



Ethnobotanical Study of Medicinal Plants Used for the treatment of Headache, Low Back, and Joint Pains in Three Provinces in Cambodia

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Abstract: In this paper, we present an ethnobotanical study on medicinal plants used in 3 provinces in Cambodia by Khmer traditional healers with a special focus on low back pain, headache, and joint pain. The survey was conducted from the 26th of September 2017 to the 6th of October 2017 in the capital city Phnom Penh, Siem Reap, and Kampot provinces. These studies areas were selected based on the Cambodian urbanity index, available contact information, and vegetation density. Thirteen traditional healers were interviewed using a semi-structured questionnaire. The ethnomedicinal use and importance of the plants cited were assessed using two ethnobotanical indices: fidelity level (FL) and informant consensus factor (ICF). A total of 108 species were used by thirteen key informants in their traditional healthcare practices to treat three targeted pains. Leguminosae was the most predominant family. *Spirolobium cambodianum* Baill. (កម្រិតក្រុម), *Scoparia dulcis* L. (ត្រីស៊ីដូស្ត្រូស្ត), and *Derris trifoliata* Lour. (ត្រីស៊ីដូស្ត្រូស្ត) had high healing potential for low back pain and headache with FL of 100%, 67%, and 67%, respectively, while *Cibotium barometz* (L.) J.Sm. (ប្រមាណស្លា), and *Loesneriella cambodiana* (Pierre) Tardieu (ត្រីស៊ីដូស្ត្រូស្ត) were effective for alleviating joint pain with a FL of 67%. Oral administration was the most reported administration route. The entire plants, woods, and rhizomes were described as the most frequently used parts, and decoction was the most cited method of preparation. Sixty-five species were reported for the treatment of low back pains, 35 for headache, and 46 for joint pains. Chemical and pharmacological studies on five medicinal plants with high FL should be conducted to justify the traditional use. As people still depend chiefly on medicinal plants for daily healthcare, medicinal plant resources should be carefully preserved, and used sustainably.

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Keywords: Ethnobotany, Informant consensus factor, Fidelity level, Khmer traditional healers, Pain



INTRODUCTION

Pain is defined as a displeasing sensory and emotional experience associated with actual or potential tissue damage [1]. Statistically, almost 70% of the world population is affected by pain which is a direct or indirect consequence of several diseases [2]. It is noticed as a public health priority issue [3,4]. International Association for the Study of Pain and the World Health Organization (WHO) has been working to figure out the solutions for this health issue. In recent years, there is an upward number of research studies that have been conducted concretely to seek for the latest analgesic molecules. Among the studies, the ethnobotanical approach has shown a promising result and plays a crucial role in demonstrating the popular use of plants for pain relief in the search of new therapeutic strategies as well as for new molecular patterns with anti-nociceptive activity [5]. Furthermore, people use plants as the sources of traditional medicines in such a way they interact with their surrounding environment [6]. According to WHO, approximately 65-80% of the world's population in developing countries relies essentially on plants for their primary healthcare due to poverty and lack of access to modern medicine [7].

Cambodia, a Southeast Asian country, possesses copious natural resources (namely a biodiversity hot-spot) and the unique original ecosystem due to Mekong River and Tonle Sap Lake. The country comprises about 545 species of birds, 123 species of mammals, 874 species of fishes, and over 3000 plant species including 214 endemic species [8]. For this reason, approximately 233,670 of the population use traditional medicines in their quotidian routines [9]. However, not many studies on medicinal plants have been conducted in the country. Indeed, Pauline *et al.* reported for the first time 94 species used in various indications such as stomachache, postpartum pain, diarrhea, and cold [8]. Within the same province, Chassagne *et al.* then undertook an ethnopharmacological study among the Bunong community and listed the use of 214 plants used to treat many ailments including headache, back pain, and stomachache [10]. Additionally, 161 medicinal plants were subjected to ethnobotanical study in two villages on the Plateau of Kulen Mountain in Siem Reap [11]. In a recent study, ethnobotanical knowledge of the Kuy and Khmer people was recorded by N. Turreira Garcia *et al.* on the use of 374 wild plants that cure postpartum, fever, skin problems, and stomach problems in Prey Lang, Cambodia [12].

