

## Traditionally utilization of *Selaginella*; field research and literature review

AHMAD DWI SETYAWAN<sup>♥</sup>

Department of Biology, Faculty of Mathematic and Natural Sciences, Sebelas Maret University. Jl. Ir. Sutami 36a Surakarta 57126, Central Java, Indonesia. Tel./Fax.: +92-271-663375. ♥email: volatileoils@gmail.com

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**Abstract.** Setyawan AD. 2009. *Traditionally utilization of Selaginella; field research and literature review. Nusantara Bioscience 1: 146-158.* The aims of this research were to find out traditional usage of *Selaginella* in medication and its other usages, especially in Java and other Indonesian Archipelago. About 200 of 700-750 world species of *Selaginella* was found in Indonesian Archipelago. Field research and literature review indicated that *Selaginella* is used traditionally to heal wound, bloody stools, internal hemorrhoid bleeding, menstrual and uterine disorder, blood expediting, enhancing body endurance and longevity of live, headache, etc. Besides that some of *Selaginella* are also used as raw dishes vegetable, ornamental plants, and crafts materials. The utilization of *Selaginella* is very limited against the amount of species and medicinal potency, it is needed an advance study on ethnobotany and phytochemistry to improve their uses.

**Key word:** traditional medicines, herbal, ethnobotany, *Selaginella*, Java.

**Abstrak.** Setyawan AD. 2009. *Pemanfaatan Selaginella secara tradisional; penelitian lapangan dan telaah pustaka. Nusantara Bioscience 1: 146-158.* Penelitian ini bertujuan untuk mengetahui manfaat *Selaginella* dalam pengobatan tradisional dan pemanfaatan lainnya, melalui penelitian lapangan dan telaah pustaka, khususnya di Jawa dan Kepulauan Nusantara. Sebanyak 200 dari 700-750 spesies *Selaginella* hadir di Kepulauan Nusantara. Secara tradisional *Selaginella* digunakan untuk mengobati luka, pendarahan, gangguan menstruasi dan kandungan, memperlancar peredaran darah, meningkatkan daya tahan tubuh, memperpanjang usia, mengobati sakit kepala dan lain-lain. Di samping itu beberapa jenis *Selaginella* juga digunakan sebagai sayuran (lalapan), tanaman hias, dan bahan baku kerajinan tangan. Pemanfaatan *Selaginella* sangat terbatas dibanding jumlah jenis dan potensi manfaat obatnya, sehingga diperlukan kajian etnobotani dan fitokimia lebih mendalam untuk meningkatkan pemanfaatannya.

**Kata kunci:** obat tradisional, tanaman obat, etnobotani, *Selaginella*, Jawa.

### INTRODUCTION

Medicinal plants are plants that contain ingredients that can be used for treatment or becoming drug synthesis precursor (Sofowora 1982). Medicinal plants have become the leading contributor to health to mankind since time immemorial. In Indonesia, there are various systems of traditional medicine, as a result of high biological and cultural diversity in this country (Erdelen et al. 1999). The oldest and the most widespread system of traditional medication in Indonesia and the Malay Archipelago (Nusantara or Malesia) is a native herb from Java (*jamu*). Herbal medicine or *jamu* contains more than 30 species of plants. The existence of the process of making herbal relief in Borobudur temple shows that the herb has been widely known since the early 9th century (Jansen 1993). This system has been recorded since the last centuries in various *serat* (letters) and *primbon* (prophecy) (Soedibjo 1989 1990; Sutarjadi 1990). *Jamu* is an original vocabulary of the Java language, which means traditional medicine, in addition it has been absorbed into the Indonesian language (Riswan and Sangat-Roemantyo 2002), and the word *jamu* has also been used by other Malay speakers. This system is

widespread through trade and migration, since the kingdoms of Hindu Mataram (Sanjaya), Sriwijaya (Sailendra), and Majapahit. At this time, *jamu* plays an important role in health and economic development of Indonesia and around countries (Sidik 1994). In Indonesia, more than 75% disease was treated with *jamu* or traditional medicine (Al-Janabi 2001). Even according to the WHO, 80% of the developing countries depend entirely on traditional medicine to maintain the people's health (Farnsworth et al. 1985; Bodeker et al. 2005).

Tropical forests are the habitat and the main source of medicinal plants (Stepp and Moerman 2001; Stepp 2004), due to high levels of biodiversity and endemism (Gentry 1993; Macilwain 1998). Some 40,000 species (Rifai MA, 2008, personal communication) or 15% of flowering plants can be found in Indonesia (MOSPP 1993). 10% of the plants are potential for medicinal plants (Schumacher 1996). Heyne (1927) noted the existence of 996 species of flowering plants used in traditional medicine in Indonesia, when added with algae, fungi, ferns, and gymnosperms and the number can reach 1040 species. Kazahara (1986) noted 7500 plant species in Indonesia, where 3689 species of which are medicinal plants. Zuhud et al (1994) mentions

the 1260 species of trees in the Indonesian rain forests are used as medicinal plants.

*Selaginella* (*cakar ayam* or *rane*) is a medicinal plant that has not been widely used, either traditional or modern. Small amounts of the species are also used as ornamental plants and vegetables. Family Selaginellaceae Reichb has only one genus, *Selaginella* Pal. Beauv, consisting of 700-750 species and widespread in a cosmopolitan way (Tryon and Tryon 1982; Jermy 1990). In Nusantara or Malay Archipelago (Malesia), there are more than 200 species of *Selaginella*, with the highest diversity and endemism in Papuasias, Borneo, and the Philippines. In Java there are 24 with 5 endemic species. Some species are still waiting to be discovered, but a number of other species waiting to be extinct (Setyawan 2008). All species of Nusantara have small leaves resembling scales, with two different sizes: the smaller median leaves in the inner row and the larger lateral leave in the outer rows (Jermy 1990; Camus 1997).

