Cooling the Heat - Traditional remedies for malaria and fever in Northern Peru

Rainer W. Bussmann and Ashley Glenn

Research

Abstract

Malaria continues to be a major health challenge worldwide especially due to the increasingly fast development of resistance of *Plasmodium falciparum* to the drugs currently in use.

A total of 17 plant species belonging to 17 genera and 13 families were documented and identified as anti-malarial herbal remedies in Northern Peru. Most species used were in Asteraceae, followed by Fabaceae and Solanaceae. The majority of anti-malarial herbal preparations were made from the leaves of plants, while the whole plant, flowers and stems were used less frequently. This suggests that the local healers count on a very well developed knowledge about the properties of different plant parts. In almost 70% of the cases fresh plant material was used to prepare remedies. Over half of all remedies were prepared as mixtures with multiple ingredients by boiling plant material either in water or in sugarcane spirit.

The information gained on frequently used traditional remedies against malaria might give some leads towards future targets for further analysis in order to develop new anti-malaria drugs. However, more detailed scientific studies are desperately needed to evaluate the efficacy and safety of the remedies employed traditionally.

Resumen

Malaria todavía continua como problema de salud mayor al nivel global, especialmente por la rapidez de desarrollo de resistencias en *Plasmodium falciparum* a los medicamentos en uso.

Un total de 17 especies de plantas medicinales de 17 géneros y 13 familias han sido documentadas e identificadas como plantas anti-malariales en el Norte de Perú. La mayoría de as especies pertenece a Asteraceae, Fabaceae y Solanaceae. La mayoría de las plantas preparaciones en contra de malaria fueron preparadas de las hojas de las plantas, mientras que la planta entera, flores y tallos fueron usados con menos frecuencia. Este indica que los curanderos locales tienen un conocimiento muy profundo de las propiedades de diferentes partes de las plantas. En casi 70% de los casos usaron material fresco para preparar los remedios. Casi la mitad de los remedios fueron preparados como mezcla con ingredientes múltiples en agua o aguardiente.

La información encontrado sobre remedies usados con frecuencia contra malaria pueda apoyar en encontrar nuevos posibilidades de análisis para el desarrollo de nuevos compuestos anti-malariales. Sin embargo, se necesita estudios mas detallados sobre la eficaz y la toxicidad de los remedies tradicionalmente usados.

Introduction

Malaria is still a major global public health problem in most tropical countries. It is thought that malaria is by far the most serious tropical disease causing one to two million deaths per year, and it plays a major role in the high

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Ethnobotany Research & Applications 8:125-134 (2010)

Published: May 28, 2010

www.ethnobotanyjournal.org/vol8/i1547-3465-08-125.pdf

mortality seen in infants and children (El Kamali & El Kijalifa 1997, Milliken 1997). It is also responsible for miscarriages, premature deliveries, growth retardation, low birth weight and anemia (Connally *et al*. 1996, Geissler *et al*. 1998, Hay *et al*. 2003, Minakawa *et al*. 2002).

The World Health Organization (WHO) has estimated that about 2 billion people in over 100 countries are exposed to malaria, with 247 million cases in 2006 alone, and half of the world's population is potentially exposed to the disease (WHO 2009). The worsening global economic situation makes it difficult to expand modern health services, hence effective low-cost delivery medical system is urgently needed (El Kamali & El Kijalifa 1996).

This is even more pressing because the use and misuse of over the counter anti-malaria remedies like chloroquine to prevent and treat falciparum malaria has led to widespread appearance of resistant parasites (Milliken 1997). This is complicated by the fact that global warming may lead to expansion of areas in which the ambient temperature and climatic conditions are suitable for plasmodium transmission. Climatic variability has been associated with some of the recent epidemics (Minawaka *et al*. 2002).

Northern Peru is believed to be the center of the Central Andean Health Axis (Camino 1992), and traditional medicinal practices in this region are still an important component of everyday life (Bussmann 2006b, Bussmann & Sharon 2006, De Feo 1992, Joralemon & Sharon 1993, Polia 1988, Sharon 1978, 1980, 1994, 2000, Sharon & Bussmann 2006). Traditional Medicine is also gaining more and more respect by national governments and health providers. Peru's National Program in Complementary Medicine and the Pan American Health Organization recently compared Complementary Medicine to allopathic medicine in clinics and hospitals operating within the Peruvian Social Security System (EsSalud 2000). According to WHO (2002), the sustainable cultivation and harvesting of medicinal species is one of the most important challenges for the next few years.