To the best of our understanding, an ethnobotanical study on plants used to treat the most prevalent pain types in 3 socio-economically regions in Cambodia has not yet been conducted. The aims of our study are to: i) document potential plants traditionally used to treat low back pains, headache, and joint pains in Phnom Penh, Siem Reap, and Kampot, ii) to contribute to the conservation of ethnobotanical knowledge of Khmer traditional healers iii) constitute a baseline study for further investigations in the fields of medicinal plant-related researches.

MATERIAL AND METHODS

Sampling and study area: Ethnobotanical study was carried out in 3 different regions in Cambodia: Phnom Penh, Siem Reap, and Kampot. These areas were purposefully selected based on the urbanity index, socio-economic status, available contact information, and vegetation density [13] [14]. The key informants in this study correspond to 13 traditional healers who were certified by the National Center of Traditional Medicine (Ministry of Health) and currently in the above-mentioned areas.



Data collection: To collect the data from the 26th of September to the 6th of October 2017, a mixture of approaches using in-depth telephone and face-to-face interview were utilized. Indeed, a telephone survey was used as a tool in data collection in the ethnobotanical study. Both interviewers and interviewees can express freely and confidently because of the anonymity of the telephone interviews. Furthermore, it is easier to schedule and re-schedule than in-person interviews if the interviewers or interviewees were to miss the appointment for any reason, which saves money and time [15]. Three traditional healers were from Phnom Penh, six from Siem Reap, and four from Kampot. Their consents were all required before the interview, their voice record and information were coded anonymously.

A semi-structured questionnaire (appendix 1) was used for the interview and was divided into two different parts:

- First, socio-demographic data was recorded (age, gender, occupation, religion, education level, length of stay in the place of interview).
- Second, the traditional healers were questioned to list the natural remedies that can be used to alleviate or to treat the 3 most prevalent painful conditions: low back pain, headache, and joint pain. Other aspects of ethnobotanical knowledge *e.g.* vernacular names, part used, preparation method, posology, route of administration, toxicity, and recipes of individual species were also recorded.

Botanical identification: Medicinal plants in both dry and fresh (leaves, fruits, flowers) forms were collected and stabilized using the technique described by Professor Sun Kaing Cheng. The specimen was pressed and dried under the sun for 7-10 days. Then, freeze it. After that, take it out and leave it to the atmospheric temperature for two days, and then, freeze for one more week. Finally, stick the herbarium specimen and the label on the mounting paper. Voucher specimens collected were authenticated by experts at Herbarium of Faculty of Pharmacy (University of Health Science) and National Herbarium of Cambodia (RUPP) using morphological comparison with specimens deposited at these two Herbariums. Voucher specimens in the form of plant parts were verified by a specialized herbalist at the National Center of Traditional Medicine (NCTM). Plants' names were carefully checked for accepted names based on taxonomical website database "The plant list 2013" <http://www.theplantlist.org/>.

Data analysis: Data associated with collected ethnobotanical plants were analyzed by MS excel 2010. Therapeutic activities were discussed versus the literature about ethnomedicinal use of plants in Cambodia including "Les Plantes Médicinales du Cambodge, du Laos et du Vietnam" volume I-IV published between 1952 and 1954 by Alfred Petelot and "Medicinal plants in Cambodia" volume I-V published between 2008 and 2012 by National Center of Traditional Medicine [16,17]. The information on medicinal plants used for the treatment of different types of ailments among the key informants of the study area was analyzed using the below formula.

Fidelity level (FL): Fidelity level (FL) is the percentage of informants claiming the use of a certain plant for the same major purpose, FL was calculated using the following formula:

$$FL = Ip / Iu \times 100$$



Where I_p is the frequency of citation of a species for an ailment and I_u is the total number of citations of the species [18].

Informants consensus factor (ICF) ICF was calculated to identify the agreement of informants on the reported use report for different types of disease. ICF value was calculated using the following formula

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where Nur is the number of use reports of ailment category and Nt is the number of species used for a particular ailment category [19].

