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Medicinal plants diversity in Bukit Rimbang Bukit Baling wildlife reserve, Riau, Indonesia

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Abstract

Documentation of indigenous knowledge on medicinal plants from people live in remote areas plays an important role in preserving local wisdom and culture. The objectives of this study were to explore the diversity of medicinal plants and to produce documentation on indigenous knowledge from people living in the Bukit Rimbang Bukit Baling Wildlife Reserve. Data on medicinal plants were obtained based on interviews with 20 respondents from two villages. Collection of plant specimens was done for species identification. Results showed that there were 63 species from 38 families used as traditional medicine. Part of plants most widely used for treatment of illness or health problems was leaves. Decoction and maceration were two methods mainly used for preparing herbal recipes. The most common mode of oral administration was by drinking the potion of herbal recipes, whereas topical administration was generally done by rubbing the herbal poultice on the affected body parts.

Keywords: Ethnobotany, indigenous knowledge, plant diversity, Riau, traditional medicine

1. Introduction

Bukit Rimbang Bukit Baling Wildlife Reserve (BRBBWR) in Riau Province is a forest area with important ecological value for protection of plant and animal diversity. This wildlife reserve, located at Kampar Regency, was established in 1982 which covers an area of 136,000 hectare and is largely consisted of a lowland forest. The forest of BRBBWR is a habitat for Sumatran tiger (*Panthera tigris ssp. sumatrae*), a critically endangered species as noted the IUCN Red List of Threatened Species ^[1]. The forest also has an economic value for the community live in the area as a source of livelihood.

The BRBBWR is inhabited by indigenous people of the Malay ethnic since a long time before the area was designated as conservation area. The Malay ethnic community uses plants in their surrounding forest for various purposes, including source of food and traditional medicine. The indigenous knowledge of Malay ethnic on the use of plants for food and traditional medicine is worth documenting through ethnobotanical study. Ethnobotany is the study of interactions between plants and people ^[2], including the use of plants in a particular ethnic and culture. Accordingly, ethnobotanical study plays an important role in understanding the dynamic relationships between biological diversity and socio-cultural systems ^[3]. Furthermore, ethnobotany may open opportunities for further research on plants potential for the development of new drugs ^[4, 5]. In this case, scientific validation on therapeutic properties of traditionally used medicinal plants through phytochemical screening and biological activity studies is very important ^[6].

The indigenous knowledge on the use of plants for everyday life by particular ethnic is passed though from the older generation to the younger in a traditional way, and is generally not well documented. This practice may lead to a decline or even loss of knowledge in the younger generations as they are usually less interested in learning and preserving it ^[4, 7]. The risk of a decline and loss of knowledge about medicinal plants has been reported in various ethnics and communities in Indonesia, such as in Serampas, Jambi, Sumatra ^[8], and in Manokwari, West Papua ^[9]. Systematic documentation of indigenous knowledge through ethnobotanical studies could prevent such risk ^[5, 6]. In this regard, the urgent need on preservation of indigenous knowledge on medicinal plants in Asian countries need has been noted since almost a decade ago ^[10]. This notion was motivated by the important role of ethnobotanical studies in generating valuable documentation of traditional culture, biodiversity, and in providing scientific basis for new drug development.

Ethnobotanical study in protected areas, such as the BRBBWR, is important because the people who live in it become an integral part of the maintenance of the ecosystem. A number of ethnobotanical studies in protected areas have been conducted in many countries, such as at Tian Mu Shan Biosphere Reserve, China ^[11], in Tesso Nilo National Park, Riau, Sumatra,

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Indonesia^[12], in Ipassa- Biosphere Reserve, Gabon^[13], and in Samar Island Natural Park, the Philippines^[14]. For people who live around the forest, the existence of medicinal plants is not only beneficial for their health but also has an impact on their socio-economic aspects^[15].