*Selaginella* contains a variety of secondary metabolites such as alkaloids, phenol (flavonoids, tannins, saponins), and terpenoids (triterpene, steroid) (Chikmawati and Miftahudin 2008; Chikmawati et al. 2008). The main secondary metabolite of this plant is biflavonoid, whose type is various depending on the species. Biflavonoid that has been identified from *Selaginella*, among others amentoflavone, 2',8"-biapigenin, delicaflavone, ginkgetin, heveaflavone, hinokiflavone, isocryptomerin, kayaflavone, ochnaflavone, podocarpusflavone A, robustaflavone, sumaflavone, and taiwaniaflavone. These compounds act as antioxidants, anti-inflammatory, anti-cancer, anti-allergic, antimicrobial, antifungal, antibacterial, antiviral, protective against UV irradiation, vasorelaxant, heart boosters, anti-hypertensive, anti-clotting, and affect the metabolism

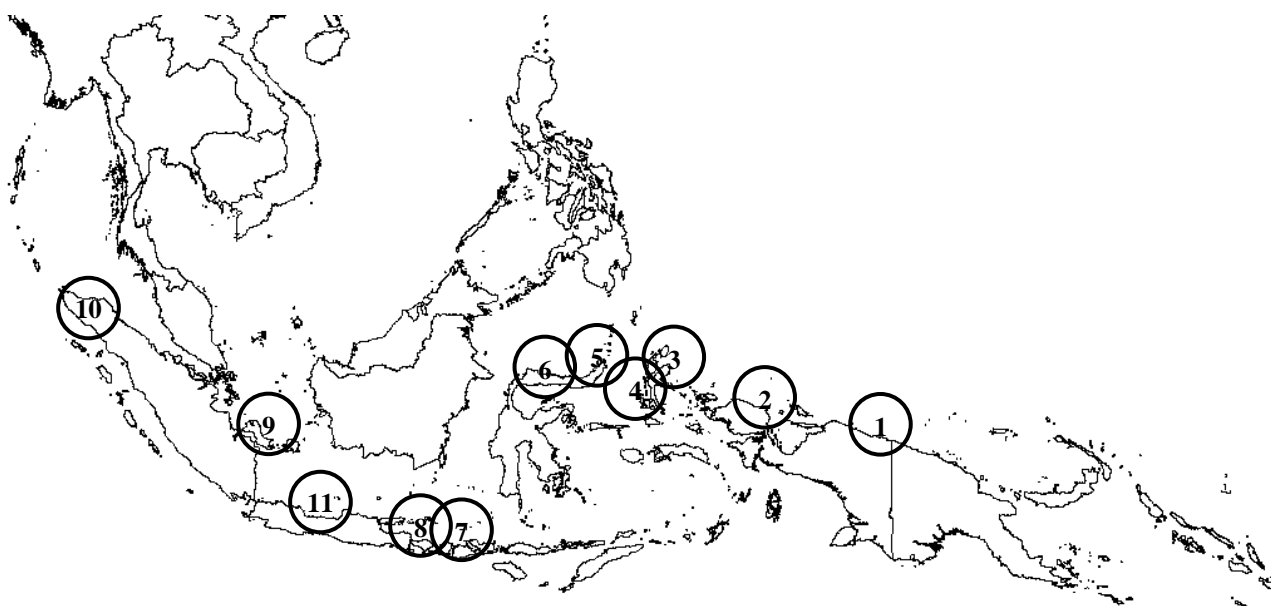
enzymes (Setyawan and Darusman 2008). Biflavonoid is a typical of secondary metabolites which are found only in Selaginellales, Psilotales, gymnosperms (Seigler 1998), and several species of Bryophytes and Angiosperms (DNP 1992).

This study consists of two main activities, namely the field research and literature review. The field research was conducted in several areas in Indonesia, especially Java, in order to know the traditional use of medicinal plants *Selaginella*, while the literature review were collected from studies around the world, especially from the Nusantara regions. The literature review is intended to strengthen and expand the knowledge about the traditional use of medicinal plants, *Selaginella*.

## MATERIALS AND METHODS

### Field research

The field research was conducted to know current state of traditional use of *Selaginella*. The field research was conducted at 100s locations in Java and 10 locations in other islands, namely: (i) Cycloops Mountain Nature Reserve, Jayapura, Papua, (ii) Mount Meja Protected Forest, Manokwari, West Papua, (iii) Mount Gamalama, Ternate, North Maluku, (iv) Atakejawe-Lolobata National Park, Halmahera, North Maluku, (v) Mount Soputan, Minahasa, North Sulawesi, (vi) Nantu Game Reserve, Boalemo, Gorontalo, (vii) Mount Rinjani, Lombok, West Nusa Tenggara, (viii) Batu Kahu Nature Reserve, Tabanan, Bali, (ix) Mount Penumbing, Bangka-Belitung, and (x) Mount Leuser National Park, Aceh (Figure 1). The field research was conducted in the mid of 2007 to the late of 2008.



**Figure 1.** Selaginellas research sites in Nusantara. 1. Cycloops Mountain Nature Reserve, Jayapura, Papua, 2. Mount Meja Protected Forest, Manokwari, West Papua, 3. Mount Gamalama, Ternate, North Maluku, 4. Atakejawe-Lolobata National Park, Halmahera, North Maluku, 5. Mount Soputan, Minahasa, North Sulawesi, 6. Nantu Game Reserve, Boalemo, Gorontalo, 7. Mount Rinjani, Lombok, West Nusa Tenggara, 8. Batu Kahu Nature Reserve, Tabanan, Bali, 9. Mount Penumbing, Bangka-Belitung, and 10. Mount Leuser National Park, Aceh, 11. Java (100s sites).