RESULTS

Socio-demographic characteristics of the informants: Socio-demographic characteristics of the key informants in the current study are presented in Table 1. The percentages of male informants (85%) dominated women informants (15%) whose age ranged between 31 and 78 years old. During our study, the knowledge of medicinal plants seemed to be related to the age of informants where elderly people knew large number of plants and were keen to spread out their knowledge more than young people. This study is consistent with an ethnobotanical survey in Southern Ethiopia in which older traditional healers had greater knowledge and information on ethnomedicinal plant species than younger traditional healers [20]. Fifty-four % of key informants pursued higher education while 15% of them were illiterate. Fifty-four% of traditional healers occupied a secondary job as farmers and 23% owned herbal shops. Sixty-nine % of key informants reported most of their knowledge was inherited from their ancestors, 31% from personal researches, and 85% from the vocational training courses at NCTM.

Repartition of plant families: A total number of 108 medicinal plant species were cited by the key informants. Out of these, 108 medicinal plant species belonging to 94 genera from 49 families. Among all plants cited, 35 species were used by key informants in Phnom Penh, 68 species in Siem Reap and 30 species in Kampot (appendices 2 and 3). The most predominant plant family in ethnobotanical use for 3 types of pain was Fabaceae (12 species), following by Menispermaceae (6 species), Rutaceae (6 species), and Acanthaceae (6 species) (figure 1). Similarly, Fabaceae was also reported to be the most important family in other ethnopharmacological studies undertaken in Mondulkiri by Pauline *et al.* [8]. This could be explained ecologically by its vegetation richness because it is considered as the third most abundant family in angiosperms, thus it is more accessible for traditional medicine used [21].

Part of use, recipes, and route of administration: Key Informants of each study area used different plant parts for preparation of traditional remedies (*e.g.* entire plants, rhizomes, woods, leaves, roots, seeds, barks, stems, and fruits). Among the parts of medicinal plants used for pain treatment, traditional healers frequently prefer to utilize the entire plants (49%), followed by woods (15%) and rhizomes (11%) (Figure 2).

Indeed, informant 2 mentioned that:

“...traditional medicine is different from modern medicine; we cannot extract the active substance or determine which part of the plant is effective against the ailment. For instance, before, “Voir an tong sor” (*Eurycoma longifolia* Jack). Some people used roots, some used stems and others used leaves for curing joint pain,



but all parts cited have the same efficacy. Later, after personal research and experiences we decided to use the whole plants to heal the ailment...”.

Socio-demographic-data		Number	Percent-(%)
Gender	Male	11	85
	Female	2	15
Age	31-40-years	1	8
	41-50-years	4	31
	51-60-years	2	15
	61-and-more	6	46
Education	Illiterate	2	15
	Secondary-school	4	31
	Higher-education-level	7	54
Occupation	Farmer	7	54
	Employed (NCTM, village...)	4	31
	Herbal	3	23
	Retired	2	15
Religion	Buddhism	12	92
	Christian	1	8
Duration-of-residence	Phnom-Penh		
	>15-years	13	23
	<15-years	0	0
	Siem-Reap		
	>15-years	5	38
	<15-years	1	8
	Kampot		
	>15-years	4	31
<15-years	0	0	
Duration-of-occupation-as-traditional-healer	>5years	13	100
	<5years	0	0
Number-of-people-per-household	1-4	4	31
	5-8	7	54
	>8	2	15

Table 1: Sociodemographic data of the informants (n=13)