In this study, the inventory of plants used as traditional medicine by the Malay ethnic living in the BRBBWR area was done using ethnobotanical approach. The objectives of this study were to explore the diversity of medicinal plants and to document the indigenous knowledge on the use of medicinal plants by people live in two villages in Bukit Rimbang Bukit Baling Wildlife Reserve.

2. Materials and Methods

This study was conducted on November 2016 in two villages, the Aur Kuning and Kota Lama, within the Bukit Rimbang Bukit Baling Wildlife Reserve area, of Kampar Kiri Hulu District, Kampar Regency, Riau. The Aur Kuning Village is located on the banks of the Subayang River, while Kota Lama Village is on the banks of the Bio River (Fig.1). These two rivers are the main transportation routes for these two villages. The residential areas of these villages are at the altitude of 90-130 m above sea level. The surrounding forest where the collection of medicinal plants was carried out is in the range of 140-350 m above sea level.

The ethnobotanical data was collected by interview using purposive sampling and snowball sampling methods. Interviews were carried out on key persons, with the criteria: 1) village residents who understand the use of plants for traditional medicine, such as traditional healers; 2) village residents who have used and are using plants for traditional medicine, and 3) village residents who are able to provide relevant information on the use medicinal plants. The number of respondents interviewed in this study was 20, consisting of 10 respondents from Aur Kuning Village and 10 respondents from Kota Lama Village. The respondents were representatives of ethnic leaders, village leaders, traditional healers, traditional birth attendants, and people who categorized as common users of medicinal plants. The information asked during the interview includes local names of plants, the plant parts used, medicinal uses, methods of preparation, and methods of administration.

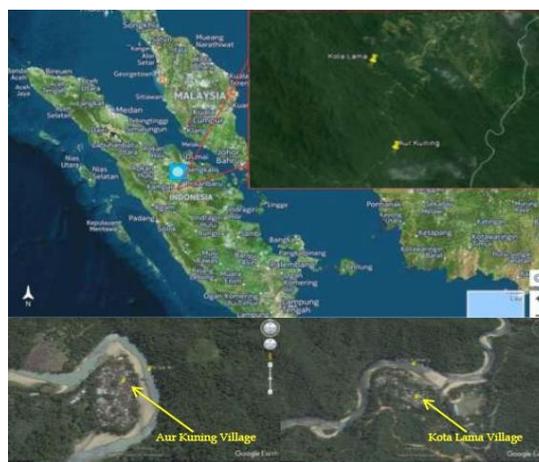


Fig 1: Location of Aur Kuning and Kota Lama Villages within the BRBB Wildlife Reserve

Data on medicinal plant diversity was collected based on the checklist of plant species obtained from the interview. Plant specimens were collected using exploration method from home gardens and from forest surrounding the village where the plants grow naturally. Local people with adequate knowledge on medicinal plants and their locations in the adjacent forest and surrounding areas of the two villages were asked for their technical assistance during forest exploration. Plant identification was done based on specimens collected during field observation. Only medicinal plants which could be identified at species level were reported in this study.

3. Results and Discussion

The Malay ethnic communities live in the Bukit Rimbang Bukit Baling Wildlife Reserve area use plants from the surrounding forest and their home gardens for treating various diseases and health problems. They have good knowledge on traditional medicine since they live in an area where there is no accessible road to hospital. Results of the interview showed that there were 63 plants species from 38 families used as traditional medicine (Table 1). Among the 38 plant families, Euphorbiaceae, Piperaceae and Solanaceae have the highest number of species used as traditional medicine, with four species were recognized in each of these families.