Note: Study sites in Java included: **West Java, Banten and Jakarta:** *Bogor Lowland* (UI campus at Depok-Jakarta, Cifor educational forest, Bogor Botanic Garden, Mekarsari Park, BAU campus at Darmaga, Ciampea limestone hill); *Mount Halimun Salak* (Cikaniki research station, Nirmala tea plantation, Gunung Bunder, Gunung Malang, Cijeruk, Gunung Wiru, Kabandungan, Cibedug); *Mount Gede-Pangrango* (Cibodas Botanic Garden, Cibodas trekking); *Pembarisan Mountain* (Darma, Kudugede), *Mount Ciremai* (Linggarjati, Cilimus, Jalaksana). **Central Java and Yogyakarta:** *Nusakambangan Island* (Lempong Pucung, Ujung Alang); *Mount Slamet* (Baturraden, Serang); *Dieng Plateau* (Telaga Warna, Sikidang crater, Tuk Bimo Lukar or Serayu water spring, Batur's ex PT. Dieng Jaya factory, Kejajar riverside, Mladi, Sikarim waterfall); *Wonosobo Township, 500-1000 m.asl.* (Kejiwan, Kaliangget, Sambek, Tawang Sari); *Wonosobo's Lowland Community Forest: 250-500 m. asl.* (Kepil, Burat pine forest, Bejen water spring, Dempes pine forest, Lamuk pine forest, Ngalian pine forest, Wadaslintang dam, Wadaslintang outlet); *Dieng alternatif route* (Sigaluh salak plantation, Madukoro salak plantation, Talunombo agathis and pine plantation, Pagentan, Pejawaran, Batur highland); *Mount Sindoro* (Jumprit water spring, Candimulyo tea plantation, Kledung tobacco plantation, Damarkasian, Sojopuro, Gedekan, Ngelo, Andongsili, Blederan, Sigedang, Tambi tea plantation); *Mount Sumbing* (Margoyoso, Kwaderan, Rejosari, Kaliangkrik, Butuh, Batusari); *Mount Telomoyo* (Gedong Songo temples, Bandungan); *Mount Merapi and Merbabu* (Deles, Kalikuning, Plawangan hill, Kaliurang, Kalitengah Lor, Bale Rante, Ampel trekking route, Selo, Musuk, Sawangan, Kopeng, Getasan); *Menoreh Mountain* (Loano, Kaligesing, Girimulyo); *Mount Lawu* (Grojogan Sewu waterfall, Jobolarangan hill, Cemoro Sewu, Ngargoyoso forest park, Kemuning tea plantation, Jenawi rubber plantation); *Sewu Mountain* (Batuseribu, Nguntoronadi, Wuryantoro, Gajah Mungkur dam, Wanagama I forest, Dadapan's Pacitan bay, Pancuran Tegalombo); **East Java:** *Mount Wilis* (Telaga Ngebel), *Mount Kelud* (Kelud crater area), *Mount Kawi-Butak* (Cuban Rondo waterfall), *Mounts Bromo, Tengger, Semeru* (Wonokitri village, Bromo crater, Tuttur's Kutukan river, Cuban Pelangi waterfall), *Mount Argopuro* (Cuban Dalungan waterfall, Breml recreational area), *Iyang Mountain* (Gumitir, Boto-Mrawan, Ijen Mountain).

The data of the traditional use of *Selaginella* were obtained through interviews (in-depth interviews) with local residents (key person) about 2-3 people at each location. Selected respondents were adults (aged > 18 years), and were born and raised in that region. Respondents did not necessarily have high education or work as traditional healers. To maintain the spontaneity of respondents, interviews were conducted in an informal, unstructured, using a general interview guide; by showing a number of *Selaginella* specimens that have been collected previously from these locations, to ensure the local name of each taxon and other data. In some locations, field studies were conducted more than one visit to deepen the research, so there were 5-10 local residents per location that were interviewed.

The data recorded include the location, scientific name, local name, the efficacy in the treatment, the used parts, single or ingredients (if ingredients, then mentioned the other ingredients that are added), the preparation procedure, the charged dose, the duration of treatment, the abstinence during treatment and the best time of collection. In addition, other non-medical use was also noted (Table 2).

All species of *Selaginella* found at each study site were sampled and made into herbarium, and also identified further to confirm their identity. Identification was done by referring to the Alderwereld van Rosenburgh (1915a, b; 1916 1917 1918 1920 1922) and Alston (1934 1935a, b; 1937 1940); and herbarium sheets of the Herbarium Bogoriense collection (BO) especially which has been determined by Alston in the past. Herbarium specimens are stored mainly in the Herbarium Soloense (SO), Biology Department, Sebelas Maret University of Surakarta; with the collection numbers of ADS et al. The duplicate will be sent to the Herbarium Bogoriense (BO), Research Centre for Biology, Indonesian Institute of Sciences, Cibinong Bogor and the Leiden Herbarium (L), the Netherlands.

### Literature review

Literature review data were collected until the end of 2008, primarily through the collection of abstracts from: Medline ([www.pubmed.gov](http://www.pubmed.gov)), JSTOR ([www.jstor.org](http://www.jstor.org)), HighWirePress (<http://highwire.stanford.edu>), BioInfoBank (<http://lib.bioinfo.pl>), Elsevier ([www.sciencedirect.com](http://www.sciencedirect.com)), and Springer ([www.springerlink.com](http://www.springerlink.com)). Literature review data in the form of books, journals, abstracts, articles, patents, and bibliographies were also collected from Google ([www.google.com](http://www.google.com)) and Yahoo ([www.yahoo.com](http://www.yahoo.com)). Data collection is not restricted to language or time of publication. The data collection used the keyword

'*Selaginella*' and/or 'medicinal plant' and/or 'biflavonoid', including the 12 compounds of biflavonoid, namely: amentoflavone, 2',8"-biapigenin, delicaflavone, ginkgetin, heveaflavone, hinokiflavone, isocryptomerin, kayaflavone, ochnaflavone, podocarpusflavone A, robustaflavone, sumaflavone, and taiwaniaflavone. Selection was then performed manually by reading the manuscript one by one to separate the valuable data (from a trusted author and publisher) from the invaluable ones and to avoid duplication.