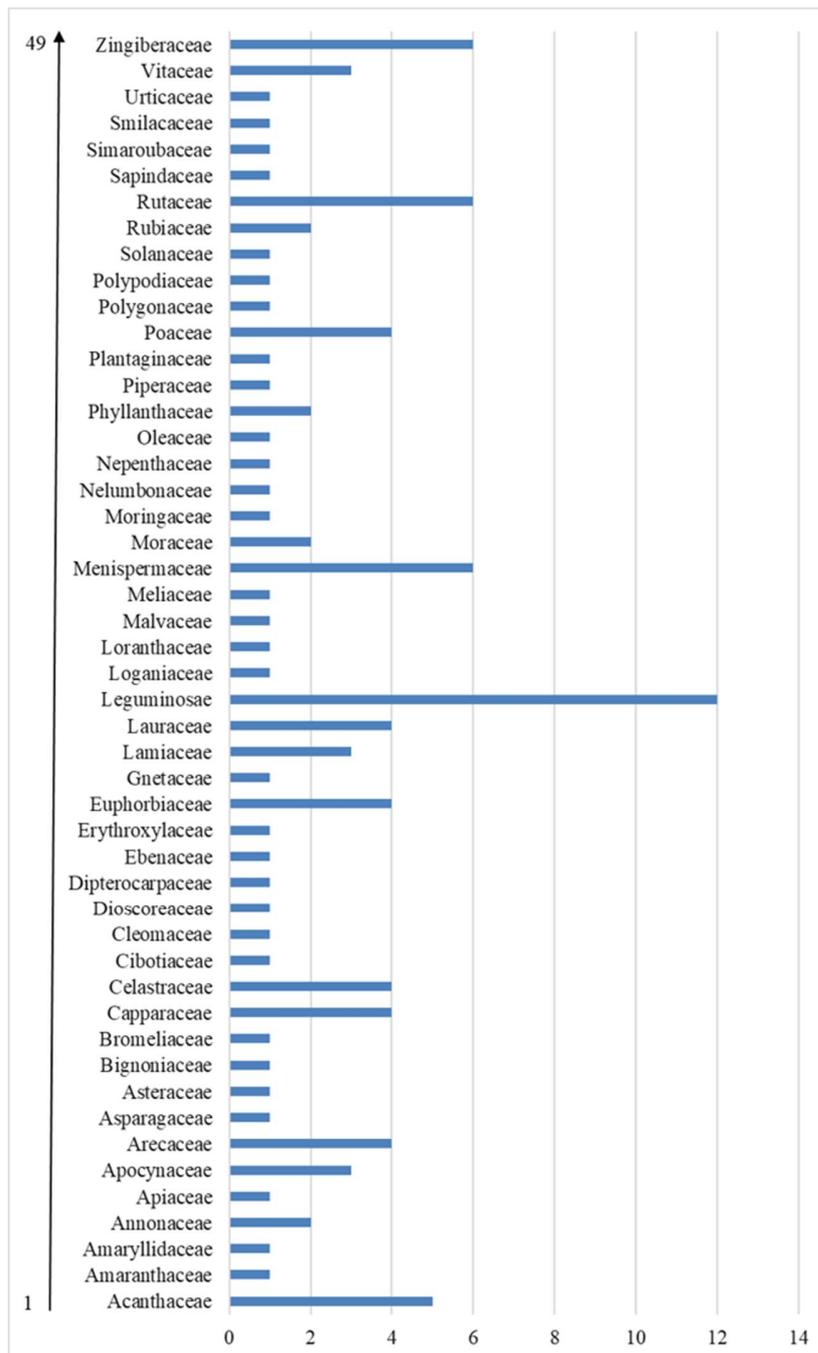


Figure 1: Plant Families used for treatment of headaches, low-back pains and joint pains in Phnom Penh, Siem Reap and Kampot