Table 1: List of plant species used by the Malay ethnic in Aur Kuning and Kota Lama Villages, Kampar Kiri Hulu District, Kampar Regency, Riau

No.	Family	Species	Illness or health problems treated	Plant part used
1..	Acanthaceae	<i>Justicia gendarussa</i> Burm.f.	Fever, Headache	Leaf ^[8,30,38,42]
		<i>Graptophyllum pictum</i> (L.) Griff.	Headache	Leaf ^[8,12,30,46]
2.	Acoraceae	<i>Acorus calamus</i> L.	Muscular pain	Leaf ^[8,38,42,49]
3.	Adoxaceae	<i>Sambucus javanica</i> Reinw. ex Blume	Malaria	Seed ^[42,46]
4.	Amaryllidaceae	<i>Crinum asiaticum</i> L.	Back pain	Leaf ^[8,9,39,49]
5.	Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br.	Toothache, fever	Sap ^[8,9,39]
6.	Arecaceae	<i>Cocos nucifera</i> L.	Chicken pox, fever	Liquid endosperm (coconut water) ^[4,8,30]
		<i>Areca catechu</i> L.	Diarrhea	Fruit ^[8,30,42,49]
7	Asteraceae	<i>Ageratum conyzoides</i> L.	Wound and bruises	Leaf ^[8,13,27,38]
		<i>Enhydra fluctuans</i> Lour.	Asthma; Chicken pox	Leaf ^[45,48]
8.	Caesalpiniaceae	<i>Cassia tora</i> L.	Stomach ache	Leaf ^[38]
		<i>Senna alata</i> (L.) Roxb.	Chicken pox, psoriasis	Leaf ^[9,12,38]
9.	Campanulaceae	<i>Hippobroma longiflora</i> (L.) G. Don	Cataract	Flower ^[46]
10.	Caricaceae	<i>Carica papaya</i> L.	Stomach ulcer, Toothache	Leaf, sap ^[4,7,8,49]
11.	Clusiaceae	<i>Garcinia atroviridis</i> Griff. ex T.Anderson.	Animal poison	Leaf ^[30,42]