All the data whose strength had been proved were compiled in the tables. For traditional use, as well as field research, data collected includes location (country, place), scientific name, local name, the efficacy in the treatment, the used parts, single or ingredients (if ingredients, then mentioned the other ingredients that were added), governance way of preparation, the dose, duration of treatment, abstinence during treatment and the best time of collection. In addition, non-medical use and a list of libraries were also noted (Table 2).

### Data analysis

The ethnobotany data was explained descriptively and compared with utilization in the whole world.

## RESULTS AND DISCUSSION

### Species diversity

*Selaginella* species found in the 100s sites in Java and 10 sites outside Java is listed in Table 1; photo collection of some samples are presented in Figure 2. In this study, 40 species of *Selaginella* has been found, where 18 species can not be identified, although by matching them with Herbarium Bogoriense collection. Some species are thought to be a new species, new records or species introductions to Nusantara. *Selaginella* identification of the archipelago is difficult because most libraries for the identification of old age and require revision. *Selaginella* species mostly not been used as medicinal plants or other purposes of economic potential, but there are at least 10 species that have been used with varying intensity (Table 2). *S. involvens*, *S. ornata*, *S. willdenowii*, and *S. plana* used as medicinal ingredients. *S. ciliaris*, *S. singalanensis*, and *Selaginella* sp.1 used as an ornamental plant. *S. opaca*, *S. plana* and *S. willdenowii* used as a vegetable. *S. caudata* and *Selaginella* sp.4 used as a wrapping of fruits and vegetables from the garden.

**Table 1.** Diversity of *Selaginella* in the research sites.

Location	Scientific name
<b>Java*)</b>	<i>Selaginella aristata</i> Spring
	<i>Selaginella ciliaris</i> (Retz.) Spring
	<i>Selaginella frondosa</i> Warb.
	<i>Selaginella intermedia</i> (Bl.) Spring
	<i>Selaginella involvens</i> (Sw.) Spring
	<i>Selaginella longiaristata</i> Hieron
	<i>Selaginella opaca</i> Warb.
	<i>Selaginella ornata</i> (Hook & Grev.) Spring
	<i>Selaginella plana</i> (Desv. ex Poir.) Hieron
	<i>Selaginella remotifolia</i> Spring
	<i>Selaginella repanda</i> (Desv. & Poir.) Spring
	<i>Selaginella rothertii</i> Alderw.
	<i>Selaginella singalanensis</i> Hieron
	<i>Selaginella subalpina</i> Alderw.
	<i>Selaginella willdenowii</i> (Desv.) Baker
	<i>Selaginella zollingeriana</i> Spring
	<i>Selaginella</i> sp.1 “hortus-mekarsari”
<i>Selaginella</i> sp.2 “halimunensis”	
<i>Selaginella</i> sp.3 “kaliwiroensis”	
<b>Cycloops Mountain Nature Reserve</b>	<i>Selaginella angustiramea</i> Muell.
	<i>Selaginella caudata</i> (Desv.) Spring
	<i>Selaginella velutina</i> Cesati
	<i>Selaginella</i> sp.4
	<i>Selaginella</i> sp.5
<b>Mount Meja Protected Forest</b>	<i>Selaginella caudata</i>
	<i>Selaginella</i> sp.4
<b>Mount Gamalama</b>	<i>Selaginella cupressina</i> (Willd.) Spring
	<i>Selaginella</i> sp.6
<b>Atakejawe-Lolobata National Park</b>	<i>Selaginella angustiramea</i>
	<i>Selaginella velutina</i>
	<i>Selaginella</i> sp.7
	<i>Selaginella</i> sp.8
	<i>Selaginella</i> sp.9
<b>Mount Soputan</b>	<i>Selaginella cupressina</i>
	<i>Selaginella</i> sp.10
	<i>Selaginella</i> sp.11
<b>Nantu Game Reserve</b>	<i>Selaginella caudata</i>
	<i>Selaginella cupressina</i>
	<i>Selaginella vonroemeri</i> Alderw.
<b>Mount Rinjani</b>	<i>Selaginella</i> sp.12 “rinjaniensis”
	<i>Selaginella plana</i>
<b>Batu Kahu Nature Reserve</b>	<i>Selaginella opaca</i>
	<i>Selaginella remotifolia</i>
	<i>Selaginella</i> sp.13 “pseudoinvolvens”
	<i>Selaginella</i> sp.14 “pseudoplana”
<b>Mount Penumbing</b>	<i>Selaginella ketra-ayam</i> Alderw.
	<i>Selaginella</i> sp.15
<b>Mount Leuser National Park</b>	<i>Selaginella mayeri</i> Hieron.
	<i>Selaginella</i> sp.16
	<i>Selaginella</i> sp.17
	<i>Selaginella</i> sp.18

Note: \*) Javan selaginellas of BO collection that cannot find in this research are: *S. alutacia* Spring, *S. stipulata* (Blume) Spring, and *S. subspinulosa* Spring.

### Medicinal use of *Selaginella*

The traditional utilization of *Selaginella* based on field studies and literature review are presented respectively in Table 2. From Table 2, it appears that the traditional use *Selaginella* in Java and other islands in Nusantara is still relatively rare, compared to the number of species that grow in this region. At least the local name given shows the little popularity of this plant in the community, this is certainly due to least utilization of the plants. The dominance of Javanese herbal medicine systems (*jamu*) in traditional medicine in Indonesia and Malaysia, which is generally made from raw materials of about 30 species of cultivated plants, especially rhizomes and spices seem to have put aside the potential use of *Selaginella*, whose availability in nature is affected by seasons. From the field studies, it is known that the *Selaginella* is useful to treat wounds, menstrual disorders and for treatments before, during, and after giving birth, and to improve fitness and endurance of the body (tonic).

