective species.

Respiratory complaints

Thirteen percent (79) of all species and 5% (219) of all use-reports were assigned to this group. The F_{ic} is 0.64 (Table 9). Cough, asthma and pertussis are the most common respiratory complaints. The most frequently mentioned therapy consists of a hot and honey-sweetened infusion of aromatic plant parts or a syrup. This is a generally useful form of treatment for minor respiratory complaints. Several introduced taxa are used in this group. Possibly respiratory complaints were less common in earlier times and the healing concept was introduced by the Spaniards or the Mexican Mestizos.

Fractures, bruises, general body pain and rheumatic disorders (Skeletal-muscular disorders)

Sixteen percent (101) of the plant taxa and 4,7% (211) of all reports referred to this group, leading to the relatively low F_{ic} (0.52) (Table 10). Bruises are often treated systemically with an infusion while sprains are carefully massaged. Rheumatic complaints are treated with a cataplasm while muscular pain is treated by washing the affected part with heated medicinal plants or a decoction. From the bark of *Cedrela odorata* sesquiterpenes, sitosterol, octacosanol and oleanonic acid are reported (Campos et al 1991), but the literature available does not allow conclusions on the appropriateness of the indigenous usage.

Problems of the ear, eye and toothache

This group shows a low intra-cultural consensus, which can be explained at least partially by the few use-reports gathered (Tables 11 a-c). Aching ears and inflamed inner ears are treated with heated leaf juice introduced onto or into them. *Plectranthus amboinicus* is the most frequently cited species and a native of South Africa, but is now found in home gardens in many regions of Mexico and Central America. Its ethnobotanical uses on this continent are not very well known (perhaps because it has been rarely identified botanically, as it flowers only irregularly). The Popoluca heat a succulent leaf on the "comal" (a large plate made out of clay and used on the fire in the preparation of tortillas) and

the warm sap is squeezed into the aching ear. The essential oil with delta-3-carene, carvacrol, camphor and gamma-terpinene as main components (Vera et al 1993) has antibacterial and fungicidal activity (Prudent et al 1995).
The sap of astringent plants is applied into the eye in order to clean the retina. *Croton repens*, which is most frequently used, has not yet been studied phytochemically and there are no data to support the indigenous claims. Although the genus *Croton* is well known for its irritant diterpene-esters the Popoluca do not report irritant effects.
Toothache is treated with fresh plant sap on cotton, administered topically, or by chewing parts of fresh roots. Some of these saps are said to break the aching tooth in parts. *Acmella radicans* (= *Spilanthes ocymifolia)* roots and leaves are used. The same species is also known as a popular Salvadoranian folk remedy against toothache and contains *N*-2-phenylethylcinnamamide, which is a pungent olefinic alkamide with insecticidal and mucuous membrane anesthetic properties (Borges del Castillo et al 1984, Molinatorres et al 1996, Hegnauer 1989).

Conclusion

This study is the first ethnopharmaceutical study on the Popoluca. It uses an interdisciplinary method combining pharmacognosy / botany, anthropology and (ethno-) pharmacology.
The selection of plants within the ethnopharmacopoeia of the Popoluca is based on a systematic selection of plants as medicines using culture specific concepts (e.g. taste and smell properties, hot and cold dichotomy) which have in part been discussed in this paper. The application of astringent teas for the treatment of diarrhoea and the use of bitter and aromatic teas in case of stomach-ache has previously been reported by our group in other cultures (Brett and Heinrich 1998). This example points to common selection criteria, which thus seem to be a Pan-Mesoamerican tradition. For many taxa our analysis of phytochemical and pharmacological data provides some rationale which may explain the plants' usage by the Popoluca. This analysis also points to important gaps in our knowledge about bioactive constituents of the species used. Of particular toxicological concern with respect to indigenous medicinal plants are taxa which do not have noticeable toxic effects in the short term, but which produce such effects after prolonged exposure. Plants containing pyrrolizidine alkaloids

or aristolochic acid are common examples. Our analysis provides a scientific basis for programmes aimed at reducing the frequency of usage of such species.

The data presented here are the basis for a series of further studies, which will look at specific details of the Popoluca's medicinal plant usage:

- A pharmacological screening of the plants collected in the regions against a variety of targets and subsequent phytochemical studies;
- A comparison with the use of medicinal plants of the linguistically closely related Mixe (Heinrich 1989);
- An analysis of the criteria for selecting species as medicinal plants. While there are about 3.000 species known in the region only about 500 are culturally important as medicinal plants. The strategies the Popoluca use to select these species will be analysed.

As proposed recently the concept of ethnopharmacology is specifically relevant with respect to further developing indigenous "ethnopharmacopoeias". In this study we demonstrate the breadth of ethnopharmacolgy's approach to medicinal plants and point to its potential as a basis for further studies not just in natural products research combining pharmacology and pharmacognosy but also with respect to anthropological aspects of the study of indigenous medicinal plants. Finally, these data should also serve as a basis for biodiversity conservation and community development.

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12.1 Introduction to Publication II: Medicinal Plants of the Popoluca, México: Organoleptic Properties as Indigenous Selection Criteria

In contrast to the traditional Chinese, Japanese, and Ayuvedic medicine which rely on a systematic theoretical base the Western perception of the traditional Latin American medicine is quite confused (Lozoya 1994). One reason for this situation probably is the colonial repression and the Christian religion which tried to break the cultural identity of the natives (Lozoya 1994). With our investigation on the organoleptic properties as indigenous selection criteria we try to contribute to the better understanding and comprehension of Latin American medicine. The detection of a putative systematic base would facilitate the selection of efficacious plants. Moreover, it could bring the different Mexican and maybe Latin American ethnopharmacopoeias in general into relation which would revaluate them and make them more applicable.

Previous studies on selection criteria for medical plants in Latin America mostly considered only the humoral system with its hot/cold dichotomy (Browner 1985; Foster 1988). This hot/cold classification often differs significantly between ethnic groups (Browner and Ortiz de Montellano 1986) and so far its meaning has barely been compared interculturally. Amongst others Brett and Heinrich (1998) critisized the humoral system as being too narrow for the understanding of the indigenous medical plant use. Taste, smell, colour and morphology can also serve as selection criteria (Browner and Ortiz de Montellano 1985; Frei 1997; Johns 1990). So far only few studies on this subject have been cunducted (Brett and Heinrich 1998). In order to obtain a better understanding of the selection criteria for medical plants, one can ask the informants about the typical characteristics of a medical plant (Heinrich 1997). It has been shown that smell and taste can play an important role in the decision making process (Frei 1997; Heinrich 1997; Negbi 1992). Such perceptions are filtered culturally and are classified in a cultural system. Decoding these classificatory systems can bring a better understanding of the cultural perception of medical plant use (O'Mahony and Ishii 1986; Frei 1997; Browner et al. 1988). For this purpose the healer is asked to describe the taste and smell of medical and non-medical plants (taste and smell tests).

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12.2

Medicinal Plants of the Popoluca, México: Organoleptic Properties as Indigenous Selection Criteria

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Abstract

The taste and smell of the environment are important to humans in everyday life and are of particular relevance for the selection of medicinal vs. non-medicinal plant species. In a 16-months study with the Popoluca of southern Veracruz (Mexico), we focused on the indigenous selection criteria for medicinal plants. We provide evidence for a highly significant association between organoleptic properties of plants and the use of these species as medicine. Additionally, the doctrine of signature is an essential mnemonic aid, which facilitates remembering the use assigned to the plant. From the Popoluca point of view, it is essential to find substitutes or alternative treatments when a certain species is not at hand. We show that organoleptic properties and the doctrine of signature are excellent guides for selecting or memorising such medicinals.

Resumen

El sabor y el olor del ambiente son importantes por el eser humano en la vida cotidiana y relevantes para la selección de plantas medicinales en respecto a plantas non-medicinales. Durante un estudio etnobotánico de 16 meses con los Popoluca ubicados en la parte sur de Veracruz (México) hemos enfocado la cuestión de las criterias indigenas para la selección de plantas medicinales. Aportamos pruebas por una asociación de alta significación entre propriedades organolepticos de plantas y el uso medicinal de estas mismas especies. Además la doctrina de la signatura es una mnemotécnica que facilita a recordar el uso atribuido a las respectativas plantas. Del punto de vista de los Popoluca es esenciál de encontrar substituentes o tratamientos alternativos si una especie no esta a la mano. Demostramos que propriedades organolépticos y la doctrina de la signatura son guias excelentes para selectar o memorizar plantas medicinales.

Introduction

Ethnopharmacology as a discipline requires a truly multidisciplinary investigation. However, many studies still only pay lip-services to such an approach and there remains an urgent need to further strengthen the contributions made by anthropology and other social and cultural sciences (Etkin, 2001). Also, ethnopharmacology as a field of science has largely remained descriptive and has not yet explored in detail the process and rationale for the use of plants as medicine (Brett and Heinrich, 1998; Moerman et al., 1999).

One aspect of cultural reasoning is the selection of plants as medicine based on their taste and smell properties (Johns, 1990; Johns and Keen, 1985). This aspect has only in recent years received some attention but seems to be an important selection criterion in many cultures (Brett and Heinrich, 1998). Other authors have systematically explored the humoral hot/cold concept and its role in indigenous medicine (Foster, 1994). This concept has been criticized as a too narrow one in order to understand the reasons for plant use (Brett and Heinrich, 1998). In a previous approach we sought to verify the hypothesis that the Maya use taste and odor to characterize medicinal plants. Indeed the classification of medicinal vs. non-medicinal plants among some communities of the Yucatec Maya revealed that the labels they applied to them (astringent, bitter, aromatic, etc.) include, or encode, considerable information about the groups of illness(es) a particular phytomedicine is best used for (Ankli et al., 1999); examples included plant remedies classified as astringent or aromatic. For instance, diarrhoea is most often treated with astringent (50%) or aromatic (65%) species, while pain and fever mostly are treated with aromatic (52%) species. However, this study concluded that the difference in the total number of species classified as bitter in the two groups "medicinal" and "non-medicinal" remained non-significant.

The present study implemented a more systematic questionnaire protocol in order to understand the criteria being used to characterize and select medicinal plants on the perception of taste and smell properties, while additionally, reference is made to the hot/cold classification.

This paper intends to contribute to the development of an ethnobotanical theory by analysing the Popolucan criteria for distinguishing between medicinal and non-medicinal plants. The present study shows that the Popoluca use organoleptic (taste, smell, optical) properties to select between medicinal and

non-medicinal plants and also shows the wealth of ethnobotanical information, which the Popoluca healers conserve (for additional data see Leonti et al., 2001). Their medical system and knowledge is without doubt a vital part of their culture. According to Foster (1969), the Popoluca were (and still are) one of the least studied ethnic groups of Mexico and our work is the first ethnobotanical study in collaboration with this ethnic group.

Background and Methods

The Popoluca

The Popoluca live on the southern and western slopes of the Sierra Santa Marta, a range of volcanoes between the Lake of Catemaco and the gulf shore. These volcanoes form the southern foothills of the "Sierra de Los Tuxtlas" mountain range, a region particularly well known for its biodiversity: the holarctic and neotropical floristic kingdoms overlap here. In a recently published list (Ramirez, 1999), 2.400 species were recorded, but there are probably at least 3.000 species growing in the Sierra (Chevalier and Buckles, 1995 and references therein). Important vegetation zones include the tropical montane cloud forest, the tropical rain forest and a semi-dry oak forest (for details see Leonti et al 2001).
The language is transcribed using a system employed by the bilingual teacher in the region. In addition to the common consonants and vowels, an open [o] written as [¥] is used.

Ethnobotanical Research

The ethnobotanical research was conducted in the sub-districts (municipios) of Hueyapan de Ocampo and Soteapan in southern Veracruz from March 1999 to July 2000. The comparison between medicinal and non-medicinal plants is based on research in the community of Santa Rosa Loma Larga (municipio Hueyapan de Ocampo). Fieldwork was conducted during 16 months and focused on collecting information on the medicinal plant use and general ethnographical (background) data as well as on the preparation of dried herbarium specimens and the collection of samples for further phytochemical analysis.

The research was conducted with the permit No. DOO. 02.-1750 obtained from the Instituto Nacional de Ecología, Secretaría de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP). Complete sets of voucher specimens (Leonti 1-599) are deposited at the National Mexican Herbarium MEXU (UNAM, México, D.F.), the Herbarium-Hortorium of the Colegio de Postgraduados de Chapingo CHAPA (Texcoco), IMSS-M (Instituto Mexicano del Seguro Social, México, D.F.), Instituto de Ecología (Xalapa), the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, Univ. London and the ETH Zurich (CH). Identification was mainly conducted at MEXU and the Colegio de Posgraduados de Chapingo, in many cases with the help of specialists from these institutions.

Indigenous selection criteria

While walking through an area with secondary vegetation with different successional zones we asked a group of eight persons to show us plants, which have *no* curative property (Table 1). Only plants where all informants agreed upon were included. Next, we asked them to show us plants that *all* members of the group considered to be medicinal (Table 2).
At another occasion, we interviewed the same eight participants individually: all participants were asked to smell and taste barks, roots or leaves of the plants selected previously by the group. They were asked about the plant's smell and taste properties, their virtues and about healing concepts in general. We recorded the *spontaneous* responses of the informants. Due to the large number of species, the amount of time required for testing the samples and logistical aspects (availability of plant material), not all species were tried by each informant, represented by ('-') in both categories, smell and taste (Tables 1 and 2). However, frequently the informants gave only reference to either property – smell or taste – and in this case a ('-') symbolizes the omitted response; this occurred quite often and is due to various reasons. As expected, in case of astringent or bitter bark samples from species like *Ulmus mexicana*, *Byrsonima crassifolia* and *Exostema mexicana*, the informants did not accentuate the non-existing smell properties. The lack of such a response has to be seen as an implicit recognition of this fact. With *Thunbergia alata*, on the other hand it seemed like the informants were not sure whether the plant rather smells or tastes. In order to assure a fair statistical analysis (chi-square test) between the

non-medicinal and the medicinal plants, we included a maximum of one answer per informant and species. Finally, if the informant made reference to both categories, to an existing smell/taste property, and the lack of any smell and taste properties (N), we included the existing property in the analysis and ignored the indifferent responses.

Results and Discussion

Taste and smell properties of Popoluca plants

In an initial series of interviews we identified the following organoleptic categories as they are distinguished by the Popoluca healers:

- ***Smell***: – k¥npa – (good), uxang – (weak), angjejpa – (bad), strong, no smell
- ***Taste***: – dya k¥npa – (bad), paak – (sweet), uxang – (weak), tu'n tu'n – (astringent), katsu – (sour), k¥npa – (good), tam – (bitter), strong, no taste

Other named taste and smell categories include:

- ***Smell***: – agi tsan tsan – (smells bad like rotten fish), agi pua – (smells bad like rotten meat), agi u¥y¥ u¥y¥ – (smells bad like wet dog)
- ***Taste***: – caana – (salty)

In conducting the interviews we routinely asked the informants "Why is this plant useful as a medicine?" (Por que esta planta es una medicina?). The question was understood by some informants as referring to the origin of their knowledge about this plant. In other cases it provoked a response regarding the properties of the species. Statements like: "This plant is good against fever because it is cold..." or: "This plant is good against pain because it is bitter" were often given as explanations. Sometimes, and especially if the species was not used medicinally, the responses referred to a more common taste or smell sensation, like: "Tastes like wheat or smells like mango". Especially in the case of species used in the treatment of fever, reference was made to the plant's "cooling" effect. Concerning the taste and smell properties of the medicinal

plants there generally was a high agreement except with *Sickingia mexicana* and to a lesser extent with *Zanthoxylum caribaeum*. The barks of these two species indeed have hard to define and slowly developing taste properties.
This led us to investigate the ascribed properties of medicinal plants in relation to non-medicinal ones more systematically.

Characteristics of plants used as medicine

Indigenous healers sometimes state "every plant is a potential medicine". However, not all species form part of an ethnopharmacopoeia because there are simply too many to memorize and use [it is estimated that >2500 species grow in the region (Ramirez-Ramirez, 1999)]. Wherever people go, work or live, i.e. in every ecological zone, a sufficient number of species has to be available in order to treat the most common ailments like diarrhoea, stomach-ache and snake bites (which were a serious health problem in former times). Thus, from the Popoluca point of view it is essential to find substitutes or alternative treatments if a certain species is not at hand. During our fieldwork, we identified some cultural parameters, which are commonly used to describe medicinal plants in specific illness categories. Most prominent were taste and smell properties, as well as the doctrine of signature as shown, for example, in the colour of the plant part used medicinally.

Humoral classification

The biotic and abiotic environment of the Popoluca is culturally classified into the humoral states cold/cool (frio/fresco) and hot (caliente). Plants, animals, colours (and hence textiles bearing the specific colour), traditional operations, and ailments may have such a humoral state. The extent of agreement about the humoral state of something depends on the grade of cultural interaction. This implies that the human being acts like a sensor and classifies the agents being exposed to by the impact on his own humoral state. For this reason, a humoral state is more likely to be attributed to a well used medicinal species than to a non-medicinal plant.

Astringent

Remedies against diarrhoea and dysentery are almost always astringent (bark and root), with the exception of *Cissampelos pareira* root, which is bitter. For

example, the bark of *Byrsonima crassifolia* is used in the treatment of diarrhoea. It is widely used for this purpose in Mexico and is rich in tannins, as are many other species used for this purpose in Mexico. Stomach-ache and vomiting, however, are treated with aromatic – bitter herbs like *Tagetes lucida* and *Aristolochia* spp.

Bitter

Bitter plants are considered to have a strong impact on the body as well as being somewhat risky in their use because of a possible overdose. Plants or plant parts with bitter properties [like *Calea ternifolia* (syn.: *C. zacatechichi)*] are generally used to treat pain of the body, e.g., of the skeleto-muscular system and stomach-ache. "Bitter" is associated with the humoral system and perceived as being hot, having a warming effect.

Sweet

Decoctions and tinctures against cough are composed of sweet plants (*Cinnamomum* sp., *Bougainvillea* sp., *Eucalyptus* sp.), and often artificially sweetened with sugar or honey. Because most species with this property have been introduced over the last centuries, the concept may be derived from the Spanish predecessors.

Sour

Sour plants and plant parts are related to the cold humoral state. The sour leaves from *Bursera simaruba*, *Spondias purpurea* and *Tamarindus indica* are used to treat the hot symptoms of fever and headache in form of a shower-bath of the whole body. The sour stalks from *Costus* sp., *Begonia heracleifolia* and *Arthrostemma ciliatum* are used to treat "pain while urinating" because this burning pain too requires a cold therapy.

Red

Of course, visual perception plays a role in the recognition of medicinal properties as well. It is part of the doctrine of signature. Plant parts yielding a red decoction (*Sickingia mexicana, Smilax domingensis*) or red coloured seeds (*Erythrina* sp., *Rhynchosia* sp., *Ormosia isthmensis*) are used to treat haemorrhage and general menstrual problems and are associated with a hot virtue.

Yellow

A yellow decoction from species like *Diphysa* sp., *Cochlospermum vitifolium*, and *Cuscuta* sp. is administered against hepatitis and snake bites. Yellow is seen as the appropriate colour, because in both cases, it is involved in the illness: the yellow colour of the skin in case of hepatitis, and the yellow colour of the venom in case of snake bites.

Shape of plant organs and the doctrine of signature

In this case, plants or plant parts which look like a specific human organ are selected as medicine. Some *Peperomia* spp. have leaves which look like ears and are therefore used against ear-ache. A more complex example are species, which symbolize the pain (i.e. the symptom) and the affected organ. The thorn-bearing vine of *Serjania mexicana* symbolizes the pain of the urinary pathway and its white latex the pus of gonorrhoea, the ailment against which the vine is used for.

The doctrine of signature is a mnemonic aid, which facilitates remembering the indication assigned to the plant, as expressed by Fermin (a local healer) for *Monstera tuberculata*, which has leaves shaped like a heart: "it cures only through the believe in its form, not because of any ingredients (incredientes)". Hence the doctrine of signature is essential in the maintenance of medical traditions, but it can not be studied as well as the humoral system in biomedical or bio-scientifical terms. However, the species used may well be of interest with respect to ethnopharmacological effects on symptoms or illnesses treated with these remedies.

Table 1. Taste and smell properties of non-medicinal plants

Botanical name	Family / vernacular name	Properties and non-medicinal uses	Smell (S) Taste (T)	Taste and smell classification by eight Popoluca healers (1-8) and the 1st author (A)								
				1	2	3	4	5	6	7	8	A
Aliberta edulis (Rich.) A. Rich.	Rubiaceae	Edible fruit	S	-	-	-	(n)	-	(n)	(n)	-	n
ex DC.	Wikpak / Catarita		T	n	n	n	n	a	n	n	sa	sa
Amaranthus spinosus L.	Amaranthaceae	spiny	S	-	n	-	-	-	-	-	-	n
	Tsaman		T	n	-	sw	-	-	-	n	-	sw
Canna indica L.	Cannaceae	Leaves are used to	S	-	-	-	-	-	n	(n)	(n)	n
	¥y¥ng ay / Chilalaga	wrap "tamales"	T	n	n	n	n	n	-	n	n	n
Casearia corymbosa Kunth	Flacourtiaceae		S	-	(n)	(g)	-	-	-	-	-	n
	¥kx cuy		T	sa,g	sa	sa	g	a	a	n	sa	g,sa
Ceiba pentandra (L.) Gaertn.	Bombacaceae	Mythical tree	S	-	-	(n)	(n)	-	(n)	(n)	-	n
	Pixtyiñ / Ceiba		T	n	n	n	n	-	n	n	n	n
Coix lacryma-jobi L.	Poaceae	Horse fodder	S	n	-	-	-	-	-	-	g	n
	Trigo cimarrón		T	-	n	ba	n	sw	sw	n	-	sw
Cordia alliodora (Ruiz et Pav.)	Boraginaceae		S	-	n	(n)	(n)	-	(n)	(n)	-	n
Oken	Kiwa / Solería		T	n	-	n	n	-	n	n	n	n
Crotalaria longirostrata Hook.	Fabaceae	Vegetable	S	-	g	-	-	g	-	g	n	n
& Arn.	Txipiñ ts¥p¥ / Chipile		T	n	-	-	-	-	-	-	-	n
Elvira biflora (L.) DC	Asteraceae	Weed in maize field	S	n	-	-	s	g	g	n	s	g
	Meje / Escamilla		T	-	-	-	-	-	-	-	-	n
Hyperbaena mexicana Miers	Menispermaceae		S	-	-	(n)	-	-	(n)	-	(n)	n
	Txa cuy / Huesillo		T	sa	n	sb	sb	s	n	sb	n	sa
Poulsenia armata (Miq.) Standl.	Moraceae	Fruit edible, latex used	S	-	-	-	(n)	-	(n)	-	-	n
	Cartagena	to blend chicle gum	T	n	n	n	n	-	n	-	n	n

Table 1. (continued)

Robinsonella mirandae Gómez	Tiliaceae	S	-	-	(n)	(n)	-	(n)	-	-	n
Pompa	Puk cuy / Algodoncillo	T	n	n	ssw	n	a	n	n	n	n
Thunbergia alata Bojer ex Sims	Acanthaceae	S	-	-	-	ba	ba	ba	g	ba	ba
	Makti mooya	T	ba	ba	n	-	-	-	-	-	n
Ulmus mexicana (Liebm.)	Ulmaceae	S	-	-	-	-	-	-	-	-	n
Planch	Pagaxniakcuy / Palo cuero	T	a	a	n	a	a	a	a	a	a

a = astringent, ba = bad, g = good, n = no smell/taste, s = slight smell/taste, sa = slightly astringent, sb = slightly bitter, ssw = slightly sweet, sw = sweet, - = no data,
(x) = excluded data

Table 2. Taste and smell properties of medicinal plants

Botanical name	Family / vernacular name	Medical uses	Smell	(S) Taste and smell classification by eight Popoluca healers (1-8) and the 1st author (A)								
			Taste	(T)	1	2	3	4	5	6	7	8	A
Aloe sp.	Liliaceae	Dermal infection, burns,	S	-	(ba)	(ba)	-	(ba)	-	-	(ba)	ba
	/ Sabila	gastritis, rheumatism, fever	T	b	b	ba	ba	-	b	b	-	b,ba
Aristolochia ovalifolia	Aristolochiaceae	Vertigo, stomach-ache,	S	-	g	-	g	(g)	(g)	-	g	g
Duch.	Guaco / Guaco blanco	colics, vomiting, snake bites	T	b	-	b	-	b	b	b	-	b
Bursera simaruba	Burseraceae	Fever	S	-	g	-	-	-	(g)	g	-	g
(L.) Sarg.	Ts¥k / Palo mulato		T	-	-	n	a	so	so	-	-	so,a
Byrsonima crassifolia	Malpighiaceae	Washing of wounds, diarrhoea	S	-	-	-	-	-	-	-	-	n
(L.) Kunth	Nanchiñ / Nanchi		T	a	-	a	a	a	a	a	-	a
Cedrela odorata L.	Meliaceae	Bruise, sprains	S	st	st,sba	(g)	g	st	(st)	-	-	st
	Acuy / Cedro		T	-	-	b	-	-	b	ba,b	-	ba,b
Cochlospermum vitifolium	Cochlospermaceae	Snake bite, stings of the black	S	-	-	-	-	ba	-	-	n	n
(Willd.) Spreng.	Puts cuy / Pongolote	widow, diabetes	T	sa	n	n	sa	-	sb	sw	-	sba
Diphysa americana	Fabaceae	Snake bite, stings of the black	S	-	n	-	-	-	sba	-	n	n
(Mill.) M. Sousa	Tsus cuy / Chipile	widow, washing of wounds	T	a	-	n	-	-	-	n	-	n
Exostema mexicanum	Rubiaceae	Stomach-ache, pain,	S	-	-	-	-	-	-	-	-	n
A. Gray	Tam nazareno / Nazareno amargo	washing of wounds	T	-	b	b	b	b	b	b	b	b
Gliricidia sepium	Fabaceae	Fever	S	-	-	-	-	-	-	ba	-	n
(Jacq.) Steud.	Paaki / Cocuite		T	-	n	n	n	n	-	-	-	n
Guazuma ulmifolia	Sterculiaceae	Dysentery, vaginal infection,	S	-	-	-	-	-	-	-	-	n
Lam.	¥k¥ / Guazimo	diabetes, washing of wounds	T	a	sa	n	-	n	a	n	a	sa

Table 2. (continued)

Iresine diffusa Humb. et	Amaranthaceae	Fever	S	-	-	-	-	-	-	-	-	n
Bonpl. ex Willd.	Tsus tunuk koso / Tlan cuaya		T	-	-	n	-	-	n	n	-	n
Licaria capitata (Schltdl.	Lauraceae	Stomach-ache	S	-	(st)	st	g	(st)	(st)	(g)	(g,st)	g
et Cham) Kosterm.	Y¥k moko / Laurel negro		T	b	st	-	-	b	st	b	st	b,st
Manilkara chicle	Sapotaceae	Haemorrhage after parturition,	S	-	-	-	-	-	-	-	g	g
(Pittier) Gilly	Jiya / Chico zapote	stomach-ache	T		a	b	a	a	a	b	-	sa
Maytenus belizensis	Celastraceae	Diarrhoea, dysentery,	S	-	-	-	-	-	-	-	-	n
Standl.	Ñiwi cuy / Retamo	menstrual problems	T	a	a	b	a	a	a	a	a,sb	a
Mentha sp.	Lamiaceae	Vomiting, stomach-ache	S	g	g	st	g	-	g	-	g	g
			T	-	-	-	-	-	-	g	-	g
Myroxylon balsamum	Fabaceae	Bruise, rheumatism,	S	-	g	-	g	g	g	g	g	g
(L.) Harms	Balsa cuy / Balsa, arbol de	washing of wounds	T	-	-	-	-	-	-	-	-	s
Parmentiera aculeata	Bignoniaceae	Cough, whooping cough	S	-	-	-	ba	-	-	-	-	ba
(Kunth) Seem.	/ Guajilote		T	-	-	-	-	sw	sw,g	-	sw	sw
Piper amalago L.	Piperaceae	Infected wounds,	S	-	s	-	st	st	g	ba	-	st
	Tooso /	snake bites	T	-	-	ba	-	-	-	-	-	st
Psidium guajava L.	Myrtaceae	Diarrhoea	S	-	-	-	-	-	-	-	-	n
	Patan / Guajava dulce		T	a	a	a	a,sb	a	a	a	a	a
Quercus oleoides	Fagaceae	Diarrhoea, dysentery, washing of	S	-	-	-	-	-	-	-	-	n
Schltdl. et Cham.	Pop soj / Encino	wounds, menstrual problems	T	a	a	a	a	a	a	a	a	a
Securidaca diversifolia	Polygalaceae	Fever	S	-	(g)	g	g	g	(g)	g	g	g
(L.) S. F. Blake	Kipats ay / Balsamillo		T	-	b	-	-	-	b	-	-	b

Table 2. (continued)

Sickingia mexicana	Rubiaceae	Menstrual problems,	S	-	-	-	-	-	-	-	-	n
Bullock	/ Nazareno rojo	inflammation of uterus, anemia	T	b,a	sb	s	b	n	-	a	b	sb
Smilax domingensis	Smilacaceae	Diabetes, in anemia, as a	S	-	-	-	-	-	-	-	-	n
Willd.	Mom / Axquiote, Guatotole	"vitamin"	T	a	a	n	a	-	n	-	-	a
Teloxys ambrosioides L.	Chenopodiaceae	Parasites	S	st	-	-	st	-	st	-	-	st
	Epazut / Epasote		T	-	st	st	-	-	-	g	g	st
Wimmeria bartlettii	Celastraceae	Menstrual problems,	S	-	-	-	-	-	-	-	-	n
Lundell	/ Canserina	gastritis	T	a	a	sb	b,a	n	sb	a	-	a
Zanthoxylum caribaeum	Rutaceae	Diarrhoea, dysentery, gastritis,	S	-	n	-	(n)	-	-	-	-	n
Lam.	Apitx cuy / Tachuelillo	rhenal disfunction, menstrual problems	T	a,b	-	b	n	sb	b	a,b	a,b	a,b

a = astringent, b = bitter, ba = bad, sba = slightly bad, g = good, n = no smell/taste, s = slight smell/taste, sa = slightly astringent, sb = slightly bitter, st = strong, so = sour, sw = sweet, - = no data, (x) = excluded data

Medicinal vs. non-medicinal plants – a comparison

In a further analysis, we looked at the frequency by which a certain species was classified as having taste or smell in a group of 26 medicinal plants versus 14 non-medicinal ones, selected by the same group of healers. We were interested, whether there is a statistically significant difference between the two groups of plants with respect to the emic taste and smell classification. For this evaluation, some of the very specific descriptions (smell like mango) had to be classified into more common categories like "slight" or "good" taste/smell (Table 1 & 2). All informants (as well as the first author) tested the plants by chewing them briefly. Overall, we recorded 189 responses for the group of medicinal plants (26 species) and 122 for the group of non-medicinal plants (14 species). As explained before, not all data were included in the analysis; (i) in the group "medicinal plants", 174 responses were included, whereby only 24 responses (14%) make reference to an indifferent taste and/or smell for the samples tested; and (ii) in the group "non-medicinal plants", 99 responses were included, whereas 57 (56%) refer to an indifferent taste/smell.
On the basis of these data (Tables 1 and 2) we performed a chi-square (χ^2) test yielding a value of 58 (Table 3). The 0-hypothesis (no difference between the two groups) was rejected with $\alpha = 0.01$, and the corresponding border of significance of 6.63 (cf. Lorenz 1988). The fact that χ^2 is about 8 times higher than the corresponding border of significance shows that the selection of medicinal plants is closely correlated with the organoleptic properties of these species. This is a highly significant association between organoleptic properties and the use of these species as medicine.

Table 3.

	taste/smell	no taste/smell	total
Medicinal plants	150	24	174
Non-medicinal plants	42	57	99
Total	192	81	273

$\chi^2 = 58$; $P < 0.0001$

In the group "medicinal plants", astringent and bitter taste properties were most frequently mentioned. Out of 127 responses to taste qualities 53 referred to astringency and 43 to bitterness, partly due to the fact that plants are frequently used in the treatment of gastrointestinal disorders. In addition, it is noteworthy

that in case of the qualities astringent and bitter, the informants showed a high degree of agreement with respect to the indication mentioned. For example, *Psidium guajava* and *Quercus oleoides* (bark) are classified as astringent, *Aloe* sp. as bitter (see Table 2). The latter case is also of interest since it shows that – not surprisingly – the informants also tend to give value judgements about the properties of the species (it is considered to have a "bad" smell and taste).
If a species which is currently not used medicinally showed some interesting taste or smell properties, informants sometimes considered this species as a potential medicinal. For example, when Leopoldo Martinez Lazaro (a local healer) tested the bark of *Ulmus mexicana*, which is not used medicinally by the Popoluca (Table 1) he noted that it is astringent (tu'n tu'n) and it, therefore, could serve against diarrhoea or dysentery. "Of course one would have to boil it....but since there are plenty of astringent plants we don't use this one".

The humoral system of the Popoluca

Concerning the ascribed humoral properties of plants, the remedy must have an opposing effect (as they are defined culturally) to the state of the ailment or illness (see Leonti et al. 2001).
A humorally hot property, expressed as also by using organoleptic labels like bitter and red is used to cure ailments such as stomach-ache, colics, pain in general, menstrual problems and others, which are thought to be provoked by cold agents. On the other hand, the humorally cold thermal property is inherent in green (especially big and watery) leaves and in the sour organoleptic property, and implies for instance uses for treating fever, a symptom caused by hot agents.
Astringency is perceived as being more or less normal and is closely correlated with uses against diarrhoea, dysentery and the treatment of fresh wounds in general and is not associated with a humorally hot or cold, but with a normal state. The sweet and the salty sensation were not found to be classified consistently.
Considering these aspects it seems that the organoleptic properties (taste, smell and visual interactions) and the humoral system (hot/cold sensation) condition each other. However, organoleptic properties can be objectified more easily (the 1st author had similar sensations) and could well be shared *inter*-culturally, while the humoral classification is culture-specific.

Conclusion

Our investigations show that the Popoluca have well defined concepts about medicinal plants, and that the organoleptic properties of plants are used to structure this part of their natural environment. These properties also help mnemonically if one requires a remedy for a certain illness. A phytochemical discussion of these properties is beyond the scope of this paper (cf. Leonti et al. 2001).

Unfortunately, it is not possible to deduce the origin of plant uses in ethnobotanical research. Thus, both the questions: "How came a plant to be used?" and "Why is a plant used in the treatment of a certain illness" can only be answered partially. It seems very likely that taste and smell as well as visual characteristics were important in the selection of the plants which are today used by the Popoluca. However, we cannot prove a causal relationship. The relationship between organoleptic properties and medicinal use is best expressed by Leopoldo M. L.: "Plantas que no tienen esencia, sea olor, amargo, amarativo o agua no tienen propiedad" (Plants which do not have an essence, whether it is smell, bitter, astringent or a liquid [i.e. a liquid exudates or plant sap] do not have [medicinal] properties).

Cultures constantly change and in recent decades the rate of change has accelerated drastically. We noticed that the hot/cold classification is no longer used by all members of the group, and with the loss of native traditions including the native language, the future use of medicinal plants by the Popoluca as well as its cognitive base is destined to change drastically.

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13

Antiquity of Medicinal Plant Usage in two Macro-Mayan Ethnic Groups (México)

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Abstract

In the biological sciences the use of medicinal plants in indigenous cultures is commonly seen as being based on a long tradition ('traditional medicine'). However, under normal circumstances, ethnobotanical studies cannot provide evidence on the antiquity of specific uses for medicinal plants since oral traditions have a limited historical depth and archaeological evidence does not provide evidence for the specific medicinal use of a certain plant.

Here, we provide evidence for the antiquity of medicinal plant use in the Olmec region in Mexico by comparing the pharmacopoeias of the linguistically related Lowland Mixe and Zoque-Popoluca. These cultures, separated for about 2000 years, have cognates for vernacular medicinal plant names in common. For fifteen species such cognate names were detected. Also, a statistically significant segment of the medicinal flora is used for similar purposes. Overall, 123 species are shared between the two groups and of these 62 have a similar usage. In nine cases they also have a similar name. These findings make a transmission of such knowledge since the time of the Olmecs highly likely.

Resumen

El uso de plantas medicinales por culturas indigenas es considerada por las ciencias biologicas de eser basado sobre una larga tradición (medicina tradicional). Sin embargo estudios etnobotanicos non pueden aportar pruebas por la antiguidad de usos especificos de plantas medicinales porque tradiciones orales tienen una profundidad historicalmente limitada y evidencias arqueólogicos non pueden aportar la prueba para el uso especifico de una cierta planta tampoco. Con este contributo aportamos la evidencia por la antiguidad del uso de plantas medicinales en la region Olmeca en Mexico comparando la farmacopea de los dos linguisticalmente relacionados Mixe de tierra baja y de los Zoque-Popoluca. Estas culturas separadas por aproximadamente 2000 años tienen cognates para nombres comunes de plantas en común. Para 15 especies nombres similares han sido detectado y un segmento de la flora medicinal es usada para una indicación similar. Los dos grupos étnicos usan en total 123 especies en común y de estas 62 especies tienen un uso similar. Además, en nueve casos tienen también un uso similar. Estos resultados favorecen la posibilidad de la trasmissión de la sabiduría sobre plantas medicinales desde el tiempo de los Olmecas considerablemente.

Introduction

It is generally assumed that the use of medicinal plants in indigenous cultures is based on a long tradition ('traditional medicine'). However, for cultures with no written records there is practically no evidence available to establish the historical depth of traditional medicinal plant use (Cox, 2000, cf. Pieroni et al, 2002). While archaeobotanical research may provide evidence for the use of food plants widely used in a society and stored so that remains may be detected (e.g. cacao; Hurst et al., 2002) it cannot answer the question of the historical depths of medicinal plant use since archaeobotany does not provide evidence for a specie's medicinal use (Leroi-Gourhan, 1975) and it is in fact difficult to establish the exact use context of such findings (Sommer, 1999). Archaeological relicts, comprising dried plant material together with human arts in forms as paintings, rock carvings, amulets, ceramic artefacts, stone figurines and monuments exist from whose depictions the use of plants for magico-religious ceremonies unambiguously can be derived (Schultes, 1998). Overall, proof exists only for some isolated and important species used as stimulants and hallucinogens but not for medicinal plants in their narrower sense.

Establishing the historical depth of medicinal plant use is relevant from a variety of perspectives. Not only would it show unambiguously that indigenous cultures have an *in depth knowledge of certain botanical taxa, which has been transmitted over centuries* prior to it becoming important in the context of developing novel pharmaceuticals or nutraceuticals, but as importantly, such research would demonstrate the historical development of an *intricate relationship between a culture and its environment* (Posey, 2002a). Local knowledge of indigenous peoples includes information about the ecosystem in general, but also about specific plants used as medicine, food, building material and the like. In view of the rapid loss of such knowledge both the documentation of this knowledge as well as a better understanding of its botanico-historical roots has become an essential task of ethnobiology.

Two independent ethnobotanical studies (Heinrich et al., 1992, Leonti et al., 2001) have resulted in detailed understanding of the medicinal plant use in selected Lowland Mixe and Zoque-Popoluca communities in the Isthmus of Tehuantepec, México. The two cultures have not been in direct contact for many centuries and live in similar ecological environments.

Both their languages belong to the Macro-Mayan linguistic stock, which also includes Yucatec Maya and Tzotzil of Highland Chiapas. The northern part of the Isthmus, including the current settlement area of the Zoque-Popoluca, was the Olmecs' homeland (1500-300 BC). The Olmecs were one of the first cultures in Mesoamerica with permanent monuments and influenced many of the subsequent cultures in Mesoamerica. Deciphered epi-Olmec hieroglyphic writings dated to 160 A.D. and assigned to an early form of Zoque implicate that the Lowland Mixe and the Zoque-Popoluca have been separated prior to this date (Justeson and Kaufman, 1993). Thus, two cultures have been without direct contact for about two millennia and only during the last century has some indirect contact been possible. The development of telecommunication and transport infrastructures in the lowlands of México, especially since the 1950's, has increased the contact of both peoples with the dominant Mexican Mestizo culture, but direct contact between the two cultures is still extremely rare.

Background and Methods

Ethnobotanical background

Mixe and Popoluca inhabit two areas in the Mexican states of Oaxaca and Veracruz, respectively. Their subsistence is based on shifting and seasonal cultivation (corn), cash cropping (coffee, citrus fruits), gathering and wage labour.

The Popoluca

The Popoluca live on the southern and western slopes of the Sierra Santa Marta, a range of volcanoes between the Lake of Catemaco and the gulf shore. These volcanoes form the southern foothills of the "Sierra de Los Tuxtlas" mountain range, a region particularly well known for its biodiversity: the holarctic and neotropical floristic kingdoms overlap here. In a recently published list (Ramirez, 1999), 2.400 species were recorded, but there are probably at least 3.000 species growing in the Sierra (Chevalier and Buckles, 1995 and references therein). Important vegetation zones include the tropical montane cloud forest, the tropical rain forest and a semi-dry oak forest.

The data on the Popoluca were collected in the subdistrict (municipios) of Hueyapan de Ocampo in southern Veracruz from March 1999 to July 2000 as

well as in Sta. Rosa Loma Larga. Fieldwork was conducted during 16 months and focused on collecting information on the medicinal plant use and general ethnographical (background) data as well as on the preparation of dried herbarium specimens and the collection of samples for further phytochemical analysis. The research was conducted with permit No. DOO. 02.-1750 obtained from the Instituto Nacional de Ecología, Secretaría de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP). Complete sets of voucher specimens (Leonti 1-599) are deposited at the National Mexican Herbarium MEXU (UNAM, México, D.F.), the Herbarium-Hortorium of the Colegio de Postgraduados de Chapingo CHAPA (Texcoco), IMSS-M (Instituto Mexicano del Seguro Social, México, D.F.), Instituto de Ecología (Xalapa), the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, Univ. London and the ETH Zurich (CH). Identification was largely conducted at MEXU and the Colegio de Posgraduados de Chapingo, in many cases with the help of specialists from these institutions.

The Mixe

The land of the Mixe extends mostly through the cool and humid mountains of the *Sierra de Juarez* in the Mexican state of Oaxaca. *San Juan Guichicovi* is the only Mixe-speaking community in the subtropical *Istmo de Tehuantepec*. It is the principal community (*cabecera*) in a subdistrict (*municipio*) of the same name. In 1980, the *municipio* had 20,000 inhabitants, while the *cabecera* 5,500 to 6,500 (Heinrich et al., 1992). The data were collected from November 1985 to March 1986 and during several short stays thereafter.

The original vegetation in the region is tropical ombrophilous forest (broad-leaved cloud forests and montane forests) in the humid lowlands to the east and north, and drought deciduous lowland (and submontane) forest in the south. Most of the study area was originally covered by evergreen conifer and oak forest (with *Pinus oocarpa* Schiede and other *Pinus* spp., Pinaceae; *Quercus* spp., Fagaceae) as well as (sub-)-tropical evergreen, partly submontane (broad-leaved) seasonal forest types (with *Manilkara zapota* (L.) P. Royen, Sapotaceae; *Coccoloba barbadensis* Jacq., Polygonaceae; *Enterolobium cyclocarpum* (Jacq.) Griseb., Mimosaceae). In higher elevations tropical ombrophilous forests replace the above mentioned vegetation types (Frei et al., 2000).

This primary vegetation has been modified by indigenous manipulation for at least 600 years. Since no archaeological studies have been conducted in the area, the occupation prior to the historical record is uncertain. The current

vegetation is heavily influenced by the agricultural activities of the Mixe and Popoluca as well as neighbouring groups.
Complete sets of voucher specimens for this collection are deposited at MEXU, IMSS-M, and the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, London.

Comparative analysis

In order to allow for a cross-cultural comparison, the ethnobotanical reports were separated into 13 categories of use (CoU), sorting the illnesses into well-defined ethnomedical groups, e.g. dermatological, gastrointestinal illnesses (Table 2). These may differ in importance between the Zoque-Popoluca and the Lowland Mixe and one plant may be used for more than one CoU.
Using the statistic software "R" (also known as "GNU S", a language and environment for statistical computing and graphics, www.gnu.org) we tested for the statistical probability of getting at least one match with a certain CoU in the two cultures per plant species.
On the base of the proportions of the use categories the probability (p) of striking the same category of use in both pharmacopoeias was tested for each of the 123 plant species. If a plant species is assigned to more than one use category in either or both ethnic groups the probability of striking at least once the same use category gets higher.
The probabilities (p) of all plant species to share at least one use category were summed up. The result reflects the amount of matches to be expected if the two ethnic groups would share the plants at random. The statistical method chosen did not allow us to take the existing double matches (2 or 3 strikes in either ethnic groups) into account which would have yielded a lower p (for the distinct cases) and fewer matches to be expected in total. The statistically relevant range (95% confidence interval) is defined as the expected value +- two times the standard deviation. Variance is obtained if p*(1-p) is calculated for each of the 123 cases (plants) and then is summed up (Stahel, 1999).

Results and Discussion

The ethnopharmacopoeias of the two groups have 123 out of 600 (Zoque-Popoluca) and 215 (Lowland Mixe) documented medicinal plants in common. Table 1 summarises the data on fifteen species for which cognate names (i.e. words related in origin) were detected. These are species which are named and used in a similar way by both ethnic groups. In nine cases they also have a similar usage. Clearly most of the names [cuma (P) / cum (M), tsëk / tsëk, pixtyiñ / pix ti'ink, ëkë / ëëk, panats / pa'ants, tyiñcuy / tsiin, mok / mëëk] are morphemes (i.e. words which cannot be divided into smaller meaningful units) and knowledge about these plants goes back at least two millennia.

Some other ones are descriptive and make reference to the habitat [tsa ay / tsak aay - herb of the stone, xoj muk - oak herb, i.e. grows near *Quercus* spp.], the taste [tam huñi - bitter gum / poop taam ujts - white bitter herb] or smell [patscang ay / pats ujts - skunk leaf / herb], the form of the fruit [më aktsa - deer testicle / atsëm tu'ty - pig testicle], or its usage [tsus cuy / tsusxp - snake plant]. While in some of the latter cases it is difficult to ascertain, whether these species are part of the common heritage, the similarity in usage and the detailed observation of the environment common in indigenous cultures clearly point to a common base. In other articles we have argued that, for example, taste, and smell are important selection criteria in indigenous cultures like the Popoluca (Leonti et al., 2002), as well as the Mixe (Heinrich, 1998).

For *Ceiba pentandra*, the mythical tree of the Maya, cognates (Pixtyiñ, (P) / Pix ti'ink, (M)) are employed in both languages, but the medicinal uses differ pointing to an independent development in both ethnobiological traditions. Some striking similarities exist even with the Yucatec Maya, who, for example, name *Diphysa carthagenenis* as Susup / Ts'us'uk and also use it in the treatment of snake bites (Ankli et al., 1999) (Table 1).

Table 1.
Popoluca and Mixe plant species with similar names.