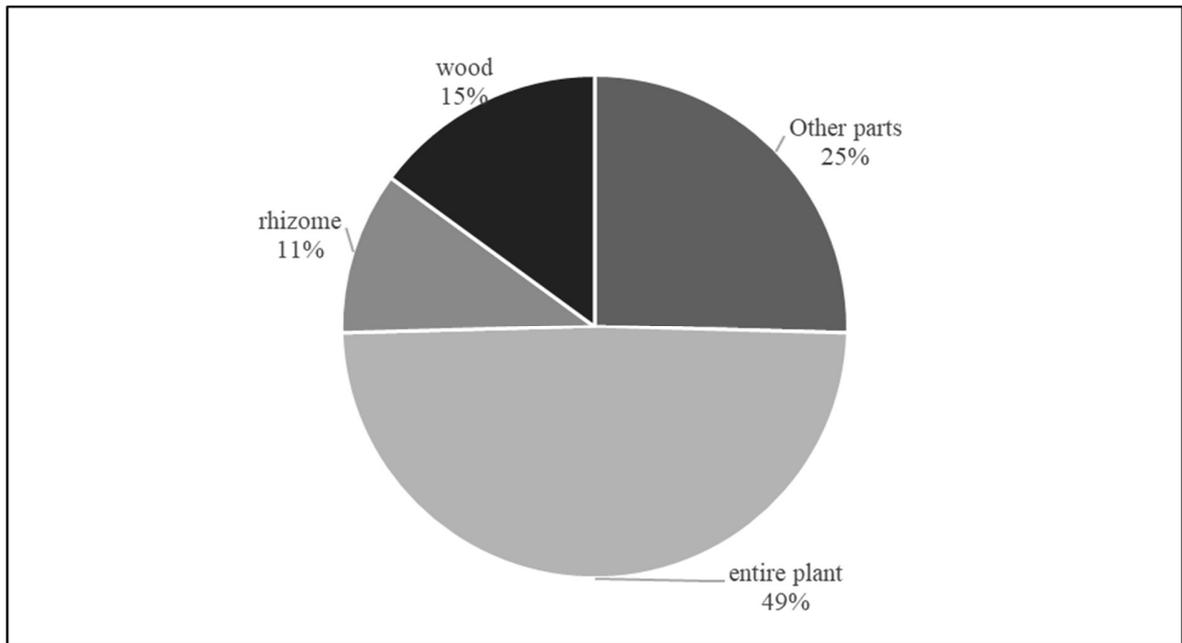


Figure 2: Used Parts

This study was in agreement with the ethnobotanical study in China by Hong, L *et al* in which the part used was also the entire plant [22]. However, our findings were not consistent with another previous study in Mondulkiri by Pauline *et al.* where roots/tubers [10], leaves [23] [5] were highly used plant parts. Most traditional healers commonly used multi-herbal recipes. In our survey, 19 multi-ingredient recipes (appendix 2) were made from 108 species. These combinations of herbal medicines can treat ailments more effectively than single herbal medicine, by having synergistic effects and reduce undesired harmful effects [24]. For instance, low back pain was reported to be treated by a single or mixture of plant species according to two traditional healers in Phnom Penh: *Anomianthus dulcis* (Dunal) J. Sinclair (Treal Sva/ត្រែលស្វា), *Kaemferia harmandiana* Gagnep. (Broh Sva/ប្រូស្វា) ឬ ប្រស្វា), *Archidendron quocense* (Pierre) I.C.Nielsen (Ang-konh Sva/អង្គកងស្វា), *Bauhinia bracteata* (Benth.) Baker, (Jon Der Sva/ច័ន្ទធីស្វា), and *Crotalaria pallida* Aiton (Chong Krong Sva/ច្រង់ក្រងស្វា).

Another noticeable recipe was the combination of *Strychnos nux-vomica* L. (Sleng/ស្លែង) with *Tinospora cordifolia* (Wild.) Miers. (Voir Om Boh Preah/វ៉ៃរ៉ូមប៉ូហ្វ្រេអ៊ែ). The multi-herbal drug strategy is not only the fact of Khmer traditional healers, and it is widely described in Traditional Chinese Medicine and Ayurvedic medicine [25]. Furthermore, informants applied different medicinal plant remedies in various ways of preparation such as decoction, maceration, crushing, grinding, chopping, boiling and steaming. Among those, decoction seemed to be a preferable way of preparation. Generally, when they decocted plants, they reduced by a third and drank until getting better.

The informant 9 stated that:

“... While we simmer over a gentle flame for a longer period, the large amount of water will vaporize, so about one-third of water contain high concentration which means we drink less but we obtain an effective result. It



also increases the activities of the active substances in the medicinal plant. Moreover, it reduces the toxicity in plants while simmering...”

In a previous study in Southern Brazil by Stolz *et al.* was equivalently reported that decoction was widely used in preparation [5]. In contrast, the study of the medicinal plant used in Northern Ethiopia by Chekole *et al* showed that crushing was reported frequently [26]. To addition healer’s point of view, efficacy and safety are the priorities for curing their patients.

The informant 4 claimed that:

“...For me, I do not prescribe any medications to pregnant women. Although the herbal medicines are effective, but safety comes first. In fact, I will give the herbal medicines after 5 months of giving birth...”

In addition, 99% of plants are administered orally. Only one specie: *Crateva adansonii* DC. was used as cataplasm (combined with rice) applied on the forehead. Oral administration was mentioned as the most practical way of administration, and the same finding was also reported in previous researches [5] [10] [26] [27].