It is also known that the utilization of *Selaginella* was not only found in Nusantara, but relatively and evenly distributed throughout the world, although the number of species that have been used relatively limited. The result of literature study also shows that the herb is commonly used to treat wounds and bleeding, either external wounds or internal injuries such as menstrual disorders and postpartum hemorrhage, and also used as a tonic to improve fitness and stamina (Table 2). The more number of utilization of *Selaginella plana* (Desv. ex Poir.) Hieron. in Indonesia and Malaysia compared to other species may be linked to the size distribution of these plants on the islands of Nusantara, western Nusantara region considering the ancestral home of this species (Setyawan 2008). The utilization of *S. tamariscina* (Beauv.) Spring and *S. doederleinii* Hieron indicates the presence of the influence of traditional Chinese medicine in an area, considering that both are widely used in traditional Chinese medicine recipes that are relatively advanced.

### Field research

In the Indonesian language, especially new libraries generally name *Selaginella* as *cakar ayam*, referring to the leaf shape that resembles the scales on either side of the stem, like scales on a chicken leg (Dalimartha 1999); or *rane* uptake of Sundanese, the most common ethnic utilize this plant (Sastrapradja and Afriastini 1985). *Selaginella* has many local names, such as: *rumpit Solo*, *cemara kipas gunung*, *cakar ayam* (Java), *paku rane* (Sunda), *menter* (Betawi), *tai lantuan* (Madura), *usia* (Ambon), *sikili batu*, *lingonai* (Minangkabau) (Heyne 1927; Winter and Jansen 2003), and *shi shang bai* or *juan bai* (Chinese) (Bensky et al. 2004). But the field research shows local names are now beginning not to be recognized by people; even most of the respondents did mention the local names of *Selaginella* shown to them, except in West Java where the Sundanese people uniformly used the word *rane* to name a few species from genus *Selaginella*, particularly *S. plana*. On the Dieng plateau and surrounding the word *pulalata* was used to name *Selaginella opaca* Warb. In the vicinity of Mount Argopuro, East Java where there was pretty much of the



A



B



C



D



E



F



G



H



I



J



K



L



M



N



O



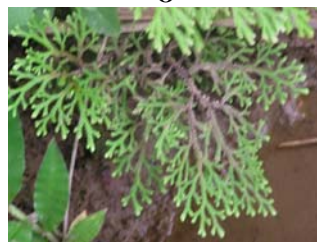
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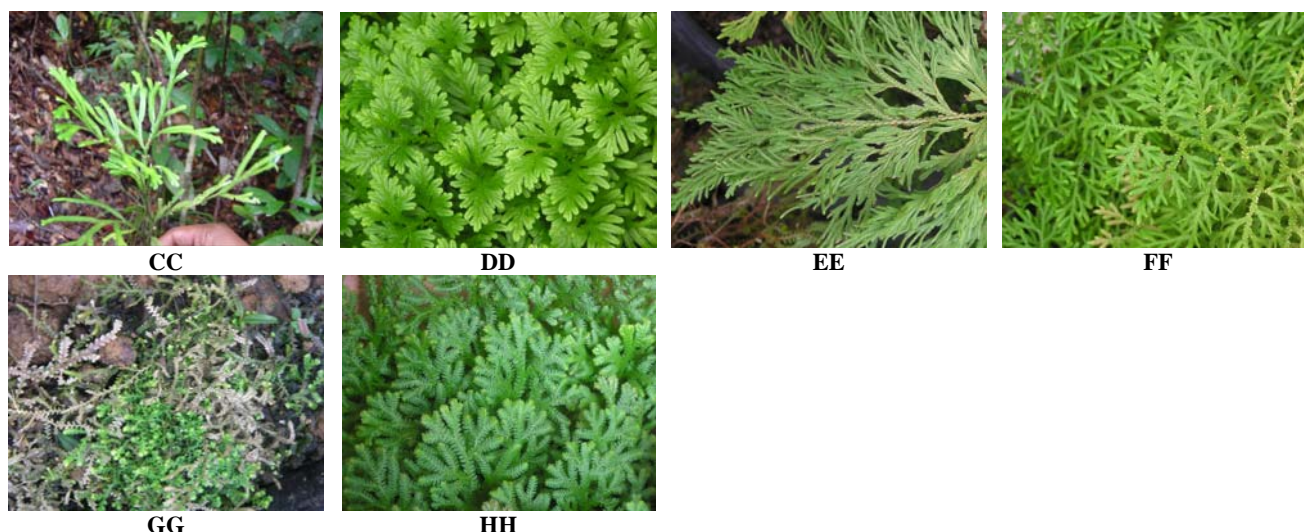
Z



AA



BB



**Figure 2.** Most Selaginella found in this research in Nusantara. A. *S. aristata*, B. *S. ciliaris*, C. *S. frondosa*, D. *S. intermedia*, E. *S. involvens*, F. *S. longiaristata*, G. *S. opaca*, H. *S. ornata*, I. *S. plana*, J. *S. remotifolia*, K. *S. repanda*, L. *S. rothertii*, M. *S. singalanensis*, N. *S. subalpina*, O. *S. willdenowii*, P. *S. zollingeriana*, Q. *Selaginella* sp.1, R. *Selaginella* sp.2, S. *Selaginella* sp.3, T. *S. angustiramea*, U. *S. caudata*, V. *S. velutina*, W. *Selaginella* sp.4, X. *Selaginella* sp.5, Y. *S. cupressina*, Z. *Selaginella* sp.7, AA. *Selaginella* sp.8, BB. *Selaginella* sp.9, CC. *S. vonroemeri*, DD. *Selaginella* sp.12, EE. *Selaginella* sp.13, FF. *Selaginella* sp.14, GG. *S. ketra-ayam*, HH. *S. mayeri* (source: photos Y until CC contributed by J. Kinho).