Latin Binominal	Popoluca name	Main Use(s), Popoluca	Mixe name	Main Use(s), Mixe
Acacia cornigera	juan apitx	gyna	juag aptx (horn of the cow)	derm
**Acrocomia mexicana*	cuma	gast (diarrhoea) / anemia	cum	gast (parasites)
Anthurium schlechtendalii	tsa ay (herb of [on] the stone)	urol / derm	tsak aay (herb of [on] the stone)	gyna
**Bursera simaruba*	tsëk	fever / gast	tsëk	fever
**Calea zacatechichi*	tam huñi (bitter gum)	gast (stomach-ache, diarrhoea) / derm / resp (cough, asthma) / gyna	poop taam ujts (white bitter herb)	gast (stomach-ache) / fever
Ceiba pentandra	pixtyiñ	cult (to gain weight)	pix ti'ink	derm
**Croton repens*	xoj muk (oak herb), xoj kobak (oak head)	gast (diarrhoea) / ophtalmological ailments	poop tsaxoj (white stone oak)	gast (dysentery)
**Diphysa* sp.	tsus cuy	snake bites	tsuxp	snake bites
**Guazuma ulmifolia*	ëkë	gast (diarrhoea) / gyna / derm (wound washing)	ëëk	gast (diarrhoea)
**Heliocarpus donell-smithii* & H. *americanus*	panats ([the] slippery)	derm (wounds, pustules)	pa'ants	derm (wounds)
**Quercus oleoides* & *Qu.* spp.	pop soj (white oak)	gast (diarrhoea) / gyna (haemorrhages)	pop xoj (white oak)	gast (diarrhoea) / gyna (haemorrhages)
Petiveria alliacea	patscang ay (skunk leaf)	skmu / cult (against black magic)	Pats ujts (skunk herb)	resp (cough, asthma)
**Pinus oocarpa*	tyiñcuy	derm (infections) / resp (cough) / cult (ritually)	tsiin	derm (infections) / resp (cough) / cult (ritually)
Thevetia ahouai	më aktsa (deer testicle)	derm / skmu	atsëmtu'ty	toothache
Zea mays	mok	gyna / urol	mëëk	gast

derm = dermatological / gast = gastrointestinal / gyna = gynaecological / urol = urological / cult = cultural syndrome / resp = respiratory / skmu = skelto-muscular

*With shared use and name

In other cases we documented different names but a specific medical usage is common to both cultures (Appendix 1). A particularly striking example is provided by two collections of *Crotalaria* (Fabaceae, s.str) - *C. cajanifolia* (Lowland Mixe) and *C. sagittalis* (Zoque-Popoluca), which share a very specific and unique usage: to prevent children from urinating into the bed.

Many other examples of common usage point to a common history in many of these medicinal plants.

Tables 2 and 3 provide the basic date required for the statistical analysis. In Table 2 we present the relative proportion of the 13 categories of use within the two ethnic groups according to the number of plant species assigned to each group. Table 3 shows the probabilities of getting at least one match for the distribution patterns of use categories as outlined in the table for the two ethnic groups. This results in an anticipated number of species with a shared use in the two ethnic groups if these uses are distributed at random. According to the statistical analysis randomly distributed plant uses predict a value within the range of 35 ± 2 x 4.5 matches (95% confidence interval). The fact that our comparison of the 123 shared plant species yielded 62 species with at least one common use indicates that pure coincidence can be excluded to explain this finding. This result is a highly significant indicator for a common cultural heritage and/or common selection criteria for plants used as a medicine (Leonti et al, 2002).

Table 2.

Relative proportion of the 13 categories of use within the two ethnic groups according to the number of plant species assigned to.

Categories of use	Abrev.	Popoluca	Mixe
Diseases of the skin	(DERM)	21.7	20.0
Gastrointestinal disorders	(GAST)	18.5	20.6
Gynaecology	(GYNA)	12.6	11.8
Fever and headache	(FEVE)	8.5	16.5
Urological problems	(UROL)	7.7	1.9
Venomous animals	(VENO)	5.8	0.9
Culture bound syndromes	(CULT)	5.4	8.4
Respiratory complaints	(RESP)	4.9	6.2
Skeleto-muscular disorders	(SKMU)	4.7	5.0
Problems of the ear		1.6	1.9
Problems of the eye		1.2	0.3
Toothache		1.2	2.2
Others		6.2	4.3

Table 3.
Probabilities for at least one match for the distribution pattern of use categories

Popoluca	Mixe	Probability to get at least one match
1	1	10.6%
1	2	20.6%
1	3	30.7%
1	4	40.1%
1	5	48.5%
2	1	21.0%
2	2	38.7%
2	3	53.6%
2	4	65.9%
2	5	75.2%
3	1	30.8%
3	2	53.6%
3	3	70.1%
3	4	81.3%
3	5	89.0%
4	1	40.2%
4	2	66.2%
4	3	81.6%
4	4	90.7%
4	5	95.5%
5	1	49.2%
5	2	75.9%
5	3	89.4%
5	4	95.6%
5	5	98.5%

This study thus identifies a small, but highly conserved group of medicinal plants which are part of the medico-botanical heritage of these two Macro-Mayan groups. This group of medicinal plants very likely belonged to the pharmacopoeia of a proto-Mixe / Zoque culture. Combining linguistic evidence and current ethnobotanical data, this study opens a novel corridor to the past and provides evidence for the antiquity of medicinal plant usage in the Olmec region.

Conclusions

To our knowledge it is the first study which employs a botanico-linguistic approach in order to better understand the plant use in cultures without written history. Our study thus contributes both to a better scientific understanding of the use of botanical resources by indigenous groups like the Popoluca and Mixe, but also offers a method for contextualising indigenous knowledge about botanical resources (Posey, 2002b). This botanical knowledge may no longer be as central to the Popoluca and Mixe as it was just a few decades ago and botanical anthropology is faced with the challenge of understanding as much of this knowledge as soon as possible, and also we need to support these cultures in passing this local knowledge on to future generations. However, this challenge is not just one for a few specialists but for all researchers interested in biological and cultural diversity.

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Appendix 1: Popoluca and Mixe medicinal plant species with similar uses (total 62).

Acosmium panamense (Benth.) Yakovlev (RESP-GAST-GYNA) *Acrocomia mexicana* Karw. ex Mart.(GAST) *Adiantum princeps* T. Moore (P) / *Adiantum tenerum* Sw. (M) (GYNA) *Annona muricata* L. (GAST) *Bixa orellana* L. (FEVE) *Bursera simaruba* (L.) Sarg. (FEVE) *Byrsonima crassifolia* (L.) Kunth (GAST-GYNA) *Carica papaya* L. (GAST) *Cassia moschata* Kunth (P*) / *Cassia fistula* L. (M) (RESP) *Chamaecrista hispidula* (Vahl) H. S. Irwin et Barneby (GYNA) *Chaptalia nutans* (L.) Pol. (DERM) *Cissampelos pareira* L. (GAST) *Crescentia cujete* L. (GYNA) *Critonia quadrangularis* (DC.) R. M. King et H. Rob. (SKMU) *Crotalaria sagittalis* L. (P) / *Crotalaria cajanifolia* Kunth (M) (UROL) *Croton repens* Schltsl. (GAST) *Diphysa americana* (Mill.) M. Sousa (P) / *Diphysa carthagenensis* Jacq. (M) (VENO) *Eryngium foetidum* L. (GAST) *Eugenia acapulcensis* Steud. (GAST) *Gliricidia sepium* (Jacq.) Steud. (FEVE) *Gouania polygama* (Jacq.) Urb. (DERM) *Guazuma ulmifolia* Lam. (GYNA-GAST) *Heliocarpus americanus* L. (DERM) *Heliotropium indicum* L. (DERM-GYNA) *Hymenaea courbaril* L. (RESP-GAST) *Hyptis verticillata* Jacq. (GAST-FEVE) *Jatropha curcas* L. (DERM) *Kalanchoe pinnata* (Lam.) Pers. (FEVER) *Koanophyllon albicaule* (Sch. Bip. ex Klatt) R. M. Krug et H. Rob. (CULT) *Lippia alba* (Mill.) N. E. Br. (GYNA-GAST) *Loxothysanus sinuatus* (Less.) B. L. Rob. (DERM) *Ludwigia octovalvis* (Jacq.) P. H. Raven (DERM) *Machaerium floribundum* Benth. (DERM-GAST) *Malvaviscus arboreus* Cav. (GAST) *Miconia albicans* (Sw.) Triana (DERM) *Mimosa pudica* L. (CULT) *Muntingia calabura* L. (VENO) *Musa* sp. (GAST) *Myroxylon balsamum* (L.) Harms (SKMU) *Parmentiera aculeata* (Kunth) Seem. (RESP) *Parthenium hysterophorus* L. (SKMU) *Pavonia schiedeana* Steud. (FEVE) *Persea americana* Mill. (GAST-GYNA) *Phoradendron quadrangulare* (Kunth) Griseb. (P) / *Phoradendron piperoides* (Kunth) Trel. (M) (DERM) *Pinus oocarpa* Schiede ex Schltdl. (DERM-RESP) *Piper auritum* Kunth (DERM) *Pluchea symphytifolia* (Mill.) Gillis (GYNA-GAST-DERM) *Plumeria rubra* L. (FEVE) *Psidium guajava* L. (GAST) *Psidium guineense* Sw. (GAST) *Quercus glaucescens* Humb. et Bonpl. (GYNA-GAST) *Quercus oleoides* Schltdl. et Cham. (GAST) *Russelia sarmentosa* Jacq. (GAST) *Salvia xalapensis* Benth. (DERM) *Sambucus mexicana* C. Presl ex DC. (RESP) *Scoparia dulcis* L. (DERM) *Spondias purpurea* L. (GAST) *Tagetes lucida* Cav. (GAST) *Teloxys ambrosioides* L. (GAST) *Tithonia*

diversifolia (Hemsl.) A. Gray (DERM-SKMU) *Xanthosoma robustum* Schott (DERM) *Zea mays* L. (UROL)

* - (P) - Popoluca, (M) - Mixe

Appendix 2: Popoluca and Mixe medicinal plant species with different uses (total 61).

Abelmoschus moschatus Medik. *Acacia cornigera* (L.) Willd. *Andira galeottiana* Standl. *Annona purpurea* Moc. et Sessé ex Dunal *Annona reticulata* L. *Anthurium schlechtendalii* Kunth *Artemisia ludoviciana* Nutt. *Asclepias curassavica* L. *Begonia heracleifolia* Schltdl. et Cham. *Biophytum dendroides* (Kunth) DC. *Buddleia americana* L. *Calea ternifolia* Kunth = *zacatechichi* Schltdl. *Calea urticifolia* (Mill.) DC. *Capsicum* sp. *Cecropia obtusifolia* Bertol. *Cedrela odorata* L. *Ceiba pentandra* (L.) Gaertn. *Cochlospermum vitifolium* (Willd.) Spreng. *Critonia morifolia* (Mill.) R. M. King et H. Rob. *Curatella americana* L. *Datura stramonium* L. *Desmodium incanum* DC. *Doliocarpus dentatus* (Aubl.) Standl. *Enterolobium cyclocarpum* (Jacq.) Griseb. *Epaltes mexicana* Less. *Erythrina* sp. *Gnaphalium attenuatum* DC. *Impatiens balsamina* L. *Lantana camara* L. *Lantana trifolia* L. *Lygodium venustum* Sw. *Mirabilis jalapa* L. *Momordica charantia* L. *Nicotiana* sp. *Ocimum micranthum* Willd. *Passiflora foetida* L. *Pedilanthus tithymaloides* (L.) Poit. subsp. *tithymaloides Peperomia tetraphylla* (G. Fost.) Hook. et Arn (P) *Peperomia quadrifolia* (L.) Kunth (M) *Petiveria alliacea* L. *Pimenta dioica* (L.) Merr. *Piper aduncum* L. *Piper amalago* L. *Pityrogramma calomelanos* (L.) Link *Porophyllum ruderale* (Jacq.) Cass. *Sechium edule* (Jacq.) Sw. *Senna occidentalis* (L.) Link *Senna spectabilis* (DC.) H. S. Irwin et Barneby *Sida acuta* Burm. f. *Sida rhombifolia* L. *Siparuna andina* (Tul.) A. DC. *Solanum schlechtendalianum* Walp. *Solanum torvum* Sw. *Stachytarpheta jamaicensis* (L.) Vahl *Tabebuia rosea* (Bertol.) DC. *Tabernaemontana alba* Mill. *Tagetes erecta* L. *Tagetes filifolia* Lag. *Thevetia ahouai* (L.) A. DC. *Turbina corymbosa* (L.) Raf. *Ximenia americana* L. *Zamia loddigesii* Miq.

Note: Excluded from both appendices are plants introduced from outside of neotropical America (e.g. *Allium sativum* - garlic)

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Medicinal Flora of the Popoluca, México: A Botanico-Systematical perspective

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Abstract

We studied the medicinal plants used by the Popoluca of the Sierra de Santa Marta (Eastern Mexico). Using Moerman's method of regression analysis we determined which ethnomedically used taxa are over-represented in the Popolucan pharmacopoeia (e.g. Asteraceae) and which are underrepresented (e.g. Orchidaceae). Moerman et al. found high correlation between the holarctic pharmacopoeias and assume that apart from the relatedness of the northern floras a "global pattern of human knowledge" may account for this finding. The Popoluca who dwell in a habitat dominated by neotropical flora but intermixed with important holarctic elements include considerably fewer neotropical taxa in their pharmacopoeia as one would expect if not historical transmitted knowledge would influence their selection. This finding confirms the theory stated by Moerman et al. However, the Popoluca include some neotropical taxa in their pharmacopoeia and thus a moderate correlation exists between the Popolucan pharmacopoeia and the neotropical pharmacopoeia analysed by Moerman et al. We therefore conclude that apart from historically transmitted knowledge about specific taxa the "global pattern of human knowledge" addressed by Moerman et al. is as well based on "common selection criteria".

Resumen

Estudiamos las plantas medicinales que usan los Popolucas de la Sierra de Santa Marta, Veracruz, en el oriente de México. Aplicando el método de análisis de regresión de Moerman, determinamos cuales taxa utilizados etnomédicamente están sobre-representados (p. ej. Asteraceae) y cuáles taxa están sub-representados (p. ej. Orchidaceae) en la farmacopea Popoluca. Moerman y colaboradores encontraron una alta correlación entre diversas farmacopeas holárticas y supone que este hecho se debe a la semejanza de las floras boreales y a la existencia de un "cuadro común de sabiduría humana". Los Popolucas, quienes viven en un medio ambiente dominado por la flora neotropical mezclada con elementos boreales, incluyen menos taxa neotropicales en su farmacopea de lo que se hubiera esperado. Este resultado apoya la teoría expresado por Moerman et al. sobre la influencia de un conocimiento de la etnofarmacopea holártica que ha sido transmitido desde tiempos prehistóricos. Sin embargo comprobamos que existe una clara influencia neotropical en la farmacopea Popoluca por lo cual concluimos que además de los conocimientos sobre taxa específicos transmitidos históricamente, el hipotético "patrón común de sabiduría humana" citado por Moerman et al. se refiere también a "criterios comunes de selección".

Zusammenfassung

Während einer ethnobotanischen Feldstudie untersuchten wir die Medizinalpflanzen der Popoluca in der Sierra de Santa Marta (östliches Mexiko). Wir wandten Moermans Methode der Regressionsanalyse an, um die ethnomedizinisch überrepräsentierten (z. B. Asteraceae) und unterrepräsentierten Taxa (z. B. Orchidaceae) dieser Ethnopharmakopöe zu bestimmen. Moerman et al., welche eine hohe Korrelation zwischen holarktischen Pharmakopöen fanden, vermuten, dass neben der Verwandschaft der nördlichen Flora ein "globales Muster menschlichen Wissens" für dieses Ergebnis verantwortlich ist. Die Popoluca, welche in einem Habitat siedeln, in dem die neotropische Flora dominiert, aber klare holarktische Einflüsse aufweist, schliessen bedeutend weniger neotropische Elemente in ihre Pharmakopöe mit ein als man erwarten würde, wenn nicht historisch tradiertes Wissen ihre Selektion beeinflussen würde. Dieses Ergebnis bestätigt die Theorie von Moerman et al. Da jedoch in der Pharmakopöe der Popoluca ein bestimmter Teil der neotropischen Flora vertreten ist, besteht eine moderate Korrelation zu der von Moerman et al. analysierten neotropischen Pharmakopöe. Daher schlussfolgern wir, dass das von Moerman et al. vermutete "globale Muster menschlichen Wissens" nebst historisch tradiertem phytomedizinischem Wissen über spezifische Taxa auch auf "gemeinsamen Selektionskriterien" beruht.

Introduction

Research on medicinal and other useful plants used in indigenous societies has been driven by two complementary interests:

- The use of such information for research in the field of the natural sciences, especially with regard to 'new' bioactive natural products derived from plants and the use of plant extracts in primary health care (Heinrich and Gibbons 2001) and
- the interest in better understanding the anthropological basis (if possible on a cross-cultural basis) of the use of these resources by humans and particularly on the rationale(s) behind the selection of these resources (Moerman et al. 1999).

One particularly exciting development which contributes to both lines of investigation is the study of botanico-systematic aspects of plant usage. Dan Moerman (e.g. 1996, 1998 a,b) has developed and used (partially in collaboration with several other scholars) a method which allows for a statistical analysis of ethnobotanical information, given that the number of medically used taxa and the total number of taxa in a certain region is known.
Most of his research focuses on the North temperate region of North America, but also on three additional northern (Kashmir, Korea, Chiapas) and one southern hemispheric (Ecuador) ethnopharmacopoeias. Thus only one neotropical lowland region (Upper Napo River valley in Ecuador) is included in his analyses. The main reason for this is a lack of taxonomic and systematic research in such regions. The results of the comparison by Moerman et al. (1999) show that holarctic peoples rely on similar plant families in their health care. The Pearson correlation factors between the holarctic data sets is always higher than 0.6 while the correlation of the Ecuador data set with the holarctic data set is always lower than 0.19 (maximum possible correlation is one, lowest is zero). Moerman et al. (1999) suggest that the relatively high correlation between the holarctic ethnopharmacopoeias and the low correlation between the holarctic pharmacopoeias and the neotropical one is due to the relatedness of the northern floras and the possibility that the knowledge about medicinal plants has been passed on from prehistoric times through space and time. This implies that the peoples entering the New World through the Beringian Street already shared a common idea about medicinal plants with the peoples moving to other areas and remaining on the Asiatic continent. Presumably, three major waves of immigrants populated the Americas. The

first wave was formed by Pre-Mongoloid tribes at around 40'000 BP, followed by Paleo-Mongoloids at 30'000 BP and the Diego-allele positive Neo-Mongoloids at about 9'000 BP (Layrisse and Wilbert 1999). When peoples during their migration to southern America transgressed the border of the holarctic flora into the realm of the neotropical plant kingdom they suddenly were confronted with 'new' plant families and had to adapt themselves and their pharmacopoeia to this new pool of plants.

We have recently completed a detailed study of the medicinal plant use of the Popoluca in southern Veracruz, Mexico (Leonti et al. 2001). The Popoluca inhabit the "Sierra de Santa Marta", a range of volcanoes between the Lake of Catemaco and the gulf shore. These volcanoes form the southern foothills of the "Sierra de Los Tuxtlas" mountain range, a region particularly well known for its biodiversity: the holarctic and neotropical floristic kingdoms overlap here. However, the neotropical influence is stronger than the holarctic one. According to Rzedowski (1991) the overwhelming part of the Mexican flora belongs to the neotropical plant kingdom, even though the pine and oak forests of the Mexican highlands and Chiapas share the northern and southern floral influences at about the same parts. Important vegetation zones in the Sierra de Santa Marta include the tropical montane cloud forest, the tropical rain forest and a semi-dry oak forest.

The study area of about 1350 km^2 lies at altitudes between 0 to 1720 m above sea level. Ramirez R. (1999) published a comprehensive checklist of the flora of the region with records for 2.400 species. Although, it is estimated that about 3.000 species grow in the Sierra (Chevalier and Buckles 1995, p: 182), we consider an evaluation as feasible. This enables an analysis of the use of biodiversity for medical purposes by this indigenous group, which is particularly interesting because the unique composition of the flora including elements from two kingdoms.

Here we report on a regression analysis of the previously published ethnobotanical data. In order to better understand the cultural rational for the ranking of the most salient plant families we analyse for which illness categories the respective plant families are used for, elucidate the phytochemical spectra of these families and highlight ecological and organoleptical characteristics.

Methods

Ethnobotanical Research

The ethnobotanical research was undertaken in the subdistricts (municipios) of "Hueyapan de Ocampo" and "Soteapan" in southern Veracruz from March 1999 to July 2000. Fieldwork was conducted during 16 months and focused on collecting information on the medicinal plant use and general ethnographic (background) data, as well as on the preparation of dried herbarium specimens and the collection of samples for further phytochemical analysis (for details see Leonti et al. 2001; Leonti, Sticher and Heinrich 2002, cf. Ankli, Sticher and Heinrich 1999).

The research was performed with the permit No. DOO. 02.-1750, obtained from the Instituto Nacional de Ecología, of the Secretaría de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP), México. Complete sets of voucher specimens (Leonti 1-599) are deposited at the National Mexican Herbarium MEXU (UNAM, México, D.F.), the Herbarium-Hortorium of the Colegio de Postgraduados de Chapingo CHAPA (Texcoco), IMSS-M (Instituto Mexicano del Seguro Social, México, D.F.), Instituto de Ecología XAL (Xalapa), the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, Univ. London and the ETH Zurich (CH). Identification was largely conducted at MEXU and the Colegio de Postgraduados en Ciencias Agrícolas, Montecillo, Mexico, in many cases with the help of specialists from these institutions. In this contribution voucher specimens are only cited if they have not been reported previously.

Evaluation methods

In order to determine the importance of the medicinal families we used Moerman's (1991) method applying the regression analysis. The families were then ranked according to their decreasing residuals (see appendix), which reflects the proportion of plants used as medicinals in a certain family. The residual is the difference between the number of medicinal species predicted by the regression analysis and the true, ethnographically determined number of medicinal species (Moerman et al. 1999).

Since Moerman et al. used only angiosperm families in his analysis, we decided to do so as well in order to secure the comparability of the set of data. For the same reason some plant families had to be unified: Anthericaceae and Amaryllidaceae into Liliaceae *s.l.*, Phyllonomaceae into Grossulariaceae,

Hypericaceae into Clusiaceae, Mimosaceae, Fabaceae *s.str.* and Caesalpiniaceae into Fabaceae *s.l.*

To determine the relationship between the different floras the Pearson correlation coefficient of the number of species per family was calculated. Similar, the relationship of the different medicinal floras was calculated by the Pearson correlation coefficient of the residuals (see Moerman et al. 1999).

Results and Discussion

The database on medicinal plants of the Popoluca consists of 614 plant species, contributed by 72 informants with a total of 4488 use-reports (Leonti et al. 2001). These taxa belong to a total of 117 out of a total of 174 Angiosperm families recorded for the region (Ramirez R. 1999). According to the residuals of the regression analysis ($y = 0.2716x + 0.1042$) of the "Popolucan ethnomedical flora" the top five families used by the Popoluca are (Table 1):

- Asteraceae
- Piperaceae
- Fabaceae, *s.l.*
- Euphorbiaceae and
- Lamiaceae

Table 1. Position of the five most used families in Veracruz as compared to the dataset from Moerman et al. (1999)

FAMILY	Veracruz	Chiapas[1]	Kashmir[1]	North America[1]	Korea[1]	Ecuador[1]
Asteraceae	1	1	1	1	3	45
Piperaceae	2	105	-	237	89	27
Fabaceae, *s.l.*	3	138	85	253	8	2
Euphorbiaceae	4	21	2	234	13	90
Lamiaceae	5	2	4	8	4	91
Total families	174	144	100	255	136	118

[1] from Moerman et al. 1999

The five families (positions 174 - 170, Table 2) with the lowest level of used species in the regression analysis are:

- Orchidaceae
- Poaceae
- Rubiaceae
- Cyperaceae and
- Moraceae (see appendix).

Table 2. Position of the five least used families from Veracruz as compared to the dataset from Moerman et al. (1999)

FAMILY	Veracruz	Chiapas[1]	Kashmir[1]	North America[1]	Korea[1]	Ecuador[1]
Orchidaceae	174	143	100	245	134	118
Poaceae	173	144	100	255	135	51
Rubiaceae	172	82	9	250	65	109
Cyperaceae	171	142	94	254	136	102
Moraceae	170	113	8	33	21	117
Total families	174	144	100	255	136	118

[1] data from Moerman et al. 1999

It is of considerable ethnobotanical interest to better understand the cultural reasons for a taxon's usage or its avoidance. Reasons for a taxon's ethnomedical importance include, for example:

- Ecological factors, including the importance of some of the taxa as managed house garden plants. If a high percentage of medicinal plants from a certain plant taxon (e.g. Lamiaceae) is cultivated in house gardens many species may well be of particular ethnomedical importance, have further ethnobotanical uses (culinary, ornamental, for construction). Very often such species are hard to find in the natural habitat or are introduced into the region. It is important to note that if the calculation of the regression analysis would have been performed without the introduced species the Lamiaceae would rank 34th and be substituted by the Acanthaceae.
- Phytochemical characteristics of the plant families relating to the presence of pharmacologically active secondary metabolites.
- Organoleptical characteristics of the members of a family (e.g. aromatic species are very prominent in the Lamiaceae; Leonti et al 2002).

In the following the five top and bottom ranked families are discussed separately.

Top ranked families

1. Asteraceae

The Asteraceae are the Popoluca's most frequently used family, and take priority in the illness groups of gastrointestinal disorders, dermatological ailments, skeleto-muscular problems, respiratory ailments and are very important (2nd most often used family) in gynecology (see Table 3). The Asteraceae are phytochemically very diverse and so far at least 7.000 natural compounds have been isolated from chemical classes like sesquiterpene lactones, diterpenes, phenols, and polyenes (Frohne and Jensen 1998). This variety of chemical compounds has been recorded to have a multitude of pharmacological activities including anti-inflammatory, cytotoxic, bactericidal, fungicidal and appetite-inducing properties. The pharmacological properties of the compound classes reflect the broad therapeutic application with the Popoluca and may in part explain the Popoluca's reliance on the Asteraceae.

From the 57 Asteraceae species used seven (12%) are regularly grown in the house gardens for medicinal purposes (*Tagetes* spp., *Artemisia ludoviciana* Nutt., *Porophyllum ruderale* (Jacq.) Cass. / *Leonti 224*). They are mainly introduced species and do not occur spontaneously. The rest of the Asteraceae used by the Popoluca are all weeds and normally gathered in the immediate surroundings of the community.

Asteraceae flower heads are attractive and conspicuous, although there are many species with similar looking (yellow) flower heads and sometimes they are difficult to distinguish. Therefore in folk taxonomy some species are summarised into one taxon.

2. Piperaceae

The Piperaceae are predominantly used to treat dermatological complaints (*Piper* spp., *Potomorphe* sp.) and skeleto-muscular problems (*Peperomia* spp.) like rheumatic conditions. The Piperaceae are rich in monoterpenes, sesquiterpenes, phenylpropanes and amides, with a variety of significant pharmacological effects recorded (Frohne and Jensen 1998). Out of the 22 medicinally used Piperaceae species only *Piper auritum* Kunth is cultivated regularly in house gardens, mainly for culinary reasons to flavour chicken soup, pork stew and pork tamales with its leaves. The main constituent of *P.*

auritum leaves is the cancerogenic safrole and thus may constitute a health risk if consumed excessively.

The genus *Piper* and the genus *Peperomia* are morphologically homogeneous and therefore the species are difficult to separate from each other. In Popoluca folk taxonomy all species from the genus *Piper* except *P. auritum* (Acuyo) are called 'Tooso' and are conceived as having more or less the same virtue. Therefore, the high ranking according to the residual of the Piperaceae seems to be largely due to the inseparability of many of the highly diverse Piperaceae (according to Popoluca concepts) and the Popoluca's indiscriminate use of these species.

3. Fabaceae, s.l.

The Fabaceae, *s.l.* are most important in the illness categories of gynaecology, fever and headache, urological conditions, bites from venomous animals and are second most important to treat gastrointestinal and dermatological complaints. Members of the Fabaceae, *s.l.* are often rich in polyphenoles (tannins and flavonoids) and triterpene saponins (Frohne and Jensen 1998). Especially the Fabaceae *s.str.* used contain many toxic genera and species like *Canavalia* (lectines), *Ormosia* (quinolizidine alkaloids), *Erythrina* spp. (isoquinoline alkaloids), *Crotalaria sagittalis* L. (pyrrolizidine alkaloids). *Mucuna pruriens* (L.) DC. seeds, containing L-DOPA and hallucinogenic tryptamines, are ground, toasted and used as a coffee surrogate which is typical for rural regions in Guatemala and Mexico (Buckles, Triomphe and Sain 1998).

Of the 70 medicinally used Fabaceae, *s.l.* twelve (17%) are cultivated regularly in house gardens, ten of these are trees, having ornamental (*Caesalpinia pulcherrima* (L.) Sw. / *Leonti 118, Senna multijuga* ssp. *doylei* (Britton et Rose) H. S. Irwin et Barneby / *Leonti 70*) or nutritional (*Tamarindus indica* L., *Dialium guianense* (Aubl.) Sandwith / *Leonti 298*) uses, too. *Crotalaria longirostrata* Hook & Arn. (*Leonti 479*) is cultivated and eaten as a vegetable but no soporific (sleep-inducing) effect (as reported by Morton 1994) was mentioned by the Popoluca informants. The frequent use of Fabaceae, *s.l.* for medicinal purposes is probably due to the conspicuous character of many of its species, their abundance, the diversity of highly active chemical constituents and recognisable organoleptic properties (see Leonti, Sticher and Heinrich 2002).

4. Euphorbiaceae

The Euphorbiaceae are predominately used in the illness categories of gastrointestinal disorders, dermatological complaints and urological ailments. Polyphenols (flavonoids and condensed tannins), rubber, different types of alkaloids, cyanogenic glycosides and diterpenes are the main classes of secondary natural products of the Euphorbiaceae (Frohne and Jensen 1998). The genus *Croton*, known to contain toxic diterpene esters is represented with five species in the Popolucan pharmacopoeia.

Of the 26 medicinally used Euphorbiaceae two are cultivated frequently with *Cnidoscolus chayamansa* McVaugh (*Leonti 182*) being primarily used as a vegetable. The Euphorbiaceae have very inconspicuous flowers or inflorescences but the genera are optically separated by well distinguishable morphological characters (herbs, shrubs, trees) and all grow as weeds in the surroundings of the villages. Also the taste and smell characteristics may well be important in selecting and recognising a species.

5. Lamiaceae

The Lamiaceae are used in gynecology and to treat gastrointestinal disorders. Essential oils, tannins, bitter diterpenoids and iridoid glycosides are typical Lamiaceae constituents with antimicrobial, antimycotic, antiviral, anti-inflammatory and choleretic properties (Frohne and Jensen 1998). Of the twelve Lamiaceae included in the pharmacopoeia six introduced species, which do not grow spontaneously are regularly cultivated in the house gardens. *Plectranthus amboinicus* (Lour.) Spreng (*Leonti 253*) is a medicinal plant and an often used spice to flavour meat soups. Neither *Rosmarinus officinalis* L. nor *Ocimum basilicum* L. and *O. micranthum* Willd. (*Leonti 54*) are used in the kitchen.

Table 3. Most commonly used species in the major groups of indigenous use

Group of medical use	No. Taxa	First	2nd	3rd	4th	5th
Dermatology	303	Asteraceae	Fabaceae, s.l.	Rubiaceae	Piperaceae	Euphorbiaceae
Gastrointestinal disorders	251	Asteraceae	Fabaceae, s.l.	Myrtaceae	Lauraceae	Euphorbiaceae / Lamiaceae
Gynaecology	218	Fabaceae, s.l.	Asteraceae	Rubiaceae	Lauraceae	Commelinaceae
Urological problems	157	Fabaceae, s.l.	Zingiberaceae	Euphorbiaceae	Malpighiaceae	Araceae
Venomous animals	121	Fabaceae, s.l.	Aristolochiaceae	Cochlospermaceae	Rubiaceae	Piperaceae
Culture bound syndromes	127	Euphorbiaceae	Lamiaceae	Fabaceae, s.l.	Asteraceae	Rubiaceae
Fever and headache	112	Fabaceae, s.l.	Burseraceae	Anacardiaceae	Acanthaceae	Verbenaceae
Skeleto-muscular disorders	101	Asteraceae	Piperaceae	Meliaceae	Fabaceae, s.l.	Solanaceae / Lauraceae
Respiratory complaints	79	Asteraceae	Fabaceae, s.l.	Malvaceae	Myrtaceae	Verbenaceae

Least used families

1. Orchidaceae

The tubers of this family are best known for their content of starch and glucomannane mucilage. The presence of a variety of alkaloids such as pyrrolizidine and phenylisoquinoline alkaloids has been reported (Frohne and Jensen 1998). The Orchidaceae are important in *none* of the illness groups (two out of 99 species are medicinal). The mucilage of the tubers of *Maxillaria tenuifolia* Lindl. (*Leonti 504*) is used as natural glue in the construction of 'jaranas' (traditional little guitars). The Orchidaceae are often rare, have relatively dispersed and often inaccessible populations, which complicates the acquisition of plant material and moreover (in case of the Popoluca) do not grow as weeds in the secondary vegetation zones around the villages (Stepp and Moerman 2001).

2. Poaceae

Silicate is the main chemical characteristic of this family. Normally low concentrations of coumarin derivatives and cyanogenic glycosides are common, too, (Frohne and Jensen 1998). *Zea mays* L., (corn) is the most widely cultivated plant in the region and in Mexico in general but is used medicinally only very rarely by the Popoluca. In the Popolucan pharmacopoeia the genus *Lasiacis* is used for a special dermatological condition, but as a whole the Poaceae are important in none of the illness groups. Out of 93 reported species five are medicinal and two of these are introduced species cultivated in house gardens: Bamboo, (*Bambusa* sp.) apart from its medicinal usage is primarily used for construction, while *Cymbopogon* sp., rich in essential oils such as citronellal and geraniol, is used to treat gastrointestinal complaints.

While the family is abundant throughout the regions and includes many 'weeds', the species of this family are normally very inconspicuous and difficult to distinguish (especially in the sterile state). This makes them unlikely candidates to be selected as a medicine.

3. Rubiaceae

Characteristic for the members of this family are xanthine derivatives, anthranoids, coumarins, triterpenes, triterpene saponins, proanthocyanidins and indol- and emetane alkaloids (Frohne and Jensen 1998). In the illness categories "dermatological conditions" and gynecology the Rubiaceae are the

third most frequently used family and therefore of considerable importance in the Popoluca pharmacopoeia. *Coffea arabica* L. is cultivated as a cash crop in the higher regions and rarely used as a source of medicine. Of the 26 medicinally used species two are regularly grown in house gardens: *Sickingia mexicana* Bullock (*Leonti 272*) used in gynecology has become a rare species in the past years due to deforestation. Recently midwives began to cultivate this tree, simultaneously securing their medicine and contributing to the protection of biodiversity. *Gardenia* sp. is mainly grown for ornamental reasons but has medicinal uses, too. Some taxa of the Rubiaceae are utilized extensively by the Popoluca (e.g. *Hamelia patens* Jacq used for bleeding wounds and the species with the second largest number of recorded use reports in the whole ethnopharmacopoeia, Leonti et al. 2001), but the fact that the family is represented by many species, of which a overwhelming majority grows in primary forest remote from the Popoluca villages results in a relatively low ranking. Also the Rubiaceae are (especially in the sterile state) very inconspicuous (*Psychotria* spp.), which probably influences the selection (or the lack thereof) of species from this family.

4. Cyperaceae

The Cyperaceae have a similar chemical spectrum as the Poaceae. Silicate, proanthocyanidin and essential oils are the main chemical constituents (Frohne and Jensen 1998). Only two out of 35 Cyperaceae species of this region have medicinal uses but are without importance in the pharmacopoeia of the Popoluca. Again, the lack of usage of this taxon seems to be due to the inconspicuousness of its species. Also, Cyperaceae generally grow in humid and not commonly accessed habitats.

5. Moraceae

The occurrence of latex is very characteristic and it often contains phototoxic furanocumarins and toxic cardenolides (Frohne and Jensen 1998). The Moraceae have no importance in the Popoluca's health care. Out of the 31 reported species three are used medicinally. *Ficus pertusa* L. f. (*Leonti 63*) is sometimes grown in house yards as a medicinal plant and as a fruit tree. The neglecting of the Moraceae may in part be explained by their life form as climbers (*Ficus* sp.) (which does not allow one to distinguish the species even on the basis of their leaves). Also many taxa are abundant in more or less undisturbed forest habitats.

Intracultural ethnopharmacological comparison

Importantly, chemical characteristics seem to be an essential criterion for plant selection. These are based on the perception by the Popoluca on the basis of the taxa's taste and smell properties and their pharmacological effects (as they are seen by the Popoluca). They are essential for selecting and continuously using certain taxa as medicine. The high diversity of secondary compounds, taste and smell properties, but also the distinctive morphology clearly separates the Asteraceae, the Lamiaceae and the Fabaceae, *s.l.* organoleptically from neglected families like the Poaceae and the Cyperaceae. Families with many weedy taxa or ones often cultivated in the back gardens will also be particularly prominent. The first point is best exemplified by the Orchidaceae: the problems in gathering material of a species makes them unlikely candidates for medicinal plants. Both, the Poaceae and Cyperaceae seem to be neglected because they lack conspicuous characteristics which allow an easy distinction between different species. With the Piperaceae and the Euphorbiaceae on the one hand and the Rubiaceae and the Moraceae on the other the differences are not as prominent but point in the same direction.

Intercultural comparison with other regression analyses

The Asteraceae and the Lamiaceae are generally ranked highly in holarctic ethnopharmacopoeias (Moerman et al. 1999). This points to the holarctic character of the Popolucan pharmacopoeia, while the Piperaceae seem to reflect the neotropical influence in the pharmacopoeia. The Fabaceae's (*s.l.*) high ranking with the Popoluca is difficult to analyse (Table 1). They are ranked very low in North American (253rd of 255), Chiapas (138th of 144) and Kashmir (85th of 100), but are the second most used family in Ecuador and are ranked 8th in Korea. Probably the Popoluca's reliance on the Fabaceae, *s.l.* reflects the neotropical influence. The Euphorbiaceae are highly ranked in Kashmir (2nd of 100), Korea (13th of 136) and Chiapas (21st of 144), but surprisingly under represented in North America (234th of 255) and low ranked in the Ecuador (90th of 118) set of data.

Generally, the Poaceae, Cyperaceae and Orchidaceae are selected very rarely (Table 2). The Rubiaceae are ranked 10th in Kashmir but are relatively low ranked in the other sets of data. The Moraceae show a positive residual in North America, Kashmir and Korea, while in Meso- and South America the Moraceae are underrepresented in the medicinal floras (Table 2).

Pearson correlation factor

Not surprisingly the ethnopharmacopoeia (e) and the flora (f) of the Popoluca (southern Veracruz) show the highest correlation (0.81, e and 0.94, f) with the one of the Tzotzil / Tzeltal from highland Chiapas (Table 4). Both ethnic groups live in an area which harbours plant species from the holarctic as well as from the neotropical plant kingdoms, while the neotropical influence is higher in the flora of Veracruz. The most prominent difference is that the Popoluca dwell in the lowland and the Tzotzil / Tzeltal in the highlands. Both groups are part of the Macro-Mayan language stock and are culturally related. The cultural separation may have occurred about 2.500 years ago. The high correlation of their pharmacopoeias probably reflects both the biological relatedness of the area and the common cultural past of the two groups. Generally, the correlation's indicating the relatedness of the Veracruzian flora with the other floras and the correlation of the relatedness of the Popolucan (Veracruzian) ethnopharmacopoeia (with the others) are noteworthy, except for the comparison with the Ecuador data (Table 4). The flora of Veracruz shows a correlation of 0.83 with Ecuador which would predict a correlation of their pharmacopoeias of about 0.75 if the relatedness of their flora would be the only influencing factor. In fact the correlation between the Veracruzian and the Ecuadorian pharmacopoeia lies at the much lower level of 0.36.

The Veracruz (V) and the Chiapas (C) pharmacopoeia have the same performance to the other pharmacopoeias. Both show the highest correlation with Kashmir (0.74 C / 0.62 V) second highest with North America (0.73 C / 0.57 V), third highest with Korea (0.61 C / 0.54 V) and the lowest with Ecuador (0.19 C / 0.36 V). The correlation of the Chiapas set of data to the other holarctic set of data is always higher in respect to the correlation of Veracruz. On the other hand the Veracruz correlation to the neotropical set of data is considerably higher than the one from Chiapas.

The Pearson correlation factors thus show that the "Veracruz flora" is most related to the nearby "Chiapas flora" but is more related to the "Ecuador flora" than to any true holarctic flora. Nevertheless, the Pearson correlation factors of the different pharmacopoeias show that the Popoluca pharmacopoeia is generally more related to the holarctic pharmacopoeias but has a clear neotropical influence.

Table 4. Pearson correlation

Veracruz	Chiapas	Kashmir	North America	Korea	Ecuador
Pearson correl. floras	0.94	0.74	0.68	0.51	0.83
Pearson correl. med. used families	0.81	0.62	0.57	0.54	0.36

Dicotyledons compared to Monocotyledons

The classic (but now controversial) separation of the Angiosperms into Monocotyledoneae (MC) and Dicotyledoneae (DC) allows a useful analysis of still another aspect. Overall the MC seem to be less important as compared to the DC. Again this may well be partly due to the inconspicuousness of many of its taxa. The most prominent members of the MC are the Araceae (rank 8), the Commelinaceae (rank 10) and also the Liliaceae (rank 13), the latter two are families with many very showy species. All three taxa show clear differences in their ethnopharmaceutical uses. We documented 18 MC species used for urological problems (of 62 medicinal MC) with 84 (23.5%) use reports (357 total MC) while 136 (of 535 medicinal) DC species have a total of 253 (6.2%) reports in this group (DC - total number of use reports: 4029). The MC are thus more likely to be selected for urological problems.

On the other hand, out of the 62 medicinal MC species only two (3.2%) with a total of five (1.4%) use reports are used to treat respiratory ailments, while from the 535 medicinal DC 73 species (13.6%) with 198 (5%) use reports were recorded.

Why should a MC be more suitable to treat urologic conditions and less useful to treat respiratory ailments ? The empirical medico-historical experience of an ethnic group is of course an essential basis for this, but at this stage the specific reasons remain speculative. Comparing the MC with the DC, phytochemical as well as organoleptical differences exist: Concerning the phytochemistry the MC in contrast to the DC lack ellagic acid and ellagic tannins, whereas tannins are not common in general, neither are essential oils, polyterpenes and alkaloids. On various occasions in MC steroid saponins occur while the DCs have mostly triterpene-saponins and the mucilage of the MCs lack uronic acid (Frohne and Jensen 1998). Regarding the morphology, the MC distinguish themselves from the DC by not showing secondary growth, having a moderate diameter, an un-branched axis and a watery stem. However, we argue that the different spectra of secondary natural products along with the recorded

pharmacological properties is not sufficient to explain the disequilibrium between these two groups. Such products are responsible for specific organoleptical properties of a botanical drug, a set of criteria which we have previously shown to be an important selection criterion for medicinal plants with the Popoluca (Leonti, Sticher and Heinrich 2002) and other groups (Heinrich 1998, Brett and Heinrich 1998). In the classificatory system of the Popoluca and other peoples all these factors - the organoleptical perception of a plant; the morphological and ecological traits, the characteristics in terms of colour, as well as its smell and taste - are used in combination. In case of the preferential treatment of urological ailments with MC and of the respiratory conditions with DC we consider the organoleptical aspect to be more important than direct pharmacological effects.

Conclusions

The fact that the Popoluca dwell in an area where the neotropical and the holarctic plant kingdoms overlap makes an ethnobotanical together with a botanico-systematic analysis of particular interest. Our study provides additional evidence for the concepts developed by D. Moerman on the reasons for the selection of certain plant taxa as medicines. The Popoluca, respectively the preceding cultures (dwelling in a zone with neotropical as well as holarctic plant taxa) could choose to a certain extent from a similar pool of plant families as the holarctic peoples to compile their pharmacopoeia but moreover had a vast array of neotropical taxa to chose from. The correlation factors show that the Popoluca do prefer and neglect plant families to a similar extent as the holarctic peoples do. Nonetheless, the Popoluca include neotropical plant families in their pharmacopoeia, without being forced by the prevailing flora to do so. The Piperaceae, which are the most salient difference in respect to a 'purely holarctic' ethnopharmacopoeia are used to treat dermatologic conditions. Dermatologic afflictions are very common in the hot and humid lowlands of the tropics. Indeed, based on the number of taxa used and the assigned use-reports, diseases of the skin form the largest group of illnesses with the Popoluca and are the most important illness category (Leonti et al. 2001). Therefore, we suggest that the high prevalence and variance of dermal afflictions in correlation with the altered climatic conditions led to the incorporation of 'new' taxa into the pharmacopoeia. The process that led to the

incorporation of the Piperaceae and other neotropical taxa, is based on the cultural selection criteria including taste and smell properties of plants. We recently demonstrated the importance of such concepts in a completely unrelated group the Arbëreshë in Northern Lucania (Southern Italy, Pieroni et al. 2002) and there too weeds are selected based among others on their taste and smell properties but in the latter case as edible greens. Thus, the common knowledge addressed by Moerman et al. (1999) should be understood apart from the detailed knowledge about useful medicinal taxa to comprehend, "common selection criteria". The origin of "common selection criteria" may be best explained with the similar perceptual appreciation of human beings.

This research also has implication for research focusing on the selection of interesting and relevant ethnomedicinal plant species for phytochemical and pharmacological investigations. Not all plants of an investigated ethnopharmacopoeia fit into the emic classification system. Detecting such outruns and to subject them to pharmacological studies could result in a higher hit rate for promising phytochemical compounds and would at the same time advance our knowledge about such elements of indigenous ethnopharmacopoeias and their pharmacological effects.

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Appendix: Ranked list of residuals per family including the total number of species of the flora of the *Sierra Santa Marta* and the medicinal plants documented.