12.	Costaceae	<i>Costus speciosus</i> (J.Koenig) Sm.	Cough	Leaf [4,8,9]
13.	Crassulaceae	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Fever, chicken pox	Leaf [9,27,38,42]
14.	Dilleniaceae	<i>Tetracera scandens</i> (L.) Merr.	Eye irritation, fever	Stem [4,39]
15.	Dioscoreaceae	<i>Dioscorea alata</i> L.	Diabetes	Leaf, root [39]
16.	Euphorbiaceae	<i>Ricinus communis</i> L.	Fever	Leaf [7,9,42]
		<i>Codiaeum variegatum</i> (L.) Rumph. ex A.Juss.	Fever	Leaf [48]
		<i>Homalanthus populneus</i> (Geiseler) Pax	Bloated	Leaf [30,40]
		<i>Phyllanthus niruri</i> L.	Stomach ache	Leaf [38,49]
17.	Gleicheniaceae	<i>Dicranopteris linearis</i> (Burm. f.) Underw.	Fever	Leaf, stem [12]
18.	Lamiaceae	<i>Plectranthus scutellarioides</i> (L.) R.Br.	Chicken pox, psoriasis	Leaf [12,46]
19.	Lauraceae	<i>Cinnamomum rhynchophyllum</i> Miq.	Impotence	Stem [4]
20.	Malvaceae	<i>Hibiscus rosa-sinensis</i> L.	Fever	Leaf [39,42,43,50]
		<i>Ceiba pentandra</i> (L.) Gaertn	Fever	Leaf [12,27,30]
		<i>Scaphium scaphigerum</i> (Wallich ex G. Don) Guibourt & Planchon	Fever	Seed [47]
21.	Melastomataceae	<i>Melastoma malabathricum</i> L.	Boils	Leaf [30,46]
22.	Mimosaceae	<i>Mimosa pudica</i> L.	Lack of appetite	Leaf, stem [7,30,38,42]
23.	Moraceae	<i>Ficus sundaica</i> Blume	Fever	Leaf [9, 46]
		<i>Ficus variegata</i> Blume	Stomach ache	Sap [9, 46]
24.	Musaceae	<i>Musa paradisiaca</i> L.	Fever, wounds and bruises	Pseudostem, leaf [13,30,49,50]
25.	Myrtaceae	<i>Psidium guajava</i> L.	Diarrhea	Leaf [4,8,30,49]
26.	Oxalidaceae	<i>Averrhoa bilimbi</i> L.	High blood pressure	Leaf [46]
27.	Pandanaceae	<i>Pandanus immersus</i> Ridl.	Toothache	Leaf [8,40]
28.	Piperaceae	<i>Piper crocatum</i> Ruiz & Pav.	Sore eyes	Leaf [9,30]
		<i>Piper caninum</i> Blume	Fever	Leaf [52]
		<i>Piper sarmentosum</i> Roxb.	Heart disease	Leaf [9,42]
		<i>Piper betle</i> L.	Dysmenorrhea, fever	Leaf [18,46,48,50]
29.	Poaceae	<i>Sacciolepis interrupta</i> (Willd.) Stapf	Chicken pox, fever	Leaf [46]
		<i>Cymbopogon citratus</i> (DC.) Stapf	Constipation	Leaf, stem [27,42,50]
30.	Polypodiaceae	<i>Platynerium bifurcatum</i> (Cav.) C. Chr.	Hemorrhoid	Leaf [30]
		<i>Morinda citrifolia</i> L.	Bloated, fever	Fruit [8,9,40]
31.	Rutaceae	<i>Citrus aurantiifolia</i> (Christm.) Swingle	Cough	Fruit [8,12]
		<i>Citrus aurantium</i> L.	Cough	Fruit [30,43,49]
		<i>Murraya koenigii</i> (L.) Spreng.	Fever	Leaf [46]
32.	Sapindaceae	<i>Pometia pinnata</i> J.R. Forst & G.Forst	Chicken pox	Leaf [42]
		<i>Nephelium lappaceum</i> L.	Fever	Leaf [18,12,30,48]
33.	Sapotaceae	<i>Manilkara zapota</i> (L.) P. Royen	Hemorrhoid, diarrhea	Fruit [30,48]
34.	Selaginellaceae	<i>Selaginella doederleinii</i> Hieron.	Fever	Leaf [42]
35.	Simaroubaceae	<i>Eurycoma longifolia</i> Jack	Malaria	Leaf [4,12,30,51]
36.	Solanaceae	<i>Capsicum annum</i> L.	Wounds and bruises	Fruit [46]
		<i>Solanum torvum</i> Sw.	Wounds and bruises	Leaf [12,30,31,49]
		<i>Physalis angulata</i> L.	Malaria	Fruit [8,30,39]
		<i>Datura innoxia</i> Mill.	Toothache	Leaf, root [7,8,38]
37.	Verbenaceae	<i>Peronema canescens</i> Jack	Postpartum recovery	Leaf [51]
38.	Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Cough, headache	Rhizome [7,8,14,30]
		<i>Globba leucantha</i> Miq.	Fever	Rhizome [4,40]

Most of the plants used as traditional medicine by the Malay ethnic in BRBBWR have been tested scientifically for their efficacy in treating diseases and health problems. The following sections summarized the chemical constituents of some medicinal plant species used as traditional medicines based on their phytochemical studies. Coconut (*Cocos nucifera*) is traditionally used to treat fever, heartburn, skin diseases, intestinal worms, dengue fever, and even used as antidote. Laboratory analysis on coconut water showed that it contains macro and micro nutrients, and considerable amount amino acid content [16]. *Enhydra fluctuans*, a herb traditionally used to treat asthma and chickenpox, has many beneficial compounds such as β -carotene, saponins, myricyl alcohol, kaurolic acid, glucoside, sesquiterpene lactones, germacranolide, enhydrin, fluctuanin, and fluctuandin [17]. *Piper betle*, the

most popular medicinal plant species within Piperaceae family, was used to treat dysmenorrhea and fever. Leaves of *P. betle* have been widely known as having antiseptic and antioxidant characteristics, and were commonly used to treat cough and bronchitis [18]. Phytochemical analysis showed that *P. betle* various terpenoid compounds composing essential oils, including 1, 8-cineole, cadinene, camphene, caryophyllene, limonene, pinene, chavicol, allyl pyrocatechol, carvacrol, safrole, eugenol and chavibetol [19].