Madurese population, the word *tai lantuan* was still used to name a few species of *Selaginella* such as *S. plana*, *S. involvens* (Sw.) Spring, and *S. remotifolia* Spring.

In this study, most respondents did not know the local names or the benefits of *Selaginella*, either as raw drugs, food, ornamental plants or other benefits. Most of them were also unable to show the difference between one species of *Selaginella* from other species. However, many of whom were familiar with this plant, proved by the ability to indicate where the habitats of *Selaginella* grew when shown with the examples of the specimens and when they can be found abundantly. Generally, they identified the habitat of *Selaginella* as cliffs near springs, waterfalls or small water channel that was humid, wet and somewhat open; and tend to grow more abundant during the rainy season. They generally think its name was *pakis* or a kind of this plant. In fact, the word *pakis* is more properly applied to the tree ferns, such as Cyatheaceae, that have a similar appearance with *pakisaji* or cycads.

The field research shows the use of *Selaginella* in Indonesia is relatively limited, although there is a relatively large number of the species. Type of utilization is generally in the form of utilization as a medicinal plant, besides it was also noted the utilization as raw vegetables or *lalapan* and food wrappers from the field. Types of diseases and health problems that can be healed with this plants among others are injury, menstrual disorders and pregnancy, postpartum (puerperal), and to improve physical fitness. In the field research, the use of *Selaginella* as ingredients was only found in Java, while it was not found in ten other locations (islands) outside Java.

On the island of Java, the traditional use of *Selaginella* is generally limited in Western Java (West Java and Banten provinces). This may be related to the abundance and

higher diversity than in other parts of this island. This is supported by the habitat conditions which are more humid with higher rainfall and the level of a relatively higher slope as well, thus supporting the life of *Selaginella*. In East Java, the utilization of *Selaginella* was not found in the tribe of Javanese, Madurese, as well as the Tengger.

In Central Java, precisely in the Dieng plateau, *S. opaca* locally known as *pulalata* is used to cure wounds, menstrual disorders and to increase stamina. The name is specifically imposed only on *S. opaca*, whereas other species of *Selaginella* that grow on one plant site are not named *pulalata*, such as *S. remotifolia* and *S. ciliaris* (Retz.) Spring. As a drug for injury, *pulalata* freshly cleaned is to be chewed, and then placed on the wound as a poultice. Up to now the utilization is relatively limited and only used on small wounds, it is still used in case of accidents in the field, as first aid until a doctor or a drug is found in the nearest *warung* (small shops). *Pulalata* is also used as medicine for menstrual disorders and for increasing endurance, by boiling and eating them as vegetables. Besides, one respondent in the Kaliwiro subdistrict, Wonosobo stated that *S. plana* and *S. ornata* (Hook & Grev.) Spring shown to him was useful to strengthen the heart, although he did not know the local names of the plants, and did not know the procedure of how to use it. One respondent in Wonosobo informed that a private hospital in Yogyakarta once prescribed herbal remedies, '*jamu godog*', in which one form of simples was *S. plana*, to treat stroke. In Banjarnegara, *S. plana* was used to strengthen the immunity of patients against malaria. On the slopes of Mount Lawu, between Central and East Java the respondents knew that *S. opaca* is needed by a company for herbal medicine ingredients, but they themselves did not know the benefit and did not use them traditionally.

**Table 2.** Utilization of Selaginella medicinal plants through field research and literature review.

Scientific name	Local name	Location	Medical uses	Single/potion	Preparation	Dosage	Non-medical benefits	References
<b>Field research</b>								
<i>S. caudata</i> , <i>S. ciliaris</i>	-	Manokwari Wonosobo	-	-	-	-	Packaging Ornamental land cover	Field research Field research
<i>S. involvens</i>	Rane	MHSNP	Wounds, menstruation, fitness, liniment herb	Single/potion	Raw, cooked, baked	As needed	-	Field research
<i>S. opaca</i>	Pulalata	Dieng, Central Java	Wounds, menstruation, body fitness	Single	Poultice/ cooked	At sufficiently	-	Field research
	Rane	Bogor	Wounds, menstruation, post-childbirth	Single	Raw/ cooked	At sufficiently	Vegetable	Field research
	-	Mount Lawu	Purchased by pharmaceutical manufacturers	-	-	-	-	Field research
<i>S. ornata</i>	-	Wonosobo	Heart disease	-	-	-	-	Field research
	Rane	MHSNP	Wounds, menstruation, fitness, liniment herb	Single/potion	Raw, cooked, baked	As needed	-	Field research
<i>S. plana</i>	-	Wonosobo	Heart disease	-	-	-	-	Field research
	-	Wonosobo	Stroke	Potion	Cooked	5-6 handfuls	-	Field research
	-	Banjarnegara	Tonic for malaria patients	-	Cooked	½ glass, three times a day	-	Field research
	Rane	Bogor	Injury, menstrual disorders, uterine bleeding, and post-labor tonic	-	Raw/ cooked	-	Vegetable, Ornamental	Field research
<i>S. rothertii</i>	-	Bogor	-	-	-	-	Ornamental land cover	Field research
<i>S. singalanensis</i>	-	Wonosobo	-	-	-	-	Ornamental land cover	Field research
<i>S. willdenowii</i>	Rane	MHSNP	Wounds, menstruation, fitness, liniment herb	Single/potion	Raw, cooked, baked	As needed	Vegetable, Ornamental	Field research
<i>Selaginella</i> sp.1	-	Bogor	-	-	-	-	Ornamental	Field research
<b>Literature review</b>								
<i>S. argentea</i>	-	Malaysia, Sabah	Headache and high fever	-	-	-	-	Ahmad and Raji 1992
<i>S. asperula</i>	-	Columbia	Wound	-	-	-	-	Winter and Jansen 2003
<i>S. articulate</i>	-	Columbia	Treated to snake bite	-	-	-	-	Winter and Jansen 2003
<i>S. bryopteris</i>	-	India	Anti-inflammatory and cures venereal disease	-	-	-	-	Agarwal and Singh 1999
<i>S. ciliaris</i>	Semerak- merak	Malaysia, Selangor	Itchy on skin	-	Fresh for lotion	-	-	Hanum and Hamza 1999
<i>S. convoluta</i>	-	Brazil	Uterus illness	-	-	-	-	-
<i>S. delicatula</i>	-	India	Gastric illness	-	-	-	-	Dixit and Bhatt 1974; Mathew et al. 1999
<i>S. doederleinii</i>	-	Laos	Sedative	-	-	-	-	ARCBC 2004
	-	Cina	Anti-cancer	-	-	-	-	Lee et al. 1992; Lin et al. 1994
	-	Korea	Anti-cancer	-	-	-	-	Lee et al. 1992; Lin et al. 1994
	-	South East Asia	-	-	-	-	Food supplements	ARCBC 2004
<i>S. epirrhizos</i>	-	Guyana	Headaches treatment	-	-	-	-	DeFilippis et al. 2004
<i>S. exaltata</i>	-	Columbia	Decoction or spleen disease and stomach-aches for a prolonged period	-	-	-	-	Winter and Jansen 2003
<i>S. firmuloides</i>	-	Vanuatu	Post-childbirth	-	-	-	-	Bourdy and Walter 1992
<i>S. fissidentodes</i>	-	Madagascar	Cough	-	-	-	-	Winter and Jansen 2003
<i>S. imbricata</i>	-	Zambia	Not specific	-	-	-	-	Cunningham 1993
	-	Zimbabwe	Not specific	-	-	-	-	Cunningham 1993
<i>S. intermedia</i>	-	South East Asia	Decoction for stomach-ache and applied as poultice over the whole body for asthma.	-	-	-	-	Winter and Jansen 2003