Ranking	Plant family	Total species	Medicinal spp.	Residual
1	Asteraceae	116	57	25.4026
2	Piperaceae	46	22	9.4076
3	Fabaceae, *s.l.*	226	70	8.5376
4	Euphorbiaceae	70	27	7.8916
5	Lamiaceae	25	12	5.1091
6	Acanthaceae	23	11	4.6521
7	Amaranthaceae	14	8	4.0956
8	Araceae	29	12	4.0231
9	Sapindaceae	19	9	3.7381
10	Commelinaceae	12	7	3.6386

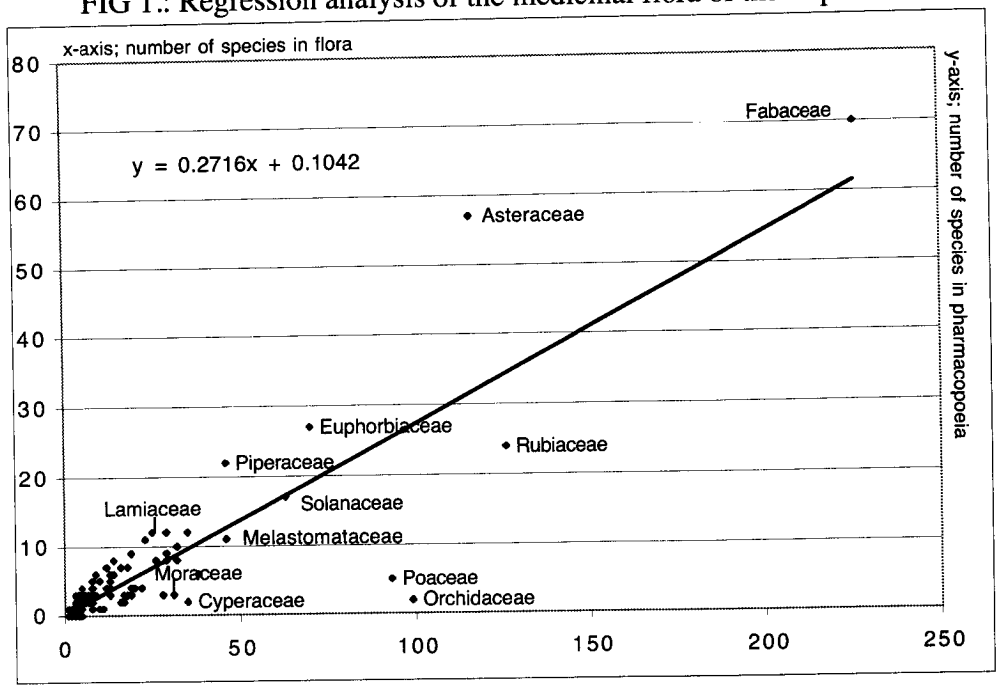
11	Anacardiaceae	9	6	3.4531
12	Aristolochiaceae	9	6	3.4531
13	Liliaceae, *s.l.*	8	5	2.7246
14	Rutaceae	16	7	2.5526
15	Oxalidaceae	5	4	2.5391
16	Malvaceae	35	12	2.3941
17	Sapotaceae	13	6	2.3671
18	Fagaceae	10	5	2.1816
19	Tiliaceae	14	6	2.0956
20	Crassulaceae	3	3	2.0821
21	Cucurbitaceae	18	7	2.0096
22	Chrysobalanaceae	4	3	1.8106
23	Begoniaceae	8	4	1.7246
24	Menispermaceae	8	4	1.7246
25	Phytolaccaceae	5	3	1.5391
26	Rhamnaceae	5	3	1.5391
27	Malpighiaceae	13	5	1.3671
28	Simaroubaceae	6	3	1.2676
29	Verbenaceae	32	10	1.2086
30	Burseraceae	3	2	1.0821
31	Lauraceae	29	9	1.0231
32	Nyctaginaceae	7	3	0.9961
33	Apocynaceae	26	8	0.8376
34	Agavaceae	4	2	0.8106
35	Polygalaceae	4	2	0.8106
36	Rosaceae	4	2	0.8106
37	Smilacaceae	4	2	0.8106
38	Bombacaceae	8	3	0.7246
39	Loranthaceae	8	3	0.7246
40	Marantaceae	8	3	0.7246
41	Zingiberaceae	8	3	0.7246
42	Meliaceae	12	4	0.6386
43	Sterculiaceae	12	4	0.6386
44	Urticaceae	12	4	0.6386
45	Balsaminaceae	1	1	0.6251
46	Basellaceae	1	1	0.6251
47	Bixaceae	1	1	0.6251
48	Caprifoliaceae	1	1	0.6251
49	Chenopodiaceae	1	1	0.6251
50	Cochlospermaceae	1	1	0.6251
51	Cuscutaceae	1	1	0.6251
52	Hamamelidaceae	1	1	0.6251
53	Myricaceae	1	1	0.6251

54	Myristicaceae	1	1	0.6251
55	Proteaceae	1	1	0.6251
56	Punicaceae	1	1	0.6251
57	Turneraceae	1	1	0.6251
58	Valerianaceae	1	1	0.6251
59	Combretaceae	5	2	0.5391
60	Passifloraceae	9	3	0.4531
61	Vitaceae	9	3	0.4531
62	Clusiaceae	13	4	0.3671
63	Alstroemeriaceae	2	1	0.3536
64	Cannaceae	2	1	0.3536
65	Cecropiaceae	2	1	0.3536
66	Magnoliaceae	2	1	0.3536
67	Martyniaceae	2	1	0.3536
68	Musaceae	2	1	0.3536
69	Olacaceae	2	1	0.3536
70	Papaveraceae	2	1	0.3536
71	Plantaginaceae	2	1	0.3536
72	Podostemaceae	2	1	0.3536
73	Apiaceae	6	2	0.2676
74	Loganiaceae	6	2	0.2676
75	Caricaceae	3	1	0.0821
76	Ebenaceae	3	1	0.0821
77	Elaeocarpaceae	3	1	0.0821
78	Portulaccaceae	3	1	0.0821
79	Myrtaceae	29	8	0.0231
80	Celastraceae	7	2	-0.0039
81	Violaceae	7	2	-0.0039
82	Caryophyllaceae	4	1	-0.1894
83	Clethraceae	4	1	-0.1894
84	Dilleniaceae	4	1	-0.1894
85	Monimiaceae	4	1	-0.1894
86	Theaceae	4	1	-0.1894
87	Solanaceae	63	17	-0.2079
88	Polygonaceae	8	2	-0.2754
89	Alismataceae	1	0	-0.3749
90	Balanophoraceae	1	0	-0.3749
91	Betulaceae	1	0	-0.3749
92	Brunellaceae	1	0	-0.3749
93	Cabombaceae	1	0	-0.3749
94	Casuarinaceae	1	0	-0.3749
95	Ceratophyllaceae	1	0	-0.3749
96	Chloranthaceae	1	0	-0.3749

97	Cunoniaceae	1	0	-0.3749
98	Haemodoraceae	1	0	-0.3749
99	Hernandiaceae	1	0	-0.3749
100	Hypoxidaceae	1	0	-0.3749
101	Juncaceae	1	0	-0.3749
102	Lacistemataceae	1	0	-0.3749
103	Lentibulariaceae	1	0	-0.3749
104	Molluginaceae	1	0	-0.3749
105	Najadaceae	1	0	-0.3749
106	Nymphaeaceae	1	0	-0.3749
107	Grossulariaceae	1	0	-0.3749
108	Plumbaginaceae	1	0	-0.3749
109	Polemoniaceae	1	0	-0.3749
110	Primulaceae	1	0	-0.3749
111	Pyrolaceae	1	0	-0.3749
112	Rafflesiaceae	1	0	-0.3749
113	Rhizophoraceae	1	0	-0.3749
114	Ruppiaceae	1	0	-0.3749
115	Saxifragaceae	1	0	-0.3749
116	Typhaceae	1	0	-0.3749
117	Tovariaceae	1	0	-0.3749
118	Vochysiaceae	1	0	-0.3749
119	Winteraceae	1	0	-0.3749
120	Zygophyllaceae	1	0	-0.3749
121	Brassicaceae	5	1	-0.4609
122	Lythraceae	5	1	-0.4609
123	Onagraceae	5	1	-0.4609
124	Ranunculaceae	5	1	-0.4609
125	Ulmaceae	5	1	-0.4609
126	Cactaceae	13	3	-0.6329
127	Burmanniaceae	2	0	-0.6464
128	Connaraceae	2	0	-0.6464
129	Cyclanthaceae	2	0	-0.6464
130	Dichapetalaceae	2	0	-0.6464
131	Gunneraceae	2	0	-0.6464
132	Hydrophyllaceae	2	0	-0.6464
133	Ochnaceae	2	0	-0.6464
134	Oleaceae	2	0	-0.6464
135	Sabiaceae	2	0	-0.6464
136	Staphyleaceae	2	0	-0.6464
137	Styracaceae	2	0	-0.6464
138	Theophrastaceae	2	0	-0.6464
139	Bignoniaceae	32	8	-0.7914

140	Aquifoliaceae	3	0	-0.9179
141	Convallariaceae	3	0	-0.9179
142	Erythroxylaceae	3	0	-0.9179
143	Gentianaceae	3	0	-0.9179
144	Juglandaceae	3	0	-0.9179
145	Pontederiaceae	3	0	-0.9179
146	Thymelaceae	3	0	-0.9179
147	Campanulaceae	4	0	-1.1894
148	Hippocrateaceae	4	0	-1.1894
149	Icacinaceae	4	0	-1.1894
150	Marcgraviaceae	4	0	-1.1894
151	Potamogetonaceae	4	0	-1.1894
152	Scrophulariaceae	19	4	-1.2619
153	Dioscoriaceae	8	1	-1.2754
154	Ericaceae	8	1	-1.2754
155	Heliconiaceae	8	1	-1.2754
156	Iridaceae	8	1	-1.2754
157	Actinidiaceae	5	0	-1.4609
158	Annonaceae	20	4	-1.5334
159	Melastomataceae	46	11	-1.5924
160	Flacourtiaceae	17	3	-1.7189
161	Capparaceae	10	1	-1.8184
162	Myrsinaceae	18	3	-1.9904
163	Arecaceae	22	4	-2.0764
164	Araliaceae	11	1	-2.0899
165	Asclepiadaceae	19	3	-2.2619
166	Gesneriaceae	16	2	-2.4474
167	Boraginaceae	17	2	-2.7189
168	Bromeliaceae	38	6	-4.4204
169	Convolvulaceae	28	3	-4.7054
170	Moraceae	31	3	-5.5199
171	Cyperaceae	35	2	-7.6059
172	Rubiaceae	126	24	-10.3124
173	Poaceae	93	5	-20.3529
174	Orchidaceae	99	2	-24.9819

FIG 1.: Regression analysis of the medicinal flora of the Popoluca.



15 Phytochemistry and pharmacology of *Mosquitoxylum jamaicense* Krug et Urb. Anacardiaceae

15.1 Goal of the screening

During the field research outstanding plant species in terms of their perceived effects and importance to the Popoluca and depending on the lack of phytochemical information were selected. Drugs from 54 different Popoluca medicinal plant species were imported to Zurich which were subjected to natural product research. The field research, the plant collection and the exportation of the plant material was conducted with the permit No. DOO. 02.-1750 obtained from the Instituto Nacional de Ecología, Secretaría de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP).

The evaluation of plant extracts through biological test systems is important in respect to the safety and efficacy of the plants used in primary health care systems.

Furthermore, the goal in natural product research is to detect compounds, which can be utilized in the health-care sector of the economically developed world (e.g. to treat cancer, aids, adiposity) and in the health-care sector of the developing countries (e.g. to treat aids, malaria, sleeping-sickness). Other goals comprise the detection of products useful in the development of anti-feedant agents, cosmetics, perfumes and as nutritional additives.

In order to select the most promising species for the isolation of (new) active natural compounds a systematic biological screening of the plant's extracts has to be conducted. The plants (i.e. extracts) with the strongest effects on critical parameters in bioassays are likely to contain the most bioactive and/or the highest quantity of bioactive compounds. As a consequence such plants are selected for the investigation of their phytochemical and pharmacological spectrum and promise the highest probability of detecting bioactive natural products during one's research project.

15.2 Background information about the Anacardiaceae and *Mosquitoxylum jamaicense*

15.2.1 The Anacardiaceae

The Anacardiaceae family is divided into approximately 75 genera and comprises about 700 species (Mitchell 2001). They are distributed throughout the tropics but are also found in the warm temperate regions of Europe, eastern Asia, and the Americas. The Anacardiaceae are mostly trees and shrubs, and only rarely climbers. Frequently they bear toxic latex. There are dioecious and monecious plants, and the leaves are mostly arranged alternately (Mitchell 2001).

Many species have been widely cultivated beyond their limited areas of origin because of their economic importance as sources for timber, lacquer, oil, wax, dye, and for their often edible fruits or nuts (Usher 1974). The most important fruit is the mango from *Mangifera indica* L., whilst the most important nuts are the cashew from *Anacardium occidentale* L. and the pistachio from *Pistacia vera* L. The yellow or red cashew "apples" (enlarged pedicel) from *A. occidentale* are very acidic and astringent but edible. Fruits of different *Spondias* species are known as hog-plums. Probably various *Spondias* species were taken into cultivation by pre-Colombian Mexican cultures (Challenger 1998). Nowadays in the isthmic zone and on the Yucatec peninsula a large variety of *Spondias purpurea* L. (ciruela) cultivars are planted yielding fruits of different colours and varying sugar content. The Popoluca distinguish four *S. purpurea* (pitx cuy) varieties which they grow in their home gardens (solares): The very sour "majei pitx cuy" (thunderbolt's hog-plum), the yellow fruit bearing "puutx pitx cuy", the red fruit bearing "tsabats pitx cuy", and the most domesticated and sweet ciruela (jamsan pitx cuy). *Spondias radlkoferi* Donn. Sm. (jobo, "w¥llam") is another species yielding edible fruits though not as appreciated as the hog-plums and is occasionally cultivated.

The Anacardiaceae are rich in essential oils or rubber-like balms and occasionally latex with protein-like crystals, which they carry in their lactiferous canals (Frohne and Jensen 1998). Monoterpenes are preponderant in the essential oils.

Of importance in the tannery industry are extracts from the leaves of *Rhus coriaria* and from the wood of *Schinopsis* species, both rich in tanning agents

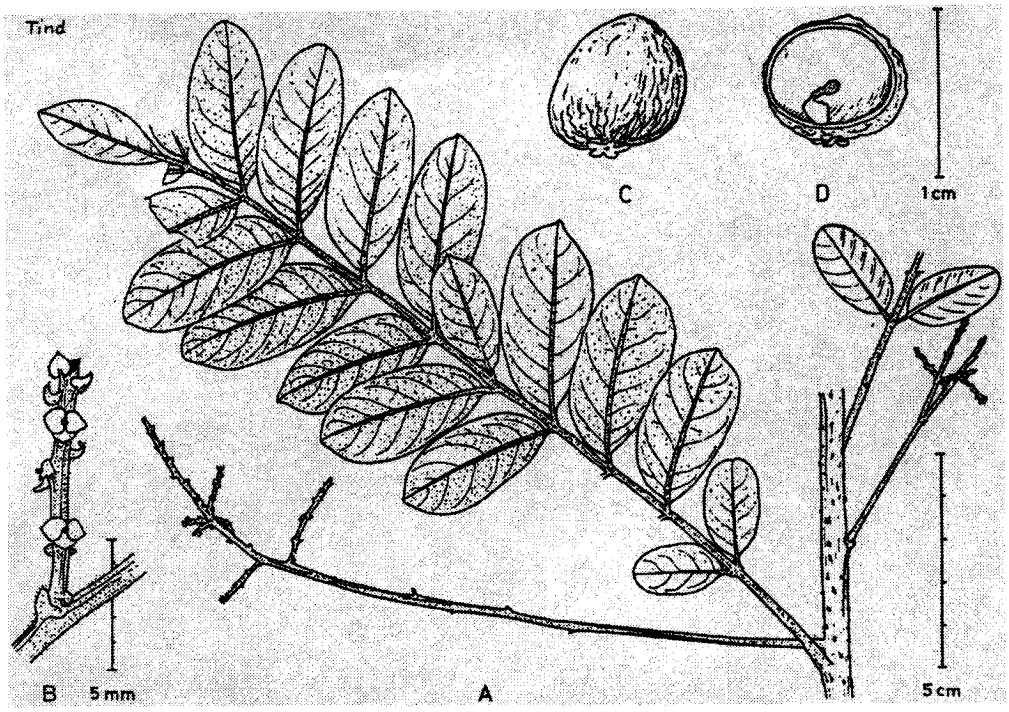
(Frohne and Jensen 1998). The galls from *Rhus semialata* caused by the sting of aphids are rich in tannic acid (Hänsel, Sticher and Steinegger 1999). Tannic acid is listed in the Pharmacopoeia Helvetica as tanninum to treat burns and other cutaneous complications. However, the Anacardiaceae are not an important source for (phyto)-medicine; on the contrary. Especially in the oleoresins and balms of *Toxicodendron* species irritating urushioles are present. The Anacardiaceae constitute the most common cause of contact dermatitis in humans. After a reclassification *Toxicodendron* now includes most of the more virulently dermatitic species such as poison ivy and poison oak formerly considered to belong to the genus *Rhus* (Gillis 1971). The principle function of these secondary compounds is to serve as a defense against herbivores (Challenger 1998).

15.2.2 The taxonomic position, morphology and ecology of *Mosquitoxylum jamaicense* Krug et Urb.

The Anacardiaceae are divided into five tribes: Dobinae, Mangiferae, Spondineae, Rhoideae and Semecarpae (Hegnauer 1964). The genus *Mosquitoxylum* constitutes together with the genera *Astronium*, *Pistacia*, *Rhus*, *Schinopsis*, *Schinus*, *Toxicodendron* and about 32 other genera the tribe Rhoideae (Hegnauer 1964; Barfod 1987). *Mosquitoxylum* is a monotypic genus with the only representative species *M. jamaicense* Krug et Urb. (Mitchell 2001). These small trees about 20 to 25 m tall and measuring up to 25 cm in diameter have a thin, smooth and slightly ripped bark, which is coofee-gray on the outside and reddish on the inner side and containing a whitish latex. The tree is locally common in primary or secondary, humid semi-deciduous and evergreen forests from Mexico southwards to Colombia and Ecuador including Jamaica (Mitchell 2001).

According to molecular data it is very probable that the orders Sapindales, Anacardiales, Rutales and the Zygophyllales belong to a monophyletic group (Frohne and Jensen 1998). Generally, the chemistry of the Anacardiaceae is very similar to the one of the Leguminosae which makes a relationship possible (Hegnauer 1964). Noteworthy convergences in chemistry exist between the Anacardiaceae and the Gymnospermae with which they share many traits such as the strong acidic cytosol of the leaf cells, accumulation of quinic-acid and

shikimiacid, turpentine-like balms and flavonol accumulation in the leaves (Hegnauer 1964).



Mosquitoxylum jamaicense *Krug et Urb. A habit, B infructescence detail, showing persistent bracts and bracteoles, C fruit, D cross-section of fruit (Barfod 1987).*

Division:	Spermatophyta
Subdivision:	Magnoliophyta
Class:	Rosopsida
Order:	Anacardiales
Family:	Anacardiaceae
Tribe:	Rhoidae
Genus:	Mosquitoxylum

15.2.3 Ethnobotany of *Mosquitoxylum jamaicense*

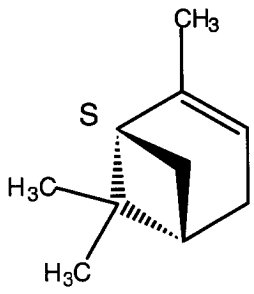
In their indigenous language the Popoluca of southern Veracruz call the tree *M. jamaicense* "Se'mpe". Traditionally they use the fresh bark as a decoction in women's medicine and particularly against hemorrhage and menstrual

problems. Further uses encompass hemorrhages after parturition and gonorrhea. Against vaginal infections and uterine inflammation a decoction is used as a vaginal shower.
The plant seems to be unique to the Popoluca, since no other ethnomedical uses of this genus were found during systematic biographic research.

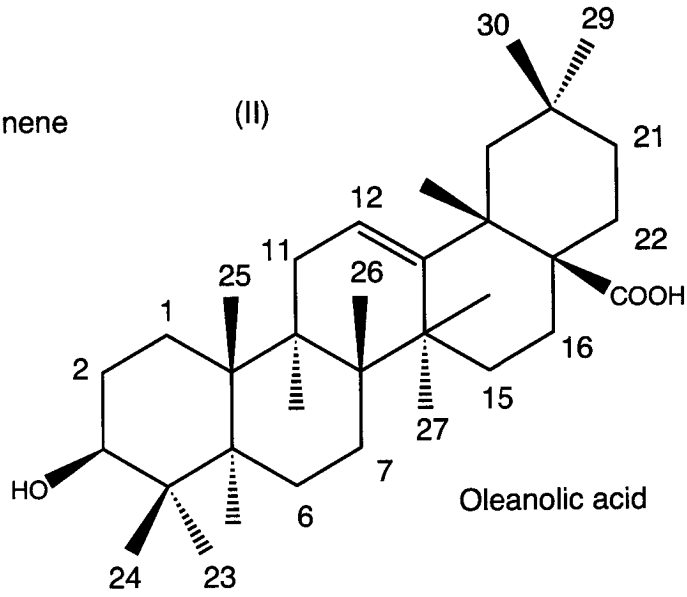
15.2.4 Phytochemistry of the Anacardiaceae

The ramified lactiferous and resin canals in the bark contain different fluid compositions. These liquids can be classified as balms (a dilution of resin in essential oils) as gum-balms (balm mixed with mucilage) or latex (suspension of solid substances in a watery serum) (Hegnauer 1964).
The essential oils are especially present in the leaves, the flowers and the fruits. The most common monoterpenes are pinene (I), phellandrene, borneol and carvacrol (Hegnauer 1964). Mastix and chiosturpentine are two commercial products of the Anacardiaceae which are in many aspects similar to the coniferous turpentine containing resin acids and triterpenealcohols like masticodiene acid, oleanolic acid (II) and tirucallol (III).

(I) (–)-α-Pinene

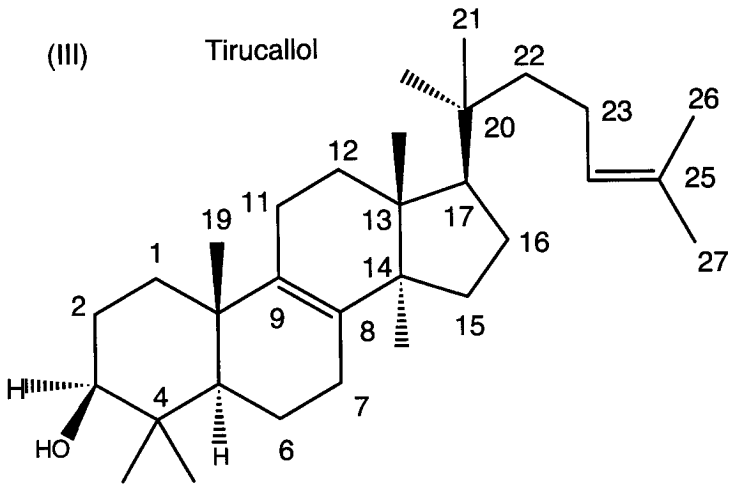


(II)

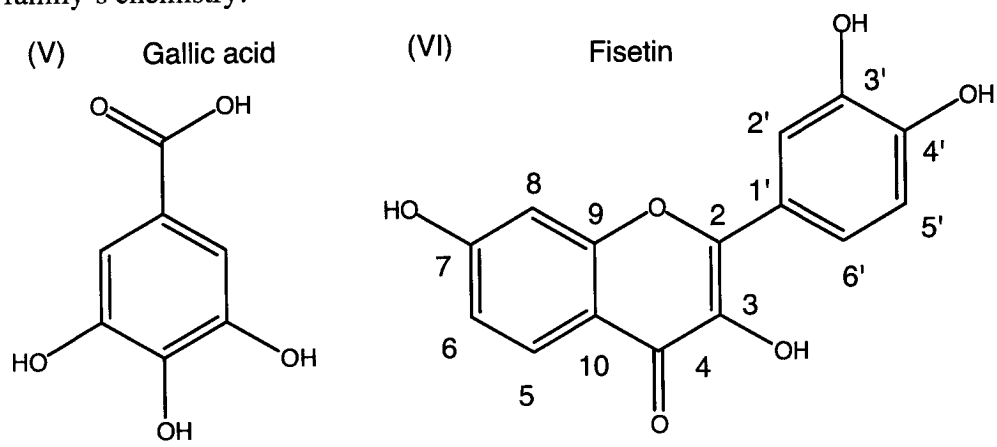


Oleanolic acid

The dermatitis causing urushioles (IV) are mixtures of phenolics which vary primarily in the length, branching, number and position of double bonds in the hydrocarbon side chain (R), and in the number of hydroxyl groups on the benzene ring (Mitchell 1990). In combination with the urushioles often mixtures of anacardic acids occur which are very hard to purify because they have C_{15}-side chains with zero up to three double bonds (Hegnauer 1964).



The Anacardiaceae are remarkable accumulators of polyphenols. Apart from flavonols and related compounds tanning agents are present like gallic acid (V), ellagic acid, catechins and leucoanthocyans. According to Hegnauer (1964) myricetin, fisetin (VI) and fustin are probably very characteristic for the family's chemistry.



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15.3 Methods

15.3.1 Biological methods

15.3.1.1 Screening for cytotoxicity

The cytotoxicity screenings were conducted with KB cells (ATCC CCL17) according to Swanson and Pezzuto (1990). The cervix-carcinoma cells utilized grow epithel-like, adhering on the surface of the culture well. Due to their high cleavage activity they are particularly sensitive to cytotoxic substances. The samples were tested at concentrations of 50 and 25 ppm in a watery solution with a maximum of 1% ethanol content. The evaluation was performed after 72 hours of incubation in an atmosphere with 37° C, 5% CO_2 and 95% relative humidity using a phase-contrast-microscope through the comparison with non-treated cultures. In order to improve the detection of dead cells or inhibited cell division methyltetrazolthiazolium salt (MTT) was added at a concentration of 5 mg/ml. MTT is transformed in the mitochondria during a redox reaction and the originally soluble yellow MTT falls out as a dark-blue insoluble salt. After a while the supernatant can be evacuated and the MTT pigments in the cells are dissolved with 150 µl of a 10% watery solution of sodiumdodecylsulfate. The blue solution is an indicator for cell viability and can easily be distinguished from the yellow solution indicating dead cultures and cytotoxicity, respectively.

15.3.1.2 Antimicrobial screening

We assessed the antimicrobial activity of the crude extracts using the agar-overlay test according to Saxena et al. (1995). The extracts were applied at quantities of 600 µg (6) and 200 µg (2) to a TLC-plate (in a petri dish) and doused with 10 ml of liquid-agar mixed with a microbial containing suspension. After incubating the petri dishes for 16 hours at 37° C the microbial cultures were displayed by applying methyltetrazolthiazolium salt (MTT). The microbial free zones indicating antimicrobial activity of an extract got visible and detectible (compare to the cytotoxicity screening described above). Blank fields are due to difficulties during detection and to the omitting of the

screening at extract quantities of 600 µg. The results for the H_2O extracts are not displayed because only few extracts showed an activity which in addition was very weak.
The antimicrobial tests were conducted with:

the gram-negative bacteria:	*Escherichia coli*	(EC)	(ATCC 25922)
the gram-positive bacteria:	*Staphylococcus aureus*	(SA)	(ATCC 25923)
	Bacillus cereus	(BC)	(ATCC 10702)
and the yeast-fungus:	*Candida albicans*	(CA)	(ATCC 25790)

15.3.1.3 Screening for inhibitors of IL-6 gene expression (NF-κB inhibition)

The screening for the inhibition of gene expression of the cytokine interleukine 6 (IL-6) was conducted at the School of Pharmacy in London by Dr. Paul Bremner.
First, the HeLa cells, transfected with an IL-6 promoter fused to the luciferase gene (Bork et al. 1997) were incubated with 100 µg/ml of plant extract. After one hour 50 ng/ml of the NF-κB (and subsequently IL-6) stimulating phorbol-12-myristat-13-acetat (PMA) was administered. About 10 hours later the luciferase activity was tested by applying luciferine, the luminescent material of the glowworm. The consequent light emission was detected for 30s with a lumionometer (Bork 1999; Schmitz et al. 1996). All extracts were screened twice. The average values of the positive control (only PMA) were equated to 100% light emission.

15.3.1.4 Screening for activity against *Trypanosoma brucei rhodesiense* and *Trypanosoma cruzi*

At the Swiss Tropical Institute in Basel selected extracts were tested in vitro for their activity against *Trypanosoma brucei rhodesiense* responsible for the sleeping sickness and *Trypanosoma cruzi* causing Chagas disease.
Basically the screening was conducted according to Heilmann et al. (2000). As reference substances melarsoprol (*T. brucei*) and benznidazol (*T. cruzi*) were

used. Cytotoxicity was assessed using L6-Cells (skeleton myoblasts of *Rattus norvegicus*) and mefloquine as a standard (IC_{50} = 1.8 µg/ml).

15.3.1.5 Screening for activity against *Plasmodium falciparum* strain K1 (resistant to chloroquine and pyrimethamine)

Furthermore, the Swiss Tropical Institute screened the extracts previously tested for their anti-trypanosomal potentials against *Plasmodium falciparum* (for methods, see Heilmann et al. 2000). *P. falciparum* is responsible for malaria in humans. Each year several hundred million people become infected with *P. falciparum*, which causes 2-3 million deaths annually.

15.3.2 Phytochemical methods

15.3.2.1 Small scale plant extraction for preliminary screenings

In order to allow for preliminary pharmacological screenings as a basis for selecting one species for a detailed phytochemical and pharmacological investigation small scale extraction of the 54 medicinal plant specimens had to be conducted.
About 20 grams of the corresponding powdered drugs were exhaustively percolated with a mixture of dichloromethane and methanol (2:1) (controlled via TLC) yielding apolar extracts. In a second extraction step polar extracts were gained by utilizing a methanol-water mixture (7:3). After removal of methanol by rotavaporization, this polar extract was further processed by a 3 fold liquid-liquid partition using butanol, and yielded two extracts of the respective polarities. For each plant species three extracts with distinct solubilities were obtained (162 in total), ready for pharmacological screenings.
In the following the DCM/methanol extract is referred to as "DCM extract" (DCM), the butanolic part of the liquid-liquid partition is called "butanolic extract" (But) and the watery part of the liquid-liquid partition is referred to as "H_2O extract".

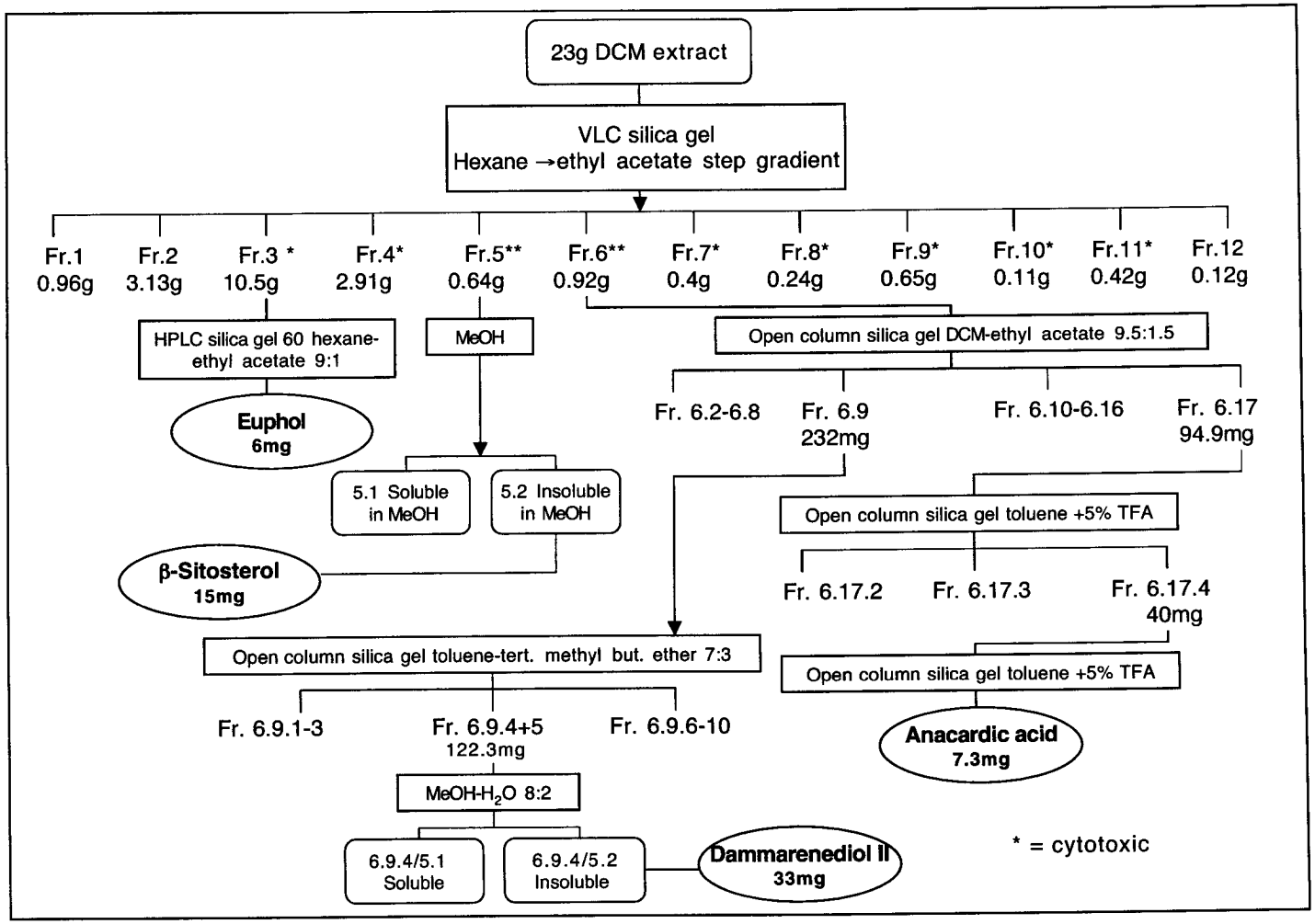
15.3.2.2 Large scale extraction

About 670 grams dried and subsequently ground bark from *Mosquitoxylum jamaicense* Krug et Urb. were mixed with the same amount of sea sand. Successive percolation with dichloromethane was performed until the extraction process reached approximately 100% (controlled via TLC). As a result, 23 grams of dried apolar bark extract were obtained.
In a second step the plant material was thoroughly leached with methanol resulting in 196 grams of dried polar extract. The subsequent processing of the distinct extracts is shown in extraction schemes I and II. The isolation process was guided by the screening for cytotoxicity with KB cells.

15.3.2.3 Processing of the dicholoromethane extract

All 23 grams were crudely fractionated by vacuum liquid chromatography (VLC) using a column of 6.5 cm in diameter and of 22 cm in length yielding 12 fractions. The stationary phase constituted silica gel 60 (60-200 µm, Merck Darmstadt, D) while the extract was eluted with mixtures of hexane and ethyl acetate (step gradient). Fraction 3 was processed by high pressure liquid chromatography (HPLC) using a 8 x 250 mm column packed with 5 µm Li Chrosorb Si 60 yielding euphol. Fraction 5 was dissolved in methanol where the less soluble β-sitosterol fell out. Fraction 6 was processed by open column chromatography using a column of 2 cm in diameter and of 75 cm length and silica gel 60 (60-200 mm, Fluka Chemie AG, Buchs, CH) as the stationary phase. The extract was eluted with a DCM-ethyl acetate mixture in the relation of [9.5:1.5]. Fraction 6.9 was further processed in an open column and eluted with a mixture of toluene and tertiary methyl butyl ether (same stationary phase used as with Fr.6). Fraction 6.9.4 and 5 were joined and dissolved in a mixture of methanol (MeOH) and water. As a consequence, the less soluble dammarenediol II fell out. Fraction 6.17 was processed in an open column of 1 cm in diameter and 34 cm in length with silica gel 60 (40-63 µm, Fluka Chemie AG, Buchs, CH). The mobile phase constituted pure toluene with 5% of trifluoro acetic acid (TFA). Fraction 6.17.4 was eluted with the same conditions as described for Fr. 6.17 and yielded anacardic acid (extraction scheme I.

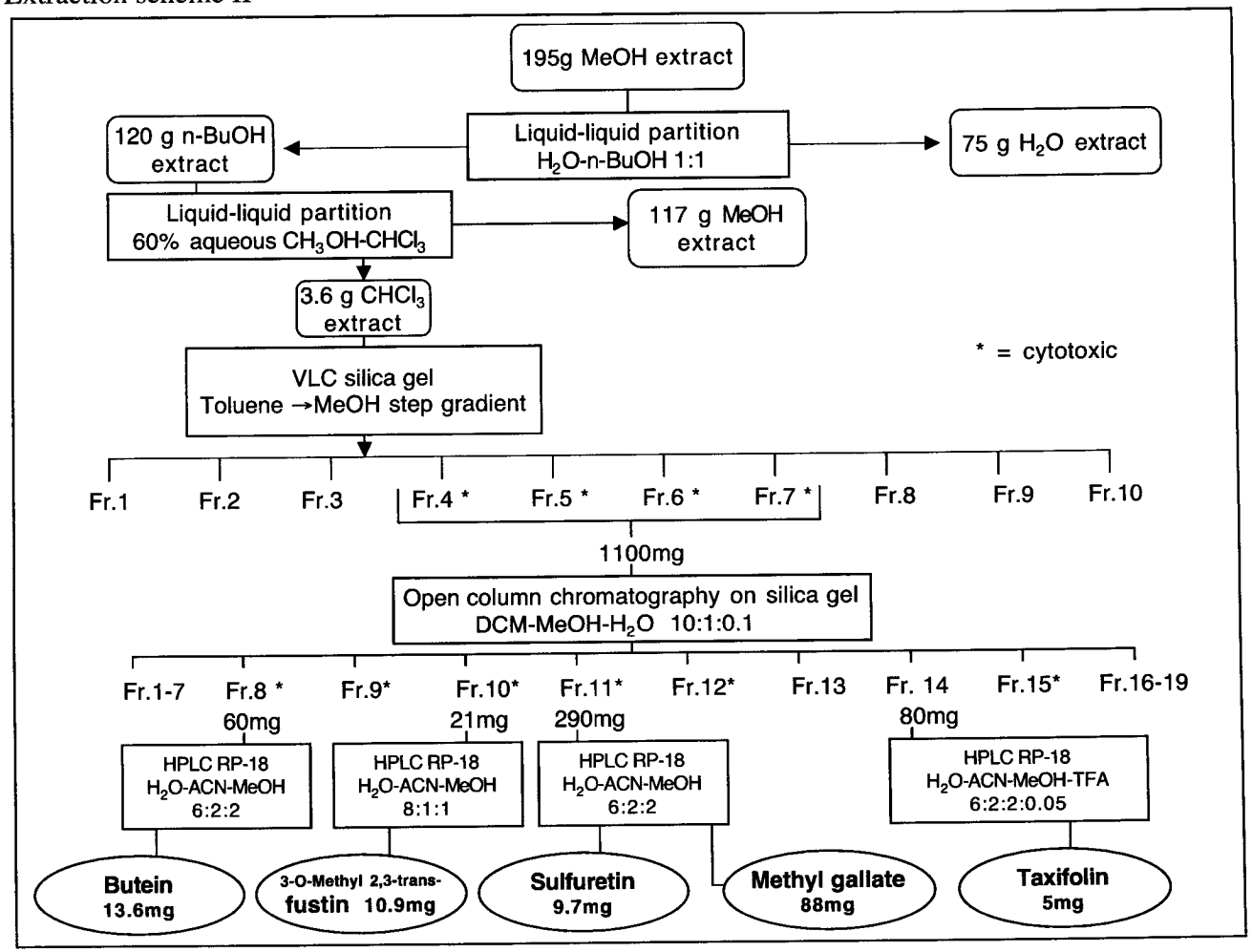
Extraction scheme I



15.3.2.4 Processing of the methanol extract

The 195 grams of dried methanol extract was partitioned three times between butanol and water [1:1] in a separation funnel yielding 120 grams of dried butanol extract. The butanol extract was further partitioned seven times with a mixture of 60% aqueous methanol and chloroform with a yield of 3.6 grams chloroform extract. These 3.6 grams were fractionated crudely by VLC with a column of 3 cm of diameter and 22 cm length and silica gel 60 (40-63 µm, Fluka Chemie AG, Buchs, CH). Fractions 4 to 7 showed cytotoxicity and a similar pattern on TLC therefore they were unified to be eluted on an open column of 2 cm in diameter and 75 cm in length packed with silica gel 60 (40-63 µm, Fluka Chemie AG, Buchs, CH) with a mixture of DCM, methanol and water [10:1:0.1]. All substances were obtained by HPLC using a reverse phase column RP-18 with distinct mixtures of water, acetonitrile (ACN), and methanol (MeOH) (extraction scheme II).

Extraction scheme II



15.3.3 Spectroscopic and spectrometric methods

Structure elucidation has been achieved by application of Nuclear Magnetic Resonance Spectroscopy (NMR). One- and two-dimensional NMR experiments have been conducted: ^{1}H, ^{13}C, DEPT, DQF-COSY, ROESY, TOCSY, HMBC, HSQC and HSQC-TOCSY. All spectra have been registered at 295 K on a

Bruker AMX-300 Spectrometer (300.13 MHz for ^{1}H, 75.47 MHz for ^{13}C) and a
Bruker AMX-500 Spectrometer (500.13 MHz for ^{1}H, 125.77 MHz for ^{13}C)

at the Institute for Pharmaceutical Sciences, ETH Zurich.
The spectra were calibrated on:

Chloroform-d ($CDCl_3$), $\delta^{1}H = 7.27$ ppm, $\delta^{13}C = 77.0$ ppm, and
Methanol-d_4 (CD_3OD) $\delta^{1}H = 3.31$ ppm, $\delta^{13}C = 49.0$ ppm.

Solvents: Cambridge Isotope Laboratories, Andower, USA.

To determine the molecular weight of the isolated compounds mass spectrometric experiments were used. Electron impact (EI)-MS experiments were conducted on a micromass TRIBIRD double focusing mass spectrometer with an ionization energy of 70 eV. HiResMALDI mass spectra were obtained on a IonSpec Ultima FTMS spectrometer with 2,5-dihydrobenzoic acid as matrix.
All MS experiments have been performed by the MS service of the department of chemistry at the Swiss Federal Institute of Technology (ETH) in Zurich.

15.4 Results of the screening

15.4.1. Results of the screening for cytotoxicity of the crude extracts

The different plant parts showed unequal tendencies to cytotoxicity. Of the 20 cortex drug samples 55% showed an activity while of the 29 folium drug samples only 34% had a cytotoxic effect. This effect could be due to semi polar tannic agents which are known to show unspecific cytotoxicity. However, the

tannic agent rich H_2O extract never showed toxicity. The results for the H_2O extract were all negative and are therefore not compiled separately in a table.

Table 1. *Results of the screening for cytotoxicity.*

KB-cell screening		**1=DCM 50ppm / 2=DCM 25ppm / 3=But 50ppm / 4=But 25ppm**				
Plant species		**Drug**	**1**	**2**	**3**	**4**
Aegiphila deppeana	(Verbenaceae)	Folium	-	-	-	-
Agarista mexicana	(Ericaceae)	Folium	(+)	(+)	(+)	-
Aphelandra aurantiaca	(Acanthaceae)	Folium	-	-	-	-
Ardisia compressa	(Myrsinaceae)	Cortex	+	(+)	-	-
Bocconia frutescens	(Papaveraceae)	Folium	+	+	-	-
Bursera graveolens	(Burseraceae)	Cortex	-	-	-	-
Calophyllum brasiliense	(Clusiaceae)	Cortex	+	+	(+)	-
Centratherum punctatum	(Asteraceae)	Folium	+	+	-	-
Chamaecrista flexuosa	(Caesalpiniaceae)	Radix	-	-	-	-
Chamaecrista hispidula	(Caesalpiniaceae)	Radix	+	-	+	(+)
Cinnamomum brenesii	(Lauraceae)	Cortex	-	-	(+)	-
Coccocypselum hirsutum	(Rubiaceae)	Folium	-	-	-	-
Cochlospermum vitifolium	(Cochlospermaceae)	Cortex	-	-	-	-
Conostegia xalapensis	(Melastomataceae)	Folium	(+)	(+)	-	-
Cornutia grandifolia	(Verbenaceae)	Folium	-	-	-	-
Couepia polyandra	(Chrysobalanaceae)	Cortex	-	-	-	-
Eleutherine bulbosa	(Iridaceae)	Bulbus	+	(+)	-	-
Eupatorium schultzii	(Asteraceae)	Folium	(+)		-	-
Gouania lupuloides	(Rhamnaceae)	Folium	-	-	-	-
Gouania polygama	(Rhamnaceae)	Folium	-	-	-	-
Hamelia patens	(Rubiaceae)	Folium	-	-	-	-
Heliocarpus americanus	(Tiliaceae)	Cortex	-	-	-	-
Hoffmannia nicotianifolia	(Rubiaceae)	Folium	-	-	-	-
Liabum discolor	(Asteraceae)	Folium	-	-	-	-
Licaria capitata	(Lauraceae)	Cortex	(+)	(+)	-	-
Matayba oppositifolia	(Sapindaceae)	Cortex	+	(+)	+	(+)
Maytenus belizensis	(Celastraceae)	Cortex	+	-	-	-
Melothria pendula	(Cucurbitaceae)	Folium	-	-	-	-
Miconia argentea	(Melastomataceae)	Folium	-	-	-	-
Mimosa albida	(Mimosaceae)	Folium	-	-	+	(+)
Mosquitoxylum jamaicense	(Anacardiaceae)	Cortex	+	(+)	+	(+)
Myroxylon balsamum	(Fabaceae)	Cortex	-	-	-	-
Ocotea veraguensis	(Lauraceae)	Cortex	(+)	-	-	-
Odontonema callystachium	(Acanthaceae)	Folium	-	-	-	-
Pachira aquatica	(Bombacaceae)	Cortex	-	-	-	-
Peperomia granulosa	(Piperaceae)	Folium	(+)	-	-	-
Peperomia obtusifolia	(Piperaceae)	Folium	-	-	-	-
Picramnia teapensis	(Simarubaceae)	Folium	+	+	-	-
Pilea irrorata	(Urticaceae)	Folium	(+)	(+)	(+)	(+)
Plectranthus amboinicus	(Lamiaceae)	Folium	-	-	-	-
Potomorphe umbellata	(Piperaceae)	Folium	(+)	-	-	-
Prestonia mexicana	(Apocynaceae)	Cortex	-	-	-	-
Pseudobombax ellipticum	(Bombacaceae)	Cortex	(+)	-	-	-
Psychotria hebeclada	(Rubiaceae)	Folium	-	-	-	-
Salvia xalapensis	(Lamiaceae)	Folium	(+)	(+)	-	-
Securidaca diversifolia	(Polygalaceae)	Radix	+	-	-	-

Serjania mexicana	(Sapindaceae)	Cortex	-	-	-	-
Siparuna andina	(Monimiaceae)	Folium	-	-	-	-
Talinium paniculatum	(Portulaccaceae)	Folium	-	-	-	-
Tapirira mexicana	(Anacardiaceae)	Cortex	-	-	(+)	-
Valeriana scandens	(Valerianaceae)	Folium	-	-	-	-
Vismia baccifera	(Clusiaceae)	Cortex	+	(+)	+	(+)
Waltheria indica	(Sterculiaceae)	Radix	(+)	-	-	-
Wimmeria bartlettii	(Celastraceae)	Cortex	-	-	-	-

Legend explication: - = no toxicity; (+) = showing moderate toxicity; + = showing good toxicity.

15.4.2 Results of the antimicrobial screening of the crude extracts

As expected, only few (three) extracts showed a moderate activity against *Candida albicans*. If an extract was active against *Escherichia coli* it showed activity against *Staphylococcus aureus* and *Bacillus cereus*, too (see Table 1 and 2). The results for the H_2O-extracts are not displayed because only few extracts showed an activity which in addition was very weak.