Areca catechu which grows well in many places of the village was used by the people in BRBBWR to treat diarrhea. Phytochemical studies showed that on this species contains polyphenols, alkaloids, vitamin B6, vitamin C, various kinds of fatty acids, and a number of important minerals including calcium, phosphorus, and iron, and therefore *A. catechu* has

anti-inflammatory, antimicrobial, wound healing, and central nervous system stimulant properties [20]. *Acorus calamus* which is used to treat muscular ache complaints was known to have glycosides, flavonoids, saponins, tannins, polyphenolics, and volatile oils compounds, which makes this species has neuromodulatory effects, anti-inflammatory and analgesic activities [21]. *Costus speciosus* which was used as traditional medicine for relieving cough has a number of bioactive compounds including β -amyrin, camphene, costunolide, diosgenin, eremanthin, α -humulene, lupeol, zerumbone, and therefore has biological activities as anti-inflammatory, antioxidant, and anticancer [22]. Papaya (*Carica papaya*) was traditionally used to cure stomach ulcers and toothache. Phytochemical study revealed that the ethanolic extract of *C. papaya* leaves contain tannins and flavonoids which act as antioxidants to counteract the free radicals [23, 24]. Meanwhile, chili (*Capsicum annuum*) was found to be a common vegetable used by the community at BRBBWR as a traditional medicine for wound healing. Chili fruit contains flavonoids, tannins, saponins, capsaicin, vitamin C, beta-carotene, and has multifunction as medicine for wounds, fevers, colds and nasal congestion, headaches, and lowering blood cholesterol level [25].

People in BRBBWR have been using *Bryophyllum pinnatum* since long time ago to treat fever and chickenpox. This plant contains alkaloid, flavonoid, cardiac glycoside, and showed diuretic, anti-diabetic, and wound healing properties [26]. In Jambi, this species was used to treat fever and abscess [8], while in Nigeria its leaves was used to treat convulsion stroke, fever and high blood pressure [27]. A wild plant with edible fruit, *Physalis angulata* was traditionally used to cure malaria either by preparing decoction of the fruits or eat the raw fruits directly. This species contained alkaloid, flavonoid, and various kinds of plant steroids including nine types of physalin, which made *P. angulata* known as traditional medicine in Peru with antimalarial, anti-inflammatory and post-partum treating properties [28]. The leaf of *Solanum torvum* known locally as *rimbang*, the same name as the study site, was used as topical remedy for wounds and bruises. This species has a number of chemical constituents such as steroids, steroid saponins, steroid alkaloids, and phenols, which make *S. torvum* has, anti-bacterial, anti-viral, and anti-inflammatory properties [29]. The use of *S. torvum* as a medicinal plant was also reported in North Sumatera to treat ulcers and eye irritation [30] and in Subang for the treatment of diabetic [31].

Plant materials used for traditional remedies were prepared by various techniques before being applied for treating sickness or healing health problems. Results of this study showed that two most common methods used for preparing herbal medicine were decoction and maceration. Some herbal medicines were prepared by heating or burning plant materials, especially those to be applied on skin. A number of previous studies also stated that decoction is the most widely used method in the use of traditional medicine [6, 9, 32, 33]. Meanwhile, preparing herbal recipe by maceration has been reported in some studies [4, 13]. The herbal recipes were then applied either orally or topically. There were three modes of administration for oral applications namely by drinking, eating, and chewing herbal medication. Meanwhile, the topical applications were commonly done by sticking or rubbing the macerated or poultice herbal on part of body being treated, as in treating chickenpox and psoriasis by using poultice of herbal recipes. In case of treating the eye irritation, topical application was done by dropping the plant sap into

the eyes. Another method of topical application was by wrapping the affected body parts with herbs, such as for healing back pain using *Crinum asiaticum* leaves. Regarding the composition of herbal medicine, most of recipes were used single plant material from one species, and only a small portion (16%) were prepared using two or more plant materials from different species. Similar finding was reported in other study, in which most of herbal recipes was prepared from single plant species [33]. For medication which was taken orally by drinking herbal recipes, honey was commonly added to increase palatability. For the recipes that were rubbed on body parts, the herbal poultice was commonly mixed with coconut oil or calcium carbonate paste. The same way in formulating herbal recipe for topical application has been mentioned previously [4].