Fidelity level (FL): To determine the relative healing potential for each species, fidelity level (FL) of plants was calculated based on used report in which a plant correspond for curing an ailment against the possibility to heal other ailment categories [18] (appendix 4). In general, the high FL of a species indicated its high efficacy on a specific illness treatment and the utilization of this species in an area. The analysis showed that the highest FL values found in *Spirolobium cambodianum* Baill. (Kom rerk kom/កម្រឹកកុម្ម) (100%) followed by *Scoparia dulcis* L. (Ey Sey psom srech/ឥសីផ្សំស្រួច) (67%) for low back pain. Whereas, for headache the highest FL values indicated in *Derris trifoliata* Lour. (Voir Preng kro-ham/វ្រើប្រងក្រហម) (67%). *Spirolobium cambodianum* Baill. was reported for low back pain treatment with the highest healing potential which had not mentioned before in the literature [10]. There are also few studies about *Scoparia dulcis* L. Chassagne, F *et al.* reported that it was used to treat sprain, backache and stomachache [10]. In another previous study, the leaves of *Scoparia dulcis* L. are used for diabetes in India. They found that the extract of its aerial parts has high potential uses including pain relieving, antispasmodic, anti-inflammatory activities possess cytotoxic, anti-cancerous, antimicrobial, anti- malaria, anti-ulcer, anti- acid, anti-diabetes, anti- cholesterol and antioxidant actions. Also, the effect of the ethanolic extract of aerial parts has a significant nephroprotection against cisplatin induced nephrotoxicity [28]. Interestingly, our study reported that the low back pain and joint pain were alleviated by using the whole plant of *Scoparia dulcis* L. In addition, *Ciborium barometz* (L.) J.Sm. (Promoay Sva/ប្រម៉ាយស្វា), *Loesneriella cambodiana* (Pierre) Tardieu (Voir Tortung/វ្រើតុន) for curing joints pain with the same FL of 67%. In accordance with “Edible Medicinal and Non-Medicinal Plants Volume 10, Modified Stems, Roots, Bulbs” by T.K. Lim, pharmacological effect of *Ciborium barometz* (L.) J.Sm., and its processed products were stated in using as analgesic, anti-bone lose, anti-inflammatory and haemostatic [30]. On the other hand, some species such as *Tinospora cordifolia* (Willd.) Miers (Voir om boh preah/ វ្រើអំបោះព្រោះ), *Diospyros ehretioides* Wall.ex G.Don (Ming Moang/ មីងម៉ាង), *Leea rubra* Blume ex Spreng (Kdang Bay /ក្តាងបាយ) and *Stephania rotunda* Lour. (Koma pich merm/ កុមារពេជ្រមើម) appeared to have the lowest FL values which indicate the low healing potential on a specific ailment, instead they can cure three pain conditions and other varied ailments. For instance, *Leea rubra* Blume ex Spreng was cited by three informants and it ranged as one of the lowest FL values 25% because it can be used to treat low back pain, headache, joint pain and other nine ailments.



Informant consensus factor (ICF): For the analysis of the general use of plants, informant consensus factor was used to highlight plants of cultural relevance and accordance in the use of plants. ICF values ranges from 0 to 1 where increasing values of the factor indicate high rate of informant consensus or agreement among the information about the use of plant species for the treatment of a particular ailment category [29]. Whereas, in our study low ICF values were recorded concerning headache (ICF=0.227) followed by low back pain (ICF=0.189) and joint pain (ICF=0.196). In fact, these low values appeared due to the vegetation abundance in different areas where informants reside. Plant with high ICF and FL values can be subjected to bioassay investigation and those with low values required analysis of their bioactivity to indicate their use for treating given ailments [30].

CONCLUSION

Our study provides relevant information on the medicinal plants used to treat pain conditions frequently encountered by Cambodian people. It appears that most of the plants reported have been already described as safe and efficient for the health problem cited. Chemical and pharmacological studies on 5 medicinal plants with high FL should be conducted to justify the traditional use. As people still depend significantly on natural medicinal plants for daily healthcare, medicinal plant resources should be carefully preserved and used in a sustainable way.

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DECLARATION OF CONFLICT OF INTEREST

We have no conflicts of interest to declare.

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