Table 2. *Results of the antimicrobial screening of the DCM-extract, 6=600µg, 2=200µg.*

DCM-extract	**Drug**	**EC6**	**EC2**	**SA6**	**SA2**	**BC6**	**BC2**	**CA6**
Plant species								
Aegiphila deppeana (Verbenaceae)	Folium	-	-	-	-	-	-	-
Agarista mexicana (Ericaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Aphelandra aurantiaca (Acanthaceae)	Folium	-	-	-	-	-	-	-
Ardisia compressa (Myrsinaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Bocconia frutescens (Papaveraceae)	Folium	++	+	+	+	+	+	+
Bursera graveolens (Burseraceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	+	-
Calophyllum brasiliense (Clusiaceae)	Cortex	++	+	++	+	+	+	-
Centratherum punctatum (Asteraceae)	Folium	+++	+++	+++	+++	+++	+++	-
Chamaecrista flexuosa (Caesalpiniaceae)	Radix	n.t.	n.t.	n.t.	+	n.t.	-	-
Chamaecrista hispidula (Caesalpiniaceae)	Radix	n.t.	n.t.	n.t.	-	n.t.	+	-
Cinnamomum brenesii (Lauraceae)	Cortex	++	++	++	++	++	++	-
Coccocypselum hirsutum (Rubiaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Cochlospermum vitifolium (Cochlospermaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	-	-
Conostegia xalapensis (Melastomataceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Cornutia grandifolia (Verbenaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Couepia polyandra (Chrysobalanaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	-	-
Eleutherine bulbosa (Iridaceae)	Bulbus	n.t.	n.t.	n.t.	+++	n.t.	+++	-
Eupatorium schultzii (Asteraceae)	Folium	+	+	++	+	+	+	-

Gouania lupuloides (Rhamnaceae)	Folium	-	-	-	-	-	-	-
Gouania polygama (Rhamnaceae)	Folium	+	-	+	-	+	-	-
Hamelia patens (Rubiaceae)	Folium	-	-	-	-	+	-	-
Heliocarpus americanus (Tiliaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Hoffmannia nicotianifolia (Rubiaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Liabum discolor (Asteraceae)	Folium	+	-	++	-	++	+	-
Licaria capitata (Lauraceae)	Cortex	+	+	+	+	+	+	-
Matayba oppositifolia (Sapindaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Maytenus belizensis (Celastraceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	+	-
Melothria pendula (Cucurbitaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Miconia argentea (Melastomataceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Mimosa albida (Mimosaceae)	Folium	+	-	+	-	+	-	-
Mosquitoxylum jamaicense (Anacardiaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Myroxylon balsamum (Fabaceae)	Cortex	+	-	+	+	+	+	-
Ocotea veraguensis (Lauraceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Odontonema callystachium (Acanthaceae)	Folium	-	-	-	-	-	-	-
Pachira aquatica (Bombacaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Peperomia granulosa (Piperaceae)	Folium	-	-	+	-	+	+	-
Peperomia obtusifolia (Piperaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Picramnia teapensis (Simarubaceae)	Folium	+	+	++	+	+	+	+
Pilea irrorata (Urticaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Plectranthus amboinicus (Lamiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Potomorphe umbellata (Piperaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Prestonia mexicana (Apocynaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Pseudobombax ellipticum (Bombacaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Psychotria hebeclada (Rubiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Salvia xalapensis (Lamiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Securidaca diversifolia (Polygalaceae)	Radix	n.t.	n.t.	n.t.	-	n.t.	-	-
Serjania mexicana (Sapindaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	-	-
Siparuna andina (Monimiaceae)	Folium	+	-	+	-	+	-	-
Talinium paniculatum (Portulaccaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	-	-
Tapirira mexicana (Anacardiaceae)	Cortex	+	+	+	+	++	+	-
Valeriana scandens (Valerianaceae)	Folium	+	+	+	-	+	+	-
Vismia baccifera (Clusiaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Waltheria indica (Sterculiaceae)	Radix	n.t.	n.t.	n.t.	-	n.t.	-	-
Wimmeria bartlettii (Celastraceae)	Cortex	++	++	++	++	++	++	-

Legend explanation: - = no activity; + = moderate activity (inhibitory zone as large as the extract spot); ++ = showing good activity (radius of inhibitory zone is about 1-3 mm larger than the spot of the extract; +++ = showing strong activity (radius of inhibitory zone is lager than the one of the extract spot plus 3 mm), n.t.; = not tested.

Table 3. *Results of the anti-microbial screening of the But-extract.*

But-extract	**Drug**	**EC6**	**EC2**	**SA6**	**SA2**	**BC6**	**BC2**	**CA6**
Plant species								-
Aegiphila deppeana (Verbenaceae)	Folium	-	-	-	-	-	-	-
Agarista mexicana (Ericaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	(+)	-
Aphelandra aurantiaca (Acanthaceae)	Folium	-	-	-	-	-	-	-
Ardisia compressa (Myrsinaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	++	-
Bocconia frutescens (Papaveraceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Bursera graveolens (Burseraceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Calophyllum brasiliense (Clusiaceae)	Cortex	+	+	+	-	+	+	-
Centratherum punctatum (Asteraceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Chamaecrista flexuosa (Caesalpiniaceae)	Radix	n.t.	n.t.	n.t.	-	n.t.	-	-
Chamaecrista hispidula (Caesalpiniaceae)	Radix	n.t.	n.t.	n.t.	(+)	n.t.	+	-
Cinnamomum brenesii (Lauraceae)	Cortex	++	+	+	-	+	+	-
Coccocypselum hirsutum (Rubiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Cochlospermum vitifolium (Cochlospermaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Conostegia xalapensis (Melastomataceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Cornutia grandifolia (Verbenaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Couepia polyandra (Chrysobalanaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Eleutherine bulbosa (Iridaceae)	Bulbus	n.t.	n.t.	n.t.	+	n.t.	(+)	-
Eupatorium schultzii (Asteraceae)	Folium	-	-	n.t.	-	+	-	-
Gouania lupuloides (Rhamnaceae)	Folium	-	-	-	-	-	-	+
Gouania polygama (Rhamnaceae)	Folium	-	-	-	-	+	-	-
Hamelia patens (Rubiaceae)	Folium	-	-	-	-	+	-	-
Heliocarpus americanus (Tiliaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Hoffmannia nicotianifolia (Rubiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Liabum discolor (Asteraceae)	Folium	-	-	-	-	-	-	-
Licaria capitata (Lauraceae)	Cortex	-	-	+	-	+	-	-
Matayba oppositifolia (Sapindaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Maytenus belizensis (Celastraceae)	Cortex	n.t.	n.t.	n.t.	(+)	n.t.	(+)	-
Melothria pendula (Cucurbitaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Miconia argentea (Melastomataceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Mimosa albida (Mimosaceae)	Folium	+	+	+	+	+	-	-
Mosquitoxylum jamaicense (Anacardiaceae)	Cortex	n.t.	n.t.	n.t.	+	n.t.	+	-
Myroxylon balsamum (Fabaceae)	Cortex	-	-	-	-	-	-	-
Ocotea veraguensis (Lauraceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Odontonema callystachium (Acanthaceae)	Folium	-	-	-	-	+	-	-
Pachira aquatica (Bombacaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	-	-
Peperomia granulosa (Piperaceae)	Folium	-	-	-	-	-	+	-
Peperomia obtusifolia (Piperaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Picramnia teapensis (Simarubaceae)	Folium	+	+	+	+	+	+	-
Pilea irrorata (Urticaceae)	Folium	n.t.	n.t.	n.t.	+	n.t.	n.t.	-
Plectranthus amboinicus (Lamiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Potomorphe umbellata (Piperaceae)	Folium	-	-	-	-	-	-	-

Prestonia mexicana (Apocynaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	+	-
Pseudobombax ellipticum (Bombacaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	(+)	-
Psychotria hebeclada (Rubiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	(+)	-
Salvia xalapensis (Lamiaceae)	Folium	n.t.	n.t.	n.t.	-	n.t.	-	-
Securidaca diversifolia (Polygalaceae)	Radix	n.t.	n.t.	n.t.	-	n.t.	-	-
Serjania mexicana (Sapindaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	(+)	-
Siparuna andina (Monimiaceae)	Folium	-	-	-	-	-	-	-
Talinium paniculatum (Portulaccaceae)	Folium	n.t.	n.t.	n.t.	(+)	n.t.	-	-
Tapirira mexicana (Anacardiaceae)	Cortex	+	+	+	+	+	+	-
Valeriana scandens (Valerianaceae)	Folium	-	-	-	-	-	-	-
Vismia baccifera (Clusiaceae)	Cortex	n.t.	n.t.	n.t.	-	n.t.	+	-
Waltheria indica (Sterculiaceae)	Radix	n.t.	n.t.	n.t.	(+)	n.t.	(+)	-
Wimmeria bartlettii (Celastraceae)	Cortex	+	-	+	-	-	+	-

Legend explanation: - = no activity; (+) = slightly active (inhibitory zone less large than the extract spot); + = moderate activity (inhibitory zone as large as the extract spot); ++ = showing good activity (radius of the inhibitory zone is about 1-3 mm larger than the spot of the extract), n.t.; not tested.

15.4.3 Results of the screening for inhibitors of IL-6 gene expression (NF-κB inhibition) of the crude extracts

Most active was the DCM/methanol (2:1) extract of *Vismia baccifera* (Clusiaceae) with a value of 26% of light emisson in relation to the positive control. This could be due to hypericin like naphtodianthrones or related compounds occurring in *Vismia* spp. (Bilia et al. 2000; Nagem and Faria 1990). Hypericin has been shown to inhibit PMA- and TNF-alpha-induced activation of NF-κB in vitro (Bork et al. 1999). Furthermore, the DCM/MeOH (2:1) extract of *Securidaca diversifolia* (Polygalaceae) showed inhibitory activity (66% of stimulated controls). However, the inhibition of interleukine (luciferase) expression was not high enough to pass the threshold (20%) set for relevant activity.

15.4.4 Results of the screening for activity against *Trypanosoma brucei rhodesiense* and *Trypanosoma cruzi*

The IC_{50} values were assessed for the DCM extract (DCM) and for the butanolic extract (But) (Table 4). Promising results, which encourage a bio-assay guided fractionation were received for the butanolic extract of *Cochlospermum vitifolium* (5.8 µg/ml), with a value of 61.5 µg/ml for

cytotoxicity, for the DCM extract of *Maytenus belizensis* (5.6 µg/ml), with a value of 54.7 µg/ml for cytotoxicity, and for both the DCM (5.6 µg/ml) and the butanolic extract (6.1 µg/ml) of *Wimmeria bartlettii* (36 µg/ml and 48 µg/ml cytotoxicity value) against *T. brucei* while against *T. cruzi* all extracts showed lesser activity.

Table 4. *Table showing the selection of the extracts tested for their anti-trypanosomal activity with their corresponding IC_{50} value (all values indicated in µg/ml).*

Plant species		**Drug**	***T. b. rhod.* IC_{50}**		***T. cruzi* IC_{50}**	
			DCM	**But**	**DCM**	**But**
Standard			0.00228		0.16	
Ardisia compressa	(Myrsinaceae)	Cortex	15.3	59.5	>90	>90
Bursera graveolens	(Burseraceae)	Cortex	57.8	53.1	>90	>90
Chamaecrista flexuosa	(Caesalpiniaceae)	Radix	56.1	68.8	>90	>90
Chamaecrista hispidula	(Caesalpiniaceae)	Radix	17.5	18.1	40.2	44.5
Cochlospermum vitifolium	(Cochlospermaceae)	Cortex	14.1	5.8	>90	58.7
Licaria capitata	(Lauraceae)	Cortex	14.8	16	17.4	>90
Matayba oppositifolia	(Sapindaceae)	Cortex	16.6	44	39.6	>90
Maytenus belizensis	(Celastraceae)	Cortex	5.6	17.5	37.9	75.0
Mosquitoxylum jamaicense	(Anacardiaceae)	Cortex	11.6	16.9	36.4	47.8
Pilea irrorata	(Urticaceae)	Folium	39.9	59.4	41.5	>90
Prestonia mexicana	(Apocynaceae)	Cortex	38.8	34.7	>90	>90
Securidaca diversifolia	(Polygalaceae)	Radix	40.2	41.2	46.3	55.7
Serjania mexicana	(Sapindaceae)	Cortex	37.8	16.2	>90	>90
Waltheria indica	(Sterculiaceae)	Radix	13.5	45.2	10.3	>90
Wimmeria bartlettii	(Celastraceae)	Cortex	5.6	6.1	29.0	48.0

15.4.5 Results of the screening for activity against *Plasmodium falciparum* strain K1 (resistant to chloroquine and pyrimethamine)

None of the extracts showed strong activity but it is noteworthy that the extracts exhibiting an activity with *Trypanosoma* spp. showed no activity with *P. falciparum* and vice versa. The DCM-extracts of *Securidaca diversifolia* (3.7 µg/ml), *Pilea irrorata* (3.78 µg/ml), *Waltheria indica* (4.12 µg/ml) and *Licaria capitata* (4.73 µg/ml) showed moderate activity (Table 5). Activities of the extracts at concentration higher than 5 µg/ml are considered to be of no relevance for fractionation. Chloroquine showed an IC_{50} value of 0.037 µg/ml and a MIC of 0.116 µg/ml, while qinghaosu has its IC_{50} level at 0.0009 µg/ml and its MIC at 0.0032 µg/ml. The cytotoxicity of the extracts was assessed with L6-cells.

Table 5. *showing the selection of the extracts tested for their anti-plasmodial activity with their corresponding IC_{50} value (all values indicated in µg/ml) and cytotoxicity values (n.a. = no cytotoxic activity).*

Plant species		**Drug**	***P. falciparum* IC_{50}**		**Cytotox. L6 IC_{50}**	
			DCM	**But**		
Standard: Chloroquine / Qinghaosu Cytototox: Mefloquine			0.037 / 0.0009		1.8	
Ardisia compressa	(Myrsinaceae)	Cortex	> 5	> 5	n.a.	n.a.
Bursera graveolens	(Burseraceae)	Cortex	> 5	> 5	n.a.	n.a.
Chamaecrista flexuosa	(Caesalpiniaceae)	Radix	> 5	> 5	n.a.	n.a.
Chamaecrista hispidula	(Caesalpiniaceae)	Radix	> 5	> 5	n.a.	n.a.
Cochlospermum vitifolium	(Cochlospermaceae)	Cortex	> 5	> 5	n.a.	61.5
Licaria capitata	(Lauraceae)	Cortex	4.73	> 5	50.2	n.a.
Matayba oppositifolia	(Sapindaceae)	Cortex	> 5	> 5	n.a.	n.a.
Maytenus belizensis	(Celastraceae)	Cortex	> 5	> 5	54.7	n.a.
Mosquitoxylum jamaicense	(Anacardiaceae)	Cortex	> 5	> 5	51.8	n.a.
Pilea irrorata	(Urticaceae)	Folium	3.78	> 5	n.a.	n.a.
Prestonia mexicana	(Apocynaceae)	Cortex	> 5	> 5	n.a.	n.a.
Securidaca diversifolia	(Polygalaceae)	Radix	3.7	> 5	n.a.	n.a.
Serjania mexicana	(Sapindaceae)	Cortex	> 5	> 5	n.a.	n.a.
Waltheria indica	(Sterculiaceae)	Radix	4.12	> 5	> 90	n.a.
Wimmeria bartlettii	(Celastraceae)	Cortex	> 5	> 5	36	45.6

15.5 Criteria which led to the selection of *Mosquitoxylum jamaicense* for further phytochemical and pharmacological investigations

During the ethnobotanical enquiry in the Sierra Santa Marta about 600 plant species were mentioned by the local healers. The project has foreseen to select one of these plants for phytochemical and pharmacological investigations. Therefore, already in the field selection criteria were established (as follow) for choosing from the large medicinal treasure.

- The species has several individual use-reports (high-ranking) and is of considerable importance in the Popolucan pharmacopoeia.
- The species should be applied systemically or topically.
- Only species could be taken into consideration of which sufficient material could be provided (i.e. the plant also should not be rare or endangered).
- Well known plant species were to be avoided.

These constricting criteria led to a selection of 54 medicinal species (Table 1) of which sufficient plant material (500g - 1kg) was collected in order to

warrant a potential subsequent phytochemical and pharmacological investigation.

All plant material was collected in the Sierra de Santa Marta (Veracruz, Mexico) by the author. The identification of the plant material was conducted by the author at the National Mexican Herbarium MEXU (UNAM, México D.F.) and the Colegio de Postgraduados de Chapingo, in many cases with the help of specialists from these institutions.

To provide extracts for the preliminary pharmacological screenings small quantities of the crude drugs of the selected 54 medicinal plants were percolated. Antibacterial, antifungal (Table 2 and 3) and cytotoxic (Table 1) assays were performed, with the goal to detect the most salient pharmacologic active species (i.e. extracts). After a literature search on the 54 species the selection process was concluded as follows:

- On the species in question no or only few phytochemical and pharmacological data should have been available.
- Positive screening results should have been obtained, whereas we considered the results of the cytotoxicity test as more important than the results of the antibacterial tests.

15.6 Conclusion and discussion of the screening results

The antimicrobial screening of the crude DCM-extracts revealed good activity of *Centratherum punctatum* and *Eleutherine bulbosa* against all three bacteria strains. What concerns the activity of *C. punctatum* the sesquiterpene lactones present in its DCM-extract are very probably responsible for this effect.

None of the crude plant extracts showed sufficiently high inhibitory activity in the screening for inhibitors of IL-6 gene expression, and consequently no species was of interest using this criterion.

The antiprotozoal screening results were obtained during the late phase of the project and therefore these results are destined for future projects.

Several crude plant extracts showed promising activity against KB cells whereas no activity was found against *C. albicans* except for *Bocconia frutescens*. The extracts of *Bocconia frutescens* showed good cytotoxicity but the genus has already been subjected to phytochemical and pharmacological

investigations. The same can be said for the genera *Calophyllum*, *Ardisia*, *Eleutherine*, *Vismia* and the species *Centrantherum punctatum*.
The genus *Picramina* is known to contain bioactive anthraquinones and glycosides thereof (Hernandez et al. 1998; Solis et al. 1995). The isolation of anthraquinones is problematic because they autooxidize spontaneously and hence the genuine character of the isolated compounds would be doubtful.
The Sapindaceaen species *Matayba oppositifolia* and the Anancardiaceaen *Mosqitoxylum jamaicense* have so far never been investigated phytochemically nor pharmacologically. The selection between these two species was left to chance.

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15.7 Results of the bioassay-guided isolation process and structure elucidation

Through bioassay-guided isolation of the apolar and polar extracts of *Mosquitoxylum jamaicense* 9 pure compounds were obtained. We identified an anacardic acid, 3 triterpenes, methyl gallate and 4 flavonoids. However, structure elucidation by means of one- and two dimensional NMR experiments could not confirm new compounds.

15.7.1 Anacardic acid monoene, (6-(8-pentadecenyl)salicylic acid): 2-hydroxy-6-(8E)-8-pentadecenyl-benzoic acid ($C_{22}H_{34}O_3$)

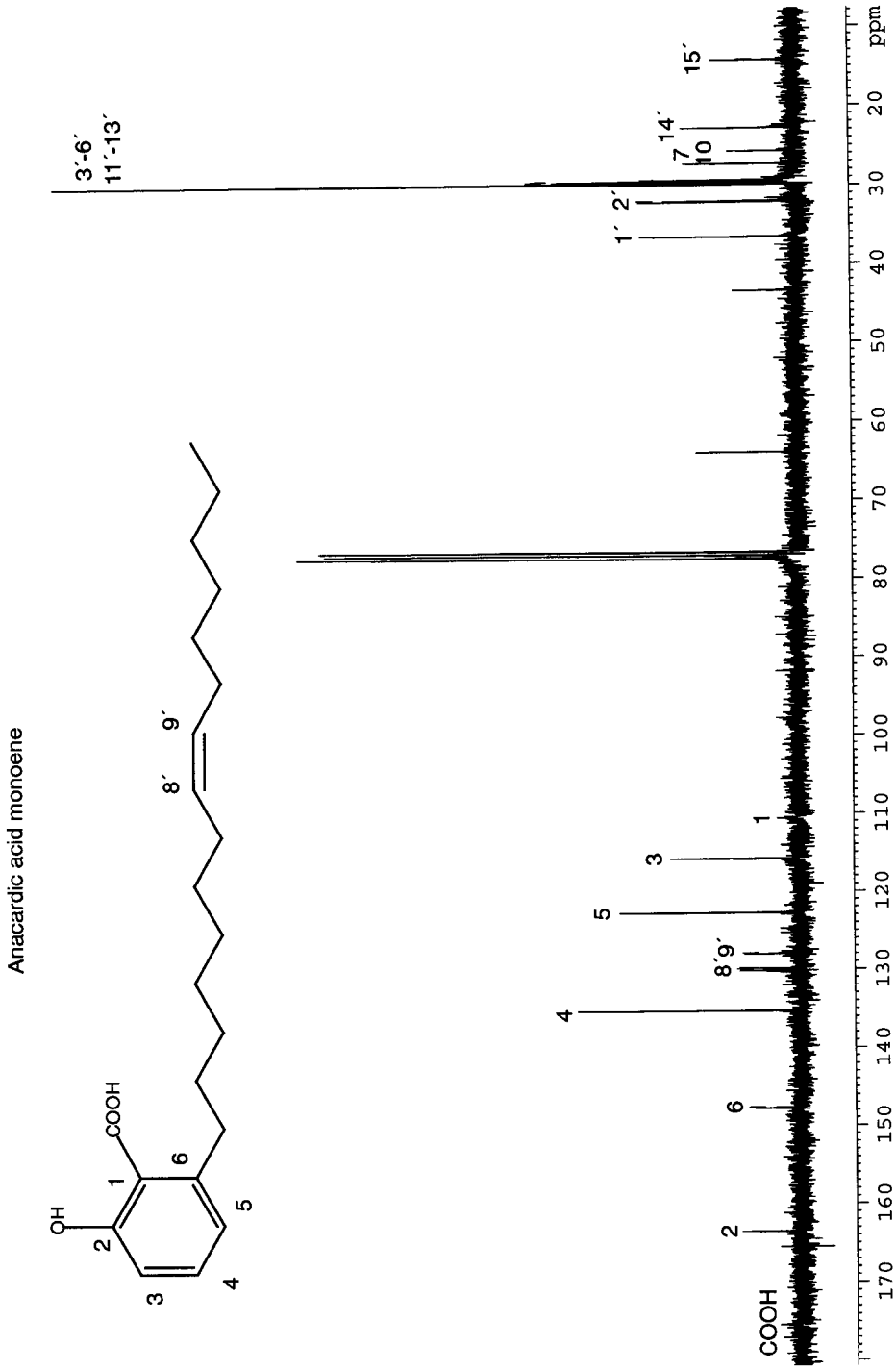
The NMR data was compared with published NMR data (El Sohly et al. 1982; Bagchi et al. 1985).
^{13}C NMR ($CDCl_3$, 75.5 MHz): δ175.5 (COOH), 163.5 (C-2), 147.7 (C-6), 135.2 (C-4), 122.7 (C-5), 115.8 (C-3), 110.5 (C-1).
130.1 (C-8'), 128.0 (C-9'), 36.5 (C-1'), 32.0 (C-2'), 31.9 (C-3'), 29.8 (C-4',5'), 29.7 (C-6'), 29.6 (C-11'), 29.5 (C-12'), 29.4 (C-12'), 27.2 (C-7'), 25.6 (C-10'), 22.7 (C-14'), 14.1 (C-15').
The EI-MS spectrum showed a pseudo-molecular peak at *m/z* 348.3 $[M+2H]^+$. Furthermore, the mass spectrum revealed the fragments $[M+2H-H_2O]^+$ at *m/z* 330.3, $[M+2H-COO]^+$ at *m/z* 304.3 and $[M+2H-OHCOO]^+$ at *m/z* 287.3, which corresponds to the molecular formula ($C_{22}H_{34}O_3$) and weight (M_r = 346.2).
The isolated anacardic acid has *E*-configuration which does not correspond to published data where only *Z*-configuration is mentioned for anacardic acids (El Sohly et al. 1982; Yalpani et al. 1983). We therefore assume that the utilization of trifluoric acid (5%) during the isolation process led to isomerisation and that the genuine product showed Z-configuration.
Anacardic acids have been found to exhibit a moderate antibacterial activity against the gram-negative bacterium *Helicobacter pylori*, which causes acute gastritis (Kubo et al. 1999). The minimum inhibitory concentration was detected with the agar dilution method. 6-(8,11,14-Pentadecatrienyl)salicylic acid (C15:3) and 6-(8,11-pentadecadienyl)salicylic acid (C15:2) were most effective with a minimum inhibitory concentration (MIC) of 200 µg/ml, while the 6-(8-pentadecenyl)salicylic acid (C15:1) showed MIC at 400 µg/ml. As a

reference tetracycline exhibits MIC at 6.25 µg/ml (Kubo et al. 1999). The sodium salts of anacardic acid have been shown to exhibit anti-inflammatory activity against induced inflammation in rats (Bhattacharya et al. 1987).
Anacardic acids have been previously isolated from different Anacardiaceae as well from Geraniaceae, Ginkgoaceae and Myristicaceae (Hegnauer 1964).

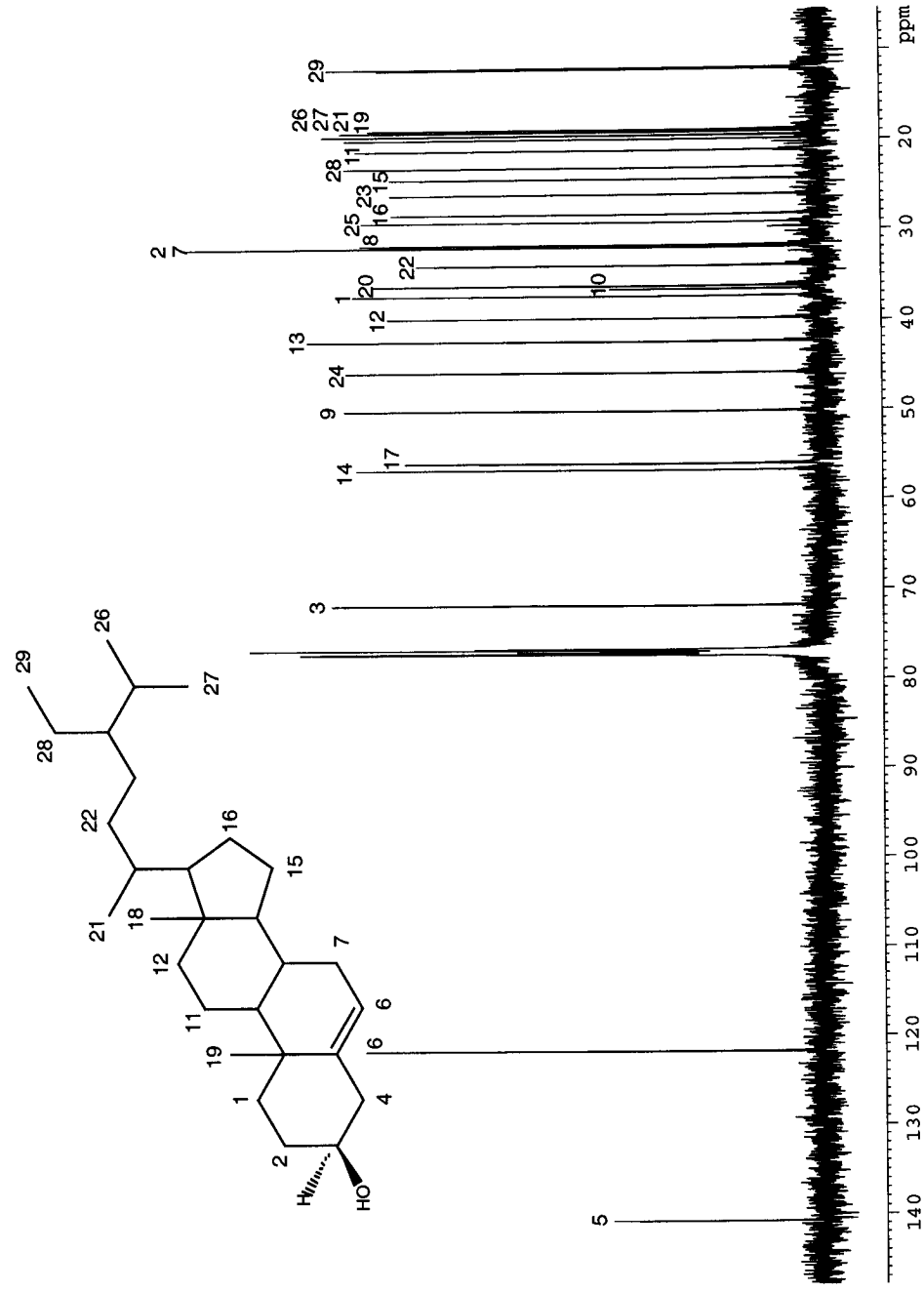
15.7.2 β-Sitosterol (22,23-dihydro-stigmasterol): (3β)-stigmast-5-en-3-ol ($C_{29}H_{50}O$)

In order to elucidate the structure the experimental NMR data was compared with published NMR data (Nes et al. 1992).
^{13}C NMR ($CDCl_3$, 150.9 MHz): δ140.7 (C-5), 121.6 (C-6), 71.6 (C-3), 56.7 (C-14), 56.0 (C-17), 50.1 (C-9), 45.7 (C-24), 42.2 (C-4,13), 39.7 (C-12), 37.2 (C-1), 36.4 (C-10), 36.1 (C-20), 33.9 (C-22), 31.9 (C-7), 31.8 (C-2), 31.5 (C-8), 29.1 (C-25), 28.2 (C-16), 26.0 (C-23), 24.2 (C-15), 23.0 (C-28), 21.0 (C-11), 19.8 (C-26), 19.3 (C-19), 19.0 (C-27), 18.7 (C-21), 11.9 (C-29), 11.8 (C-18).
The melting point was determined to be ranging between 136 and 137° C which corresponds to published data (Steglich et al. 1997).
This phytosterol probably occurs in all green plants. It is estimated that in the western countries the average uptake of phytosterols through daily diet is about 160-360 mg per person, most of it in the form of β-sitosterol (Fritsche and Steinhart 1999). Phytosterols show a broad spectrum of pharmacological activities including anti-inflammatory, antibacterial, antifungal and tumor inhibiting activities (Hänsel, Sticher and Steinegger 1999). β-Sitosterol inhibits competitively the resorption of cholesterol and is used therapeutically to lower serum cholesterol level (Hänsel, Sticher and Steinegger 1999). Epidemiologic approaches and *in vivo* studies with immunodeficient mice let Awad et al. (2001) suggest that dietary phytosterols (including β-sitosterol) may offer protection from breast cancer by inhibiting growth of the tumor and its metastasis.

^{13}C NMR spectrum of anacardic acid monoene in $CDCl_3$ at 75.47 MHz and 295K



^{13}C NMR Spectrum of β-sitosterol in $CDCl_3$ at 75.47 MHz and 295K



15.7.3 Dammarenediol II (20S-dammarendiol II): (3β)-dammar-24-ene-3,20-diol ($C_{30}H_{52}O$)

To confirm the elucidated structure the experimental NMR data were compared with published NMR data (Tori et al. 1988).
^{13}C NMR (CD_3OD, 125.8 MHz): δ131.5 (C-25), 126.0 (C-24), 79.6 (C-3), 76.0 (C-20), 57.4 (C-5), 52.1 (C-9), 51.5 (C-14), 50.5 (C-17), 43.5 (C-13), 42.4 (C-22), 41.6 (C-8), 40.4 (C-1), 40.1 (C-4), 38.3 (C-10), 36.5 (C-7), 32.3 (C-15), 28.8 (C-12), 28.6 (C-28), 28.1 (C-2), 25.9 (C-26), 25.7 (C-16), 25.2 (C-21), 23.6 (C-23), 22.7 (C-11), 19.4 (C-6), 17.7 (C-27), 17.0 (C-30), 16.8 (C-19), 16.1 (C-29), 16.0 (C-18).
The EI-MS spectrum showed a peak at *m/z* 426.4 $[M-H_2O]^+$ which confirmed the determined molecular formula ($C_{30}H_{52}O_2$) and weight (M_r = 444.74). The fragment $[M-2H_2O]^+$ was detectable at *m/z* 408.4.
The compound was found to exhibit antiviral activities in vitro against herpes simplex virus type I and II (Poehland et al. 1987).
There are studies on the cytotoxicity and cancer preventing activities of dammarane-type saponins *in vitro* and *in vivo* (Shibata 2001), but none on dammarenediol. We found the compound to be weakly cytotoxic, with an IC_{50} of 24-29 μM.
Dammarendiol II has already been isolated from different *Pistacia* species and from *Mangifera indica*, both Anacardiaceae (Hegnauer 1964; Steglich et al. 1997; Anjanaeyulu et al. 1985; Caputo et al. 1979), and from Dipterocarpaceae, Sapotaceae, Rosaceae and Rubiaceae (Hegnauer 1964).

15.7.4 Euphol (eupha-8,24-dienol): (3β, 13α, 14β, 17α)-lanosta-8,24-dien-3-ol ($C_{30}H_{50}O$)

To confirm the elucidated structure the ^{13}C NMR data and optical rotation were compared with published ^{13}C and optical rotary power data of (-)-tirucallol and (+)-euphol (De Pascual et al. 1987, Lin et al. 2000). The determined optical rotary power $[a]_D^{20} = +25.0$ fitted very well with the published data by Lin et al. (2000) for euphol ($[a]_D^{25} = +25.1$) (hexane).

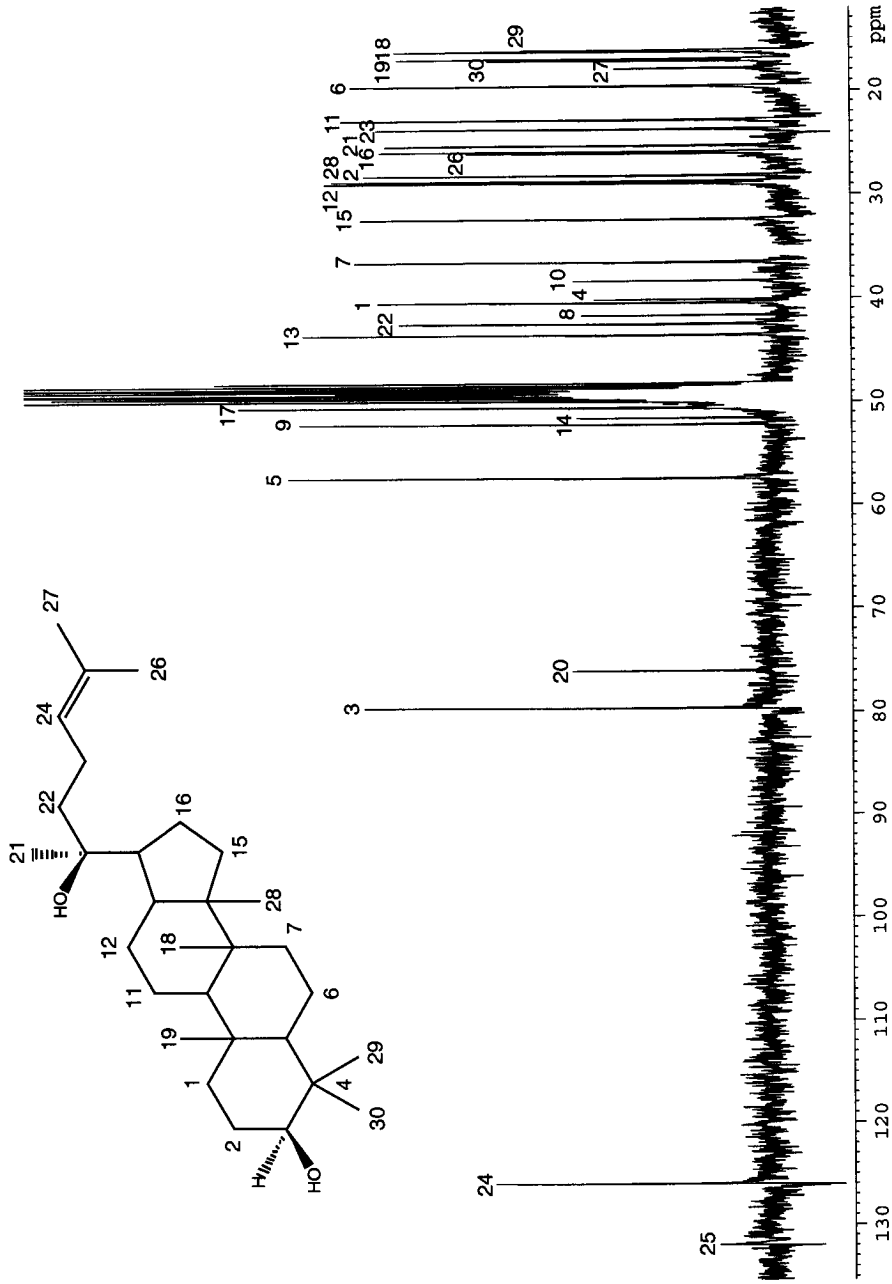
^{13}C NMR (CDCl3, 125.8 MHz): δ134.0 (C-9), 133.5 (C-8), 130.9 (C-25), 125.2 (C-24), 79.1 (C-3), 50.9 (C-5), 50.0 (C-14), 49.6 (C-17), 44.1 (C-13), 38.9 (C-4), 37.2 (C-10), 35.9 (C-20), 35.4 (C-22), 35.2 (C-1), 30.9 (C-12), 29.7 (C-15), 28.2 (C-16), 28.0 (C-29), 27.9 (C-2), 27.6 (C-7), 25.8 (C-27), 24.7 (C-23), 24.5 (C-28), 21.5 (C-11), 20.1 (C-19), 18.9 (C-6,21), 17.7 (C-26), 15.6 (C-30), 15.5 (C-18).

The EI-MS spectrum showed the molecular peak $[M]^+$ at *m/z* 426.3 corresponding to the determined molecular formula ($C_{30}H_{50}O$) and weight (M_r = 426.424). A peak corresponding to $[M\text{-}CH_3]^+$ was detectable at *m/z* 411.2.

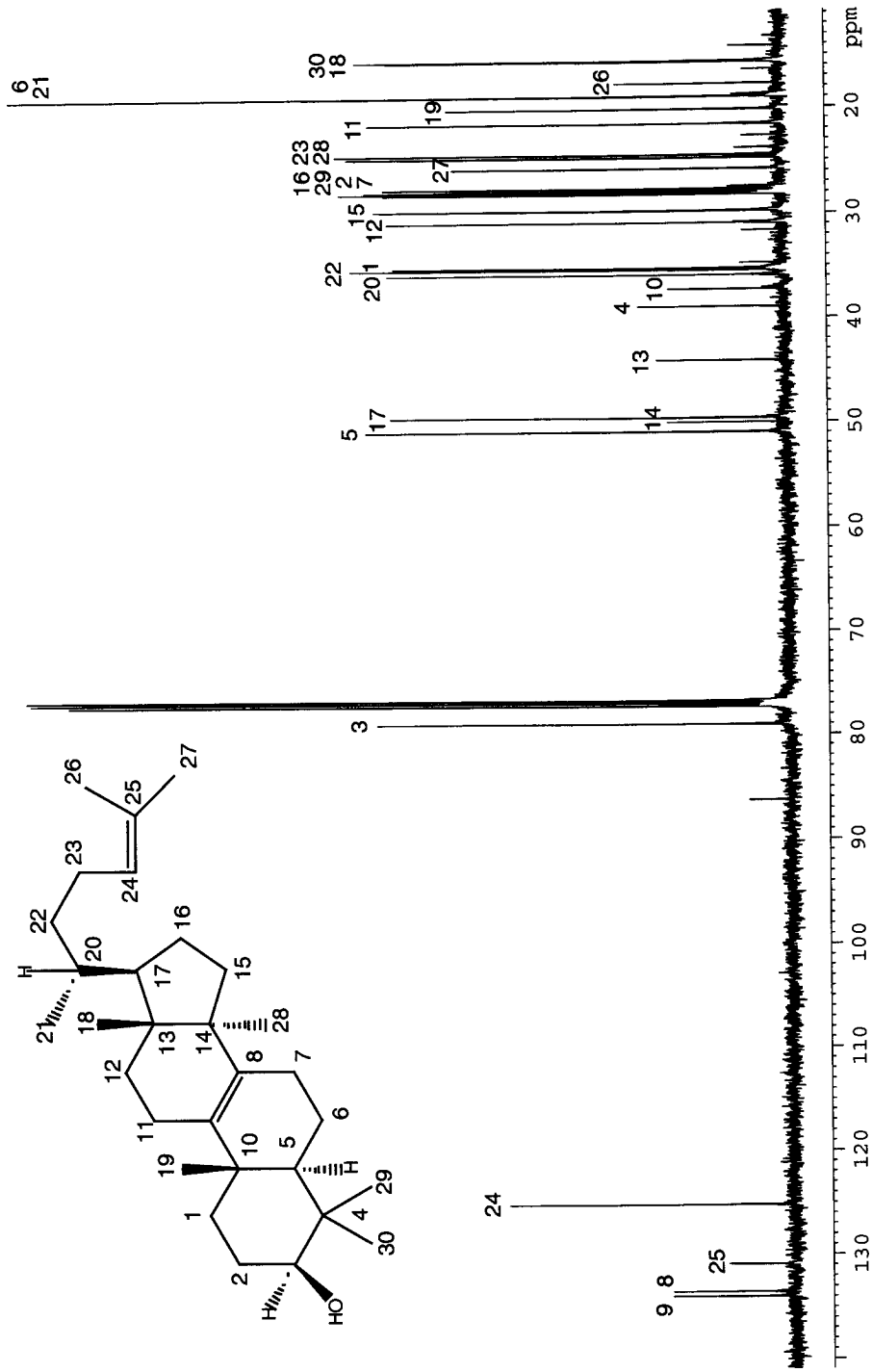
Hypotensive activity of euphol was observed in an animal test with dogs with an ED_{50} value of 2.18 mg/kg *i.v.* (Singh 1989).

Tirucallol, the 21-epimer of euphol but not euphol has already been isolated from the Anacardiaceae (*Pistacia* mastix) (Hegnauer 1964). Euphol is widespread in the Euphorbiaceae (Hegnauer 1964) and has previously been isolated from Theaceae as well (Akihisa et al. 1997).

^{13}C NMR Spectra of dammarenediol II in CD_3OD at 125.77 MHz and 295K



^{13}C NMR spectrum of euphol in $CDCl_3$ at 75.47 MHz and 295K



15.7.5 Methyl gallate: 3,4,5-trihydroxy-benzoic acid-methyl ester ($C_8H_8O_5$)

The elucidated structure was confirmed by comparison of the experimental with published NMR-data (Lajis and Khan 1993).
^{13}C NMR (CD_3OD, 75.5 MHz): δ169.0 (CO), 146.5 (C-3,5), 139.8 (C-4), 121.4 (C-1), 63.0 (C-2,6), 52.3 (CH_3).
The EI-MS spectrum showed a pseudo-molecular peak $[M+H]^+$ at *m/z* 185.0 corresponding to the determined molecular formula ($C_8H_8O_5$) and weight (M_r = 184.146). Fragments were detectable at *m/z* 154 $[M+H-OCH_3]^+$ and at *m/z* 126 $[M+H-COOCH_3]^+$.
Methyl gallate was found to have an antitumor activity against B 16 melanoma in mice at a dose of 25 mg/kg (Bailey et al. 1986). Bailey et al. (1986) suggest that antitumor activity detected in random *in vitro* screening of plant extracts may be due to this widely distributed compound. Furthermore, antioxidant activity was detected in a 1,1-diphenyl-2-picrylhydrazyl free-radical scavenging assay with an IC_{50} of 18.5 µg/ml (Westenburg et al. 2000). The hydroxyls linked to the aromatic ring were made responsible for this effect (Galato et al. 2001). Kato et al. (2001) report anti-inflammatory properties of methyl gallate *in vitro* where they found concentrations of 10 µg/ml to suppress the secretion of interleukine 4 and 5. Chung et al. (1998) found methyl gallate to have an inhibitory effect on the growth of intestinal bacteria *in vitro*, exhibiting the highest activity with *Clostridium perfringens* with a MIC of 7.1 µM. Saxena et al. (1994) report antimicrobial properties on gram-negative as well as on gram-positive bacteria *in vitro* with the lowest MIC being 12.5 µg /ml. Antiviral activity of methyl gallate against herpes simplex virus type 2 was detected in a plaque reduction assay with a IC_{50} 0.22 µg/ml in monkey kidney cells (Kane et al. 1988). We determined the IC_{50} value for cytotoxicity with KB cells to be 43 µM.
The Anacardiaceae (Saxena et al. 1994), as well as the Myrtaceae, Tamaricaceae (Hegnauer 1964), Aceraceae (Bailey et al. 1986), Combretaceae (Adnyana et al. 2000) and the Fabaceae (Meyre-Silva et al. 2001) and other plant families are known to accumulate methyl gallate.

15.7.6 Sulfuretin (3',4',6-trihydroxyaurone): 2-{(3,4-dihydroxyphenyl) methylene}-6-hydroxy-3(2H)-benzofuranone ($C_{15}H_{10}O_5$)

To corroborate the determined structure the experimental ^{1}H and ^{13}C NMR data were compared with published data (Huke and Görlitzer 1969; Markham et al. 1982).

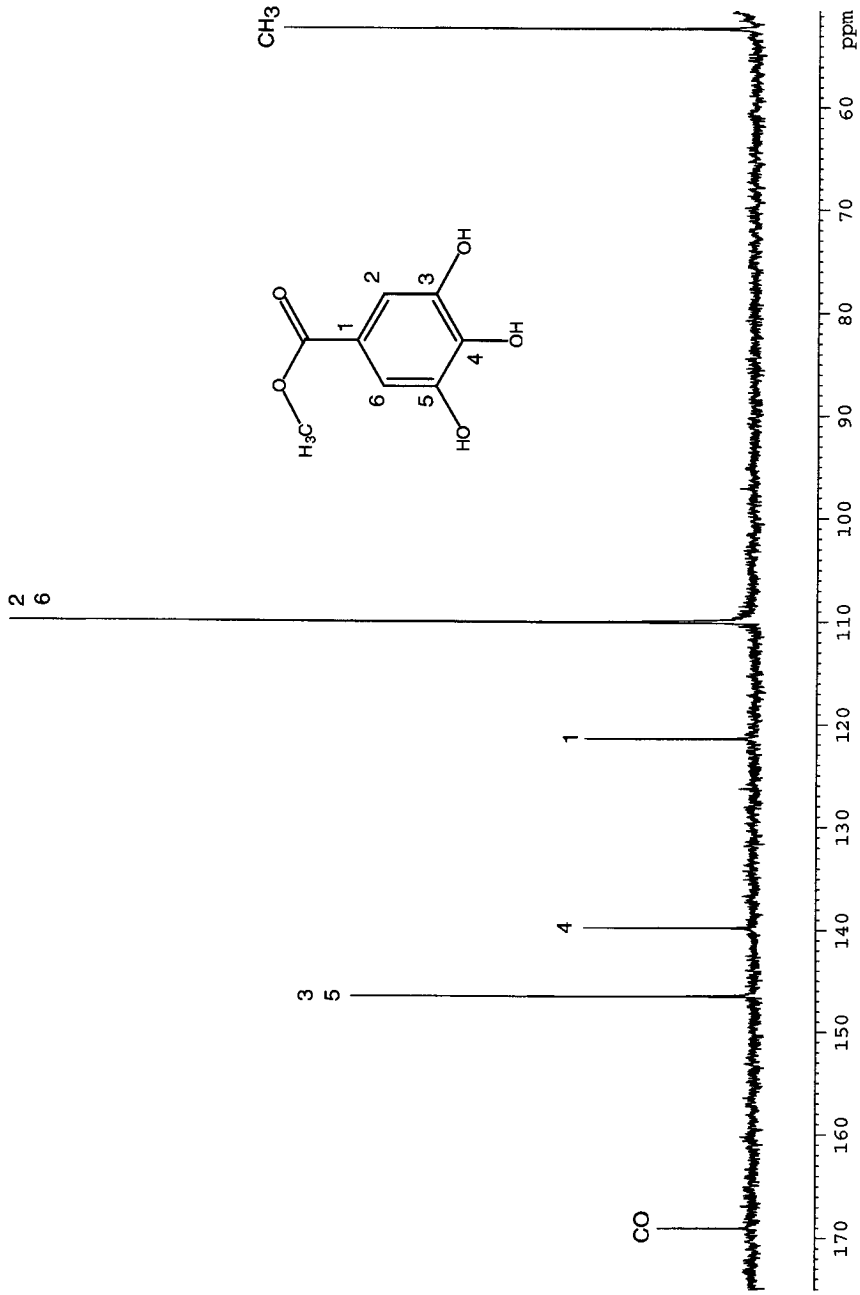
^{13}C NMR (CD_3OD, 75.5 MHz): δ184.3 (C-3), 169.9 (C-6), 169.4 (C-8), 149.3 (C-4'), 147.8 (C-2), 146.7 (C-3'), 126.8 (C-4), 126.3 (C-6'), 125.6 (C-1'), 118.9 (C-5'), 116.6 (C-5), 114.5 (C-9,10,2'), 99.4 (C-7).