The present study attempts to give an overview on medicinal plant species employed in traditional therapies in Northern Peru to treat malaria, and compare this use to the western scientific evidence regarding their efficacy.

Materials and Methods

Plant Collections

Plants in Peru were collected in the field, in markets, and at the homes of traditional healers (**curanderos**) in Northern Peru (Figure 1) in August-September 2001, July-August 2002, July-August 2003, June-August 2004, July-August 2005, July-August 2006, June-August 2007, June-August 2008, March-April 2009 and June-August 2009. A total of 116 informants (healers and market venders) in the Trujillo and Chiclayo area were interviewed using structured questionnaires. The informants were always provided with fresh plant material, either collected with them, by them, or available at their market stands. The questionnaires did not include any reference as to disease concepts, plant parts or preparations. In contrast, the participants were only asked simple questions along the lines "What is this plant used for, which part, which quantity, how is it prepared, are any other plants added to the mixture." All questions were asked in the same order. All informants were of Mestizo origin, and spoke only Spanish as their native language. The study covered the four existing medicinal plant markets of the region, and included all venders present. All interviews were conducted with the same set of participants. The specimens are registered under the collection series "RBU/PL," "ISA," "GER," "JULS," "EHCHL," "VFCHL," "TRUBH," and "TRUVANERICA," depending on the year of fieldwork and collection location. Surveys were conducted in Spanish by fluent speakers. Surveyors would approach healers, collectors and market vendors and explain the premise for the study, including the goal of conservation of medicinal plants in the area.

Vouchers of all specimens were deposited at the Herbario Truxillensis (HUT, Universidad Nacional de Trujillo), and Herbario Antenor Orrego (HAO, Universidad Privada Antenor Orrego Trujillo). In order to recognize Peru's rights under the Convention on Biological Diversity, most notably with regard to the conservation of genetic resources in the framework of a study treating medicinal plants, the identification of the plant material was conducted entirely in Peru. No plant material was exported in any form whatsoever.

Nomenclature

The nomenclature of plant families, genera, and species follows the Catalogue of the Flowering Plants and Gymnosperms of Peru (Brako & Zarucchi 1993) and the Catalogue of Vascular Plants of Ecuador (Jørgensen & León-Yanez 1999). The nomenclature was compared to the TROPICOS database. Species were identified using the available volumes of the Flora of Peru (McBride 1936-1981), as well as Jørgensen & Ulloa Ulloa (1994), Pestalozzi (1998) and Ulloa Ulloa & Jørgensen (1993), and the available volumes of the Flora of Ecuador (Sparre & Harling 1978-2009), and reference material in the herbaria HUT, HAO, QCA, LOJA and QCNE.

Results

A total of 17 plant species belonging to 17 genera and 13 families were documented and identified as anti-malarial herbal remedies in Northern Peru. Most species used were in Asteraceae while most families only contributed

Figure 1. Research area in Northern Peru and adjoining environmental areas.

one species (Table 1). A complete overview of all plants encountered, including data on use-recipes and preparation, is given in Appendix 1. The most important anti-malarial families are clearly over-represented in comparison to the overall medicinal flora, while some other medicinally important families (e.g., Lamiaceae, Euphorbiaceae, Poaceae, Apiaceae) are completely missing from the anti-malarial portfolio (Table 2) (Bussmann & Sharon 2006). In the context of the questionnaires healers and venders often referred to "Fever" when talking about malaria. Fever however included a variety of conditions, from fevers accompanying flu to fever as a result of malaria. Malaria was recognized as a parasitic infection, and treated accordingly, while other plant species were used to treat fever as a symptom, mainly focusing on lowering body temperature. The majority of anti-malarial herbal preparations were prepared from the leaves of plants (38.46%), while other parts were used less frequently (Table 3). Leaves and stems were used more often for malaria treatments than would have been expected in comparison to the overall medicinal preparations found in the region, while seeds of plants were employed much less frequently and other plant parts not at all (Table 3, Bussmann & Sharon 2006). This indicates that the local healers count on a very well developed knowledge about the properties of different plant parts. In almost 70% of the cases fresh plant material was used to prepare remedies, which differs little from the average herbal preparation mode in Northern Peru (fresh 69.6%: dry 30.4%). Interestingly, only about 55% of the remedies were applied orally, while the remaining ones were applied topically. This is little different from the regional average of application. Over half of all remedies were prepared as mixtures of multiple ingredients by boiling plant material either in water or in sugarcane spirit.