Parts of plants used as traditional medicine include leaves, stems, roots or rhizomes, flowers, fruit or seeds, and sap. Results of this study showed that leaves were the most widely used in traditional medicine (64%). The use of other plant parts such as stems, roots, flowers, fruits, seeds, and sap was relatively small (1.5-12%). Similar results were reported from ethnobotanical studies in other regions of Indonesia, such as in Manokwari, West Papua [9], North Sumatera [30], and Subang District, West Java [31]. These studies found that leaves were most frequently used for the treatment of diseases using traditional medicine. The main reason for using leaves as materials in traditional medicine is because leaves are easily obtained in large quantities and available throughout the year. Moreover, leaves are easily extracted to get the bioactive compounds [34, 35].

The use of leaves as materials for traditional medicine does not an adverse effect for the survival of plants, because leaves will always grow steadily during the plants' life. This is an important aspect in the conservation of the plants [36]. Different situation will occur if the plant part taken is the root, which will have a bad impact on the survival of the plant. When plant roots are taken, the plant is threatened with death because the roots are not easily regenerated as leaves. An example for this case is the use of *Eurycoma longifolia*, a plant species commonly harvested for its roots to be used as a tonic to increase endurance, such as reported from the local people at Tesso Nilo [12]. The whole plant of *E. longifolia* was used as medicines for asthma, fever, and as aphrodisiac by people in the sub-ethnic Batak Simalungun [30]. A different practice was found in BRBBWR area, where people used leaves of *E. longifolia* for treating malaria.

Considering that ethnobotany is a study which covers both scientific and socio-cultural aspects, the results also have a role in these fields. The importance of documenting the original knowledge on medicinal plants used by ethnic communities is as an effort to preserve culture, and at the same time explore the potential of traditional medicines. Ethnobotanical studies serve important role in providing a basis for the discovery of new drugs, and therefore preservation of indigenous knowledge on medicinal plants deserve serious attention to support the development of modern medicine [2, 37]. A number of remarkable references on medicinal plants known in the Asian regions [38, 39, 40, 41] as well as of worldwide scope [42, 43, 44] showed the important role of scientific documentation of medicinal plants to support modern drug discoveries based on natural products of plant origin. In addition, documentation on the diversity of medicinal plants also serves as a foundation for plant conservation as well as preservation of the habitats where the plants grow. Thus the results of ethnobotany research not only

enrich the botanical knowledge but also have an important role in conservation for sustainable use of medicinal plants [4, 13, 45, 46, 47]. The effort to preserve medicinal plants by the people in BRBBWR was done by cultivated a number of medicinal plants in the yard or in a garden near their home yard gardens. Similar conservation practices have also been reported in other regions, either by cultivating the plants in home yard gardens and parks [48, 49], by developing urban forest [31, 50] or maintaining sustainability of community forest by applying the valuable local wisdom [51]. The vast diversity of medicinal plants is also found in rainforests, and its potential need to be explored through the collection, extraction and bioactivity screening of their biochemical compounds, such as those carried out on medicinal plants in rainforest in Paluma, North Queensland Australia [52].

4. Conclusions

This study showed that there was high diversity of plant species used in traditional medicine by the Malay ethnic communities live in the Bukit Rimbang Bukit Baling Wildlife Reserve. Medicinal plants traditionally used as remedies for various illness and health problems were proven to have bioactivity properties due to their phytochemical compounds. Documentation of indigenous knowledge on traditional medicine generated in this study has important role in preserving best practices on traditional medicine which serve as basis for new drug discovery in modern medicine. Moreover, this ethnobotanical study might help the community to preserve the knowledge which was strongly collated to their culture.

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