The EI-MS spectrum showed the molecular peak $[M]^+$ at *m/z* 270.1 confirming the detected molecular formula ($C_{15}H_{10}O_5$) and weight (M_r = 270.239). Fragments were detectable at *m/z* 253.0 $[M\text{-}OH]^+$ and *m/z* 149.0 $[M\text{-}C_7O_2H_5]^+$.

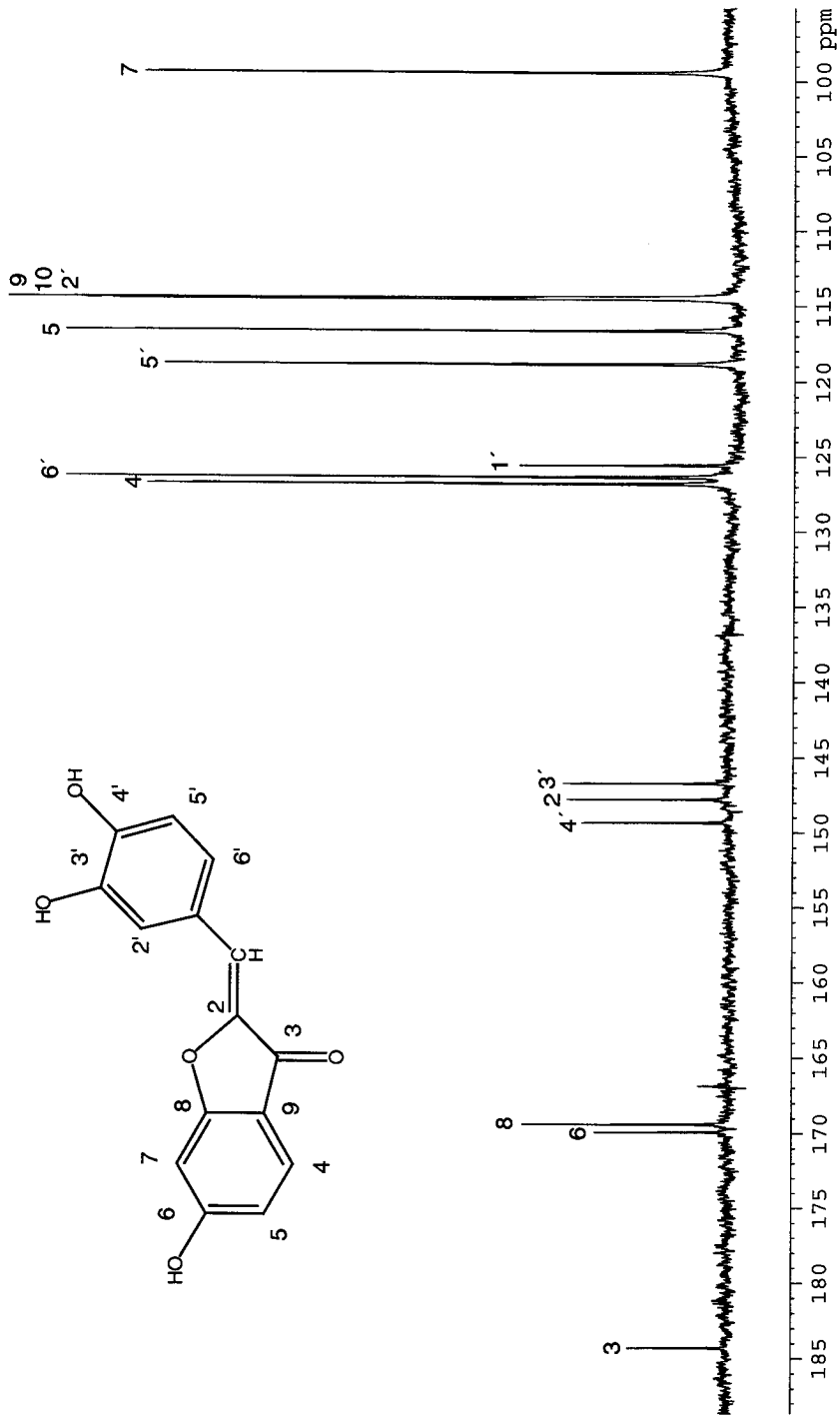
Sulfuretin was found to be a potent antioxidant in a 1,1-diphenyl-2-picrylhydrazyl free-radical scavenging assay with an IC_{50} of 16.1 µg/ml (Westenburg et al. 2000). We determined the IC_{50} value for cytotoxicity with KB-cells to be 46 µM.

Sulfuretin has already been isolated from the Anacardiaceae, Asteraceae, Cyperaceae, (Hegnauer 1964) and the Fabaceae (Chan et al. 1998), amongst other families.

^{13}C NMR spectrum of methyl gallate in CD_3OD at 75.47 MHz and 295K



^{13}C NMR spectrum of sulfuretin in CD_3OD at 75.47 MHz and 295K



15.7.7 Butein (3,4,2',4'-tetrahydroxychalcone): 1-(2,4-dihydroxyphenyl)-3-(3,4,-dihydroxyphenyl)-(2E)-2-propen-1-one ($C_{15}H_{12}O_5$)

To corroborate the structure ^1H and ^{13}C data were compared with published values (Lin et al. 1997).
^{13}C NMR (CD_3OD, 75.5 MHz): δ193.4 (CO), 167.5 (C-4'), 166.3 (C-2'), 149.9 (C-4), 146.8 (C-3), 146.1 (b), 133.3 (C-6'), 128.4 (C-1), 123.6 (C-6), 118.2 (α), 116.6 (C-5), 115.8 (C-2), 114.7 (C-1'), 109.1 (C-5'), 103.8 (C-3').
The EI-MS spectra showed the molecular peak $[M]^+$ at *m/z* 272.1, which corresponds to the detected molecular formula ($C_{15}H_{12}O_5$) and weight (M_r = 272.254). Fragments were detectable at *m/z* 255.1 $[M\text{-}OH]^+$, at *m/z* 163.0 $[M\text{-}C_6O_2H_5]^+$, at *m/z* 150.0 $[M\text{-}C_7O_2H_6]^+$ and at *m/z* 137.0 $[M\text{-}C_8O_2H_7]^+$.
Yit and Das (1994) reported cytotoxic properties of butein *in vitro* by inhibiting the incorporation of thymidine, uridine and leucine into cancer cells (concentration used 2 µM). We determined the IC_{50} value for cytotoxicity with KB cells to be 3.7 µM, which fits well with the values obtained by Yit and Das (1994). Other investigations propose that butein is a powerful antioxidant inhibiting iron-induced lipid peroxidation in rat brain homogenate in a concentration-dependant manner with an IC_{50} of about 3.3 µM (Cheng et al. 1998). Butein is known to occur in the Anacardiaceae as well as in Asteraceae (Hegnauer 1964) and Fabaceae (Cheng et al. 1998).

15.7.8 (+)-Taxifolin, ((+)-dihydroquercetin): 2-(3,4-dihydrophenyl)-2,3-dihydro-3,5,7-trihydroxy-4H-1-benzopyran-4-one ($C_{15}H_{12}O_7$)

The elucidated stucture was confirmed by comparing experimental NMR data with published ^1H and ^{13}C data (Markham et al. 1982; Foo and Karchesy 1988).
^{13}C NMR (CD_3OD, 75.5 MHz): δ198.5 (C-4), 168.7 (C-7), 165.3 (C-5), 164.5 (C-9), 147.1 (C-4'), 146.3 (C-3'), 129.8 (C-1'), 120.9 (C-6'), 116.0 (C-2'), 115.8 (C-5'), 97.3 (C-6), 96.2 (C-8), 85.1 (C-2), 73.6 (C-3).
The HiRes-MALDI-MS (positive mode) spectrum showed the pseudo-molecular peak $[M+H]^+$ at 305.1 corroborating the determined molecular formula ($C_{15}H_{12}O_7$) and weight (M_r = 304.253).
Optical rotary power was determined as $[a]_D^{25}$ = +5.0 (methanol) and fitted in the range of the literature data, which were very inconsistent (probably due to

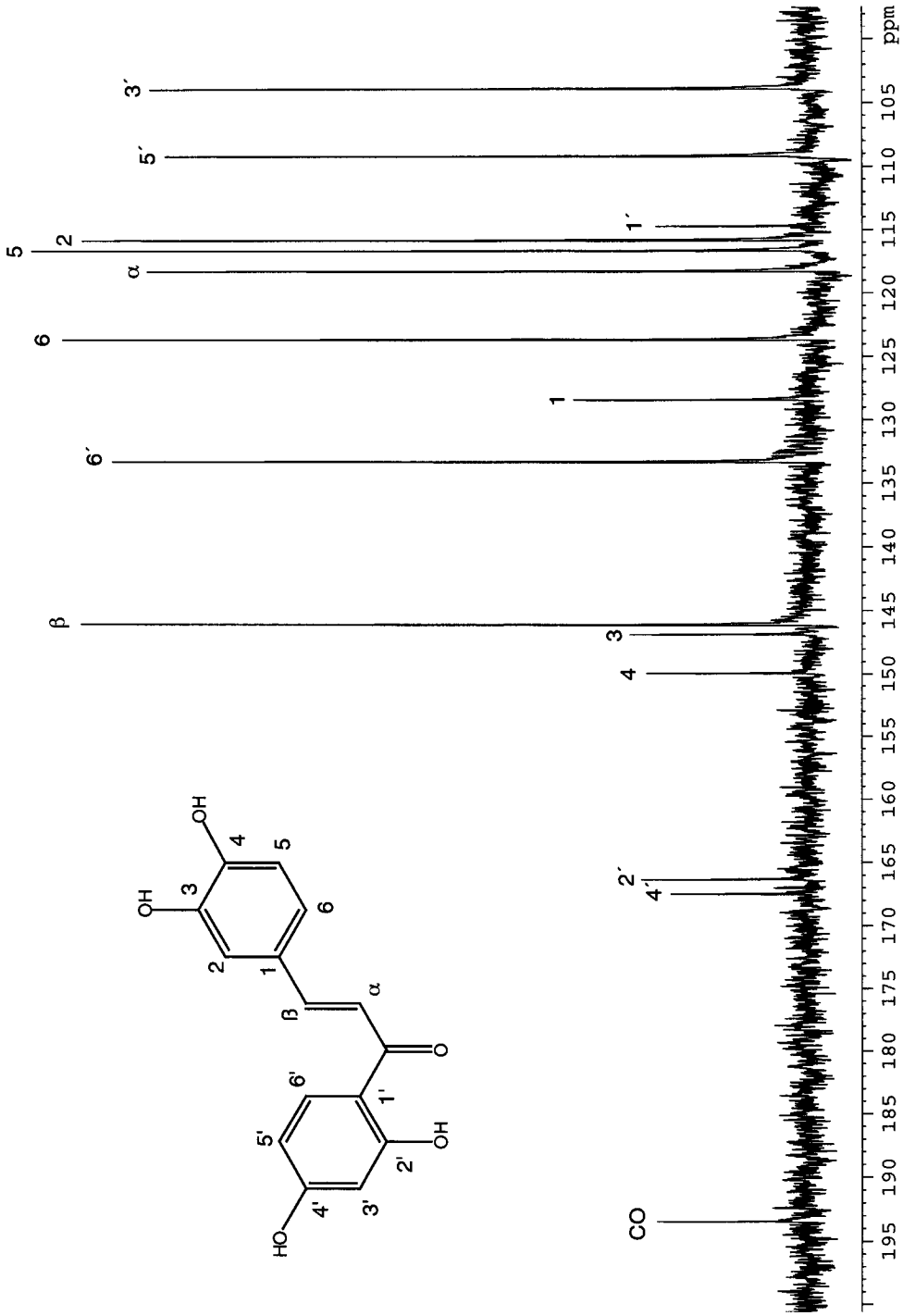
impurity) and varied from +1.9 degree (methanol) up to +36.5 degree (methanol). All measurings were undertaken with the sodium D-line (589 nm).
It was shown that taxifolin protects murine fibroblast cells from tumor necrosis factor-alpha induced cytotoxicity at an EC_{50} of 200 µM (Habtemariam 1997). Nowadays taxifolin is widely used as a dietary supplement to which anti-oxidative, anti-inflammatory and antitumor properties are being attributed.
Taxifolin has previously been isolated from the Anacardiaceae and from many other plant families like Fagaceae, Lauraceae, Sapotaceae, Saxifragaceae, Winteraceae, and Pinaceae (Hegnauer 1964), just to mention a few.

15.7.9 2,3-Trans-3-methoxyfustin: 2-(3,4-dihydroxyphenyl)-2,3-dihydro-7-hydroxy-3-methoxy-(2R-trans)-4H-1-benzopyran-4-one ($C_{16}H_{14}O_6$)

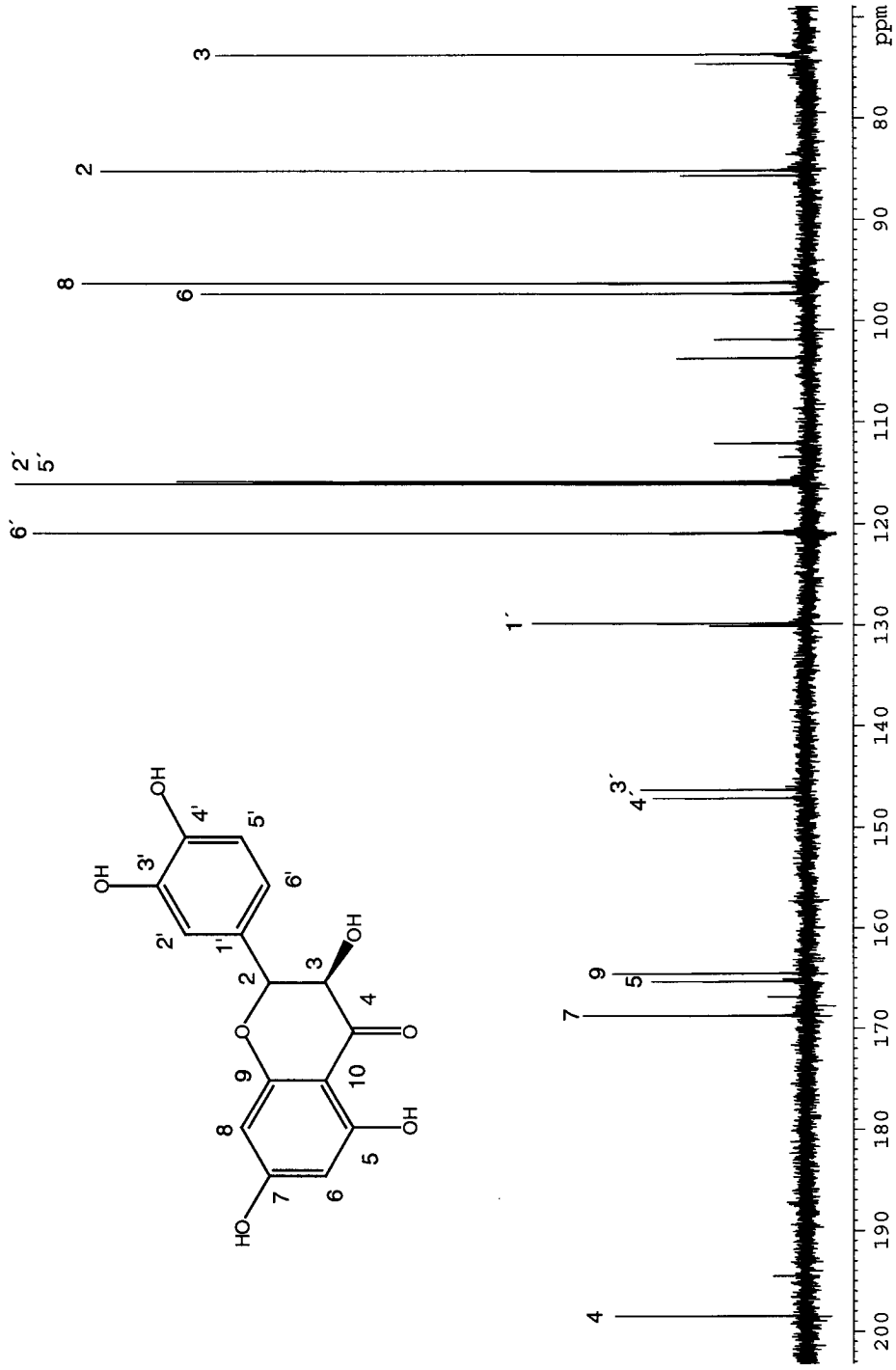
For establishing the structure published ^1H data were used (Ferreira et al. 1974; Van der Merwe 1972). The ^1H NMR data are given only for its teramethylether (-3,3',4',7-tetra-O-methyl-2,3-trans-fustin) provided by complete synthesis.
The chemical shifts are exposed in τ-values and can be easily transformed applying following equation: $\tau = 10-\delta$.
The $J_{2,3}$ coupling of 10.4 Hz characterizes the trans position of the involved protons.
^1H NMR (CD_3OD, 300.13 MHz): δ7.69 (d, 1H-5), 6.94 (d, 1H-2'), 6.83 (dd, 1H-6'), 6.80 (d, 1H-5'), 6.51 (dd, 1H-6), 6.32 (dd, 1H-8), 5.06 (d, 1H-2), 4.16 (d, 1H-3), 3.29 (s, 3H-OMe).
^{13}C NMR (CD_3OD, 75.5 MHz): δ193.2 (C-4), 167.2 (C-7), 164.7 (C-9), 147.1 (C-4'), 146.4 (C-3'), 130.1 (C-5), 129.8 (C-1'), 120.5 (C-6'), 116.1 (C-5'), 115.6 (C-2'), 113.8 (C-10), 112.2 (C-6), 103.7 (C-8), 84.2 (C-2), 83.3 (C-3), 60.6 (OCH_3).
The EI-MS spectra showed the molecular peak $[M]^+$ at *m/z* 302.1 corroborating the determined molecular formula ($C_{16}H_{14}O_6$) and weight (M_r = 302.281). Fragments could be detected at *m/z* 272.1 $[M+2H-OHCH_3]^+$, at *m/z* 193.1 $[M-C_6O_2H_5]^+$, at *m/z* 166.1 $[M+H-C_7O_3H_5]^+$ and at *m/z* 137.0 $[M+H-C_9O_3H_{10}]^+$.
No pharmacological data are available on this compound. We determined the IC_{50} value for cytotoxicity with KB cells to be 40 µM.

The compound has previously been isolated from two Fabaceaean genera; *Acacia* (Brandt and Roux 1979) and *Trachylobium* (Van der Merwe et al. 1972; Ferreira et al. 1974).

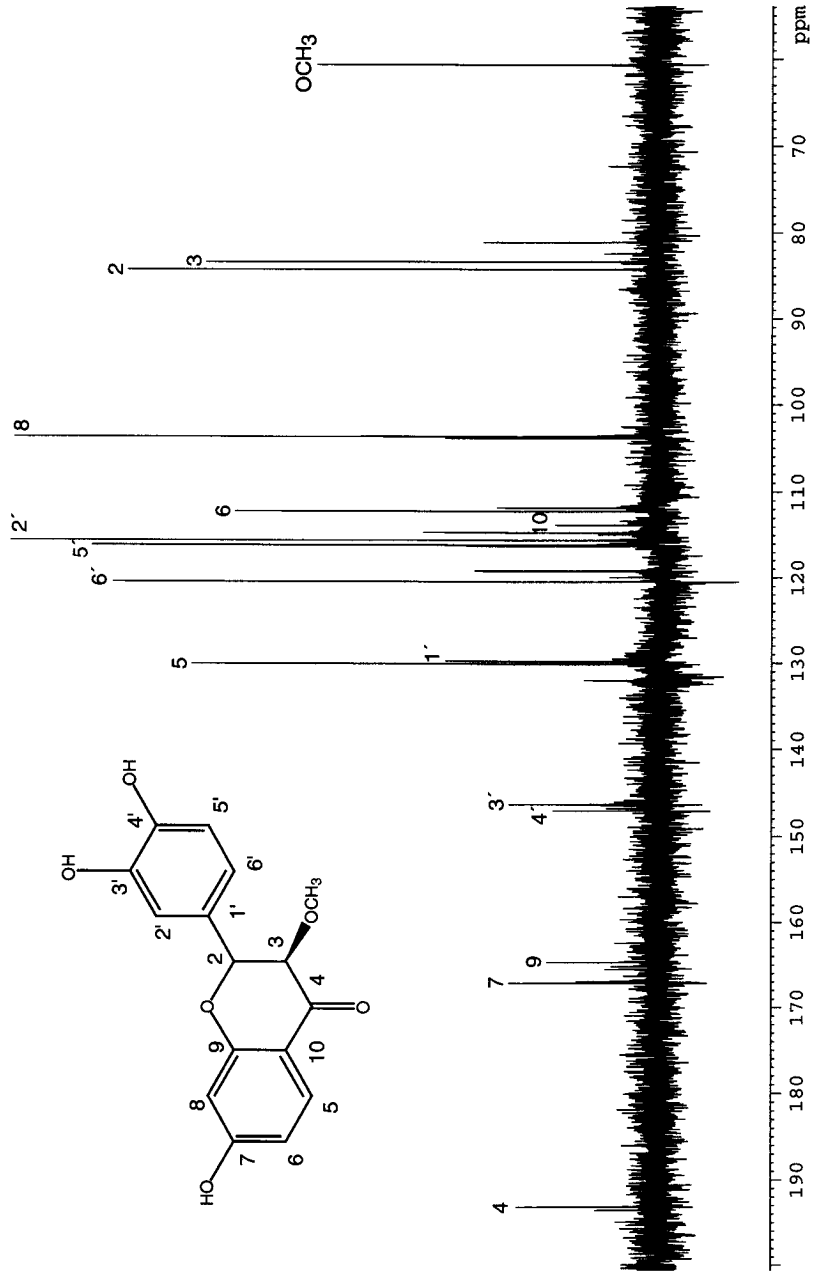
^{13}C NMR spectrum of butein in CD_3OD at 75.47 MHz and 295K



^{13}C NMR spectrum of taxifolin in CD_3OD at 75.47 MHz and 295K



^{13}C NMR spectrum of 2,3-trans-3-methoxyfustin in CD_3OD at 75.47 MHz and 295K



15.8 Further phytochemical screenings

In the methanol extract the presence of condensed tannins could be established. The extract was dissolved in a formaldehyde-8%-hydrochloric acid-3%-solution. After heating up to 100° C a pellet of condensed tannins was formed (Hänsel, Sticher and Steinegger 1999). The supernatant was tested positive for the presence of gallo-tannins with FeIII salts (Hänsel, Sticher and Steinegger 1999).
Thin layer chromatographic evidence for catechin using catechin as a reference was positive.

15.9 Biological screenings of the pure compounds

15.9.1 Antibacterial screening

All compounds except β-sitosterol were tested in an antimicrobial assay. Minimal inhibitory concentration (MIC) for bacterial growth was assessed with the agar dilution method according to Liu et al. 1999 and Winkelmann et al. 2000. Only butein inhibited down to a concentration of 32 ppm temporarily the vitality of *Staphylococcus epidermidis*, but was not mortally. None of the compounds showed antibacterial or antifungal activity at a concentration of 128 ppm or less with following enlisted microorganisms. As reference substances chloramphenicol and miconazole were used.

Staphylococcus epidermidis	(ATCC 12228)
Candida albicans	(H29 ATCC 26790)
Pseudomonas aeruginosa	(ATCC 27853)
Escherichia coli	(ATCC 25922)

15.9.2 Cytotoxicity screening of the pure compounds

The cytotoxicity screening was conducted as described before. Butein showed the strongest cytotoxic activity with an IC_{50} value of 3.7 μM (1 μg/ml) followed by dammarendiol with an IC_{50} between 24 and 29 μM (10-12 μg/ml),

2,3-trans-3-methoxyfustin with an IC_{50} of 40 µM (12.5 µg/ml), methyl gallate with an IC_{50} of 43 µM (8 µg/ml), and sulfuretin with an IC_{50} of 46 µM (18.8 µg/ml). The other compounds had all higher IC_{50} values, whereas β-sitosterol was not tested. As a reference podophyllotoxin exhibits an IC_{50} value of 0.0145 µM (0.006 µg/ml) (Winkelmann 2001).

15.10 Conclusions

With the investigations on *Mosquitoxylum jamaicense* bark the monotypic genus of *Mosquitoxylum* was studied the first time regarding its phytochemistry and pharmacology. The bioassay-guided fractionation of the dichloromethane-extract yielded four known substances which are characteristic for the Anacardiacean chemistry (extraction scheme I). All substances except euphol have previously been reported for this family.

From the methanol extract five previously known compounds were obtained by bioassay-guided fractionation (extraction scheme II). All molecules belong to compound classes which are characteristic for the Anacardiaceaen chemistry. 2,3-Trans-3-methoxyfustin is herewith reported for the first time for this family.

We were able to detect relevant *in vitro* activities of some isolated compounds. However, the transmittance of the *in vitro* data on the *in vivo* properties of the extract are limited.

The potential beneficial property of a medicinal plant is not only dependant on its chemical spectrum. Apart from the chemical spectrum the preparation and the application of the remedy must be taken into consideration. Moreover, the treatment of menstrual problems by the Popoluca can involve various plant species. Up to 10 plants may be included in the decoction with tree barks being used most frequently. The barks are boiled and the resulting extract is administrated orally over time. However, the interaction with compounds from other medicinal plants is beyond the scope of this discussion.

The constituents isolated from the bark extracts are (according to the extraction method) of diverse polarity and solubility in water and therefore of unequal availability to the patient.

In order to verify if any of the isolated classes of compounds dissolve during the preparation process a decoction of 50 grams of *M. jamaicense* bark were

boiled with 1.5 dl of water, yielding 5 grams of polar extract. With the TLC method a triterpene band, though not very intense but visible after vanillin and H_2SO_4 treatment and probably corresponding to euphol was detected.

Triterpenes are present at a high concentration in *M. jamaicense* bark. 23 grams of DCM-extract contained about 15 grams (70%) triterpenes which in relation to the total bark weight is about 2.5%.

If a freshly harvested bark piece with leaking latex is used, droplets of latex may form an emulsion with water and can be ingested with the decoction. However, in a decoction made from dried bark, as shown in the above described experiment only small quantities of apolar substances get dissolved. The main part corresponds to sugars, condensed tannins, gallotannins and very likely to phlobaphenes, too.

In the methanolic extract methyl gallate was by far the most abundant compound determined at amounts of about 150 to 200 mg in the 3.6 grams of the total butanol partitioned extract. All other compounds detected in the methanol extract were present at much lower levels (up to 30 mg).

The fact that *M. jamaicense* bark is used in the treatment of menstrual problems raise the question if any of the isolated compounds are able to exhibit a hormonal effect. The discussion about possible estrogenic effects of phytosterols has still not resulted in satisfactory conclusions. Assuming that about 100 grams of bark are used for a medicinally destined decoction about 2.5 grams of triterpenes are potentially available. However, here we show that using dried bark material only minor parts of phytosterols, dissolve in water, above all in quantities which are not significant in relation to the potential uptake of phytosterols with vegetables. Therefore a potential estrogenic effect of dried *M. jamaicense* bark seems to be unlikely.

The reported anti-inflammatory properties of methyl gallate, butein and taxifolin may well play a role in the treatment of menstrual problems.

The high concentration of tannins and the antibacterial properties of methyl gallate may well be partially responsible for a beneficial effect in the treatment of vaginal infections and gonorrhea.

Importantly, the data presented here show that the compounds detected in this species seem to possess little toxicological risks (at least not in the occurring concentrations) and that the plant, as far as the phytochemical and pharmacological analysis go can be applied without any health risk.

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16 Key to the plant list and plant list

The abbreviations of the plants parts used (Table 1), the preparation (Table 2) and the application method (Table 3) are all published in Spanish. Therefore the following tables show the translations.

Table 1.

Abreviación de la parte usada / Abbreviation of the plant part used	**Parte de la planta usada (Español)**	**Plant part used (English)**
A	Agua	Juice (watery)
B	Bulbo, cebolla	Bulb
Be	Bejuco	Creeper, climber
C	Camote	Tuber
Ca	Cascara	Fruit skin
Co	Corteza	Bark
Cog	Cogollo	Shoot
F	Flor	Flower
Fr	Fruta	Fruit
H	Hoja	Leaf
Hi	Hierba	Herb
L	Leche, latex	Latex, milky juice
M	Madera	Wood
Pe	Planta entera	Whole plant
R	Raíz	Root
Ra	Rama	Twig
Re	Retoño	New shoot
Res	Resina	Resin
S	Semilla	Seed
Ta	Tallo	Stem, axis

Table 2.

Abreviación de la preparación / Abreviation of the preparation	**Preparación (Español)**	**Preparation (English)**
A-E	Asar y exprimir	Steam and squeeze
E	Exprimir	Squeeze
F	Fresco	Fresh
Fe	Fermentar	Ferment
H	Hervir	Boil
J	Jarabe	Syrup
Ma	Macerar (en agua)	Maceration in water
MaA	Macerar en aguardiente	Maceration in alcohol
MaV	Macerar en vino	Maceration in wine
Mo	Moler	Ground
Po	Pomada	Ointment
Q	Quemar	Burn
R	Raspar	Rasp
S	Secar	Dry
S-Mo	Secar y Moler	Dry and ground
T	Tostar	Toast
T-Mo	Tostar y moler	Toast and ground

Table 3.

Abreviación de la forma de la aplicación / Abbreviation of the mode of application	Forma de aplicación (Español)	Mode of application (English)
Ba	Baño de asiento	Hip bath
Bca	Baño de cabeza	Head shower
Bcu	Baño de cuerpo	Body shower
Bv	Baño de vapor	Steam bath
C	Cataplasma	Cataplasm
Co	Comer	Eat
E	Enjuago bucal	Lavage of the mouth
F	Fumar	Smoke
Fo	Fumar en el oído	Smoke in the ear
G	Gotas	Drops
L	Local	Local
La	Lavar	Lavage
LaR	Lavado rectal	Rectal douche
LaV	Lavado vaginal	Vaginal douche
Li	Limpia	Ritual cleansing
Ma	Mascar	Chew
O	Olfatear	Smell
P	Plantilla	Foot packing
Po	Polvo (local)	Powder (local)
S	Sahumar	Fumigate
So	Sobar (masaje, untar)	Rub (massage)
T	Té	Tea
Ti	Tintura	Tincture
To	Tomado	Drink
U	Untar	Rub

The following list explains the abbreviations of the different illness categories and gives the translations of the different uses.

DE: Trastornos dermatologicos	**Dermatologic afflictions**
Caída del cabello	Hair loss
Candida en la boca (algodoncillo)	Thrush
Canser	Bad healing wound, ulcer
Caspa	Dandruff
Comezón	Itchiness
Encía sangriente (Gingivitis)	Gingivitis
Erisipela (infección con *Streptococcus* ssp)	Erysipelas (infection with *Streptococcus* spp.)
Granos en la boca	Infection in the mouth
Granos	Pimples
Hemoroides	Hemorrhoids
Herida infectada	Infected wound
Herida	Wound

Herpes	Herpes
Infección (de la piel)	Infection (of the skin)
Infección bucal, en la boca	Infection in the mouth
Infección de la uña	Infection of the fingernail
Llaga	Bad healing wound
Llaga con pus	Bad healing wound with pus
Manchas blancas (mal de pinto)	Discoloration of the skin (melanin deficit)
Mycosis (hongos)	Mycosis
Nacido	Furuncle
Para los cabellos	For the hair
Parar la sangre	Stop the bleeding of a wound
Pie apestoso	Athlete's foot
Piojos	Lice
Quemadura	Burning
Ronchas	Welt
Salpullido	Eczema, rash
Sarna	Scabies
Secar el ombligo de recien nacidos	To dry the umbilicus of the new born
Varices	Varices
Verrugas	Verruca, wart

GA: Afecciones gastrointestinales, enfermedades hepáticas	**Gastrointestinal disorders, hepatic complaints**
Agruras	Heartburn, pyrosis
Aperitivo	Appetizer
Bilis	Bile
Colicos	Colics
Diarrea	Diarrhea
Disentería	Dysentery
Dolor de "corazón"	Gastritis, heartburn
Dolor de estómago	Stomach-ache
Dolor del bazo	Aching milt
Dolor del intestino	Aching intestine
Empacho (indigestión)	Indigestion
Estreñimiento	Constipation
Feces verde del bebé	Green feces of children
Flatulencia	Flatulence
Gastritis	Gastritis
Hepatitis	Hepatitis
Hipo	Hick up
Indigestión (empacho)	Indigestion

Inflamación del intestino	Inflamed intestine
Latido	Palpitating umbilicus
Lombrices	Worms
Parasitos intestinales	Intestinal parasites
Ulcera	Gastric ulcer
Vertigo	Vertigo
Vesicula biliar	Gall bladder
Vomitar sangre	Vomiting blood
Vomito	Vomiting

GY: Medicina para las mujeres	**Women's medicine**
Accelerar el parto	Accelerate the parturition
Antiabortivo	Anti-abortive
Anticonceptivo	Contraceptive
Conceptivo	Ceptivum
Derigir el feto en posición	To bring the fetus in position
Después del parto	After parturition
Determinar el sexo del bebé	To influence the baby's gender
Dolor de los ovarios	Aching of the ovaries
Expulsar la placenta	Expulse the placenta
Hemorragia vaginal, hemorragia	Hemorrhage
Lavar el bebé	Wash the new born
Lavar el cuerpo después del parto	Wash the body after parturition
Matriz inflamada	Inflammation of the uterus
Ovarios inflamados	Inflamed ovaries
Para tener un varón	To make a boy
Parasitos en la matriz	Parasites in the uterus
"Secar" la matriz después del parto	To "dry" the uterus after parturition
Tonico después del parto	Tonic after parturition
Trastornos menstruales	Menstrual complaints
Ulcera de matriz	Ulcer of the uterus

UR: Trastornos urogenitales	**Urogenital complaints**
Flujo	Vaginal infection
Gonorrea	Gonorrhea
Infección vaginal	Vaginal infection
Mal de orinar	Pain while urinating
Mal de riñon	Aching of the kidney

Para los niños que orinan en la cama	To prevent children from urinating in the bed
Riñon inflamada	Inflamed kidney

CU: Enfermedades y syndromes culturales	**Culture-bound syndromes**
Amarar el Xunujti	To tie the Xunujti
Amarar los brujos	To tie the brujos (witch men)
Brujería (conta la)	Witchcraft (against)
Buena suerte	Good luck
Cansancio	Tiredness
Cuando molesta el duende	When the gremlin disturbs
Cuando el niño no abre la boca (alferesía)	When the child does not open the mouth
Desalojar maldades	To send away witchcraft
Desesperación	Desperation
Engaño	Being deceived (by a woman)
Espanto	Fright
Hacer lluvia	Rain making
Hacer maldad	Doing evil
Hechizar	To bewitch
Hechizo (contra el)	Spell, witchcraft (against the)
Hipo del engaño	Hick up of the deceived
Limpia	Ritual cleansing
Mal aire	Bad (spiritual) wind
Mal de espirito	Bad state of the spirit
Mal viento	Bad winds
Maldades	Witchcraft
Malos espiritos	Bad spirits
Melancolía	Melancholy
Niño enfermo	Sick child
Niño llorón	Crying child
Niño que no crece	Child who doesn't grow
Niño que no duerme	Child who can't sleep
Niño que no habla	Child who doesn't (learn to) speak
Para engordar	To put on weight
Para las personas en agonía	For the persons in agony
Pensamientos	Thinking about troubles
Perfume espiritual	Spiritual perfume
Protección	Protection
Quitar el calor de muerto	Send away the heat of the death
Quitar la lluvia	Sent away the rain

Sahumar la casa	To fumigate the house
Susto	Fright
RE: Problemas respiratorias	**Respiratory ailments**
Asma	Asthma
Bronquitis	Bronchitis
Tos	Cough
Tosferina	Whooping cough
FI: Fiebre (infeciones virales y por protozoas)	**Fever (including protozoan and viral infections)**
Dengue	Dengue
Dolor de cabeza	Headache
Escalofios	Shivering
Fiebre de rayo	Thunderbolt's fever
Fiebre	Fever
Malaria (paludismo)	Malaria
Sarampión	Measles
Viriuela	Chickenpox
SK: Enfermedades del sistema músculo-esquelético	**Skeleto-muscular disorders**
Artritis	Arthritis
Dolor de cuerpo	Pain of the body
Dolor de hueso	Pain of the bones
Dolor de la muñeca	Pain of the wrist
Dolor de rodilla	Pain of the knee
Dolor muscular	Muscle pain
Golpes	Bruises
Quebradura (de hueso)	Fracture
Reuma	Rheumatism
Torcedura	Sprain
Zafadura	Dislocation
VE: Piquetes y mordeduras de animales venenosas	**Counteract bites and stings of venomous animals**
Piquete de vibora	Snake bite
Piquete de alacran	Scorpion's sting
Piquete de la viuda negra	Bite of the black widow

Piquete de gusanos	Interaction with caterpillar hairs
DI: Diabetes	**Diabetes**
Diabetes (azucar)	Diabetes
DO: Dolor de muela	**Toothache**
Dolor de muela	Toothache
OI: Problemas del oído	**Problems of the ear**
Dolor de oído	Earache
OP: Trastornos oftalmologicos	**Ophtalmologic complaints**
Ardor de los ojos	Burning eyes
Conjunctivitis	Conjunctivitis
Infección del ojo	Infection of the eye
Nubes	Cloudy sight
VU: Varios usos	**Different uses**
Abuso del alcohol	Alcohol abuse
Afrodisiaco	Aphrodisiac
Alferecía	Epilepsy, cramps
Amarar los brujos	Tie the sorcerers
Anemia	Anemia
Alta presión	High pressure
Ataque nervioso	Nervous attack
Ataques epilepticos	Epilepsy
Baja presión	Low pressure
Cansancio	Tiredness
Circulación de la sangre	For the cardiovascular system
Colorar tejidos	To dye textiles
Comestible	Comestible
Comestible en caldo	Edible in soup
Fortalecer la sangre	Vitalize the blood
Fumar	Smoke
Preparar tepache	Prepare "tepache" (alcoholic beverage)
Hemorragia de nariz	Nosebleed
Hinchasón de la pierna	Swelling of the leg

Hinchasón del cuerpo	Swelling of the body
Hinchasón del pie	Swelling of the foot
Infección (dermal) de los caballos	Dermal infection of the horses
Inflamación del cuerpo	Inflammation of the body
Insomnio	Insomnia
Lavar ropa	Wash cloth
Nervios alterados	Nervousness
Papera	Mumps
Para las heridas de los caballos	To treat the wounds of horses
Pegamento	Glue
Pescar	Fishing
Pies inflamados	Inflamed feet
Rabia	Rabies
Rabia de los perros	Rabies of the dogs
Repelente para insectos	Insect repellant
Tetano	Tetanus
Tónico	Tonic
Tranquilizante	Tranquilizer
Veneno para cazar	Arrow poison
Veneno para cucarachas	Poison for cockroaches
Vitamina	Vitamin

NUM.C	NOMBRE CIENTIFICO	NOMBRE POPOLUCA	NOMBRE ESPANOL	PARTE USADA	PREPARACION	APLICACION	USOS	REPORTES
	LYCOPODIOPSIDAE							
	SELAGINELLACEAE							
L 305	*Selaginella* sp.			Hi	S/H	S/T	CU: Niño que no crece, /GY: Matriz inflamada	1/1
	EQUISETOPSIDA							
	EQUISETACEAE							
	Equisetum sp.		Cola de caballo	Hi	H	T	GY: Accelerar el parto	1
	FILICOPSIDAE							
	ADIANTACEAE							
L 304	*Adiantum princeps* T. Moore			R/H	H/H	T/T	GA: Trastornos gastrointestinales, /GY: Hemorragia vaginal	3/2
L 26	*Pityrogramma calomelanos* (L.) Link	Poja chimal		H	H/Ma	T/Bca	RE: Tos, tosferina /DE: Caspa	10/2
	BLECHNACEAE							
L 356	*Blechnum gracile* Kaulf.	Tsabats chimal		H/R	S/H	S/T	CU: Malos espiritos /GY: Determinar el sexo del bebé	1/1
	CYATHEACEAE			H,R,Re	H	T	UR: Mal de orinar, mal de la riñon	3
L 231		Cuy chimal	Rodillo burro					
L 444		Cuy chimal	Cola de chango					
	DRYOPTERIDACEAE							
L 27	*Tectaria heracleifolia* (Willd.) Underw.		Siempreviva	Hi	H	T	CU: Para las personas en agonia	1
	HYMENOPHYLLACEAE							
L 498	*Trichomanes pinnatum* Hedw.	Chimal		H	Ma	Bca	FI: Dolor de cabeza	1
	LOMARIOPSIDACEAE							
L 449	*Elaphoglossum* aff. *sartorii* (Liebm.) Mickel			Hi	H	T	GA: Estreñimiento	1

NUM.C	NOMBRE CIENTIFICO	NOMBRE POPOLUCA	NOMBRE ESPANOL	PARTE USADA	PREPARACION	APLICACION	USOS	REPORTES
	POLYPODIACEAE							
L 343	*Campyloneurum phyllitidis* (L.) C. Presl	Cuy chimal	Helecho macho	R/H	H/S	T/S	GA: Dolor colico /CU: Malos espiritos	1/1
L 136	*Microgramma nitida* (J.Sm.) A. R. Sm.	Canagual		Hi	H	T	SK: Golpes	2
L 329	*Pecluma* sp.			R/H	H/Ma	T/Bcu	GA: Dolor de "corazón" /FI: Fiebre	1/1
L 328	*Polypodium polypodioides* (L.) Watt var. *aciculare*	Tsa chimal		R,H/R/R/H/R	H/H/H/H/H	T/T/T/T/T	UR: Cálculos renales /GA: Hepatitis /RE: Bronquitis /DI: Diabetes /VU: Circulación de la sangre	2/1/1/1/1
L 269	*Polypodium triseriale* Sw.	Canagual		R/R	H/H	T/L	SK: Golpes /DE: Herida infectada	2/1
L 500	*Pteridium aquilinum* (L.) Kuhn		Ocopeta	R/H	H/S	T/S	RE: Tos /CU: Niño que llora	3/1
	SCHIZAEACEAE							
L 158	*Lygodium heterodoxum* Kunze	Naxiui	Atagota de bejuco	H	Mo	L	VE: Piquete del gusano blanco	1
L 138	*Lygodium venustum* Sw.	Naxiui	Atagota de bejuco, Bejuco de lambri	H,R/R/R/R	H,Mo/H/H/H	T,C/T/T/T	VE: Piquete de vibora, viuda negra y gusanos /UR: Mal de orín, de riñon /GA: Empacho /CU: Hipo del engaño	3/2/1/1
	CYCADOPSIDAE							
	CYCADACEAE							
L 42	*Zamia loddigesii* Miq.	Pekmuk kobak	Mais Viejo	C,S/C,S/C/C/C	H,T/R/R/T-Mo-H/H	T/C/C/T/T	GA: Gastritis /DE: Infección dermal, erisipela /VE: Piquete de vibora /GY: Hemorragia vaginal /VU: Afrodisiaco	5/5/2/1/1
L 524	*Zamia* sp.	J¥mniom pekmuk		C	H	T	UR: Mal de riñon	1
	PINOPSIDAE							
	PINACEAE							
L 457	*Pinus oocarpa* Schiede ex Schltdl.	Tyiñcuy	Ocote	Res/Res/M/Co	F/F,Po/H,J/S	L/L/T,J/S	DE: Nacido, herida /SK: Golpe, dolor muscular, quebradura /RE: Tos /CU: Hacer lluvia	7/2/2/1

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	MAGNOLIOPSIDAE							
	ACANTHACEAE							
L 195	*Aphelandra aurantiaca* (Scheidw.) Lindl.	Mecha mooya		H,Hi/H,Hi	Mo,H/T-Mo,H	C,Bv/L,La	DE: Erisipela, llaga con pus, canser /VE: Piquete de vibora	4/2
L 370	*Aphelandra deppeana* Schltdl. et Cham.	Kiñi n¥pin mooya		Hi/H	Mo,H/H	L,La/Ba	VE: Piquete de vibora y otros animales ponzoñosos /GY: Ovarios inflamados	2/1
L 88	*Blechum brownei* Juss.		Hueso de rana	Hi	H	La	DE: Pie apestoso	1
L 399	*Justicia chiapensis* Brandegee	Tutxti ay		Hi/Hi/Pe	H/S/H	T/S/T	GA: Dolor de estómago /CU: Niño llorón /GY: Matriz inflamada	1/1/1
L 24	*Justicia peckii* (S. F. Blake) Standl.	Majei chich	Pote verde	H/H	Ma/Mo	Bcu/C	FI: Fiebre /DE: Erisipela	3/2
L 18	*Justicia spicigera* Schltdl.	Chich	Pote de la tiñadora / Añil	H/H/H/H	Ma/H/Ma/Ma	Bcu,Bca/T/To /To	FI: Fiebre, fiebre de rayo, dolor de cabeza /VU: Baja presión /VU: Vitamina /VU: Alferesía	19/1/1/1
L 164	*Odontonema callistachyum* (Schltdl. et Cham.) Kuntze	Naktam ay		H/H/H/H/H	Mo/A-E/ E/Mo/Ma	C/G/L/C/Bca	DE: Nacido, llaga, erisipela /OI: Dolor de oído /VE: Piquete de vibora /SK: Reuma /VU: Hemorragia de nariz	6/2/1/1/1
L 420	*Ruellia jussieuoides* Schltdl.	Tsus ay		Hi	MaA	So	GA: Empacho	1
L 296	*Ruellia* sp.			R/Hi/H	H/H/T-Mo	T/Bv/L	GA: Diarrea, disentería /VE: Piquete de vibora /DE:Llaga	5/2/1
L 114	*Tetramerium* sp.	J¥xi ay	Hoja de verguenza	Hi	H	T,Bca	CU: Pensamiento	3
L 91	*Thunbergia alata* Bojer ex Sims	Makti mooya		H/H/Hi	A-E/H/Ma	G/T/La	OI: Dolor de oído /GA: Feces verdes del bebé /DE: Infeccón de la piel	2/1/1
L 13	*Thunbergia fragrans* Roxb.	Yommooya		F/H	Ma,H/A-E	Bcu,T/G	CU: Engaño /OI: Dolor de oído	2/1
L 489		Tsus tunuk koso						
	AMARANTHACEAE							
L 108	*Amaranthus hybridus* L.		Pie de la paloma roja	Hi	H	T	GY: Hemorragia vaginal	2
L 192	*Celosia argentea* L.	Cundauajo	Mano de leon / Cresta de gallo	F,Hi	H	T	GY: Hemorragia vaginal	5
L 300	*Gomphrena dispersa* Standl.			Hi/Hi	H/H	T/T	UR: Dolor de riñon /VU: Tónico	1/1
L 317	*Gomphrena globosa* L.	J¥pak mooya	Tinta roja	T,Pe/H	H/H	T/T	GY: Hemorragia vaginal /FI: Fiebre	6/1
L 424	*Gomphrena* aff. *pilosa* (M. Martens et Galeotti) Moq.			Hi	H	T	GY: Accelerar el parto	1