<i>S. involvens</i>	-	India	Life extending	-	-	-	-	Dixit and Bhatt 1974; Sequiera 1998, Khare 2007
<i>S. lepidophyll</i>	-	Mexico	Decoction or infusion to treat kidney stone, gastric ulcers, diarrhea, rheumatism, dyspepsia, cystitis of liver, expulsion of the placenta, blood purify	-	-	-	-	Martinez 1961; Winter and Jansen 2003
<i>S. magnifica</i> , <i>Selaginella</i> spp. <i>S. moellendorffii</i>	-	Indonesia, BBR NP China	Headache and fever, as well as for skin care Gonorrhoea, bleeding, jaundice, acute hepatitis	-	-	-	-	Caniago and Siebert 1998 Shi et al. 2009
<i>S. myosurus</i>	-	- Gabon	Asthma, fever and fatigue	-	-	-	-	Bouquet et al. 1971 Sassen and Wan 2006
<i>S. ornata</i>	Rane	Indonesia	-	-	-	-	Cultural rituals Ornamental	Sastrapradja and Afriastini 1985 Winter and Jansen 2003
<i>S. padangensis</i>	-	Indonesia, Java Sumatra, Malaya, Kalimantan,	Young leaves are eaten as vegetable and as depurative or stomachic. Smoked like tobacco and used as poultice for vertigo and treated to toothache	-	-	-	-	Winter and Jansen 2003
<i>S. parkeri</i>	-	Guyana Guyana	Treat headaches	-	-	-	-	DeFilippis et al. 2004 van Andel 2000
<i>S. plana</i>	-	Indonesia	Not specified	-	-	-	Burned and lubricate to the baby hee Dish of raw vegetables	Heyne 1927 Uluk et al. 2001
	-	Indonesia, KM NP Indonesia, MHSNP Malaysia, Sabah	Bleeding Post-childbirth Headache and high fever	-	-	-	-	Harada et al. 2002 Ahmad and Raji 1992
<i>S. pallescens</i>	-	Columbia	Snake bite	-	-	-	-	Winter and Jansen 2003
	-	Mexico	Gastro-intestinal disorder	-	-	-	-	Winter and Jansen 2003
	-	Venezuela	Decoction as an emmenagogue and diuretic	-	-	-	-	Winter and Jansen 2003
<i>S. rupestris</i>	-	India Sumatra and Malaysia	Tonic, puerperal tonic, sedative Decoction as protective medicines after childbirth	-	-	-	Ornamental	Khare 2007 Winter and Jansen 2003
<i>S. tamariscina</i>	Juan bai	Cina	Anti cancer, wounds, bleeding, hemorrhoids	-	-	-	-	PAM 2008; Lee et al. 1992; Lin et al. 1994
	Keoun back	South Korea	Anti-cancer, menstrual pain, bruises, and asthma	-	-	-	-	Lee et al. 1992; Lin et al. 1994
	-	Far East	Anti cancer , inhibit gastric cancer	-	-	-	-	Kim 2007
	-	Rusia	Delay the aging process	-	-	-	-	Mamedov 2005
	Pakong tulog	Philippine	Wounds, bleeding, hemorrhoids	-	-	-	Vegetables	PAM 2008
	-	East Asia	Advanced cancer	-	-	-	-	Lee et al. 2009
	-	-	Blood purify, hematuria, prolapse of the anus and stanching	-	-	-	-	Carlo et al. 1999
<i>S. tamariscina</i> var. <i>pulvinata</i>	-	-	Tonic to prolong life, prevent amenorrhoea, hemorrhoid	-	Boiled	-	-	Khare 2007
<i>S. uncinata</i>	-	South China	Anti-bacterial, hepatitis, tumors	-	-	-	-	Ma et al. 2002
<i>S. wallichii</i>	-	-	Post-childbirth	-	Boiled	-	-	Khare 2007
	Paku merak	Malaysia, Selangor	Cleaning sputum/cough	-	Boiled, for taking bath	-	-	Hanum and Hamza 1999
<i>S. wallichii</i>	-	Sumatra, Malaya, southern Thailand	Decoction as protective medicines after childbirth	-	-	-	-	Winter and Jansen 2003
<i>S. wightii</i>	-	India	Urinary tract infections	-	-	-	-	Dixit and Bhatt 1974; Mathew et al. 1999
<i>S. willdenowii</i>	-	-	High fever, ashes to rub back pain	-	Infusion, and burned	-	-	Khare 2007
	-	Indonesia, Java	Young leaves are eaten as vegetable and as depurative or stomachic.	-	-	-	-	Winter and Jansen 2003
	-	Java	Decoction as a protective after childbirth and tonic, treating skin disease such as itches and ringworm	-	-	-	-	Winter and Jansen 2003