Table 1. Plants used to treat malaria in Northern Peru.

Family	Genera	Species	%
Asteraceae	3	3	17.66
Fabaceae	2	2	11.77
Solanaceae	2	2	11.77
Caprifoliaceae	1	1	5.88
Clusiaceae	1	1	5.88
Convolvulaceae	1	1	5.88
Cyperaceae	1	1	5.88
Gentianaceae	1	1	5.88
Polygonaceae	1	1	5.88
Ranunculaceae	1	1	5.88
Salicaceae	1	1	5.88
Tiliaceae	1	1	5.88
Verbenaceae	1	1	5.88
			100

Table 2. Comparison of the anti-malarials to the 10 most important plant families of the medicinal flora of Northern Peru (after Bussmann & Sharon 2006).

Family	Medicinal flora of North Peru (%)	Malaria and Fever (%)
Asteraceae	13.64	17.66
Fabaceae	6.82	11.77
Lamiaceae	4.87	0
Solanaceae	4.09	11.77
Euphorbiaceae	2.33	0
Poaceae	2.33	0
Apiaceae	2.14	0
Lycopodiaceae	1.95	0
Cucurbitaceae	1.75	0
Rosaceae	1.75	0

Table 3. Plant parts used in anti-malarials in Northern Peru.

Plant Part	%
Leaves	38.46
Whole plant	26.92
Flowers	15.38
Stems	11.54
Seeds	3.85
Fruit	3.85

Discussion

The very limited number of plants employed at the Peruvian coast to treat malaria and fevers might on a first glance surprise, if compared to studies from other regions of the country (e.g., Kvist *et al*. 2007, Roumy *et al*. 2007). However, malaria has always been of relatively minor importance in the coastal desert areas, and thus it is not surprising that few remedies are employed. There are indications that health practices are in the process of changing, and traditional healers start to treat a patient with prepared western remedies (e.g., aspirin, Lariam® (mefloquine hydrochloride), Malaraquin® (chloroquine phosphate) or primaquine) although plant preparations are still important (Bussmann & Sharon 2006, Bussmann *et al*. 2007).

Little scientific evidence exists to prove the efficacy of the species employed as malaria remedies in Northern Peru. Only 41% of the plants found or their congeners have been studied at all for their medicinal properties. *Sambucus* spp. are known to be used against malaria in Turkey Everest & Ozturk 2005) and Trinidad (Lans *et al*. 2001), and Stowers *et al*. (2002) showed anti-plasmodial activity in an extract of a species of the genus. *Hypericum* spp. are traditionally used in Turkey and Southern Peru to

treat malaria (Bletter 2007, Everest & Ozturk 2005), while various species of Ipomoea are used in Africa (Bussmann 2006a, Bussmann *et al*. 2006, Kayode 2006, Knols *et al*. 2002) and the Philippines (Lacuna-Richman 2006). The genus Salix is well known as a source of Acetylsalicylic acid, widely used as analgesic and antipyretic. A wide variety of Solanaceae, including species of the genera Cestrum and Solanum are widely used as mosquito repellents or as larvicidals (Chowdhury *et al*. 2008, Rajkumar & Jebansesan 2005), or are traditionally used as malaria treatment (Bussmann 2006, Bussmann *et al*. 2006, Lans *et al*. 2001, Makundi *et al*. 2006, Nanjingi *et al*. 2008, Njoroge & Bussmann 2006, Sajem & Gosai 2006, Teklehayamont & Giday 2007), while *Verbena* sp. is known as anti-malarial from Ethiopia (Teklehayamont & Giday 2007).

Conclusions

Malaria continues to be a major health challenge worldwide especially due to the increasingly fast development of resistance of *Plasmodium falciparum* to the drugs currently in use. Many plant species are traditionally used for malaria treatment, and some have been investigated for their efficacy with positive results. An often-limiting factor to these investigations is lack of comprehensive ethnobotanical data to help choose plant candidates for potency/efficacy tests. Since the plant parts utilized in preparation of anti-malarial remedies are reported in this survey, it serves as an indication of species that may need further ecological assessment on their regeneration status.

The results of this study show that both indigenous and introduced species are used for malaria treatment and as mosquito repellents. The information gained on frequently used traditional remedies against malaria might give some leads for future targets for further analysis in order to develop new anti-malaria drugs. However, more detailed scientific studies are desperately needed to evaluate the efficacy and safety of the remedies employed traditionally.