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L 15	*Iresine diffusa* Humb. et Bonpl. ex Willd.	Tsus tunuk koso	Tlan cuaya	Hi/Hi/Hi/Hi	Ma,H/Mo/Mo/H	T,To,Bcu/C/C/T,Bcu	FI: Fiebre /SK: Dolor de rodilla /DE: Erisipela /VU: Anemia	6/2/1/1
L 359	*Iresine nigra* Uline et W. L. Bray		Maravilla	Hi	Mo	C	DE: Erisipela	4
L 288	*Pfaffia grandiflora* (Hook.) R. E. Fr.	K¥kujuki ay		Hi	Mo,MaA,H	C,L	DE: Erisipela, infección de la uña	4
	ANACARDIACEAE							
L 470	*Astronium graveolens* Jacq.	Putoki	Gateado	H/Co/Ra/Co/H	Ma,F/H/F/H/Ma	Bcu,P/La/Li/T/Bca	FI: Dolor de cabeza, fiebre /DE: Herida infectada /CU: Limpia /GA: Dolor de estómago /VU: Hemorragia nasal	3/2/1/1/1
	Juliania adstringens (Schltdl.) Schltdl.		Guachalalate	Co	H	T	GY: Hemorragia vaginal, tónico despues del parto	3
L 349	*Mangifera indica* L.	Manku	Mango	Co/Co/Co/Co/Res/Co	H/H/H/H/F/H	T,LaV,Ba/La/T/T/L/Ba	GY: Hemorragia vaginal, ulcera de matriz /DE: Herida, llaga /GA: Diarrea, dolor de estómago /RE: Tos /DO: Dolor de muela /UR: Infección vaginal, mal de orín	4/4/2/2/2/1
L 146	*Mosquitoxylum jamaicense* Krug et Urb.	Se'mpe	Cedro nogal	Co/Co/Co	H/H/H	T,LaV/LaV,T/Bv	GY: Hemorragia vaginal, matriz inflamada /UR: Infección vaginal, gonorrea /VU: Inflamación del cuerpo	6/2/1
L 362	*Rhus terebinthifolia* Schltdl. et Cham.	Katxu ay		R,H,Co/R,H	H/H	T/T	GA: Diarrea /UR: Gonorrea, mal de orín	3/2
	Spondias purpurea L.			H,Co/H,Co/H/H	Ma/H/Mo/H	Bca,Bcu/T/C/T	FI: Fiebre, fiebre de rayo /GA: Hepatitis, diarrea /DE: Infección dermal, erisipela /RE: Tos	23/7/3/1
L 503	*Spondias purpurea* L.	Jamsan pitx cuy	Condoria					
L 566	*Spondias purpurea* L.	Majei pitx cuy	Ciruela de rayo					
L 286	*Spondias purpurea* L.	Puutx pitx cuy	Ciruela amarilla					
L 287	*Spondias purpurea* L.	Tsabats pitx cuy	Ciruela roja					
L 149	*Tapirira mexicana* March.	Ocholi nuumpi	Ocholillo	Co/Co	MaA,Po/S	U/S	SK: Reuma, golpes /CU: Niño llorón	5/1
	ANNONACEAE							
L 181	*Annona muricata* L.	Katx yatyi	Guanabana	H/H/H	H/H,F/H	T/T,So/T	RE: Tos /GA: Agruras, flatulencia /FI: Fiebre	2/2/1
L 452	*Annona purpurea* Moc. et Sessé ex Dunal	Kotsak yatyi	Ilama	H/Co,H/S	A,H/H/Ma	So,T/T,C/Bca	GA: Flatulencia /GY: Anticonceptivo, matriz inflamada /DE: Piojos	4/2/1
L 169	*Annona reticulata* L.	Jon yatyi	Anona	H,S/S	A,Ma,H/Mo	C,So,T/L	GA: Flatulencia, dolor de estómago, diarrea /DE: Secar el ombligo del bebé	21/1
L 299	*Rollinia jimenezii* Saff.	Paj yatyi	Anona	H	A,T	C,T	GA: Flatulencia	4
	APIACEAE							
L 151	*Anethum graveolens* L.		Neldo	S,Hi/S,Hi	H/H	T/T	GA: Dolor de estómago, vomito, colicos /GY: Hemorragia, tónico despues del parto	7/2

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L 307	*Eryngium foetidum* L.		Perenjil / Cilantro cimarrón	R,H/H/R/H/H	H/H/H/A-E/H	T/T/T/G/T	GY: Accelerar el parto, antiabortivo / GA: Latido /RE: Tos /OI: Dolor de oído UV: Afrodisiaco	3/2/1/1/1
	APOCYNACEAE							
L 65	*Catharanthus roseus* (L.) G. Don	Ninfax	Ninfa	H,R/Hi,R/R/F	H/H/H/Ma	T,Ba/T/T/To	GY: Anticonceptivo, hemorragia vaginal /GA: Dolor de estómago /VE: Piquete de vibora /VU: Abuso de alcohol	3/2/1/1
L 565	*Echites microcalyx* A. DC.	Katx muk		H	Mo	C	VE: Piquete de vibora	1
	Nerium oleander L.	Pitx mooya		F/H	H/Mo	T/L	SK: Dolor de cuerpo /DO: Dolor de muela	1/1
L 67	*Plumeria rubra* L.	Puutx mooya		F/F/F	Ma/H/H	Bcu,Bca,To/T/T	CU: Engaño /GA: Gastritis, empacho, vomito /FI: Dolor de cabeza	7/2/1
L 122	*Prestonia mexicana* A. DC.	Kuts¥k	Bejuco de jiote	A,R,Ta	F,H	La	DE: Infección de la piel, mycosis	4
L 340	*Rauwolfia tetraphylla* L.			H/R	H,Mo/H	La,C/T	DE: Erisipela, sarna, llaga /GY: Hemorragia vaginal	3/1
L 2	*Tabernaemontana alba* Mill.	Na'a cuy	Huevo de venado	L/L/L	F/F/F	L/L/L	DE: Verrugas, infección /DO: Dolor de muela /UV: Papera	6/1/1
L 568	*Tabernaemontana alba* Mill.	Na'a cuy	Huevo de venado	L/L/L	F/F/F	L/L/L		
L 45	*Thevetia ahouai* (L.) A. DC.	Cha'lawaka / M¥aaktsa	Huevo de gato	H/H/H,R,Fr/H/R	Mo/A,Mo/H,H,F/H/H	C/C/T,T,Co/T/T,LaV	DE: Erisipela /SK: Dolor de hueso, zafadura /GY: Determinar el sexo del bebé, conceptivo /VE: Piquete de la viuda negra UR: infección vaginal	4/4/3/2/1
	ARALIACEAE							
L 523	*Dendropanax arboreus* (L.) Decne. et Planch.	Un cuy	Palo de agua	H/H/H/H/H	Mo/A-E/S/F/A-E	C/G/S/C/G	DE: Erisipela /OI: Dolor de oído /CU:Niños que lloran, malos espiritos /FI: Dolor de cabeza /OP: Nubes	2/2/2/1/1
	ARISTOLOCHIACEAE							
L 105	*Aristolochia arborea* Linden	Guaco	Guaco de arbol					
L 123	*Aristolochia arborea* Linden	Guaco	Guaco de arbol	R,Co/R,Co/R	H/H/H	T/T/T	GA: Dolor colico, diarrea, vomito /VE: Piquete de vibora /VU: Baja presión	2/2/1
L 152	*Aristolochia asclepiadifolia* Brandegee	Guaco	Guaco de cochino / Guaco Amarillo	R,Co/R,Co/R/R/R/Co/Co/R	H/H/MaA/H/H/H/H/H	T/T/U/T,So/T/Bca/La/T	GA: Dolor de estomago, vertigo, vomito /VE: Piquete de vibora y de la viuda negra /SK: Reuma /GY: Trastornos menstruales, accelerar el parto /UR: Dolor de riñon /CU: Mal viento /DE: Infección dermal /VU: Nervios alterados, baja presión	6/4/2/2/1/1/1/1/2
L 539	*Aristolochia grandiflora* Sw.	Guaco	Guaco	R,H/Co/R	MaA,H/H/MaA	Ti,T/La/U	GA: Dolor colico, vomito, dolor de estómago /VE: Piquete de vibora /SK: Dolor de cuerpo	2/1/1
L 543	*Aristolochia odoratissima* L.		Guaco de castilla	R,Co/R/H	H/MaA/MaA	T/U/La	GA: Dolor colico, vomito /SK: Dolor de cuerpo /DE: Herida infectada	3/1/1
L 115	*Aristolochia ovalifolia* Duch.	Guaco	Guaco blanco	R/R,Co/H,R,Co/R,Co/Co,R/R/R	H/H/Po,H/H/H,Po/H/H	T/T/So,T/La/T,U/T,LaV/G	VE: Piquete de vibora /GA: Dolor de estómago /GY: Derigir el bebé en posición, dolor despues del parto, hemorragia vaginal /DE: Llaga, mycosis /SK: Reuma /UR: Infección vaginal, gonorrea /OP: Infección del ojo	5/4/3/2/2/2/1
	Aristolochia sp (*ovalifolia* & *asclepiadifolia*)	Guaco	Guaco	R,Co/R,Co/R,H/H/R/Co/R/R,H	H/H/H/H/MaA/H/H/H	T/T/T,Bcu/Bcu/U/T/T,LaV/T	VE: Piquete de vibora /GA: Dolor de estómago, vomito, diarrea, latido /CU: Hechizo, mal aire /DE: Sarna /SK: Reuma /RE: Tos /UR: Infección vaginal /VU: Alferesía	9/6/3/1/1/1/1/2

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L 165	*Aristolochia pentandra* Jacq.	Paj m¥n	Camotillo	R/R,H/R	H/H,MaA/H	T/T,La,Ti/T	GA: Diarrea, dolor de estómago, vomito /VE: Piquete de vibora /GY: Hemorragia vaginal	5/3/1
	ASCLEPIADACEAE							
L 7	*Asclepias curassavica* L.	Kiñi n¥pin mooya / Misi kuts¥k	Quiebra muela	L/L,Hi/Hi/H /R	F/F,H/MaA/H /H	L/La/U/C/T	DO: Dolor de muela /DE: Hemoroides SK: Dolor de cuerpo /VE: Piquete de vibora GA: Flatulencia	3/2/1/1/1
L 521	*Asclepias glaucescens* Kunth	Tyuuxi		R	Ma	To	GA: Dolor de estómago	1
L 485	*Cynanchum schlechtendalii* (Decne.) Standl. et Steyerm.			L	F	L	DE: Mycosis	1
	ASTERACEAE							
	Achillea sp.			Hi	MaA	U	SK: Dolor de cuerpo	1
L 314	*Acmella radicans* (Jacq.) R. K. Jansen	Ñiwi sotyi		R	Mo,F	L,Ma	DO: Dolor de muela	9
L 43	*Artemisia ludoviciana* Nutt.	Poma ay	Estafiate	Hi/Hi/Hi/Hi/ Hi/Hi	H,J,MaV/H/H/ H/H/H	T,To/T/T,Ba/ T/Ba/La	RE: Tos, asma /GA: Dolor de estómago, parasitos intestinales, flatulencia, diarrea /GY: Accelerar el parto, hemorragia vaginal /FI: Fiebre /UR: Infección vaginal /DE: Herida	9/7/4/2/1 /1
L 564	*Artemisia ludoviciana* Nutt.	Poma ay	Estafiate					
L 437	*Aster bullatus* Klatt		Pericon de agua	H	Ma	Bac	FI: Fiebre	1
L 175	*Aster subulatus* Michx.	Jok poy tsus p¥k / Mok jipxi ay / Jok poy	Hierba del burro	H/H/Hi	Mo/H/H	C/T/T	DE: Granos /GY: Trastornos menstruales /GA: Dolor de estómago	2/1/1
L 584	*Aster subulatus* Michx.	Jok poy tsus p¥k / Mok jipxi ay / Jok poy						
L 374	*Baccharis trinervis* Pers.	Tsay mayorga		H/H/H/H	H,Mo,T/H/Mo /Ma	L,La/Bv/C/ Bca	DE: Nacidos, quemadura, infección dermal /VE: Piquete de vibora /SK: Artritis /FI: Fiebre	6/2/1/1
L 533	*Bartlettina* aff. *sordida* (Less.) R. M. King et H. Rob. /or *Mikania* sp.		Guaco	H	MaA	Ti	GA: Dolor de estómago	1
L 377	*Brickellia* sp.	Ueji ay		H	S	S	CU: Niño que llora	3
L 331	*Bidens alba* (L.) DC.	Uentex ay		H/H	Mo,T/H	C,L/Bv	DE: Llaga, quemadura /VU: Hinchasón del cuerpo	3/1
L 120	*Bidens pilosa* L.		Mozote blanco, Aceitilla	Hi/Pe/Hi/Hi /Hi/H/Hi	H/H/H/H/H/ Mo/H	T,La/T/T/ T,LaV/T/C/T	VE: Piquete de la viuda negra /CU: Pensamientos /GY: Dolor de los ovarios /UR: Infección vaginal /GA: Vertigo /DE: Erisipela VU: Tranquilizante, vitamina	1/1/1/1/1 /1/2
L 212	*Calea longipedicellata* B. L. Rob. et Greenm.	Añi mutx ay		H/H/H/H/H	Mo/H,F/H/H/ H	C/La,So/ La,Bv/C/Bv	DE: Erisipela, nacidos /SK: Dolor de los muscolos /VE: Piquete de vibora GA: Flatulencia /VU: Hinchasón del pie	6/2/2/1/1

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L 284	*Calea urticifolia* (Mill.) DC.		Chinche	H/R,H/Hi/Hi	Mo,H/H/S/H	C,La/T,LaV/Po/T	DE: Llaga, sarna /GY: Matriz inflamada /CU: Hechizar /UR: Gonorrea	3/2/1/1
L 203	*Calea ternifolia* Kunth = *zacatechichi* Schltdl.	Tam juñi	Jaral	H/H/H/H/H/H/H/H/H/H	H/H/H,J/H/H/H/H/H/H	T/Bcu,La/T,To/T,LaV/Bcu/T/Ba/T/Bv/T	GA: Dolor de estómago, latido, diarrea, disentería, aperitivo /DE:Sarna, herida, infección /RE: Tos, asma /GY: Matriz inflamada /SK: Dolor muscular /CU: Cansancio /UR: Infección vaginal /FI: Fiebre /VE: Piquete de vibora /VU: Vitamina	10/8/6/3/2/1/1/1/1
L 23	*Centratherum punctatum* Cass.		Serpentina morada	Hi	H	Bv	GY: Resfriado de parto	1
L 41	*Chaptalia nutans* (L.) Pol.	Jeepe ay / Nuup kobak	Diente de león	Hi,R/R,Hi/H/H/Pe/H	H/H/Mo/H/H/F,H	T/T/La/T/T/Co,T/	GY: Conceptivo, anticonceptivo, determinar el sexo del bebé /GA: Hepatitis, inflamación del intestino, vesicula biliar /DE: Herida, infección /CU: Pensamientos /UR: Mal de orinar /VU: Vitamina	4/4/2/1/2
L 400	*Cirsium mexicanum* DC.		Cardo santo	F/H/H	H/H/H	T/T/La	GA: Gastritis /RE: Asma /DE: Verrugas	1/1/1
	Conyza sp. *(bonariensis & canadiensis)*	Jok poy		H/H/Hi	H,Mo/H/H	La,C/T/T	DE: Infección, granos, llaga /GY: Trastornos menstruales /UR: Mal de orinar	6/2/1
L 418	*Conyza bonariensis* (L.) Cronquist	Jok poy						
L 524	*Conyza canadensis* (L.) Cronquist	Jok poy						
L 178	*Cosmos caudatus* Kunth	Molajtu sotyi		Hi/Hi/R	Ma,MaA/H/H	Bcu/C/Bcu	FI: Escalofríos, fiebre /DE: Salpullido /VU: Hinchasón del cuerpo	4/1/1
L 426	*Critonia daleoides* DC.	Poma cuy		Res/Res	F/S	L/S	DE: Nacido /CU: Niño enfermo	1/1
L 436	*Critonia morifolia* (Mill.) R. M. King et H. Rob.	Cortia ay	Canotillo	H/H/H/H	F,H/A/A/F	C,Bcu/C/So/C	SK: Reuma /GA: Empacho /GY: Secar la matriz después del parto /VU: Pies inflamados	3/1/1/1
L 249	*Critonia quadrangularis* (DC.) R. M. King et H. Rob.	Cortia ay	Canotillo	H/H/H/H/H	F,MaA,H/Ma,F/Ma/H/H,F	C,Bcu/Bca,C/Bcu/Ba/T,C	SK: Reuma /FI: Fiebre, dolor de cabeza /CU: Mal de espirito /GY: Hemorragia /VU: Hinchasón de la pierna y del pie	4/2/1/1/2
L 12	*Epaltes mexicana* Less.	Putax ay	Manzanilla de tres lomos	Hi/Hi/Hi/Hi/R/Hi	MaA,Mo,H/Mo,A,H/Mo,MaA,H/H/H/H	U,C,Bv/C,Bcu/C,So,T/C,Bv/T/Bcu,T	SK: Reuma, dolores musculares /DE: Llaga, nacido, comezón /GA: Flatulencia /VE: Piquete de vibora /GY: Hemorragia /FI: Fiebre	5/5/4/2/1/1
L 207	*Eupatorium* aff. *incomptum* DC.	Cimarrón ts¥ui	Tabacco cimarrón	H/H/H/H	H/H/T-Mo/S	Ba/Ba/S/F	UR: Mal de orinar /GY: Hemorragia /CU: Desalojar maldades /VU: Fumar como tabaco	1/1/1/1
L 274	*Eupatorium odoratum* L.	Tam juñi		H	H	T	GA: Latido	1
L 397	*Eupatorium schultzii* Schnittsp.	Nekx cuy		H	H	Bv,C	DE: Erisipela, infección	2
L 325	*Gnaphalium attenuatum* DC.	Poma ay cimarrón	Gordolobo	H/Hi/H/Hi	H/H/Mo/S	T/T/C/S	RE: Tos, tosferina, asma /GY: Conceptivo /DE: Herida /CU: Sahumar la casa	8/1/1/1
L 205	*Heterotheca graminifolia* (Michx.) Shinners	Poja muk		Hi	Mo	C	VE: Piquete de vibora	1
L 358	*Hidalgoa ternata* La Llave et Lex	Pitx ay		Hi/H	Mo-E/H,Mo	G/La,C	OP: Nubes, infección /DE: Infección	3/2
L 326	*Koanophyllon albicaule* (Sch. Bip. ex Klatt) R. M. Krug et H. Rob.	Z¥¥y ay		H/Ra	H,Mo/F	La,C/Li	DE: Nacido, erisipela /CU: Espanto	3/3

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L 502	*Koanophyllon albicaule* (Sch. Bip. ex Klatt) R. M. Krug et H. Rob.	Z¥¥y ay		H/Ra	H,Mo/F	La,C/Li	DE: Nacido, erisipela /CU: Espanto	
L 364	*Lagascea helianthifolia* Kunth			H	T-Mo	L	CU: Contro los malos espiritos	1
L 365	*Lasianthaea fruticosa* (L.) K. M. Becker			Ra	H	T	GA: Dolor de estómago	1
L 425	*Liabum discolor* (Hook. et Arn.) Benth. et Hook. f. ex Hemsl.	Luisa ay		H/H	H/H	Bv/H	DE: Llaga, erisipela /RE: Asma, bronquitis	2/1
L 283	*Loxothysanus sinuatus* (Less.) B. L. Rob.	W¥y¥ ay		H	Mo,A,H	C,La	DE: Manchas blancas, mycosis	9
	Matricaria chamomilla L.		Manzanilla	Hi/Hi/Hi/Hi	H/H/H/H	T/T/T/Bcu	GY: Accelerar el parto, después del parto, lavar el bebé /GA: Dolor de estómago, vomito, diarrea, flatulencia /CU: Pensamientos /SK: Reuma	16/6/1/1
L 338	*Mikania micrantha* Kunth			Hi	H	T	UR: Infección vaginal	1
L 316	*Montanoa grandiflora* Alaman ex DC.			H	H,Ma	Bcu	DE: Sarna, ronchas	2
L 383	*Neurolaena lobata* (L.) Cass.		Cola de faisán	R,H/H/R,H/H	H/H/H/H	La,Bcu/T/T/T	DE: Sarna, hemoroides, granos, herida /GA: Dolor del intestino, disentería /DI: Diabetes /VU: Cansancio	5/2/2/1
L 100	*Parthenium hysterophorus* L.		Sicutía	Hi/Hi	MaA,H,Mo/H	Ti,T,C/T	SK: Artritis, reuma /DI: Diabetes	4/1
L 153	*Pluchea symphytifolia* (Mill.) Gillis	Salve ay	Salvia	H/H/H/H/H/H/H/H	H/H/H,Po/H/H/H/Ma/H	T,Ba/T/Bcu,U/La,C/Bcu,T/Bv,C/Bca/Ba	GY: Trastornos menstruales, después del parto /GA: Gastritis, dolor de estómago, latido /SK: Reuma /DE: Varices, granos, llaga /RE: Tos /VE: Piquete de vibora /FI: Fiebre /UR: Mal de orinar, infección dermal	6/4/4/3/2/2/1/1
L 236	*Polymnia oaxacana* Sch. Bip. ex Klatt	M¥a xuxcuy		F	S-Mo	L	CU: Hacer maldad	1
L 224	*Porophyllum ruderale* (Jacq.) Cass.	Comunk¥ ts¥p¥	Papaloquelite	H/H/H/H	H/Mo/Ma/H,F	T/C/Bac/T,Co	GA: Latido, dolor de estómago /VE: Piquete de gusano /FI: Fiebre /VU: Anemia	8/1/1/2
L 241	*Pseudoelephantopus spicatus* (B. Juss. ex Aubl.) Rohr ex Gleason		Lengua de vaca	H,R/R/R/R	H/H/H/H	La/T/T/T	DE: Herida /RE: Tos /UR: Infección vaginal /GA: Diarrea, disentería	2/1/1/1
L 381	*Pseudogynoxys chenopodioides* (Kunth) Cabrera var. *chenopodioides*	Uentex ay		H/H	H,Mo,T-Mo/H	La,C,L/C	DE: Erisipela, quemaduras, infección /VE: Piquete de vibora	4/1
L 517	*Schistocarpha eupatorioides* (Fenzl) Kuntze			H	T-Mo	L	DE: Infección	1
L 62	*Tagetes erecta* L.	Tsuts mooya	Xempasoche	Hi/Hi/Hi/Hi/Hi/Hi/R,Hi	H,Mo/H,S/H/H,F/H/Ma/H	La,C/T,Bcu/T/Bcu,So/La/Bca/T,La	DE: Herida, erisipela /CU:Protección /GA: Diarrea, disentería /SK: Dolor muscular /VE: Piquete de vibora /FI: Fiebre /VU: Ataque nervioso, hinchasón del pie	5/4/2/2/1/1/2
L 222	*Tagetes filifolia* Lag.		Hierba anis	Hi/Hi	H/H	T/E	GA: Dolor de estómago /DE: Infección bucal	4/1
L 161	*Tagetes lucida* Cav.		Pericón	Hi/Hi/Hi	H/H/H	T/T/Bv	GA: Dolor de estmago, latido, colicos, diarrea, vomito /GY: Accelerar el parto, después del parto, trastornos menstruales /RE: Asma, tos seco	17/4/1

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L 462	*Telanthophora grandifolia* (Less.) Rob. et Brettell var. *grandifolia*	Nag ay		H/H	F/A	C/So	DE: Erisipela /GY: Secar la matriz	2/1
L 8	*Tithonia diversifolia* (Hemsl.) A. Gray	Tam chich	Arnica	H/H/H,F/H/H/H,F/H	H,T-Mo/H,Po/H/H/Po,H/MaA/H	L/Bv,La,U/T,Bv/T,Bv,Bcu/U,T/Ti/T	DE: Sarna, herida, piojos, hemoroides, infección /SK: Golpes, reuma / RE: Tos, asma /GY: Después del parto, hemorragia /GA: Latido, dolor de estómago /FI: Fiebre /DI: Diabetes	24/6/5/3/2/1/1
L 447	*Trixis inula* Crantz		Contrimbruja	H/H	Mo/Mo	C/C	DE: Erisipela, infección /FI: Fiebre	4/1
L 351	*Verbesina robinsonii* Fernald ex B. L. Rob. et Greenm.			F,Co	H	T	GA: Dolor de estómago	1
L 404	*Verbesina turbacensis* Kunth	Copanteñicuy		H	T-Mo	L	DE: Herida	1
L 454	*Vernonia deppeana* Less.	Ux cuy		H/H/H	A-E/H/Mo-E	G/Ba/G	OI: Dolor de oído /GY: Matriz inflamada /OP: Infección del ojo	11/1/1
L 390	*Vernonia tortuosa* (L.) S. F. Blake	Sotopok tsay		H,R/H/H/H/H	H/H/S/T-Mo/Ma	T/T/S/L/To	RE: Tos, tosferina /GA: Dolor de estómago /CU: Contro los malos espiritos /DE: Infección /FI: Fiebre	3/1/1/1/1
L 440	*Zexmenia serrata* La Llave et Lex.			H	T-Mo	L	DE: Infección	1
L 582	*Zinnia elegans* Jacq.		Clavena	F	Ma	Bcu	VU: Abuso de alcohol	1
	BALSAMINACEAE							
L 179	*Impatiens balsamina* L.		Maravilla	H/S/H	H/H/Mo	G/T/C	OI: Dolor de oído /RE: Tosferina /DE: Erisipela	1/1/1
	BASELLACEAE							
L 435	*Anredera* sp.	Pak tyoopi		R	Mo	C	SK: Zafadura, quiebradura	5
	BEGONIACEAE							
L 375	*Begonia fischeri* Schrank		Caña agria	Hi	H	T	UR: Mal de orinar	1
L 589	*Begonia glabra* Aubl.			H	Mo	C	DE: Erisipela	1
L 339	*Begonia heracleifolia* Schltdl. et Cham.	Leon k¥ / Katxu kanapoki	Mano de león / Caña agria	Hi/H/Hi/H	Ma,H/Mo/H/A-E	To,T/C/T/G	UR: Mal de orinar, dolor de riñon /DE: Erisipela, nacido /GA: Estreñimiento /OI: Dolor de oído	14/2/1/1
L 16	*Begonia nelumbiifolia* Schltdl. et Cham.	Kobakt¥k ay		H/H/R	F,H/Mo/H	C,Bv/C/T	SK: Reuma /DE: Sarna, erisipela /UR: Gonorrea	4/2/1
	BIGNONIACEAE							
L 140	*Amphitecna tuxtlensis* A. H. Gentry	Makti jeepe	Jicara del duende	H,F	S	S	CU: Niño que llora, cuando molesta el duende	9
L 487	*Anemopaegma chrysanthum* Dugand	Guatimal		Co	H	T	GY: Hemorragia	1
L 596	*Arrabidaea verrucosa* (Standl.) A. H. Gentry	Pobatsay		Co	H	T	GY: Hemorragia	1

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L 199	*Crescentia cujete* L.	Jeepe		F,H,Co/F/Fr /Fr/Fr,Ca	H/A/H/H/ MaA,H	T/G/T/T/To,T	GY: Accelerar el parto, expulsar la placenta /OI: Dolor de oído /RE: Tos /SK Golpe /VU: Anemia, circulación	4/1/1/1/1
L 558	*Paragonia pyramidata* (Rich.) Bureau	Pobatsay		Co/Co	H/T-Mo	T/L	GY: Hemorragia /DE: Llaga	2/1
L 29	*Parmentiera aculeata* (Kunth) Seem.		Guajilote	Fr/Co	H/H	T/T	RE: Tosferina, tos /GY: Hemorragia, anticonceptivo	5/2
L 106	*Tabebuia rosea* (Bertol.) DC.		Roble	Co/Co/Co/ Co	H/H/H/H	T/T/Bcu/T	GY: Anticonceptivo, matriz inflamada /SK: Dolor musculares /DE: Sarna /VE: Piquete de vibora	2/1/1/1
L 59	*Tecoma stans* (L.) Juss. ex Kunth	Puutx mooya	Argel	H/H/H/Co	H/H/Ma/H	T/T,Bcu/Bca/ T	DI: Diabetes /GA: Empacho, hepatitis /FI: Fiebre /RE: Tos	4/2/1/1
	BIXACEAE							
L 141	*Bixa orellana* L.	Cuy puk	Achiote	R,H/S/S,R/ Co	H/Ma/H/H	T/Bcu/T/La	GY: Antiabortante, anticonceptivo, hemorragia /FI: Sarampión, viriuela, dolor de cabeza /UR: Mal de orinar, infección /VE: Piquete de vibora	3/3/2/1
	BOMBACACEAE							
L 515	*Ceiba pentandra* (L.) Gaertn.	Pixtyiñ	Ceiba	Co/H	H/H	T/Bv	CU: Engordar /VE: Piquete de vibora	2/1
L 135	*Pachira aquatica* Aubl.	Uakta	Apompo	Co,Fr/Co	H/H	T/T	DI: Diabetes /UR: Mal de orinar, mal de riñon	3/2
L 456	*Pseudobombax ellipticum* (Kunth) Dugand var. *ellipticum*	Pop uakta	Solosoche	Co/Co/Co,F	H/H/H	T/T/T	UR: Mal de orinar /GY: Hemorragia, expulsar la placenta /CU: Engaño	4/3/1
	BORAGINACEAE							
L 466	*Cordia alliodora* (Ruiz et Pav.) Oken	Kiwa	Solería	H	Ma	To	VU: Abuso de alcohol	1
L 110	*Cordia spinescens* L.	Y¥k yom tsay	Vara negra	H/H/H/R/R	Mo,H/H,F/T/H /H	C,La,Bv/T,Co/ La,Bv/T/La,T	DE: Erisipela, herida /GA: Gastritis, agruras /VE: Piquete de vibora /GY: Hemorragia /UR: Infección vaginal	7/5/4/3/2
L 17	*Heliotropium indicum* L.	Tunok kiñi	Cola de alacrán	H/Hi,R/Hi/H /Hi/Hi/Hi	Mo,H,T-Mo /H/H/A-E /H/H/H	C,La,L/T,Ba/ La,Bv,C/G/Bv /T/Ba	DE: Erisipela, herida, llaga /GY: Hemorragia /VE: Piquete de vibora /OI: Dolor de oído /SK: Artritis, dolor de cuerpo /GA: Diarrea /UR: Mal de orinar	6/3/3/2/2 /1/1
	BRASSICACEAE							
	Nasturtium officinale R. Br.		Berro	H	F	Co	DE: Granos	1
	Senapis sp.		Mostaza	S	S	S	CU: Niño que llora	2
	BURSERACEAE							
L 60	*Bursera graveolens* (Kunth) Triana et Planch.	Putoki	Azafrán	Co/Co/Co,H /H	Po/H,Po/H/ Ma	U/La,U/T/Bcu	SK: Golpe /DE: Herida, varices /GA: Latido, disentería /FI: Fiebre	3/2/2/2
L 389	*Bursera simaruba* (L.) Sarg.	Ts¥k	Palo mulato	H,Co/Co/Co ,H,Res/Co/ Co,H/Co,H	Ma,H/H/H,F/H /H/H	Bcu,To/T/La, L/T/T,Ba/Ba	FI: Fiebre /GA: Hepatitis, gastritis /DE: Herida /SK: Golpe /GY: Trastornos menstruales /UR: Infección vaginal	35/5/3/2/ 2

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	CACTACEAE							
L 557	*Epiphyllum crenatum* (Lindl.) Don	Nuchchi	Pitaya	Ta/Ta/Ta	Mo,H/Mo/H	C,T/C/T	GY: Antiabortivo, hemorragia /DE: Erisipela, granos /GA: Diarrea	6/3/1
	Opuntia sp.		Nopal	Ta/Ta	F/Ma	C/To	FI: Fiebre /VU: Anemia	1/1
L 551	*Selenicereus* sp.	Nuchchi		Ta	Mo	C	DE: Herida	1
	CAESALPINIACEAE							
L 64	*Bauhinia divaricata* L.	Xitiks	Pativaca blanca	R,Co/Co/R/Co/Co/H/Co	H/H/H/H/H/S/H	T/T,Ba/T/La/Ba/S/T	GA: Hipo, diarrea /GY: Trastornos menstruales /DI: Diabetes /DE: Herida /UR: Mal de orinar /CU: Contro los malos espiritos /VU: Hemorragia nasal	4/2/1/1/1/1/1
L 259	*Bauhinia ungulata* L.	Xitiks	Pativaca roja	Co,R/H	H/S	T/S	GA: Hipo, empacho /CU: Engaño	3/1
L 118	*Caesalpinia pulcherrima* (L.) Sw.	Tsas mooya	Ortensia	H/R/Co,H	H/H/Ma,H	La/T/Bac,C	DE: Salpullido, infección /GY: Hemorragia /VU: Hemorragia nasal, hinchasón de los pies	3/1/2
L 405	*Cassia moschata* Kunth		Caña fista	Fr/Fr	H/H	T/T	RE: Tos, tosferina /FI: Fiebre	3/1
L 576	*Chamaecrista diphylla* (L.) Greene			Pe	H	T	GY: Hemorragia	1
L 322	*Chamaecrista flexuosa* (L.) Greene var. flexuosa	Copa uaxiñ	Ortiga	R/R/R/R/H	H/H/H/H/H	T/T/T,LaV/La/C	GA: Diarrea /GY: Hemorragia /UR: Infección vaginal, gonorrea /DE: Llaga /VE: Piquete de vibora	8/3/3/1/1
L 323	*Chamaecrista hispidula* (Vahl) H. S. Irwin et Barneby	Hitxi sotyi	Hoja de burbua	R,H/R/Hi/H	H/H/Mo/Mo	T/T/C/C	UR: Infección vaginal, gonorrea /GY: Hemorragia /VE: Piquete de vibora /DE: Erisipela	3/2/2/1
L 578	*Chamaecrista kunthiana* (Schltdl. et Cham.) H. S. Irwin et Barneby			Hi/R	H/H	T/G	UR: Mal de orinar /OP: Nubes	1/1
L 298	*Dialium guianense* (Aubl.) Sandwith	T¥m paki		H/Co/S	Ma/H/H	To,Bac/T/T	FI: Fiebre /GA: Flatulenia /GY: Anticonceptivo	2/1/1
L 246	*Hymenaea courbaril* L.	Payi	Guapinole	S/Fr,S/S,Co/Co	H,T-Mo/S/H/H	T/S/T/T	GA: Gastritis, dolor de estómago /CU: Hacer lluvia /RE: Tos /DI: Diabetes	2/2/2/2
L 280	*Senna alata* (L.) Roxb.			H	H	La	DE: Manchas blancas	1
L 335	*Senna hirsuta* (L.) H. S. Irwin et Barneby	Chuch acuy		H,R/R/H	H/H/H	T/T/Bac	SK: Golpe, dolor de cuerpo /GA: Latido /DE: Sarna	2/1/1
L 70	*Senna multijuga* subsp. *doylei* (Britton et Rose) H. S. Irwin et Barneby	Uaxiñ	Palo Santiago	Co/Co/Co/Co	H/H/H/H	La/Ba,T/LaV/T	DE: Herida /GY: Hemorragia /UR: Infección vaginal /GA: Vomito	6/2/1/1
L 196	*Senna occidentalis* (L.) Link	Chuch acuy		H,R/R/H/Hi	H/H/H/H	T/T/Bcu/C	RE: Asma, tos /GA: Gastritis, latido /FI: Fiebre /SK: Dolor de cuerpo	4/2/1/1
L 245	*Senna papillosa* (Britton et Rose) H. S. Irwin et Barneby	Putx tsay	Cachinbal	H/R,H	Mo,H/H	C,La/Bac	DE: Erisipela, llaga /VU: Hinchasón del cuerpo	2/2
L 218	*Senna pendula* (Humb. et Bonpl. ex Willd.) H. S. Irwin et Barneby	M¥k stogoy		H/H/H	Mo/A-Mo/Mo	C/G/C	DE: Erisipela, nacido /OI: Dolor de oído /VU: Papera	17/1/2

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L 451	*Senna quinquangulata* (Rich.) H. S. Irwin et Barneby var. *quinquangulata*	Putx tsay		H/H	H/H	Bac/T	SK: Dolor de cuerpo /VU: Cansancio	1/1
L 225	*Senna spectabilis* (DC.) H. S. Irwin et Barneby	K¥ mooya	Todos los santos amarillo	H,Co/Co/Ra /Co	H,A-E/H/E/Mo	G/La/G/L	OI: Dolor de oído /DE: Infección /DO: Dolor de muela /VU: Veneno para cucarachas	3/1/1/1
L 51	*Tamarindus indica* L.		Tamarindo	H/H/H/H	Ma,H/H/H/H	To,T,Bcu/T/T /LaR	FI: Fiebre, sarampión, viriuela /RE: Tos /UR: Mal de orinar /GA: Estreñimiento	18/1/1/1
	CAPPARACEAE							
L 157	*Cleome speciosa* Raf.	Charamooya		H	Ma	Bac	DE: Sarna	1
	CAPRIFOLIACEAE							
L 44	*Sambucus mexicana* C. Presl ex DC.		Sauco	H/F/H/H/H /H	Ma/H/Ma/A/H /H	Bca/T/La/So /Ba/T	FI: Fiebre, dolor de cabeza /RE: Tos /DE: Quemadura /GA: Flatulencia /GY: Matriz inflamada /VU: Anemia	6/4/1/1/1 / 1
	CARICACEAE							
	Carica papaya L.		Papaya	H,S,Fr/H,L/ Fr/L	H,F/H,F/Ma/F	T,Co/La/To/L	GA: Disentería, indigestión, parasitos /DE: Herida /FI: Fiebre /DO: Dolor de muela	4/2/1/1
	CARYOPHYLLACEAE							
L 386	*Stellaria cuspidata* Willd. ex Schltdl.		Cadillo ovalado	Hi	H	T	UR: Dolo de riñon, gonorrea	2
	CECROPIACEAE							
L 193	*Cecropia obtusifolia* Bertol.	Mats	Chancarro	Co,H/H/H/C o/H/Co/H/ H/H/H	H/S/H/H/H/H /H/H/A-E/S,H	T/S/La/T/T/ Bv/T/T/G/S,L a	DI: Diabetes /CU: Niño que llora, sahumar la casa, mal viento /DE: Manchas blancas, infección /GA: Flatulencia, dolor del bazo /FI: Fiebre /VE: Piquete de vibora /GY: Trastornos menstruales /RE: Tos /OI: Dolor de oído /VU: Nervios alterados, hinchasón del pie, infección de los caballos	10/8/7/2/ 1/1/1/1/1 / 1
	CELASTRACEAE							
L 111	*Maytenus belizensis* Standl.	Ñiwi cuy	Retamo	Co/Co/Co/ Co/Co	H/H/H/H/H	La/T/T,Ba/L/ Ba	DE: Herida, llaga /GA: Diarrea, disentería /GY: Después del parto, matriz inflamada /DO: Dolor de muela /UR: Mal de orinar	10/6/3/1/ 1
L 112	*Wimmeria bartlettii* Lundell		Canserina	Co/Co/Co	H/H/H	T/T/T	GY: Después del parto, trastornos menstruales /GA: Diarrea, gastritis /UR: Infección vaginal	9/2/1
	CHENOPODIACEAE							
	Teloxys ambrosioides L.	Epazut	Epasote	R,Hi/Hi	H/H	T/Bv	GA: Lombrices /FI: Dolor de cabeza	17/1
	CHRYSOBALANACEAE							
L 592	*Chrysobalanus icaco* L.	Taatsu	Icaco	Fr	F	Co	VU: Comestible	1
L 465	*Couepia polyandra* (Kunth) Rose	Pillum	Olozapote	Co/Co	H/T-Mo	T,Ba/L	GY: Hemorragia /DE: Herida	5/1
L 373	*Hirtella racemosa* Lam.	Tsus pet cuy		Co	H	T	GA: Diarrea	1

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L 548	*Hirtella triandra* Sw.	T¥kchi cuy		Co	H	T	GY: Hemorragia	1
	CLETHRACEAE							
L 506	*Clethra macrophylla* M. Martens et Galeotti			Co/Co	H/H	La/LaV	DE: Herida /UR: Infección vaginal	1/1
	CLUSIACEAE							
L 267	*Calophyllum brasiliense* Cambess.	M¥anakcuy	Varín	L/L/Co	F/F/H	L/L/T	DE: Herida, llaga /DO: Dolor de muela /GY: Dolor de matriz	4/3/1
L 512	*Rheedia edulis* (Seem.) Triana et Planch.	Uouo		Co/L/L	H/F/F	T/G/L	GY: Hemorragia /OP: Nubes /DE: Herida	1/1/1
L 464	*Vismia baccifera* (L.) Triana et Planch.		Cayamita	Co/L,Fr/S/Co	H/F,H/H/H	T/L,E/T/T	UR: Mal de orinar /DE: Herida, infección bucal /GA: Gastritis /GY: Hemorragia	2/2/1/1
	COCHLOSPERMACEAE							
L 411	*Cochlospermum vitifolium* (Willd.) Spreng.	Puts cuy	Pongolote	Co,H/Co,H/Co,H/Co,H/Co,H/H/Co	H,F/H,Mo/H/H/H/Ma/H	La,Bv,Co/La,C/T/Ba/T/Ba/Bca/T	VE: Piquete de vibora, viuda negra y gusanos /DE: Herida, erisipela, nacido /DI: Diabetes /GY: Trastornos menstruales /GA: Hepatitis /UR: Infección vaginal /FI: Fiebre /VU: Insomnio	18/4/2/1/1/1/1/1
	COMBRETACEAE							
L 509	*Combretum laxum* Jacq.	Uouo tsay / Patan tsay		Co/Co	H/T-Mo	T/L	GA: Diarrea /DE: Llaga	3/1
L 49	*Terminalia catappa* L.		Almendra	S,Co/H,Co,S/H	H/H/H	T/T/T	GY: Ovarios inflamados, anticonceptivo /DI: Diabetes /GA: Diarrea	2/2/1
	CONVOLVULACEAE							
L 56	*Ipomoea carnea* ssp. *fistulosa* (Mart. ex Choisy) D. F. Austin	Nunak mooya		H/H	H/H	La/T	DE: Infección /VU: Rabia	1/2
L 289	*Ipomoea variabilis* (Schltdl. et Cham.) Choisy	Xonege	Chonege	H/H	H/H	Co/Co	GA: Bilis /VU: Comestible	1/1
L 324	*Turbina corymbosa* (L.) Raf.	Atsay	Bejuco del viento	R/H	H/Ma,H	T/Bcu,T	GA: Disintería, dolor de estómago /CU: Desesperación, cansancio	3/2
	CRASSULACEAE							
L 291	*Kalanchoe pinnata* (Lam.) Pers.		Maravilla	H/H/H/H/H/H	F,Ma/Mo/E/H-E/A/A,Ma	C,Bcu/C/G/G/C/C,To	FI: Fiebre, dolor de cabeza /DE: Erisipela /OP: Ardor de los ojos /OI: Dolor de oído /SK: Reuma /VU: Papera, hemorragia de nariz	7/5/1/1/1/2
L 350	*Kalanchoe blossfeldiana* Poelln.			H/H	Mo/F	C/C	DE: Erisipela /VU: Papera	2/1
L 279	*Kalanchoe calycinum* Salisb.	Majei maravilla	Maravilla real	H/H/H/H	F,Ma/Mo/E/A-E	C,Bcu/C/G/G	FI: Fiebre /DE: Erisipela /OP: Nubes, ardor /OI: Dolor de oído	3/3/2/2
	CUCURBITACEAE							
	Citrullus sp.	Xandia	Sandia	S/S	H,T-Mo/Ma	T/To	GA: Disintería, vomito /FI: Sarampión	2/1

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	Cucurbita sp.		Calabaza	S/A	H,T-Mo/F	T/La	GA: Disentería, indigestion /DE: Quemadura	2/1
	Lagenaria sp.	Pok	Tecomate	S/Fr	H,T-Mo/S	T/S	GA: Diarrea, disentería, flatulencia /CU: Niño que llora	4/1
L 332	*Melothria pendula* L.	Tsaiñicut cuy / Xandia tsay		Hi,R,Fr	H,Ma,F	T,To,Co	UR: Mal de orinar, niños que orinan en la cama	5
L 31	*Momordica charantia* L.	Kundiamor	Cundiamor	Hi/Hi/Hi/ S,Hi/Hi/Hi	H/H/H,Ma/H/ H/H,F	La,Bcu/T/T,T o/T,La/T,Bcu /So,Bcu	DE: Sarna, comezón, herida /DI: Diabetes /UR: Mal de orinar / VE: Piquete de vibora /GY: Antiabortivo, después del parto /SK: Dolor de cuerpo	14/4/3/2/ 2/2
L 14	*Psiguria triphylla* (Miq.) J. Jeffrey			H	Mo	C	DE: Erisipela, nacido	3
L 186	*Sechium edule* (Jacq.) Sw.	Cuy pasun	Chayote	H,Fr/R/H/H	H/H/H/H	T/T/T/T	CU: Engaño /UR: Mal de orinar /GY: Conceptivo /VU: Hinchasón del cuerpo	1/1/1/1
	CUSCUTACEAE							
L 363	*Cuscuta* sp.	Puutx tsay		Hi/Hi/Hi	H/H/H	Bcu/T/Bcu	GA: Hepatitis /UR: Mal de orinar /VU: Hinchasón del cuerpo	2/1/1
	DILLENIACEAE							
L 185	*Curatella americana* L.	Potcuy	Tachicón	Co/Co/R	H/H/H	T/La/T	GA: Diarrea, disentería /DE: Granos /UR: Infección vaginal	3/1/1
L 495	*Davillia kunthii* A. St.-Hil.	Potcuy tsay		R/Ra	H/F	T/L	GA: Diarrea /CU: Amarar el Xunujti (animal mitico)	1/1
L 532	*Doliocarpus dentatus* (Aubl.) Standl.	Sun tsay		Co/R/Ra	H/H/F	T/T/L	GY: Hemorragia /GA: Diarrea /CU: Amarar el Xunujti (animal mitico)	3/3/1
	EBENACEAE							
L 309	*Diospyros digyna* Jacq.	Nuu	Zapote negro	Co/Co/Co/ Co	H,Ma/H/H/H	La/Bcu/T/La V	DE: Sarna, manchas blancas, infección /CU: Hechizería /GY: Ulcera de matriz /UR: Infección vaginal	6/1/1/1
	ELAEOCARPACEAE							
L 101	*Muntingia calabura* L.	Capuli	Capulin	H,Co/H,Co/ Co,A/Co/H	H,Mo/H/H,F/H /H	T,C,La,Bv/Bcu ,E/T,To/T/E	VE: Piquete de vibora y de la viuda negra /DE: Sarna, infección bucal /UR: Gonorrea, mal de orinar, infección vaginal /GA: Diarrea /DO: Dolor de muela	14/3/3/1/ 1
	ERICACEAE							
L 310	*Agarista mexicana* (Hemsl.) Judd	Unuk tyiñcuy		H/H/H/H	H,Mo/H/H/H	La,C/T/LaV/ La	DE: Sarna, infección, llaga /RE: Tos /UR: Infección vaginal /VU: Para las heridas de caballos	3/1/1/1
	EUPHORBIACEAE							
L 87	*Acalypha arvensis* Poepp et Endl.	Chi puk ay	Tapón de burro	Hi,R/Hi,R/Hi /Hi	H/H,Mo/H/H	T/T,La,C/T/L a	GA: Diarrea, dolor de estómago /VE: Piquete de gusanos /UR: Infección dermal /OP: Conjunctivitis	5/5/1/1
L 412	*Acalypha diversifolia* Jacq.	Ekchiñ poy cuy	Corre chacalacca	Hi/Co/Hi	H/H/H	T/Bv/La	DI: Diabetes /VE: Piquete de vibora /DE: Infección	1/1/1
L 430	*Acalypha* aff. *mollis* Kunth			H/Pa	A/F	C/Li	VE: Piquete de vibora /CU: Malos espiritos	1/1
L 295	*Acalypha unibracteata* Müll. Arg.	Ekchiñ poy cuy	Corre chacalacca	H/H/R	H/H/H	La/Bv/T	DE: Infección /VE: Piquete de vibora /GA: Dolor de estómago	2/2/1
L 330	*Acalypha* sp.	Tsuj mi ay		H	Ma	Bca	FI: Dolor de cabeza	1

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L 37	*Chamaesyce hirta* (L.) Millsp.	Paipai	Fraile	Hi,R/L/Hi/Hi	H/F/H/H	T/G/T/T	UR: Mal de orinar, mal de riñon, infección vaginal /OP: Infección del ojo /GA: Diarrea, dolor de estomago /RE: Tos	4/3/2/1
L 538	*Chamaesyce velleriflora* (Klotzsch. et Garcke) Millsp.	Petx kukmuk		Hi	H	T	UR: Mal de orinar	1
L 182	*Cnidoscolus chayamansa* Mc Vaugh		Chayamansa	H/H	H/H	T/Co	UR: Mal de orinar /VU: Vitamina	1/1
L 10	*Cnidoscolus liebmannii* (Müll. Arg) Lundell	Kenuk	Chichicastle	R/R/L/R/R/Pa	H/Ma/F/H/H/F	T,LaV/To/L/T/T/So	UR: Mal de orinar, infección vaginal /GA: Dolor de estómago /DO: Dolor de muela /GY: Hemorragia /RE: Tos /DE: Infección	6/1/1/1/1/1
L 529	*Cnidoscolus multilobus* (Pax) I. M. Johnst. ssp. *multilobus*	Kenuk	Chichicastle	L/R	F/H	L/T	DO: Dolor de muela /GY: Hemorragia	1/1
L 507	*Croton arboreus* Millsp.	Tapu ay		H	H	La	DE: Verrugas	1
L 66	*Croton draco* Schltdl.	N¥piñi cuy	Sangregado	L,Co/L/Co/Co/Co/Co	F,H/F/H/H/H/H	L,La,E/L/T/T/LaV/La	DE: Herida, granos en la boca /DO: Dolor de muela /GY: Hemorragia /GA: Disentería /UR: Infección vaginal /VE: Piquete de vibora	26/2/1/1/1/1
L 544	*Croton lundellii* Standl.		Contra cimarrón	Co	H	T	GA: Dolor de estómago	1
L 191	*Croton schiedeanus* Schltdl.	Tam cuy	Cascarilla	Co/A/Co/Co/Co/Co/Co/Co/Co	H/F/H/H/H/H/H/Mo/H/H	T/G/T/T/La/T/L/T/T	GA: Diarrea, dolor de estómago /OP: Nubes /VE: Piquete de vibora e de la viuda negra /GY: Hemorragia /DE: Herida infectada /SK: Dolo de cuerpo /DO: Dolor de muela /RE: Tos /VU: Tetano	10/4/4/2/1/1/1/1/1
L 1	*Croton schiedeanus* Schltdl.	Tam cuy	Cascarilla					
L 210	*Croton repens* Schltdl.	Copa n¥piñi cuy / Soj kobak / Soj muk		R/A/R/R/H/H	H/F/H/H/H/S	T/G/T/LaV,T/E/S	GA: Diarrea, disentería /OP: Nubes /GY: Hemorragia, matriz inflamada /UR: Mal de orinar, gonorrea, infección vaginal /DE: Infección bucal /CU: Malos espiritos	8/7/3/3/1/1
L 550	*Croton* sp. nov ?		Contra	Co	H	T	GA: Dolor de estómago	1
L 209	*Euphorbia heterophylla* L.		Lecheria	Hi	H	T	UR: Infección vaginal	1
L 48	*Euphorbia lancifolia* Schltdl.	M¥a xuxcuy	Lecheria	Hi/Hi	H/H,Mo	T,LaV/La,C	UR: Infección dermal /DE: Herida infectada	4/2
L 93	*Euphorbia* aff. *maculata* L.		Golondrina	Hi	E	G	OP: Infección del ojo	1
L 526	*Hevea brasiliensis* Müll. Arg.	Juñi	Pindule	L/H	F/S	L/S	DE: Mycosis, nacido /CU: Hacer lluvia	2/1
L 96	*Jatropha curcas* L.	Cuyukum	Piñon	A/Co	F/H	La,E/LaV	DE: Infección en la boca, herida, granos /UR: Infección vaginal	12/1
L 439	*Jatropha gossypiifolia* L.			H	H	La	DE: Infección dermal	1
	Manihot esculenta Crantz		Yuca	R	Ma	To	GA: Disentería	1
L 427	*Pedilanthus tithymaloides* (L.) Poit. subsp. *tithymaloides*		Mayorga	H/H/H	A,H/A-E/Ma	C,Bv/G/Bca	DE: Erisipela, sarna /OI: Dolor de oído /FI: Fiebre	4/1/1
	Phyllanthus sp. (*amarus* & *liebmannianus*)			Hi,Pe/Hi/Hi	H,Ma/Ma/H	T,Bcu/To,Bca/T	CU: Desesperación, melancolía, cansancio /FI: Fiebre /GA: Gastritis	19/2/1
L 32	*Phyllanthus amarus* Schumach. et Thonn	Antuñik¥ ay						

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L 78	*Phyllanthus* aff. *liebmannianus* Müll. Arg. et *carolinensis* Walter	Antuñik¥ ay						
L 217	*Ricinus communis* L.	Nuku tsoy	Hilgerilla	H/H/H	F/F/F	C/C/P	DE: Erisipela /SK: Artritis /FI: Fiebre	4/1/1
L 527	*Tragia* sp.	Tsay kenuk		Hi	H	T	UR: Mal de orinar	1
	FABACEAE							
L 134	*Acosmium panamense* (Benth.) Yakovlev	Sam cuy	Guayacan	Co/Co/Co/ Co/Co/Co/ Co/H/Co	H/H/H/H/H/H /H/Ma/H	T/La/T/T/T/ T/T/Bca/T,Ba c	DI: Diabetes /DE: Herida, llaga /GY: Hemorragia, anticonceptivo /GA: Latido, dolor de estómago /SK: Reuma, golpe /RE: Tos /UR: Dolor de los riñones /FI: Fiebre /VU: Anemia, hinchasón del cuerpo	7/5/5/4/4 /3/1/1/12
L 496	*Andira galeottiana* Standl.	Maka		Co	H	La	DE: Herida	1
L 562	*Andira inermis* (W. Wright) Kunth ex DC.	Tsukiñi cuy		Co	H	La	VE: Piquete de vibora	1
	Arachis hypogaea L.	Kacwa	Cacahuate	S	Ma	To	UR: Infección vaginal	1
L 366	*Canavalia villosa* Benth.	Xagalamenta	Sacramento	R,H/R	T-Mo,H/H	L,La/T	DE: Quemadura, sarna /GA: Vomito	2/1
L 303	*Centrosema pubescens* Benth.			R/F	H/H	T/Co	GA: Diarrea /VU: Comestible	1/1
L 581	*Centrosema sagittatum* (Humb. et Bonpl.) Brandegee ex L. Riley			H/Fr	A,H/F	So,T/Co	GA: Defecación verde de los niños /UR: Niños que orinan mucho en la cama	3/1
L 308	*Chaetocalyx brasiliensis* (Vogel) Benth.	M¥kstogay tsay		H/H	Mo/Mo	C/C	DE: Nacido, erisipela /VU: Papera	6/1
L 499	*Clitoria guiayanensis* (Aubl.) Benth	Jonwayi		R/F	H/MaA	La/Bca	VE: Piquete de vibora /FI: Dolor de cabeza	1/1
L 560	*Cojoba arborea* (L.) Britton & Rose	Uuts tuj cuy	Carabina de chango	Co/Co/Co	S/H/H	S/La/T	CU: Hacer maldad /DE: Herida /GA: Diarrea	1/1/1
L 479	*Crotalaria longirostrata* Hook. & Arn.	Txipiñ ts¥p¥	Chipile	H	H	T	GA: Latido	1
L 294	*Crotalaria sagittalis* L.	Tsuts ts¥p¥		S/H	F/H	Co/Bv	UR: Para que los niños no orinan en la cama /VE: Piquete de vibora	3/1
L 137	*Crotalaria vitellina* Ker Gawl.	Tsuts ts¥p¥		Hi	F	Li	CU: Limpia	1
L 401	*Dalea scandens* (Mill.) R.T. Clausen	Tsun tsun		Hi/Hi/Hi	Ma/H/H	Bac/Bcu/T	CU: Malos espiritos /GY: Después del parto /GA: Dolor de estómago	1/1/1
L 180	*Desmodium incanum* DC.	T¥ pitx nang tsang	Cadillo rojo	Hi/R/H/Hi	H/H/H,T-Mo /H	T/T/La,L/La	GY: Antiabortante /GA: Diarrea /DE: Herida	11/4/2/2
L 103	*Diphysa americana* (Mill.) M. Sousa	Tsus cuy	Chipile	Co/Co/H/H	H/H/Ma/Ma	T,La/La/To/ Bca	VE: Piquete de vibora y de la viuda negra /DE: Sarna, herida /GA: Diarrea /FI: Fiebre	6/4/2/2
L 530	*Eriosema crinitum* (Kunth) G. Don			R/R/Hi/Hi	H/H/H/T-Mo	T/C/T/L	GY: Conceptivo / VE: Piquete de vibora /UR: Mal de orinar /DE: Llaga	1/1/1/1
L 213	*Eriosema diffusum* (Kunth) G. Don	Poja sotyi		Hi/R/H	H,Mo/H/S	La,C/T/S	VE: Piquete de vibora /GA: Diarrea /CU: Niño que no duerme	2/2/1

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L 208	*Erythrina* aff. *americana* (Dryand.) Mill.	N¥tung tsen tsen	Cosquelite / Colorín	S/Co/H/S	H/H/Ma/S	T/T/Bca/S	GY: Hemorragia, anticonceptivo /VE: Piquete de vibora /FI: Fiebre /CU: Malos espiritos	5/3/1/1
L 413	*Erythrina herbacea* L.	Copa tsen tsen		Co/S,R/Co/S/S	H/H/H/H/F	T/T/T/T/L	VE: Piquete de vibora /UR: Infección vaginal, gonorrea /GA: Gastritis, hepatitis /GY: Anticonceptivo, hemorragia /CU: Buena suerte	3/2/2/2/1
	Erythrina sp.		Cosquelite / Colorín	Co	H	La	VE: Piquete de vibora	1
L 380	*Gliricidia sepium* (Jacq.) Steud.	Paaki	Cocuite	H/H/H	Ma/Ma/F	Bca,Bcu/Bca/Li	FI: Fiebre, dolor de cabeza /DE: Caspa /CU: Limpia	41/1/1
L 355	*Indigofera lespedezioides* Kunth	Chims¥k		R/R/R	H,F/H/H	T,Co/T/T	RE: Tos /GA: Dolor de estómago /GY: Anticonceptivo	4/1/1
L 367	*Indigofera lespedezioides* Kunth	Chims¥k		R/R/R	H,F/H/H	T,Co/T/T	RE: Tos /GA: Dolor de estómago /GY: Anticonceptivo	
L 445	*Indigofera suffruticosa* Mill.	Tsun tsun	Añil	H	Ma	L	VU: Colorar tejidos	2
L 552	*Lonchocarpus acuminatus* (Schltdl.) M. Sousa	N¥ts cuy		R	T/Fe	To	VU: Hacer tepache	2
L 595	*Machaerium cobanense* Donn. Sm.	Misi k¥ts¥s	Uña de gato	A/Ra	F/H	La/T	DE: Herida /DI: Diabetes	1/1
L 531	*Machaerium floribundum* Benth.	N¥pin tsay		Co/Co/Co/Co	H/H/H/H	T/E,La/T/T	GA: Diarrea, disentería /DE: Infección bucal, herida /GY: Hemorragia, matriz inflamada /UR: Gonorrea	4/3/2/1
L 410	*Machaerium isadelphum* (E. Mey.) Amshoff	N¥pin tsay		Co/Co/A/Co	H/H/F/H	T/La/La/T	GA: Diarrea, disentería /VE: Piquete de vibora /DE: Herida /GY: Hemorragia	3/1/1/1
L 587	*Machaerium riparium* Brandegee	N¥pin tsay		Co/Co	H/H	T/La	GY: Hemorragia /VE: Piquete de vibora	1/1
	Mucuna pruriens (L.) DC.		Pica pica	S	H	T	VU: Nervios alterados	1
L 160	*Myroxylon balsamum* (L.) Harms	Balsa cuy	Balsa, arbol de	Co/Co/Co	Po/H/H	U/La/La	SK: Reuma, golpe /DE: Herida, varices /VE: Piquete de vibora	4/2/1
L 107	*Ormosia isthmensis* Standl.	May cuy	Coral	S,Co	H	T	GY: Hemorragia, anticonceptivo	24
	Phaseolus sp.	S¥k	Frijol	S	H	T	GY: Expulsar la placenta	2
L 536	*Pterocarpus rohrii* Vahl	Akxcuy		A/Co	F/H	E,La/LaV	DE: Infección de la boca, herida /UR: Infección vaginal	3/1
L 573	*Rhynchosia erythrinoides* Schltdl. et Cham.	Sinchu ixcuy	Ojo de picho	S	H	T	VE: Piquete de vibora	2
L 333	*Rhynchosia pyramidalis* (Lam.) Urb.	Sinchu ixcuy	Ojo de picho	S/S	H/H	T/T	GY: Hemorragia, anticonceptivo /VE: Piquete de vibora	12/2
L 320	*Tephrosia lanata* M. Martens et Galeotti	Mokoy		R,H	H	Bca,La	DE: Piojos, herida	3
L 344	*Tephrosia multifolia* Rose	Mokoy		R/R	H,Ma/Ma	Bac/L	DE: Piojos /VU: Pescar	4/1
L 293	*Stylosanthes guianensis* (Aubl.) Sw. var. *guianensis*			Hi	H	Bv	VE: Piquete de vibora	1

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L 534	*Vatairea lundellii* (Standl.) Killip. ex Record	Y¥k cuy	Palo picho	Co	H	T	GA: Para la bilis	1
L 580	*Zornia* sp.	Tsaiñiay		Hi	H	La	VE: Piquete de vibora	1
	FAGACEAE							
L 563	*Quercus conspersa* Benth.	Cap soj / Tsabats soj	Encino rojo	Co/Co/Co	H/H/H	T/LaV/T	GA: Gastritis, diarrea /UR: Infección vaginal /GY: Anticonceptivo	2/1/1
L 442	*Quercus glaucescens* Humb. et Bonpl.	Puutx soj	Encino amarillo	Co/Co	H/H	T/T	GY: Hemorragia /GA: Diarrea	1/1
L 139	*Quercus oleoides* Schltdl. et Cham.	Pop soj	Encino	Co,S/Co/Co /Co/Co	H/H/H/H/H	T/T,Ba/T,LaV /La/E	GA: Diarrea, disentería, ulcera /GY: Hemorragia, inflamación de la matriz /UR: Infección vaginal /DE: Herida /DO: Dolor de muela	14/7/6/3/1
L 493	*Quercus peduncularis* Née	Y¥k soj	Encino negro	Co/Co/Co/Co	H/S/H/H	T,Ba/S/La/T	GY: Hemorragia, después del parto /CU: Hacer lluvia /DE: Erisipela /GA: Dolor de estómago	2/1/1/1
L 446	*Quercus xalapensis* Bonpl.	Ok soj		Co	H	T	GA: Diarrea	1
	Quercus sp.	Soj	Encino	Co/Co/Co/Co	H/H/H/H	T/T/T/T	GA: Diarrea /GY: Hemorragia /UR: Gonorrea /VU: Vitamina la sangre	3/1/1/1
	FLACOURTIACEAE							
L 473	*Casearia corymbosa* Kunth	¥kx cuy / Tajuiñi ay		H	H	La	DE: Herida	1
L 594	*Xylosma flexuosa* (Kunth) Hemsl.	Jaman juix apitx		Co/Co	Ma,H/H	Bac,To,T/T	CU: Engaño /GY: Hemorragia	3/1
L 472	*Xylosma panamensis* Turcz.	Jaman juix apitx		H/Co	H/Ma	Bv/To	VE: Piquete de vibora /CU: Engaño	1/1
	GESNERIACEAE							
L 233	*Achimenes grandiflora* (Schiede) DC.			Hi/R/H	H/H/Mo	T/LaV,T/C	GY: Conceptivo, hemorragia /UR: Infección vaginal /DE: Herida infectada	2/1/1
L 264	*Kohleria spicata* (Kunth) Oerst.		Planta capulina	H	Mo	C	VE: Piquete de vibora	1
	HAMAMELIDACEAE							
L 588	*Liquidambar styraciflua* L.	T¥x cuy	Ocozote	Res	F	L	DE: Herida	2
	HIPPOCRATEACEAE							
	Hippocratea excelsa Kunth		Canserina	Co/Co	H/H	T,Ba/Ba	GY: Hemorragia /UR: Mal de orinar	3/1
	HYPERICACEAE							
L 490	*Hypericum fastigiatum* Kunth	H¥xi ay		Hi/Hi/R	H/H/H	T/La/E	CU: Desesperación /DE: Herida /DO: Dolor de muela	1/1/1
	ILLICIACEAE							
	Illicium verum Hook. f.		Anis estrella	S/S	H/H	T/T	GY: Después del parto /GA: Flatulencia	2/1

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	JUGLANDACEAE							
	Juglans sp.		Nogal	H	H	T	GY: Accelerar el parto	1
	LAMIACEAE							
L 428	*Coleus blumei* Benth.			H	A-E	G	OI: Dolor de oído	2
L 211	*Hyptis capitata* Jacq.	Tam juñi		Hi,R/R,Hi	Mo,H/H	C,La/LaV,T	DE: Llaga, sarna /UR: Infección vaginal, dolor de riñon	3/2
L 446	*Hyptis capitata* Jacq.	Tam juñi		Hi,R/R,Hi	Mo,H/H	C,La/LaV,T	DE: Llaga, sarna /UR: Infección vaginal, dolor de riñon	
L 11	*Hyptis verticillata* Jacq.	Tsutsbet cuy	Hierba San Martín	Hi/Hi,R/Hi/ Hi/Hi/Hi/Hi	F,Ma/A,H/Ma/ H/H/H/MaA	Li,Bcu/U,T/ Bcu/T/Bv/T/ U	CU: Quitar el calor de muerto, limpia /GA: Flatulencua, latido FI: Fiebre /RE: Tos /DE: Llaga /GY: Anticonceptivo /SK: Dolor de cuerpo	9/6/5/4/2 /1/1
L 197	*Leonurus japonicus* Houtt		Marihuanilla	Hi/Hi/Hi/Hi	H/Mo/H/MaA	T,C/C/T/L	GA: Vomito, colicos /SK: Reuma, golpe /VE: Piquete de vibora /DE: Granos	2/1/1/1
	Mentha sp.		Menta	Hi/Hi/Hi/Hi	H/F/H/H	T/Li/T/T	GA: Dolor de estómago, vomito, colicos /CU: Limpia /FI: Fiebre /GY: Expulsar la placenta	13/2/1/1
L 188	*Ocimum basilicum* L.		Albahaca	Hi/Hi/Hi/Hi/ Hi/Hi	Ma/F/H/H/H/ F	Bac/Li/T/T/T /U	FI: Fiebre, dolor de cabeza /CU: Limpia /GY: Hemorragia, accelerar el parto /RE: Tos /GA: Vomito, diarrea /VU: Repelente para insectos	10/6/3/2/ 2/1
L 54	*Ocimum micranthum* Willd.		Especie cimarrón	A/Hi/H	F/H/A-E	G/Bv/G	OP: Nubes /GY: Después del parto /OI: Dolor de oído	3/1/1
L 253	*Plectranthus amboinicus* (Lour.) Spreng		Oregano	H/H/H/A/H	A,H/H/H/F/H	G/T/T/G/T	OI: Dolor de oído /GA: Dolor colico /GY: Expulsar la placenta, accelerar el parto /OP: Infección /RE: Tos	12/3/2/1/ 1
	Rosmarinus officinalis L.		Romero	Hi/Hi/Hi/Hi	H/S/Po/H	T/S/U/T	GY: Accelerar el parto, después del parto /CU: Niño que llora, sahumar la casa /SK: Reuma, golpe	15/3/2/2
L 591	*Salvia coccinea* Buc'hoz ex Etl.			Hi	H	Bac	CU: Cansancio	1
L 321	*Salvia tuxtlensis* Ramamoorthy	Poja way cuy		H/H/H,R/H	H/H/H/H	T/T/T/La	GY: Hemorragia /RE: Tos /GA: Disentería /DE: Herida	2/2/1/1
L 194	*Salvia xalapensis* Benth.	Tsus ay		Hi/Hi	A,H/H,T-Mo	U,T/Bcu,L	GA: Flatulencia, diarrea	3/2
	LAURACEAE							
L 177	*Cinnamomum brenesii* (Standl.) Kosterm.	Contra moko	Rosa negra	Co/Co/Co	H/H/H	T/T/T	CU: Brujería /GA: Dolor de estómago, diarrea /VE: Piquete de vibora	4/4/2
L 292	*Cinnamomum verum* J. Presl.		Canela	Co/Co/Co	H/H/H	T/T/T	RE: Tos, asma /GA: Dolor de estómago, vomito /GY: Expulsar la placenta, después del parto	7/7/2
	Laurus nobilis L.		Laurel	H	S	S	CU: Mal aire	1
L 133	*Licaria capitata* (Schltdl. et Cham.) Kosterm.	Y¥k moko	Laurel Negro	Co/Co/Co/ Co	H/H/H/H	T/LaV/T/T	GA: Dolor de estómago /UR: Infección vaginal /VE: Piquete de vibora /VU: Baja presión	2/1/1/2
L 409	*Licaria capitata* (Schltdl. et Cham.) Kosterm.	Y¥k moko	Laurel Negro	Co/Co/Co/ Co	H/H/H/H	T/LaV/T/T	GA: Dolor de estómago /UR: Infección vaginal /VE: Piquete de vibora /VU: Baja presión	
L 143	*Licaria peckii* (I. M. Johnst.) Kosterm.	Puutx moko	Laurel amarillo	Co/Co	H/H	T/T	GA: Dolor de estómago, flatulencia /GY: Hemorragia	2/1

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L 104	*Nectandra heydeana* Mez et Donn. Sm.	Chuch moko	Laurelillo	Co/Co	H/H,Mo	T/T,C	GA: Colicos /VU: Baja presión, papera	1/3
L 482	*Ocotea dendrodaphne* Mez	Moko	Rosa negra	Co	H	T	GA: Dolor de estómago	2
L 407	*Ocotea veraguensis* (Meissn.) Mez		Laurel negro	Co/Co/Co	H/H/H	T/T/T	GA: Dolor de estómago, flatulencia /VE: Piquete de vibora /GY: Hemorragia	3/1/1
L 187	*Persea americana* Mill.	Cuy ty¥m	Aguacate	S,Co/Co,S/ S/S,Co/Co/ Co/H/Co,S/ Fr	H/H,MaA/H/H /H/H/Mo/H/F	T/Bcu,T,U/ Bca/T,LaV/ LaV/Bv/C/T/ Co	GA: Gastritis, dolor de estómago /SK: Golpe, reuma /DE: Piojos /GY: Hemorragia, matriz inflamada /UR: Infección vaginal /VE: Piquete de vibora /DO: Dolor de muela /DI: Diabetes /VU: Afrodisiaco	11/5/5/5/ 3/1/1/1/1
L 341	*Persea americana* var. *drymifolia* (Schltdl. et Cham.) Blake	Muts cuy ty¥m	Aguacatillo	H/H,S	H/H	T/T	SK: Golpe, reuma /GA: Flatulencia	3/2
	LOGANIACEAE							
L 414	*Buddleia americana* L.	Xiapun ay	Teposan	H/H/H/H/H	Ma,Mo/A-E/ H/H/A	La,C/To/T/Bv /C	DE: Erisipela, infección /FI: Fiebre /RE: Tos /VE: Piquete de vibora /VU: Hinchasón de los pies	8/4/2/1/2
L 319	*Spigelia* sp.		Lombricera	R	H	T	GA: Lombrices intestinales	1
	LORANTHACEAE							
L 429	*Phoradendron quadrangulare* (Kunth) Griseb.	Cuyñukxi	Cabellera	H/H	Mo/H	C/T	DE: Erisipela /FI: Fiebre	2/1
L 518	*Struthanthus cassythoides* Millsp. ex Standl.	Cuyñukxi	Cabellera	H	Mo	C	DE: Erisipela	2
L 21	*Struthanthus* aff. *marginatus* (Desr.) Blume	Cuyñukxi	Cabellera	H	Mo	C	DE: Erisipela	3
	LYTHRACEAE							
L 347	*Cuphea tetrapetala* Koehne	N¥ang s¥gay		Hi/Hi/Hi/Hi	Ma/Ma/H/Ma	Bca/Bcu/Bv/ Bca	FI: Fiebre /CU: Desesperación /VE: Piquete de vibora /DE: Caída del cabello	3/1/1/1
	MAGNOLIACEAE							
L 173	*Talauma mexicana* (DC.) G. Don	Mooyniakcuy		S,F,Co/F	H/H	T/T	GA: Gastritis /GY: Hemorragia, anticonceptivo	6/2
	MALPIGHIACEAE							
L 5	*Byrsonima crassifolia* (L.) Kunth	Nanchiñ	Nanchi	Co/Co/Co/ Co/H	H/H/H/H/S	T/LaV,T/T/La /S	GA: Diarrea, disentería /UR: Infección vaginal, dolor de riñon /GY: Hemorragia, matriz inflamada /DE: Herida /CU: Niño que llora	22/9/8/7/ 1
L 47	*Byrsonima crassifolia* (L.) Kunth	Nanchiñ	Nanchi	Co/Co/Co/ Co/H	H/H/H/H/S	T/LaV,T/T/La /S	GA: Diarrea, disentería /UR: Infección vaginal, dolor de riñon /GY: Hemorragia, matriz inflamada /DE: Herida /CU: Niño que llora	
L 353	*Heteropteris beecheyana* Juss.	Meeme ay		Co,R/R/R	H/H/H	T/T/T	UR: Infección vaginal, mal de orinar /GA: Dolor de estómago /GY: Hemorragia	2/1/1
L 516	*Heteropteris laurifolia* (L.) A. Juss.	Patan tsay / Tsay uouo / T¥ts kunekne		Co/Co	H/H	T/T	UR: Gonorrea, mal de orinar /GA: Dolor de estómago	2/1

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L 6	*Stigmatophyllon ellipticum* (Kunth) Juss.	Samñi tsay		C/C	H/H	LaV/T	UR: Infección vaginal /GA: Dolor de estómago	3/1
L 455	*Stigmatophyllon* aff. *retusum* Griseb. et aff. *lindenianum* Juss.	Samñi tsay		C	H	LaV	UR: Infección vaginal	2
	MALVACEAE							
L 184	*Abelmoschus moschatus* Medik.		Boraja	S,H/H/S/H	H/H/H/H	T/T/T/T	RE: Tosferina /SK: Dolores del cuerpo /DI: Diabetes /FI: Fiebre	3/1/1/1
L 167	*Hibiscus costatus* A. Rich.	Tioch puk ay	Algodoncillo	H,R	H	E	DE: Infección bucal	3
L 61	*Hibiscus rosa-sinensis* L.		Tulipan	F/F/F/H/H	H/Ma/H/H/Ma	T/Bca/T/T,LaV/To	RE: Tos /CU: Engaño /GA: Empacho /UR: Infección vaginal /VU: Abuso del alcohol	10/3/1/1/1
L 298	*Hibiscus rosa-sinensis* L.		Tulipan	F/F/F/H/H	H/Ma/H/H/Ma	T/Bca/T/T,LaV/To	RE: Tos /CU: Engaño /GA: Empacho /UR: Infección vaginal /VU: Abuso del alcohol	
L 256	*Malvastrum coromandelianum* (L.) Garcke		Malva	Hi	S	S	CU: Niño que llora	1
L 50	*Malvaviscus arboreus* Cav.	Xoun pocuy	Rompe olla	H,R,F/H/H,F/H/R/F/F/F	H/H,Ma/H/H/H/H/Ma/Ma	T/T,To/T/Bv/T/E/Bcu/Bca	GA: Diarrea /UR: Flujo, mal de orinar /RE: Tos /VE: Piquete de vibora /FI: Fiebre /DE: Infección bucal /CU: Engaño /VU: Hemorragia nasal	7/5/2/2/1/1/1/1
L 38	*Pavonia schiedeana* Steud.	Konko	Cadillo	Hi/Hi,R/H,R/S,R	Ma,Mo/H/Ma/Ma	Bca,C/T/To/To	DE: Para los cabellos, nacido /GA: Diarrea, estreñimiento /FI: Fiebre /GY: Anticonceptivo, antiabortante	3/3/2/2
L 468	*Robinsonella mirandae* Gómez Pompa	Pukcuy	Algononcillo					
L 84	*Sida acuta* Burm. f.	Yoya malva	Malva de cochino	H,R	Ma,H	To,T	UR: Mal de orinar, flujo	2
L 36	*Sida rhombifolia* L.	Yoya malva	Malva de cochino	Hi,R/Hi/R	H/H/H	T,LaV/LaV/T	UR: Riñon inflamada, flujo /GY: Ulcera de matriz /GA: Diarrea	2/1/1
	Sida sp. (acuta & rhombifolia)			R/R,Hi/R/Hi/R/Hi/Hi	H/H/H/H/H/S/T-Mo	LaR,T/Ba/T/Bav/T/S/L	GA: Estrenimiento, diarrea /GY: Ulcera y inflamación de matriz /RE: Tos /SK: Reuma /FI: Fiebre, sarampión /CU: Niño que llora /DE: Infección dermal	4/4/3/2/2/1/1
L 327	*Sidastrum paniculatum* (L.) Fryxell			H	H	T	GA: Gastritis	1
L 345	*Wissadula amplissima* (L.) R. E. Fr.	Puk ay		H,F	S	S	CU: Malos espiritos	1
L 378	*Wissadula excelsior* (Cav.) C. Persl	J¥mniom cuy puk		R,Ra	H	La	DE: Herida, infección	2
	MARTYNIACEAE							
L 162	*Martynia annua* L.	Joun k¥ts¥s	Uña de gato	S/S	H/S	T/S	GY: Trastornos menstruales /CU: Malos espiritos	3/1
	MELASTOMATACEAE							
L 145	*Arthrostemma ciliatum* Pav. ex D. Don	Katxu kanapoki	Caña agria quadrata	Hi/Hi	H,Ma/H	T,To/T	UR: Mal de orinar y de riñon /DI: Diabetes	12/1
L 270	*Clidemia petiolaris* (Schltdl. et Cham.) Schltdl. ex Triana	Puki tesua	Tesuatillo de algodón	Co,H/H/Ra	H/Mo/H	E/G/H	DE: Granos en la boca /OP: Infección de los ojos /GA: Dolor de estómago	2/1/1

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L 497	*Conostegia icosandra* (Sw. ex Wilkstr.) Urb.	Jeepe		Ra	H	T	GA: Gastritis	1
L 247	*Conostegia xalapensis* (Bonpl.) D. Don ex DC.	Chuch jeepe	Capulin niua	H,Co,R/R,H/H	H/H/H	T/T/L	GA: Gastritis, dolor de estómago /GY: Matriz inflamada, anticonceptivo /DO: Dolor de muela	3/2/1
L 133	*Miconia albicans* (Sw.) Triana	Pak tesua		H/R,Co/R/R/Co	H/H/H/H/H	E,La/T/T/T/LaV	DE: Herida en la boca, herida /GA: Gastritis, diarrea /UR: Mal de orinar /RE: Tos /GY: Matriz inflamada	6/2/1/1/1
L 72	*Miconia argentea* (Sw.) DC.	Tesua	Tescuate	H,Co/Co/H/R	A,H/H/H/H	So,Ba/T/T/T	GY: "Secar la matriz" después del parto, trastornos menstruales /UR: Dolor de riñon /RE: Tos /GA: Diarrea	8/2/1/1
L 403	*Miconia glaberrima* (Schltdl.) Naudin			Ra	H	T	GA: Gastritis	1
L 520	*Miconia ibaguensis* (Bonpl.) Triana	Chuk jeepe		Ra	H	T	GA: Gastritis	1
L 371	*Miconia schlechtendalii* Cogn.			Ra,H/R,Ra	H/H	E/T	DE: Granos y heridas en la boca /GA: Gastritis, diarrea	3/2
L 419	*Monochaetum* sp.			Hi/Hi/Hi	Ma/H/H	Bca/La/La	FI: Fiebre /VE: Piquete de la vibora /DE: Llaga	1/1/1
L 384	*Tibouchina longifolia* (Vahl) Baill.		Tesuatillo	Hi/H	H,Mo/Mo	La,T,C/G	VE: Piquete de vibora y de la viuda negra /OP: Infección de los ojos	3/1
	MELIACEAE							
L 98	*Cedrela odorata* L.	Acuy	Cedro	Co/Co/Co/Co/H/Co	H/H/H/H/Ma/H	T,Bav/La/T/T/Bca/T	SK: Golpes /DE: Llaga, herida /GY: Hemorragia, expulsar la placenta /UR: Dolor de riñon /FI: Fiebre /GA: Diarrea	13/6/3/2/1/1
L 68	*Melia azedarach* L.		Tarai	H/H/Co,H/Co,H/H/M/H/H/Co	Ma,F/Ma/Po/H/A/H/H/H/H	Bca,P/Bcu,La/U/Bcu/G/T/Bac/T/T	FI: Fiebre /DE: Sarna, herida /SK: Reuma /GY: Lavar el cuerpo después del parto /OI: Dolor de oído /UR: Riñon inflamada /CU: Mal de espirito /DI: Diabetes /VU: Fortalecer la sangre	6/5/3/2/2/1/1/1/2
	Swietenia sp.		Cahoba	Co/Co/Co	H/H/H	T/T/T	GY: Trastornos menstruales /GA: Dolor de estómago /SK Golpes	3/3/1
L 315	*Trichilia havanensis* Jacq.	Yooni cuy	Palo cuchara	H/Co/Co/H	Ma/Ma/H/Ma	Bcu/To/T/Bcu	FI: Fiebre, dolor de cabeza /RE: Tosferina /GY: Anticonceptivo /VU: Anemia	2/1/1/1
	MENISPERMACEAE							
L 406	*Abuta panamensis* (Standl.) Krukoff & Barneby			H	H	T	UR: Gonorrea	1
L 57	*Cissampelos pareira* L.	Tyiñi woyo	Redondillo	R/R/R/R/R	H/H/H/H/MaA	T/T/T/Ba/Ti	GA: Diarrea, disentería, dolor de estómago /VE: Piquete de vibora /GY: Hemorragia /UR: Flujo /VU: Hemorragia nasal	21/8/3/1/1
L 58	*Cissampelos pareira* L.	Tyiñi woyo	Redondillo	R/R/R/R/R	H/H/H/H/MaA	T/T/T/Ba/Ti	GA: Diarrea, disentería, dolor de estómago /VE: Piquete de vibora /GY: Hemorragia /UR: Flujo /VU: Hemorragia nasal	
L 265	*Cissampelos tropaeolifolia* DC.	Tyiñi woyo	Redondillo	R	H	T	VE: Piquete de vibora	1
L 357	*Hyperbaena mexicana* Miers	Txa cuy	Huesillo	F/F	H/F	T/Co	UR: Riñon inflamada /DE: Granos en la boca	1/1
	MIMOSACEAE							
L 481	*Acacia cornigera* (L.) Willd.	Juanapitx	Cornisuelo	R/R	H/H	T/T	GY: Hemorragia /GA: Dolor de estómago	1/1

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L 85	*Acacia farnesiana* (L.) Willd.		Maroma	H/H,Co/R,H /Fr/H,F	Ma/H/H/F/F/ Ma,H	Bca/T/T/G/ Bca,T	FI: Fiebre /GY: Anticonceptivo /GA: Latido, diarrea /OP: Infección del ojo /VU: Hemorragia nasal, ataques epilepticos	2/2/2/1/2
L 306	*Calliandra houstoniana* (Mill.) Standl.	Juix mooya		R/R	H/H	T/T	GY: Hemorragia /UR: Gonorrea, flujo	3/2
L 201	*Calliandra juzepczukii* (Mill.) Standl.	Juix mooya		F/H	F/S	L/S	GY: Determinar el sexo del bebé /CU: Malos espiritos	1/1
L 575	*Enterolobium cyclocarpum* (Jacq.) Griseb.	Jipi	Nacastle	Co/Fr	H/Ma	T/L	GA: Dolor de estómago /VU: Lavar ropa	1/1
L 302	*Inga punctata* Willd.	Inki	Acotope / Vainilla	Co/Co/Co/ Co	H/H/H/H	La/T/LaV/ LaV	DE: Herida, llaga /GA: Dolor de estómago /GY: Matriz inflamada /UR: Flujo	10/4/4/4
L 147	*Inga punctata* Willd.	Inki	Acotope / Vainilla	Co/Co/Co/ Co	H/H/H/H	La/T/LaV/ LaV	DE: Herida, llaga /GA: Dolor de estómago /GY: Matriz inflamada /UR: Flujo	
L 52	*Inga vera* Willd.	Inki		Co/Co	H/H	La/T	DE: Herida /UR: Dolor de los riñones	1/1
L 142	*Lysiloma auritum* (Schltdl.) Benth.	Cana cuy	Songuavite	Co/Co/Co/ Co/Co	H/H/H/H/H	T/T/T/T/La	GY: Trastornos menstruales /DI: Diabetes /VE: Piquete de la viuda negra /GA: Diarrea /DE: Herida	4/1/1/1/1
L 166	*Mimosa albida* Humb. et Bonpl. ex Willd.	Nuk cuy	Sarsa sabanera	L/L/R/H	F/F/H/H	L/G/T/T	DE: Herida, verrugas /OP: Nubes /GA: Hipo /UR: Gonorrea	3/2/1/1
L 95	*Mimosa pudica* L.	Mong mong ay	Dormilona	Ra/R/R/R/R	F/H/H/H/H	L/T/T/T/T	CU: Niño que no duerme, que llora /GA: Diarrea, latido /FI: Fiebre /GY: Hemorragia /RE: Tos	9/3/3/1/1
L 369	*Zapoteca lambertiana* (G. Don) H. M. Hern.			R	H	Bca	DE: Piojos	1
	MONIMIACEAE							
L 174	*Siparuna andina* (Tul.) A. DC.	Tsan tsan ay		H/H/H/H/H /H	H,Mo/Ma/ H,Mo/Ma/H/ H,Ma	La,C/Bac/Bav, C/Bac/T/T,Bc u	DE: Herida, infección /FI: Dolor de cabeza, malaria /SK: Torcedura, golpe /CU: Maldades /GY: Anticonceptivo /VU: Dolor del bazo, anemia	3/3/2/2/1 /13
	MORACEAE							
L 76	*Dorstenia contrajerva* L.	Nak ay	Cresta de gallo	H,R/H/H,R/ H/H/H	H,Mo,T-Mo/ H/H,MaA/Mo/ H/A-E	La,C,L/La/ T,Ti/Ca/T/G	DE: Herida, llaga, pie apestoso /VE: Piquete de vibora /UR: Mal de orinar, de riñon /SK: Dolor de los senos, reuma/ GY: Ulcera de la matriz /OI: Dolor de oído	9/2/2/2/1 /1
L 63	*Ficus pertusa* L. f.	Tsuj		Co/H	H/Ma	LaV/Bcu	GY: Matriz inflamada /FI: Fiebre	1/1
L 567	*Maclura tinctoria* (L.) D. Don ex Steud.		Murra	A/Co	F/H	L/Bcu	DO: Dolor de muela /CU: Hechizería	5/1
L 469	*Poulsenia armata* (Miq.) Standl.		Cartagena					
	MYRICACEAE							
L 311	*Myrica cerifera* L.	Copa puso		H/R/H	S/H/H	S/T/T	CU: Malos espiritos /GY: Hemorragia /RE: Tos	1/1/1
L 393	*Myrica cerifera* L.	Copa puso		H/R/H	S/H/H	S/T/T	CU: Malos espiritos /GY: Hemorragia /RE: Tos	

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	MYRISTICACEAE							
	Myristica fragrans Houtt.		Nuez moscada	S/S/S/S/S	H/H/H/F/F	T/T/T/Co/So	GA: Dolor de estómago, latido, vomito /VE: Piquete de vibora /GY: Hemorragia, accelerar el parto /CU: Mal aire /VU: Cuando el niño no abre la boca	4/3/2/1/3
L 461	*Virola guatemalensis* (Hemsl.) Warb.	J¥mniom cas	Cedrillo	Co,L/Co	H,F/H	La/T	DE: Herida, granos en la boca /SK: Golpes	3/1
	MYRSINACEAE							
L 255	*Ardisia compressa* Kunth	Tsuk nok nok	Chagalapoli	Co,R/Co,R/Co/Co/Co	H/H/H/H/H	T/T/La,E/T/T	GA: Diarrea, disentería /GY: Hemorragia /DE: Llaga, granos en la boca /FI: Fiebre /VU: Hemorragia nasal	4/3/2/1/1
L 508	*Oerstedianthus brevipes* (Lundell) Lundell	Petx uk cuy		R/S	H/Mo	T/C	GA: Diarrea /DE: Granos	1/1
L 396	*Oerstedianthus* sp.							
L 421	*Parathesis neei* Lundell	Chu cuxamñi		Co/Co	H/H	T/T	GA: Diarrea /UR: Gonorrea	1/1
	MYRTACEAE							
	Eucalyptus sp.		Eucalipto	H/H/H/H/H	H/H/H/H/Po	T,J/T/LaV/T/U	RE: Tos /DI: Diabetes /UR: Flujo /FI: Fiebre /GY: Ovarios inflamados	11/1/1/1/1
L 239	*Eugenia acapulcensis* Steud.	Petcuy	Escobilla	Co/Co/H	H/H/H	T/La/T	GA: Diarrea /DE: Herida /GY: Hemorragia	3/1/1
L 585	*Eugenia capuli* (Schltdl. et Cham.) O. Berg	Cheks patan / Pop pet cuy		Co/Co	H/H	T/T	GA: Diarrea /GY: Hemorragia	6/1
L 491	*Myrcianthes fragrans* (Sw.) Mc Vaugh	Cheks		Co	H	T	GA: Diarrea	1
L 9	*Pimenta dioica* (L.) Merr.	Uk suk	Patololote / Pimienta gorda	H,Co,S/H,S/H/H	H/H/H/H	T/T/Bca/J	GA: Dolor de estómago, colicos, vomito /GY: Hemorragia, matriz inflamada /DE: Piojos /RE: Tos	14/6/2/1
L 46	*Psidium guajava* L.	Patan	Guajava dulce	Co,R,H/Co/Co/H/H	H/H/H/H/H	T/La/LaV,T/T/Ba	GA: Diarrea /DE: Herida /UR: Flujo, mal de orinar /RE: Tos /GY: Hemorragia	11/3/3/2/1
L 244	*Psidium guineense* Sw.	Copa patan	Guajaba sabanera	Co,R/H	H/H	T/T	GA: Diarrea, disentería /GY: Hemorragia	9/1
L 53	*Psidium friedrichsthalianum* (O. Berg) Nied.	Katsu patan	Guajava agria	Co,H	H	T	GA: Diarrea, disentería	3
L 394	*Psidium* aff. *salutare* (Kunth) O. Berg		Itamo real	R	H	T	GA: Diarrea, disietería	13
L 348	*Syzygium jambos* (L.) Alston		Pomarosa	H/Fr/Co	H/MaA/H	T/L/T	RE: Tos /CU: Perfume espiritual /VU: Abuso del alcohol	1/1/1
	NYCTAGINACEAE							
	Bougainvillea sp.		Bugambilia	F	H	J	RE: Tos	12
L 254	*Mirabilis jalapa* L.	Txuang mooya		F/Fr	Ma/Mo	Bca/So	FI: Fiebre /VU: Cuando el niño no abre la boca	1/8