Acknowledgements

The presented study was financed through MIRT/MHIRT (Minority Health Disparity International Research and Training) a grant from the National Institutes of Health (Fund: 54112B MHIRT Program, Grant: G0000613). Fieldwork for this project was supported through the assistance of a large number of MIRT/MHIRT students and volunteers. Thanks to all of them. None of the work would have been possible without the invaluable collaboration of our Peruvian colleagues, especially **curanderas** Julia Calderón, Isabel Chinguel, and Olinda Pintado, **curanderos** Germán Santisteban and Leoncio Carrión, and herbalists Manuel Bejarano, Elmer Cruz, and Iván Cruz. Thanks also go to Eric Rodriguez (Herbarium Truxillense, HUT) and Abundio Sagastegui, Segundo Leiva, and Mario Zapata (Herbario Antenor Orrego, HAO) for the use of their facilities and their assistance in plant identification.

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Appendix 1. Species encountered and used in Northern Peru to treat malaria and fever.

Scientific name [Collection #]	Vernacular name	Plant part used	Admin.	Preparation	Use
Asteraceae					
Senecio pseudotites Griseb. [GER217]	**Arnica**	Leaves and Stems, fresh	Topical	In 1/2L water boil 100g of **Arnica** for 10 minutes. Wet a piece of cloth in the warm tizana, then squeeze a bit of the water out and place cloth on affected area for a few seconds. Repeat over and over again until body temperature is lowered. Alternatively: Crush 200g add 8 drops of alcohol, warm-up on a pot over the fire. Place **emplasto** mixture on top of the affected area, then cover with a piece of cloth and then with a piece of plastic. 2 times a week as needed.	High fever
Tessaria integrifolia Ruiz & Pav. [JULS71, GER12]	**Pajaro Bobo**	Flowers and Leaves, fresh	Oral	Boil 10g **Pajaro Bobo** per 1L water. Combine with **Cola de Caballo**, **Verbena**, **Chacur**, **Paja Blanca**, and **Espiga de Maiz**. Drink 3-4 times per day for 15 days. Patient should drink hot solution for most ailments, and cold solution for bad breath.	Fever
Wedelia latifolia DC. [JULS80]	**Cuchalman**	Whole plant, fresh	Topical	Boil 10g **Chulgan** with 1L water. Patient should take solution at room temperature, once.	Fever
			Oral	Boil 1 small bundle of Chulgan with 2L water. Do not mix with other herbs. Patient should drink lukewarm solution, once.	
Caprifoliaceae					
Sambucus peruviana Kunth [EHCHL140, RBU/PL291, VFCHL44, ISA131, ISA87, JULS246, EHCHL110]	**Sauco**, **Saucotillo**	Leaves, Flowers and Stems, fresh or dried	Oral	5-20g per 1L, boil for 1 min, as tea, combine with **Llonque**. 3 times per week, up to 1L per day if needed, or until fever passes. Take while cold. Rub with **Llonque**.	Fever, Yellow Fever
		Leaves, fresh	Topical	Bath. Combine with **Nogal**, **Hierba del Susto**, **Manzanilla Blanca** with a flask of **Timolina**. 2-4 times per month, not to be used too much because it is very cold.	
		Flowers and Leaves, fresh		Boil 1L of water, then add 10g of **Sauco**. Add **Manzanilla**, **Hinojo**, **Coleo**, **Ajenjo**, **Toronjil**, **Pimpinela** and **Claveles**. Cover and let it sit for 2-3 minutes. Patient should drink warm solution, 3-4 cups per day for 1 month.	Fever
Clusiaceae					
Hypericum aciculare Kunth. [ISA135, ISA35, JULS301]	**Hierba de las Cordilleras**, **Lechuguilla**, **Hierba de Iman**	Leaves and Stems, fresh	Oral	3 leaves, chopped and made into extract. No Mixing! 1 tablespoon per day, 8 days.	Fever, Intestinal fever