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L 501	*Neea psychotrioides* Donn. Sm.	Tsabats masan ay		H/Ra	Mo,H/H	C,La/T	DE: Erisipela /FI: Fiebre	2/1
	OLACACEAE							
L 453	*Ximenia americana* L.	Paja pitx cuy		Co/H	H/Ma	T/Bca	GA: Diarrea /FI: Fiebre	4/1
	ONAGRACEAE							
L 94	*Ludwigia octovalvis* (Jacq.) P. H. Raven	Clavo sotyi		H/H/Hi	H/H/H	E/E/T	DE: Candida en la boca (algodoncillo) /DO: Dolor de muela /RE: Tos	2/1/1
	OXALIDACEAE							
L 77	*Biophytum dendroides* (Kunth) DC.	Coco ay / Chuch suyat	Palmita	Pe/Pe/Pe/Pe	H,Ma/H/Ma/H	T,To/T/To/T	CU: Deseperación /GY: Determinar el sexo del bebé /FI: Dengue /GA: Gastritis	6/2/1/1
L 385	*Oxalis corniculata* subsp. *albicans* (Kunth) Lourteig		Trebol	Hi/Hi/Hi	H/H/H	E/T/T	DE: Granos en la boca /UR: Dolor de riñon /GY: Conceptivo	1/1/1
L 121	*Oxalis frutescens* L.	Pixtic sotyi	Capulin blanco	Hi/Hi/Hi	H/H,Ma/H	T/E/T	FI: Fiebre /DE: Granos en la boca /VE: Piquete de vibora	3/2/1
L 121B	*Oxalis rhombifolia* Jacq.		Capulin blanco	Hi	H	T	VU: Insomnio	1
	PAPAVERACEAE							
L 223	*Bocconia frutescens* L.		Llora sangre	H/H	H/H	Bca,Bcu/J	DE: Piojos, sarna, salpullido /RE: Tos	6/1
	PASSIFLORACEAE							
L 528	*Passiflora ambigua* Hemsl.		Gagapachi	A/R,H/H	F/H/H	G/T/T	OP: Nubes /UR: Mal de orinar /VU: Nervios alterados	1/1/1
L 69	*Passiflora foetida* L.	Xiu tiepo		H/R/R/H	Mo/H/H/H	C/T/T/T	DE: Nacidos /GY: Hemorragia /UR: Mal de orinar /VU: Nervios alterados	1/1/1/1
L 438	*Passiflora serratifolia* L.	Xiu tiepo		A/H/R	F/Mo/Ma	G/C/To	OP: Infección del ojo /DE: Nacidos /VU: Mal de orinar	3/2/1
	PHYTOLACCACEAE							
L 235	*Petiveria alliacea* L.	Patscang ay	Hoja de zorillo	R,H/H/H/H/R/H	MaA/H/H/H/H/Mo	U/Bcu/La/La/T/O	SK: Reuma /CU: Hechizería /DE: Infección /VE: Piquete de vibora /GA: Flatulencia /FI: Fiebre	3/3/1/1/1/1
L 163	*Phytolacca rivinoides* Kunth & C. D. Bouché	Masan ay		H	Mo	C	DE: Erisipela	12
L 25	*Rivina humilis* L.	Masan ay		H/H/H	Mo/Mo/Mo	C/C/C	DE: Erisipela /SK: Reuma /VU: Papera	10/1/1
	PIPERACEAE							
L 586	*Peperomia asarifolia* Schltdl. et Cham.			H/H	Mo/Mo	C/C	DE: Erisipela, llaga /SK: Reuma	2/1
L 28	*Peperomia deppeana* Schltdl. et Cham.	Conchuru ay / Epxi ay		H/H/H/H	Mo/Mo/Ma/A-E	C/C/Bca/G	DE: Infección /SK: Reuma /FI: Fiebre /OI: Dolor de oído	2/1/1/1
L 441	*Peperomia glabella* (Sw.) A. Dietr.			H	Mo	C	DE: Llaga	1

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L 128	*Peperomia glutinosa* Millsp.	Chicu tats¥k		H/H/H	A-E/F/H	C/Co/Bv	OI: Dolor de oído /CU: Mal aire /SK: Reuma	1/1/1
L 251	*Peperomia granulosa* Trel.	Kiñi ay		H/H/H	A-E/Mo/Mo	G/C/C	OI: Dolor de oído /SK: Reuma /DE: Infección	5/4/2
L 234	*Peperomia humilis* (Vahl) A. Dietr.	Kiñi ay		H/H/H/H	A-E/Mo/ Mo/Ma	G/C/C/Bca	OI: Dolor de oído /SK: Reuma /DE: Erisipela /FI: Fiebre	3/3/2/1
L 513	*Peperomia lancifolia* Hook.			H	Mo	C	DE: Nacidos	1
L 450	*Peperomia maculosa* (L.) Hook.	Chixchix ay		H/H	Mo/Mo	C/C	SK: Reuma /DE: Erisipela	1/1
L 342	*Peperomia obtusifolia* (L.) A. Dietr.	Kiñi ay	Oreja de burro	H/H	Mo/Mo	C/C	DE: Nacidos, llaga	4/3
L 593	*Peperomia tetraphylla* (G. Fost.) Hook. et Arn			H	Mo	C	SK: Reuma	1
L 219	*Piper aduncum* L.	Tooso		H	Mo	C	DE: Llaga	1
L 227	*Piper aequale* Vahl	Tooso		H/H	Mo/Mo	C/C	DE: Llaga /VE: Piquete de vibora	1/1
L 109	*Piper amalago* L.	Tooso		H,R,Co/H/H	Mo,H/H/Ma	C,La/Bv/Bca	DE: Herida, llaga, erisipela /VE: Piquete de vibora /FI: Fiebre	9/2/1
L 34	*Piper amalago* L.	Tsus tooso	Cordoncillo verde					
L 285	*Piper* aff. *amalago* L.	Tooso						
L 89	*Piper auritum* Kunth	Aycuyo	Acuyo	H/H/H/R/H /H	F/A/Mo/Mo/ T-Mo/F	C/C/C/L/L/C	DE: Erisipela /RE: Tos /FI: Fiebre /DO: Dolor de muela /VE: Piquete de vibora /SK: Reuma	5/2/1/1/1 / 1
L 228	*Piper* aff. *fraguanum* Trel.	Tooso		H	Mo	C	DE: Llaga	1
L 159	*Piper* aff. *glabrescens* C. DC.	Tooso		H/H	Mo,H/H	C,La/T	VE: Piquete de vibora /SK: Dolor de cuerpo	4/1
L 116	*Piper guazacapanense* Trel. et Standl.	Tooso	Cordoncillo oloroso	H/Pe/Pe/R/ R,H	H/H/H/Ma/Mo	La/T/T/La/C	VE: Piquete de vibora /GY: Hemorragia /GA: Dolor de estómago /DE: Infección /VU: Papera	2/1/1/1/1
L 99	*Piper hispidum* Sw.	Tooso		H,R/H/H/H	Mo,T-Mo/H/ H/H	C,L/T/Bcu/Bv	DE: Erisipela, llaga /SK: Reuma /GY: Después del parto /VE: Piquete de vibora	3/1/1/1
L 220	*Piper* aff. *lapathifolium* (Kunth) Steud.	Tooso		H	Mo	C	DE: Llaga	1
L 376	*Piper marginatum* Jacq.	Tooso		H	Mo	C	DE: Erisipela	1
	Piper nigrum L.		Pimienta negra	S/S	H/H	T/T	GY: Inflamación de matriz /CU: Pensamientos	1/1
L 221	*Piper pansamalanum* C. DC.	Tooso		H/H	Mo/Mo	C/C	DE: Llaga /SK: Reuma	1/1
	Piper sp.	Tooso		H,Co/H/H/H	Mo/H/H/Mo	C/La,T/Bcu/C	DE: Erisipela, llaga, infección /VE: Piquete de vibora /CU: Mal de espirito /SK: Reuma	14/2/1/1
L 155	*Pothomorphe umbellata* (L.) Miq.	Aycuyo cimarrón	Bella dona	H/H/H	Mo/Mo/Mo	C/C/C	DE: Erisipela, llaga /SK: Reuma /VE: Piquete de vibora	6/3/3

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	PLANTAGINACEAE							
L 382	*Plantago australis* Lam.	Lentej ay		H	Mo	C	VU: Papera	3
	PODOSTEMACEAE							
L 434	*Marathrum* sp.	N¥muk / Niu muk		Hi/Hi/Hi	Ma/H/Ma	Bca/Bv/Bca	DE: Caída del cabello /SK: Reuma VU: Hemorragia	1/1/1
	POLYGALACEAE							
L 172	*Polygala paniculata* L.	Ueji ay		Pe/R/Hi/Pe	S/H/H/Ma	S/T/Bv/To	CU: Niño que llora, mal aire /GA: Flatulencia /VE: Piquete de vibora /FI: Dengue	6/2/1/1
L 263	*Securidaca diversifolia* (L.) S. F. Blake	Kipats ay	Balsamillo	R/R/R	H,Ma/H/H	T,To/T/T	FI: Fiebre /GA: Diarrea /VE: Piquete de vibora	14/5/1
	POLYGONACEAE							
L 40	*Coccoloba barbadensis* Jacq.	Pakum	Uvero	Co/Co/Co/H/Co/H	H/H/H/Mo/H/Mo	T/T/La/C/LaV/C	GA: Diarrea /GY: Matriz inflamada /DE: Herida /FI: Fiebre /UR: Flujo /VU: Papera	9/1/1/1/1/1
L 480	*Coccoloba montana* Standl.	J¥mniom pakum	Uvero de montaña	Co	H	T	GA: Diarrea	2
	PORTULACACEAE							
L 257	*Talinum paniculatum* (Jacq.) Gaertn.	Masan ay		H/H/H/H	Mo,H/H/Mo/Mo	C,La/La/C/C	DE: Erisipela /VE: Piquete de vibora /SK: Reuma /VU: Papera	5/1/1/1
	PROTEACEAE							
L 408	*Roupala montana* Aubl.	T¥kchicuy	Palo de cucaracha	Co	H	T	GY: Hemorragia	1
	PUNICACEAE							
L 183	*Punica granatum* L.		Granada	Ca	H	T	GA: Diarrea	13
	RANUNCULACEAE							
L 258	*Clematis grossa* Benth.	Tsay ¥wix / Kunki kuts¥wi	Bejuco de barba viejo	H/H/H/H,R	H/H/Mo/H	La/LaV/O/T	DE: Herida, llaga /UR: Flujo /FI: Fiebre /GY: Expulsar la placenta	3/1/1/1
	RHAMNACEAE							
L 204	*Gouania lupuloides* (L.) Urb.	Xiapun tsay	Jaboncillo liso	H	Mo	C	DE: Erisipela, infección	5
L 129	*Gouania polygama* (Jacq.) Urb.	Xiapun tsay	Jaboncillo	H/Co/H/H	Ma/MaA/Ma/H	La/U/Bca/LaV	DE: Erisipela, infección /SK: Dolor de cuerpo /FI: Fiebre /GY: Matriz inflamada	7/2/1/1
L 561	*Sageretia elegans* (Kunth) Brongn.	Masan kobak apitx		R/R,Co/R/Ra	H/H/H/F	T/T/T/L	UR: Mal de orinar, de riñon /GY: Hemorragia /GA: Diarrea /CU: Malos espiritos	2/1/1/1
	ROSACEAE							
	Mespilus sp.			H	H	T	VU: Alta y baja presión	1

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	Rosa sp.		Rosa concha	F/F/F/F/F/R/F/F	Ma/Ma,H/H,Ma/T-Mo/H/H/H/Ma	Bca/Bca,T/G/L/T/T/T/To	FI: Dolor de cabeza /CU: Engaño /OP: Infección del ojo /DE: Infección /GA: Empacho /GY: Hemorragia /RE: Tos /VU: Abuso del alcohol, ataques	8/3/2/1/1/1/1/2
	RUBIACEAE							
L 471	*Alibertia edulis* (Rich.) A. Rich. ex DC.	Wikpak	Catarita	Fr,Ra/H	S,F/H	S,L/T	CU: Niño que llora, malos espiritos /RE: Asma	2/1
L 541	*Borreria densiflora* DC.			Hi	H	T	UR: Mal de orinar	1
L 242	*Borreria laevis* (Lam.) Griseb.	Jutut sotyi		Hi/Pe/Pe	H/H/H	T/T/T	UR: Dolor de riñon /GA: Diarrea /GY: Hemorragia	1/1/1
L 171	*Borreria latifolia* (Aubl.) K. Schum.		Riñonina	Hi/Hi/Hi	H/H,Ma/MaA	Bv/T,To/U	VE: Piquete de vibora /UR: Mal de orinar, flujo /SK: Dolores musculares	4/3/1
L 214	*Borreria suaveolens* G. Mey.	Butun sotyi		Hi	H,Ma	La,C	VE: Piquete de vibora	2
L 75	*Chiococca alba* (L.) Hitchc.	Majei muts	Moste cimarrón	H/H/R/H/H/R/R	H,Mo/H/H/Ma/H/Mo/Ma	Bv,C/La,Bv/T/Bca/Bv/L/To	DE: Erisipela, llaga /VE: Piquete de vibora /GA: Dolor de estómago, del bazo /FI: Fiebre /RE: Asma /DO: Dolor de muela /VU: Abuso del alcohol	5/5/2/2/1/1/1
L 200	*Chiococca alba* (L.) Hitchc.	Majei muts	Moste cimarrón	H/H/R/H/H/R/R	H,Mo/H/H/Ma/H/Mo/Ma	Bv,C/La,Bv/T/Bca/Bv/L/To	DE: Erisipela, llaga /VE: Piquete de vibora /GA: Dolor de estómago, del bazo /FI: Fiebre /RE: Asma /DO: Dolor de muela /VU: Abuso del alcohol	
L 132	*Coccocypselum hirsutum* Bartl. ex DC.	Tsujmi ay	Hoja de cobertón	Hi,R/H/H/H	H/Mo/H/Ma	T/C/La/Bca	GY: Hemorragia /DE: Herida /VE: Piquete de vibora /FI: Fiebre	3/3/1/1
	Coffea arabica L.	Capel	Café	H/H	Ma/Mo	Bca/C	FI: Fiebre /VU: Papera	1/1
L 19	*Crusea calocephala* DC.	Uekx sotyi		Hi/Fr/Hi	H/S-Mo/H	Bcu/L/Bv	DE: Sarna /CU: Hacer maldades /VE: Piquete de vibora	1/1/1
L 318	*Deppea* sp.			H	Ma	Bca	FI: Fiebre	1
L 150	*Exostema mexicanum* A. Gray	Tam nazareno	Nazareno amargo	Co/Co/Co/Co	H/H/H/MaA	T/T,LaV/La/To	GA: Dolor de estómago /GY: Hemorragia, dolor después del parto, ulcera de la matriz /DE: Herida /VU: Anemia	5/5/1/1
	Gardenia sp.		Gardenia	F/F	H/H	T/T	GA: Gastritis /SK: Dolor de cuerpo	1/1
L 572	*Genipa americana* L.	Nuk t¥m		H/H	S-Mo/F	L/C	CU: Hacer maldades /VU: Hinchasón del cuerpo	1/1
L 4	*Hamelia patens* Jacq.	Chochoday / Cangchocho / Cuma ay	Coyolillo / Cosocoyole / Chupacoyole	H/R,H/R/R,H/H/H/H/H	Mo,H/H/H/H/H/Mo/H	La/LaV,T/LaV/T,Bv/Bcu/T/G/Bcu	DE: Herida, parar la sangre, llaga, sarna /GY: Hemorragia, inflamación de la matriz, ulcera de la matriz /UR: Flujo /VE: Piquete de vibora /CU: Malos espiritos /DI: Diabetes /OP: Infección del ojo /FI: Fiebre	32/8/4/2/2/1/1/1
L 74	*Hoffmannia nicotianifolia* (M. Martens et Galeotti) L. O. Williams	Masan ay / Ts¥¥b ay		H	Mo	C	DE: Erisipela	5
L 388	*Hoffmannia nicotianifolia* (M. Martens et Galeotti) L. O. Williams	Masan ay / Ts¥¥b ay		H	Mo	C	DE: Erisipela	
L 505	*Lindenia rivalis* Benth.	Pop n¥ang mooya		F/R	Ma/H	Bca/G	CU: Malos espiritos /OI: Dolor de oído	1/1

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L 549	*Psychotria flava* Oerst. ex Standl.	Tsus pitx cuy		H	Mo	C	DE: Erisipela, llaga, nacidos	3
L 81	*Psychotria hebeclada* DC.	Masan ay / Monch¥v ay	Hoja morada	H	Mo	C	DE: Erisipela, llaga	14
L 82	*Psychotria nervosa* Sw. var. *rufescens*	Masan ay	Cafecillo	H/R	H,Mo/H	La,C/T	DE: Herida, erisipela /GA: Diarrea	2/1
L 379	*Psychotria panamensis* Standl.	Tsus pitx cuy		H/H/H/H	Mo/A/F/Mo	C/So/C/C	DE: Nacidos, erisipela, llaga /GY: Matriz inflamada /SK: Reuma /VU: Papera	8/1/1/1
L 125	*Psychotria tenuifolia* Sw.	Tam txitx¥k	Simonillo	R/H/H	H/Mo,T-Mo/H	T/C,L/C	GA: Diarrea, disentería /DE: Herida, llaga, erisipela /VE: Piquete de vibora	7/6/2
L 486	*Randia* sp.	Jeepe ay / Chuk wikpak		Fr,Ra/H/Co	S,F/Mo/F	S,L/C/L	CU: Niño que llora, malos espiritos /DE: Nacidos /DO: Dolor de muela	3/1/1
L 577	*Randia* sp.							
L 226	*Rondeletia villosa* Hemsl.			Co/H	H/H	T/E	GY: Hemorragia /DE: Granos en la boca	1/1
L 272	*Sickingia mexicana* Bullock		Nazareno rojo	Co/Co/Co/Co/Co	H/H/H/H/MaA	T/T/T/T/To	GY: Hemorragia /GA: Disentería /SK: Dolor del cuerpo /VE: Piquete de vibora /VU: Anemia	8/1/1/1/1
L 488		Monch¥vay		H	Ma	Bcu	DE: Comezón de la piel	1
	RUTACEAE							
	Citrus aurantium L.	Tsootso	Naranja	Ca,H/H/H/Ca/H/H/Ca,H	H/H,Ma/H/H/H/Mo/H	T/T,Bca/C/T/T/C/T	RE: Tos /FI: Fiebre /SK: Quiebradura /GA: Diarrea /UR: Flujo /DE: Erisipela /VU: Insomnio, alta presión	6/3/1/1/1/1/1
	Citrus limon (L.) Burm. f.	Apitx cuy	Limón	H,Ca/Fr,R/R/Ca/Fr/Fr,Ra/H/R/H/Fr	Mo/F,H/H/H/A/H,F/H/H/Mo/F,Mo	C/To,T/T/T/La/Bcu,Li/T/T/C/To,C	DE: Erisipela /GA: Latido, dolor de estómago diarrea /GY: Matriz inflamada, anticonceptivo, ulcera de la matriz /RE: Tos /VE: Piquete de vibora /CU: Mal de espiritos, pensamientos /FI: Fiebre /UR: Flujo /SK: Reuma /VU: Afrodisiaco, papera	11/5/4/3/3/3/1/1/1/2
	Citrus paradisi Macfad.		Toronja	S	Ma	To	GA: Diarrea	1
L 460	*Murraya paniculata* (L.) Jack		Muraya	H	F	L	DO: Dolor de muela	1
L 127	*Ruta* sp.		Ruda	Hi/Hi/Hi/Hi/Hi	H/H/H/Po/F	T/T/Bca,La/U/Li	GA: Dolor de estómago, latido, vomito /GY: Accelerar el parto, expulsar la placenta /DE: Piojos, infección /SK: Golpe /CU: Pensamientos, limpia	13/8/2/2/2
L 124	*Zanthoxylum caribaeum* Lam.	Apitx cuy	Tachuelillo	Co/Co/Co/H/H/Co	H/H/H/Mo/H/H	T/T/T/C/La/T	GY: Hemorragia /GA: Diarrea, disentería /UR: Flujo, mal de orinar /DE: Herpes /VE: Piquete de vibora /VU: Hemorragia nasal	5/5/2/1/1/2
L 540	*Zanthoxylum* aff. *trichilioides* Standl.	Copixpix	Limoncillo	Co	H	T	VU: Anemia	1
	SAPINDACEAE							
L 417	*Allophylus* aff. *cominia* (L.) Sw. et aff. occidentalis (Sw.) Radlk.	Katxu aay		H	H	Bv	DE: Erisipela	1
L 522	*Cupania dentata* DC.	Akpak		Co/Co/Co	H/H/H	La/LaV/T	DE: Herida /UR: Flujo /GA: Diarrea	1/1/1

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L 387	*Matayba oppositifolia* (A. Rich.) Britton	Pix pix cuy		Co/Co	H/H	T/T	GY: Hemorragia /GA: Diarrea, gastritis	3/2
L 232	*Paullinia pinnata* L.	K¥kujuki ay		R,H/H	H/H	La/T	DE: Infección /UR: Gonorrea	3/1
L 494	*Paullinia tomentosa* Jacq.	Xiap¥k kakuichu		R/R	H/H	T/T	GA: Diarrea /UR: Gonorrea	2/2
L 337	*Paullinia venosa* Radlk.			H,R	H	La	DE: Infección	3
L 537	*Paullinia* sp.			H,R/Co/R/A	H/H/H/F	T/T/T/G	UR: Dolor de riñon /GA: Diarrea /GY: Anticonceptivo /OP: Nubes	2/1/1/1
L 467	*Sapindus saponaria* L.	Tsukma	Jaboncillo	S	H	La	DE: Herida	1
L 360	*Serjania mexicana* (L.) Willd.	Aki tiuts ay		R/R/R/L	H/H/T-Mo/F	T/T/L/L	GA: Diarrea /UR: Gonorrea /DE: Infección /DO: Dolor de muela	4/2/1/1
	SAPOTACEAE							
L 336	*Chrysophyllum mexicanum* Brandegee ex Standl.	Ajiya		Co/Co/Co	H/H/H	La/T/T	DE: Herida /UR: Gonorrea /GA: Diarrea	2/1/1
L 545	*Manilkara chicle* (Pittier) Gilly	Jiya		Co	H	T,LaV	GY: Matriz inflamada	3
	Manilkara sapota (L.) P. Royen	Jiya	Chicosapote	Co/Co/Co/Co	H/H/H/H	T/T/T/La	GY: Matriz infalmada /VE: Piquete de vibora /UR: Mal de orinar /DE: Herida	4/1/1/1
L 154	*Pouteria campechiana* (Kunth) Baehni	Chu kuxamñi		Co/S	H/T-Mo	T/To	GY: Hemorragia, matriz inflamada /GA: Flatulencia	4/1
L 458	*Pouteria glomerata* (Pohl ex Miq.) Radlk.	Tsatsootso		Co,H/S/S/H	H/H/T-Mo/H	T/T/U/T	GY: Anticonceptivo, hemorragia /RE: Tos /SK: Dolor de cuerpo /VU: Nervios alterados	2/2/1/1
	Pouteria sapota (Jacq.) H. E. Moore et Stearn	Kuxamñi	Mamey	Co,S/S/S,Co/S/S	H/Mo/H/H/S	T,LaV/La/T/T/S	GY: Matriz inflamada /DE: Llaga, infección /GA: Dolor de estómago, latido, flatulencia /RE: Tos /CU: Quitar la lluvia	6/6/5/1/1
	SCROPHULARIACEAE							
L 416	*Castilleja arvensis* Schltdl. et Cham.			Pe	H	T	GA: Hipo	1
L 92	*Mecardonia procumbens* (Mill.) Small	Xotete	Chotete	Hi/Hi/Hi	Ma/H/Ma	Bca,To/T/To	FI: Fiebre /GY: Matriz inflamada /VU: Anemia	11/1/2
L 243	*Russelia sarmentosa* Jacq.	Kiñi n¥pin mooya	Tronadora	R/R,H/Hi/H/H	H/H/H/Mo,T-Mo/H	T/T/T/C,L/T	GY: Hemorragia /GA: Diarrea, flatulencia, /UR: Mal de orinar, flujo /DE: Erisipela, llaga /DI: Diabetes	3/3/3/2/1
L 170	*Scoparia dulcis* L.		Cilandrillo	Hi/Hi/R	Mo,H/H/H	C,E/E/T	DE: Verrugas, infección en la boca /DO: Dolor de muela /GY: Hemorragia	2/1/1
	SIMAROUBACEAE							
L 346B	*Picramnia* aff. *andicola* Tul.	Petx maka		H	H	Bcu	DE: Sarna	2
L 443	*Picramnia hirsuta* W. Thomas	J¥mniom petx maka		H	H	Bcu	DE: Sarna	1
L 346	*Picramnia teapensis* Tul.	Petx maka		H/H	H/H	Bcu/T	DE: Sarna /VE: Piquete de vibora	1/1

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	Simaba cedron Planch.		Cedrón	S/S/S	H/H/Ma	T/T/To	VE: Piquete de vibora /GA: Flatulencia /CU: Mal aire	6/1/1
	SOLANACEAE							
L 415	*Brugmansia* aff. *suaveolens* (Willd.) Brecht. et J. Presl	Nunak mooya		H/H/H	H/A/Mo	T/C/C	GA: Dolor de estómago /SK: Golpe /VU: Papera	1/1/1
	Capsicum sp.	Ñiwi	Chili	H,Fr/H/Fr/Fr	T-Mo,H/A-E/S/F	L,La/G/S/Co	DE: Llaga, infección /OI: Dolor de oído /CU: Quitar la lluvia /VU: Afrodisiaco	3/1/1/1
L 79	*Cestrum nocturnum* L.	Mok xoxay	Huele noche	H/H/H/H/H	Ma/Mo/H/H/H	Bca/C/T,Ba/Bcu/Ba	FI: Fiebre, viriuela, sarampión /DE: Infección, nacidos /GY: Accelerar el parto, matriz inflamada /CU: Malos espiritos /UR: Flujo	13/4/2/2/1
	Datura stramonium L.	Matunu	Toloache	H/H/H	H,A/H/T-Mo	T,So/LaV/L	GA: Dolor de estómago /GY: Parasitos en la matriz /DE: Secar el ombligo de recien nacidos	3/1/1
L 71	*Lycianthes stephanocalyx* (Brandegee) Bitter	Masan ay		H	Mo	C	DE: Erisipela	2
	Nicotiana sp.	Ts¥ui	Tabaco	H/H/H	T-Mo/F/S	L/C/Fo	DE: Llaga /VE: Piquete de vibora /OI: Dolor de oído	1/1/1
L 431	*Physalis pubescens* L.	Naka txipiñ		H/H	H/H	T/E	RE: Tos /DE: Granos en la boca	1/1
L 119	*Solanum candidum* Lindl.	Ts¥n hon kiñi		R/R	H/H	T/T	GY: Trastornos menstruales /VU: Afrodisiaco	1/1
L 102	*Solanum diphyllum* L.			Fr/H	F/H	L/T	CU: Niño que no quiere mamar /SK: Dolor del cuerpo	1/1
L 334	*Soalnum erianthum* D. Don			H/Pe	F/F	C/L	DE: Erisipela /CU: Contra la hechizería	1/1
	Solanum lycopersicon L.	Txipiñ	Tomate	Fr/Fr	F/Mo	Co/C	FI: Sarampión /VU: Papera	1/2
L 86	*Solanum nigrum* L.	Ts¥p¥	Quelite	H/H/Hi	Mo/Mo/H	C/C/T	DE: Erisipela /VE: Piquete de gusanos /DI: Diabetes	6/1/1
L 216	*Solanum nudum* Dunal	Poa nanchiñ		H/H/Ra/H/H/H	MaA/Ma/F/A/H/Mo	U,C/Bca/Li/C/La/C	SK: Dolor de hueso /FI: Fiebre /CU: Limpia /GA: Dolor de estómago /DE: Pie apestoso /VU: Papera	3/1/1/1/1/1
L 230	*Solanum rudepannum* Dunal	Muutsei cuy	Berenjena					
L 144	*Solanum schlechtendalianum* Walp.	Nuup cuy		R/R,H/H/H/H	H/H/H/Ma/S	T/La,T/La/Bcu/S	GA: Dolor de estómago, vomito /VE: Piquete de vibora /DE: Herida, granos /FI: Fiebre /CU: Malos espiritos	2/2/2/1/1
L 290	*Solanum torvum* Sw.	Muutsei cuy	Berenjena					
	Solanum tuberosum L.		Papa	C	Mo	C	VU: Papera	1
L 312	*Solanum umbellatum* Mill.	Chi tiuts		H/H/H/R/H	Mo/S/Ma/H/H	Bcu/S/La/La/Bv	FI: Fiebre /CU: Malos espiritos /DE: Sarna /SK: Dolor muscular /VE: Piquete de vibora	1/1/1/1/1
	Solanum sp. (*rudepannum* & *torvum*)	Muutsei cuy	Berenjena	H/R/H/R/	H,T-Mo/Mo,H/H/H	La,L/L/Bcu/T	DE: Herida, llaga, infección hemorroides /DO: Dolor de muela /GY: Después del parto /SK: Golpe	18/6/1/1

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	STERCULIACEAE							
L 33	*Guazuma ulmifolia* Lam.	¥k¥	Guazimo	Co/Co/Co/ S/Co,H,S/ Co/Co/Co/ Co	H/H/H/H/H/H /H/H/H	T/T/LaV,T/T/ La/T/T/T/T	GY: Expulsar la placenta, hemorragia /GA: Diarrea /UR: Fllujo, gonorrea /RE: Tos /DE: Herida, infección /VE: Piquete de vibora /FI: Fiebre /DI: Diabetes /VU: Anemia	6/3/3/3/3 /1/1/1/1
L 189	*Helicteres guazumifolia* Kunth	Piniaka		Fr/R/Fr	H,S/H/S	T,L/T/So	GY: Determinar el sexo del bebé /UR: Flujo /CU: Niño que no habla	6/1/1
L 352	*Waltheria glomerata* C. Persl	Piniaka		F/Co	S-Mo/H	Po/T	CU: Hacer maldades /UR: Dolor de riñon	1/1
L 190	*Waltheria indica* L.	Pun¥g ay		R/H,R/H	H/H/S	T/T/S	GA: Diarrea, disentería /UR: Gonorrea /CU: Niño que llora	15/1/1
	THEACEAE							
L 73	*Ternstroemia sylvatica* Schltdl. et Cham.	M¥a nanchiñ	Flor de tila	S/S	H/H	T/T	GA: Gastritis /VU: Nervios alterados	3/1
	Ternstroemia sp.		Flor de tila	S/S/S/S	H/H/H/H	T/T/T/T	CU: Niño que llora /GA: Dolor de estómago /GY: Accelerar el parto VU: Alta presión	1/1/1/1
	TILIACEAE							
L 271	*Apeiba tibourbou* Aubl.	Pujki	Papachote	S/H/Co	Mo-E/H/H	La/T/T	DE: Infección, herida /GA: Agruras /UR: Gonorrea	4/1/1
L 261	*Corchorus* aff. *hirtus* L. et *siliquosus* L.	Ueji ay		Hi	S	S	CU: Niño que llora	1
L 275	*Heliocarpus americanus* L.	Panats	Jonote	Co/R/Co/ Co/Co	R/H/R/H/R	C/T/C/T/C	DE: Nacidos, erisipela /UR: Mal de orinar, dolor de riñon /VE: Piquete de gusanos /GY: Expulsar la placenta /VU: Papera	15/2/1/1/ 2
L 422	*Luehea speciosa* Willd.	Cang cang pujki	Tepecacao	Co/Co/H/H	H/H/S/H	T,LaV/T/S/La	UR: Mal de orinar, flujo /GY: Hemorragia /CU: Malos espiritos /DE: Herida	3/2/1/1
L 547	*Triumfetta polyandra* DC.	Ueji ay		R/H/H	H/S/H	La/S/La	DE: Llaga /CU: Malos espiritos /VE: Piquete de vibora	1/1/1
L 202	*Triumfetta semitriloba* Jacq.	Konko	Cadillo	H/Co	Mo/H	C/T	DE: Nacidos /UR: Mal de orinar	2/1
	TURNERACEAE							
L 423	*Turnera ulmifolia* L.			Ra/H/R	F/Mo/H	Li/C/T	FI: Fiebre /DE: Erisipela /VE: Piquete de la viuda negra	1/1/1
	ULMACEAE							
L 478	*Ulmus mexicana* (Liebm.) Planch. ex DC	Pagaxniakcuy	Palo cuero	Co	H	T,LaV	GY: Después del parto	1
	URTICACEAE							
L 262	*Pilea hyalina* Fenzl	Txiñ txay sotyi		Hi	H	La	DE: Comezón	1
L 30	*Pilea irrorata* Donn. Sm.	Kiñi ay		Hi/Hi	H,Mo/Mo	Bv,C/G	SK: Reuma /OI: Dolor de oído	2/1
L 535	*Pilea microphylla* (L.) Liebm.			Hi	Ma	Bca	FI: Fiebre	1
L 156	*Urera carcasana* (Jacq.) Griseb.			Co/Co	R/Po	C/U	DE: Infección /SK: Reuma	1/1

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	VALERIANACEAE							
L 229	*Valeriana scandens* L.	Puua ay, Puutx ay		Hi/Hi	Mo/H	C/T	DE: Llaga /VU: Cansancio	1/1
	VERBENACEAE							
L 372	*Aegiphila deppeana* Steud.	M¥a ay		H/H	F,H/H	C/Bcu	SK: Dolor de la muñeca /GY: Hemorragia	4/1
L 511	*Cornutia grandifolia* (Schltdl. et Cham.) Schauer	Cana ay		H/H/H	H/H/Ma	Bcu/La/Bcu	SK: Dolor del cuerpo /DE: Granos /CU: Malos espiritos	1/1/1
L 556	*Cornutia pyramidata* L.	Eexcuy		H	H,Ma	T,Bcu	CU: Malos espiritos	2
L 80	*Clerodendron ligustrinum* (Jacq.) E. Br.	Muts	Moste	H/H	Ma/H,Ma	Bc/T,To	FI: Dolor de cabeza, fiebre /VU: Abuso del alcohol	19/2
L 20	*Lantana camara* L.	Kan'muk	Cinco negritos	H/H/H/H/R /R	H/H,Ma,Mo/ Ma/S/H/H	T/Bc,La,C/ Bca/S/T/T	RE: Tos /DE: Sarna, comezón, erisipela /FI: Dolor de cabeza /CU: Niño que llora /GY: Anticonceptivo /GA: Diarrea	6/4/1/1/1 /1
L 276	*Lantana trifolia* L.			H	H	T	RE: Tos	1
L 55	*Lippia alba* (Mill.) N. E. Br.		Salvia de castilla	Hi/Hi/Hi/Hi/ Hi/Hi	H/H/H/Ma/ MaA/F	T/T/T/Bca/U /Li	GY: Matriz inflamada /GA: Dolor de estómago /RE: Tos /FI: Fiebre /SK: Reuma /CU: Susto	5/3/2/1/1 /1
L 35	*Lippia dulcis* Trevir.	Cana ay	Hierba dulce	Hi/Hi/Hi/Hi/ Hi/Hi/Hi	H/H/H/H/H/H /H	E/T/T/T/T/E/ Bca	DE: Encia sangriente /RE: Tos /GA: Diarrea, vomito /UR: Dolor de riñon, flujo /GY: Antiabortante /DO: Dolor de muela /VU: Hemorragia nasal	9/4/3/2/1 /1/1
L 260	*Priva lappulaceae* (L.) Pers.	T¥pich nang tsang	Sogia de tusa	Pe/Hi/Pe	H/H/H	T/T/T	GA: Diarrea /GY: Matriz inflamada /UR: Flujo	1/1/1
L 83	*Stachytarpheta jamaicensis* (L.) Vahl	Chi tiuts	Verbena	H/Hi/R/Hi/ Hi	H/H/H/H/S	La/T/E/T/S	DE: Herida, llaga /UR: Mal de orinar, dolor de riñon /DO: Dolor de muela /GY: Matriz inflamada /VU: Ataque	6/2/1/1/1
	VIOLACEAE							
L 583	*Hybanthus oppositifolius* (L.) Taub.	Nekx cuy		Hi	Mo	C	VE: Piquete de vibora	1
L 252	*Hybanthus thiemei* (Donn. Sm.) C. V. Morton		Hoja de verruga	H/Pe	Mo/H	C/T	DE: Verrugas /GY: Expulsar la placenta	1/1
	VITACEAE							
L 237	*Cissus erosa* Rich.	Chikxtsay		R/H	Mo/Mo	C/C	VE: Piquete de gusano /DE: Erisipela	2/1
L 492	*Vitis popenoei* Fennell	Mopst¥m	Totoloche	A,R/A	F,H/F	To,T/G	GA: Diarrea /OP: Nubes	4/1
L 206	*Vitis tiliifolia* Humb. et Bonpl. ex Roem. et Schult.	Y¥k ty¥m tsay	Agras	A/H/H/R,Fr /H/A	F/H,Mo/H/H,F /H/F	To/Bv,La,C/ Bv/T,La,Co/ Bv/G	GA: Diarrea /DE: Llaga, erisipela /VE: Piquete de vibora /UR: Mal de orinar, flujo, dolor de riñon /RE: Tos, asma /OP: Nubes	7/7/3/2/2 /2

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	LILIOPSIDA							
	AGAVACEAE							
L 570	*Agave angustifolia* Haw.		Maguey	H	A-E	La	DE: Herida	1
	Yucca elephantipes Regel ex Trel.			Ta	H	T	DI: Diabetes	1
	ALSTROEMERIACEAE							
L 215	*Bomarea gloriosa* (Schltdl. et Cham.) M. Roem.			B	H,Ma	T,To	UR: Flujo, gonorrea	2
	AMARYLLIDACEAE							
L 238	*Crinum* sp.		Lirio	B/H	H/F	T/C	DI: Diabetes /DE: Herida	2/1
L 248	*Manfreda pubescens* (Regel & Ortgies) Verhoek ex Pina	Copa asosena	Asosena sabanera	H,B/B	H,Mo/H	La,C/T	VE: Piquete de vibora /GY: Anticonceptivo	3/1
	ARACEAE							
L 553	*Anthurium pentaphyllum* (Aubl.) G. Don	Tsa ay cinco hojas		H	H,Mo	Bcu,C	SK: Reuma	2
L 590	*Anthurium scandens* (Aubl.) Engl. subsp. *scandens*	Kiñi ay		H	Mo	C	SK: Reuma	1
L 39	*Anthurium schlechtendalii* Kunth	Tsa ay	Raiz de piedra	R/H/R/H/R	H/Mo/H/H/Mo	T/C/T/T/C	UR: Cálculos renales, dolor de riñon, mal de orinar /DE: Nacidos, erisipela /GA: Estreñimiento /DI: Diabetes /VU: Papera	17/5/1/1/1
L 477	*Caladium bicolor* (Aiton) Vent.	Tsabats txikx pixi		C	Mo	C	DE: Manchas blancas	1
L 474	*Monstera acuminata* K. Koch	Xunujti tsay		H/Be	F/F	C/L	DE: Herida /CU: Amarar el Xunujti (animal mitico)	1/1
L 433	*Monstera tuberculata* Lundell	Anma ay	Hoja de corazón	H/H	Mo,F/H	C/C	DE: Llaga /GA: Gastritis	2/1
L 463	*Philodendron hederaceum* (Jacq.) Schott	Pasmuj ay		H/H	Mo/F	C/C	DE: Erisipela /SK: Qiebradura	7/1
L 546	*Philodendron inaequilaterum* Liebm.	Marina ay		H	H	Bv	DE: Erisipela	1
L 476	*Philodendron radiatum* Schott	Mututs		A/A	F/F	G/To	OP: Infección /VU: Rabia de los perros	1/1
L 368	*Philodendron tripartitum* (Jacq.) Schott			H/H	Mo,H/Mo	C,Bv/C	SK: Reuma /VU: Hinchasón de los pies	2/1
L 569	*Philodendron tripartitum* (Jacq.) Schott							
L 555	*Spathiphyllum* sp.			F	MaA	Li	CU: Limpia	1

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L 475	*Xanthosoma robustum* Schott	Pix ay		H	Mo,F	C	DE: Llaga	6
	ARECACEAE							
L 597	*Acrocomia mexicana* Karw. ex Mart.	Cuma	Coyole	R/R	H/H	T/T	GA: Diarrea, disentería/ VU: Anemia	2/1
L 598	*Chamaedora concolor* Mart.	Pampi	Tepejilote	H	H	T	RE: Tosferina	1
L 599	*Chamaedora* sp.	Chikx pampi		H	F	L	CU: Malos espiritos	1
	Cocos nucifera L.		Coco	R,A,Ca/R	H,F,H/H	T,To/T	GA: Diarrea, disentería /GY: Ulcera de la matriz	6/3
	BROMELIACEAE							
L 483	*Aechmea bracteata* (Sw.) Griseb.		Kardon	H/H/H	H/A/H	T/G/T	UR: Mal de orinar, cálculos renales /OI: Dolor de oído /GA: Estreñimiento	2/2/1
L 554	*Aechmea aff. magdalenae* (André) André ex Baker	Ñiauing	Ixtle	R,H/R/H	H/H/F	T/T/L	UR: Inflamación de las riñones, mal de orinar, gonorrea /GY: Conceptivo /CU: Amarar los brujos	3/1/1
	Ananas comosus (L.) Merr.	Uuju	Piña	Fr	F	Co	FI: Sarampión	1
L 559	*Bromelia plumieri* (E. Morren) L. B. Sm.	Chicuix	Pinuela	H	A-E	La	DE: Herida	1
L 278	*Catopsis* sp.		Piñita	Pe	H	T	UR: Flujo	1
L 432	*Fosterella micrantha* (Lindl.) L. B. Sm.			H	Ma	Bca	FI: Fiebre	1
	CANNACEAE							
L 484	*Canna indica* L.	¥y¥ng ay	Platanillo	H	A-E	G	OI: Dolor de oído	1
	COMMELINACEAE							
L 391	*Callisia fragrans* (Lindl.) Woodson	Uixpin		H/H/H	Mo/H/Ma	C/T/Bca	DE: Llaga /GY: Hemorragia /VU: Hemorragia nasal	1/1/1
L 273	*Commelina diffusa* Burm. f.	Tsus uixpin	Matalin verde	H	Ma	Bca	FI: Fiebre	2
L 131	*Commelina erecta* L.	Tsus uixpin	Matalin verde	H	Ma	Bca	FI: Fiebre	1
L 398	*Tradescantia pallida* (Rose) D. R. Hunt			H	H	T	GY: Matriz inflamada	1
L 90	*Tradescantia spathacea* Sw.		Maguey morado	H/H/H/H/H	H/H/H/H/H	T/T/T/T/T	GY: Hemorragia /UR: Mal de orinar, mal de riñon, flujo /GA: Vomitar sangre, intestino inflamado /DE: Varices inflamadas /VU: Hemorragia nasal	15/5/2/1/1
L 282	*Tripogandra serrulata* (Vahl) Handlos	Tsus uixpin	Matalin verde	H	Ma	Bca	FI: Fiebre	1
L 130	*Zebrina pendula* Schinzl.	Tsabats uixpin	Hierba del pollo	H	H	T	GY: Hemorragia	7

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	CYPERACEAE							
L 266	*Cyperus odoratus* L.	Pioninu / Puutx uixpin		R	Ma	To	VU: Bebés que no quieren mamar	1
L 354	*Scleria bracteata* Cav.	Neiuk		R/R	H/H	T/T	GA: Diarrea, dolor de estómago /GY: Anticonceptivo	4/1
	DIOSCOREACEAE							
L 250	*Dioscorea floribunda* M. Martens et Galeotti	Puutx naaku	Barbasco Amarillo	R	MaA	U	SK: Reuma	6
	HELICONIACEAE							
L 510	*Heliconia spissa* Griggs	Tsabats ay		Ta	Ma	To	UR: Gonorrea, dolor de riñon	1
	IRIDACEAE							
L 402	*Eleutherine bulbosa* (Mill.) Urb.		Soliman	B	S-Mo	L	VU: Veneno para cazar	1
	LILIACEAE							
	Allium cepa L.		Cebolla	B/B/B/B/B	H/Mo/H/H/Mo,H	T/C/T/T/C,T	RE: Tos /VE: Piquete de gusanos /CU: Pensamientos /DI: Diabetes /VU: Papera, afrodisiaco	1/1/1/1/2
	Allium sativum L.		Ajo	B/B/B/B/B/B	H/H/H/H/H/H/H/MaA	T/T/T/T,Bv/T/T/U	RE: Tos /GA: Dolor de estómago, flatulencia /GY: Expulsar la placenta /VE: Piquete de vibora /DI: Diabetes /UR: Mal de orinar /SK: Dolores musculares	7/6/3/2/2/1/1
L 277	*Aloe* sp.		Sabila	H/H/H/H/H/H/H/H/H	Mo/Ma/Mo/F/H/H/F/H/Mo	C/To/C/P/T/T/C/T/C	DE: Erisipela /GA: Gastritis, latido /SK: Reuma, golpe /FI: Fiebre /RE: Tos /GY: Hemorragia /VE: Piquete de gusanos /UR: Dolor de riñon /VU: Papera	11/4/4/4/3/1/1/1/1
L 574	*Sansevieria trifasciata* Prain	Txikiña		H	H	La	VE: Piquete de vibora	1
L 168	*Schoenocaulon officinale* (Schltdl. et Cham.) A. Gray ex Benth.	Tsuk tyiñ		S	H	Bca	DE: Piojos	1
	MARANTACEAE							
L 525	*Calathea lutea* (Aubl.) Schult.	Pob ay		R/Cog	H/A-E	T/G	GY: Trastornos menstruales /OP: Nubes	3/1
	Calathea macrosepala K. Schum.		Chochogo	F	H	Co	VU: Comestible en caldo	1
L 571	*Maranta arundinacea* L.	Uaja		Hi	H	La	DE: Infección de la uña	1
	MUSACEAE							
	Musa sp.	Hoko samñi	Platano	A/A	F/F	To/La	GA: Diarrea, disentería /DE: Quemadura	6/4
	ORCHIDACEAE							
L 504	*Maxillaria tenuifolia* Lindl.	Kowa nokcha		R	Mo	C	VU: Papera, pegamento	2
L 3	*Onicidium* sp.	Tsuk i tyutsu	Cola de raton	H/H/H	A-E/H/H	G/T/Bv	OI: Dolor de oído /UR: Flujo /VE: Piquete de vibora	2/1/1

NUM.C	NOMBRE CIENTIFICO	NOMBRE POPOLUCA	NOMBRE ESPANOL	PARTE USADA	PREPARACION	APLICACION	USOS	REPORTES
	POACEAE							
	Bambusa sp.	Masi caña		Cog	Ma	Bcu	CU: Engaño	2
	Cymbopogon citratus (DC.) Stapf	Limunmuk	Zacate limón	H/H/H	H/H/H	T/T/T	GA: Dolor de estómago, vomito, diarrea /RE: Tos	5/1
L 268	*Lasiacis procerrima* (Hack.) Hitchc.	K¥kujuki ay	Carisso	Hi	H	La	DE: Infección de la uña	5
L 148	*Lasiacis ruscifolia* (Kunth) Hitchc.	K¥kujuki ay	Carisso	Hi	H	La	DE: infecciôn de la uña	6
	Zea mays L.	Mok	Mais	F/S,H/F	H/H/H	T/T/T	UR: Flujo, mal de orinar /GY: Antiabortante, hemorragia /VE: Piquete de vibora	3/2/1
L 579		M¥¥j	Tarquisal	R/R	H/H	T/T	CU: Engaño /VU: Afrodisiaco	1/1
	SMILACACEAE							
L 514	*Smilax aristolochiifolia* Mill.		Sarsa	R	H	T	DE: Sarna, granos	4
L 459	*Smilax* aff. *aristolochiifolia* Mill. et aff. *regelii* Killip et C. V. Morton		Sarsa					
L 176	*Smilax domingensis* Willd.	Mom	Axquiote / Guatotole	R/R/R/R/R	H/H/H/H/H	T/T/T/T/T	UR: Gonorrea, mal de orinar, flujo, dolor de riñon /GY: Hemorragia, anticonceptivo /GA: Diarrea, disentería /DI: Diabetes /VU: Anemia, papera, afrodisiaco	13/4/3/1/11
	ZINGIBERACEAE							
L 97	*Costus pictus* D. Don	Chimpa tutu	Caña agria					
L 126	*Costus pulverulentus* C. Persl	Chimpa tutu	Caña agria					
	Costus sp. *(pictus & pulverulentus)*	Chimpa tutu	Caña agria	R,Ta/Ta	H,Ma/Ma	T,To/To	UR: Mal de orinar, gonorrea, flujo, dolor de riñon /GA: Disentería	26/2
L 198	*Zingiber officinale* Roscoe	Kaxtxan ñiwi	Genjible	R/R/R/R	H/H/H/H	T/T/T/Bcu	GA: Dolor de estómago, latido /VE: Piquete de vibora /GY: Hemorragia /SK: Dolor de cuerpo	12/4/1/1