Scientific name [Collection #]	Vernacular name	Plant part used	Admin.	Preparation	Use
Convolvulaceae					
Ipomoea pauciflora M. Martens & Galeotti [GER222]	**Huanarpo**	Whole plant, fresh	Oral	Put together in a bottle of **cañazo** (**Yonque**) 20g of the plant material plus 20g of **Cascarilla**, **Diego Lope**, **Hualtaco**. Let it sit for 8 days. Drink temperate 1 small cup once a day or as needed (max 2 days only).	Chills
Cyperaceae					
Scirpus californicus Steud. subsp. *tatora* (Kunth) T. Koyama [JULS111, GER169]	**Balsa**, **Totora**	Whole plant, dried	Oral	1/2 cup of water add 10g of Totora, 10g of **Saze** and boil for 3 minutes. Drink cold, 1/2 cup a day for 8 days.	Fever
Fabaceae					
Dolichos lablab L. [GER235]	**Frijol chileno**	Fruits, fresh	Oral	Boil for 10 minutes 1/2kg of the plant material in 1l of water. Drink it at room temperature. 1/2 cup 2 times a day for 8 days.	Fever
Melilotus albus Medik. [GER223]	*Alfalfilla*	Seeds, dried	Oral	Boil for 10 minutes 100g of the plant material in 1/2L of water. Drink cold, 1/2 a cup. Once a day for 8 days.	Fever
Gentianaceae					
Gentianella graminea (Kunth) Fabris [EHCHL22, RBU/PL285, VFCHL8, JULS148]	**Sumaran**, **Chinchimali**, **Corpushuay**	Whole plant, fresh or dried	Oral	20g per 1L water. 1L daily, 1 week, best with food, because it has a bitter taste. Drink cool while the patient is fasting. Exceeding doseage can lead to blindness.	Fever
Polygonaceae					
Muehlenbeckia tamnifolia (Kunth) Meisner [RBU/PL309, ISA30]	**Chumbiauri**, **Chumbiauria**	Leaves, fresh	Topical	Crush and mix with **Yonqué**. **Limpia**, 2 times a day, no more.	Fever
Ranunculaceae					
Thalictrum decipiens B. Boivin [ISA15]	**Chontilla** (**Chica**)	Whole plant, dried	Topical	Combine with **Ajenco**, **Salva Real**, **Lailambo**, **7 Espiritus**, and **Agua del Susto**, Twice per month or as illness requires.	Fever, **Papera** in children, Mumps
Salicaceae					
Salix chilensis Molina [TRUBH25, JULS82, GER39]	**Sauce**	Leaves, fresh	Topical	Smash leaves for juice, apply as enema once. Do not ingest. Use only when the patient is very sick.	Fever, Malaria
			Oral	Boil 10g of **Sauce** and 10 fruits of **Capuli** in 1L of water for 30 minutes. Drink warm, 1/2 small cup every time the patient has chills.	

Scientific name [Collection #]	Vernacular name	Plant part used	Admin.	Preparation	Use
Solinaceae					
Cestrum auriculatum L'Hér. [JULS166, RBU/PL281, EHCHL172, ISA122, GER174, EHCHL102]	**Hierba Santa**, **Agrasejo**	Leaves, fresh or dried	Topical	Children: Boil 5g per 1/2L water for 2 minutes. Adults: Boil 10g per 1L water for 2 minutes. Add **7 Espiritus** and **Yonque**. Do not mix with other plants. Immerse body in the leaves and bath water or apply as enema. 3-4 times per month.	Fever
Solanum americanum Mill. [EHCHL125, JULS76, EHCHL87, GER85, GER159]	**Hierba Mora**, **Hierba del Susto**, **Baja del Espanto**, **Semora**	Whole plant, fresh	Topical	Adult: 1L of water per 10g. Children: 1/2L of water per 10g. 3 times per day until all mucus is released.	Fever
Tiliaceae					
Tilia platyphyllos Scop. [JULS257]	**Tilo**	Flowers and Leaves, fresh	Oral	Boil 1L of water, then add 10g of **Sauco**. Add **Manzanilla**, **Hinojo**, **Coleo**, **Ajenjo**, **Toronjil**, **Pimpinela** and **Claveles**. Cover and let it sit for 2-3 minutes. Patient should drink warm solution, 3-4 cups per day for 1 month.	Fever
Verbenaceae					
Verbena littoralis Kunth [RBU/PL369, JULS77, EHCHL69, VFCHL28, GER138]	**Verbena**, **Berbena**	Whole plant, fresh or dried	Topical	Adults: 10g of **Verbena** per 1L of water. Children: 10g of **Verbena** per 1/2L of water. Apply enema when water is lukewarm. Once only. Alternatively boil 10g per 2L of water for 30 minutes, combined with **Matico**, **Malva**, **Llantén**, and **Para Para**. 3 times per day for 8 days.	Fever