-	Malaya	Given internally as an infusion to treat fever and the ashes is used in liniment for backache	-	-	-	-	Winter and Jansen 2003
<i>Selaginella</i> spp.	Indonesia, MHSNP	Wounds	-	-	-	-	Nasution 1993
<i>Selaginella</i> spp.	Rane Indonesia, MHSNP	Post-childbirth and menstruation	-	-	-	-	Setyawan and Darusman 2008
<i>Selaginella</i> spp.	Cakar ayam Indonesia	Cancer, respiratory infection, injury, heart disorders, urinary infections, broken bones and rheumatism	Single/ herb	Fresh, dry, raw/cooked	-	-	Dalimartha 1999; Wijayakusuma 2004
<i>Selaginella</i> spp.	Malaysia	Endurance	-	-	-	-	Batugal et al. 2004
<i>Selaginella</i> spp.	Sumatra, Java	Counter poison, drug fever, washing blood, menstrual blood purifier, eczema and for drug after childbirth	-	-	-	-	Warintek 2002

Note: The plant used as samples are all, especially the leaves. KMNP: Kayan Mentarang National Park, MHSNP: Mount Halimun-Salak National Park. BBBR NP: Bukit Baka Bukit Raya National Park.

In West Java, the respondents generally knew the traditional benefits of *rane* to treat wounds, menstrual disorders, and to improve fitness. In West Java, particularly in the lowlands of Bogor, sub-districts such as West Bogor, Darmaga, and Ciampea, *S. plana*, known as *rane* was used as drugs for injury, menstrual disorders and uterine bleeding, and post-labor tonic. As a drug for wounds, fresh herbs that have been chewed is put on the wound, while for other treatment purposes it is used by cooking or eating it straight as a vegetable. Meanwhile in the highlands of Bogor, for example in the sub-district of Pamijahan, or at sub-district Kalapanunggal, Sukabumi, the term *rane* is also used for some other species such as *S. willdenowii* (Desv.) Baker, *S. involvens*, and *S. ornata* also used for the purpose of treatment as above, besides the ash produced from burning dried herbs are used as a liniment to relieve stiffness and warm the back.

#### Literature review

*Selaginella* has been prescribed in traditional medicine of China and India, which has been thousands of years old. The utilization of these medicinal plants was also done by various other cultures, although generally limited to specific species. *Selaginella* can be found in the pharmacopoeia in Asia, Africa and Latin America, but not found in Europe and North America (Duke et al. 2002). The high diversity of species of *Selaginella* in the first three locations is likely to be the cause of this difference in the rates of utilization. The intensity of the highest utilization was carried out in China, especially for *S. tamariscina* (include var. *pulvinata* Spring), *S. doederleinii*, *Selaginella moellendorffii* Hieron, *S. uncinata*, and *S. involvens* (Chang et al. 2000; Lin et al. 1991; Wang and Wang 2001). In India, there were several species of *Selaginella* used as ingredients, such as *S. involvens*, *Selaginella rupestris* Spring, *S. tamariscina* var. *pulvinata*, *S. wallichii* Spring, *S. willdenowii* and others (Dixit and Bhatt 1974; Mathew et al. 1999; Khare 2007).

*Selaginella* traditionally used to treat several diseases such as: injury, treatment of post-childbirth, cancer, skin diseases, headaches, fever, respiratory infections, urinary tract infections, menstrual disorders, liver disorders, fractures and arthritis. The parts used are all parts of the plants, although sometimes they are called only a leaf

(herb) (Setyawan and Darusman 2008). Its use can be done singularly or in combination, fresh or dried, eaten immediately or cooked before (Dalimartha 1999; Wijayakusuma 2004). These plants are sweet and have warm effect (Bensky et al. 2004).

**Nusantara (Malesia).** In Nusantara, the utilization of *Selaginella* is still relatively limited. The Javanese traditional herbal medicine or *jamu*, as a traditional medicine's most advanced systems in the region, tends to use rhizomes and spices, while the use of herbs and wild grasses is more limited.

In Kalimantan, the Dayaks in the vicinity of Kayan Mentarang NP, East Kalimantan using *S. plana* to treat bleeding (Uluk et al. 2001), whereas in the surrounding of Bukit Baka-Bukit Raya NP, West Kalimantan, *Selaginella magnifica* Warb and several other species of *Selaginella* are used to treat headaches and fever, as well as for skin care (Caniago and Siebert 1998). In Sabah, Malaysia, *Selaginella argentea* (Wall. ex Hook. & Grev.) Spring and *S. plana* are used to treat headaches and high fever (Ahmad and Raji 1992). In northern Borneo, the dry leaves of *S. padangensis* Hieron is smoked like tobacco and also used as poultice for vertigo and treated to toothache (Winter and Jansen 2003).

In Java, Sundanese people in the surrounding of Mount Halimun-Salak NP, West Java, use some species of *Selaginella* to treat wounds, post-childbirth, menstrual disorders, and as a tonic (Nasution 1993; Harada et al. 2002; Setyawan and Darusman 2008). *S. plana* leaves is drunk in decoction as tonic for treatment after childbirth (Harada et al. 2002). *Selaginella intermedia* (Bl.) Spring is given in decoction for stomach-ache and is applied as poultice over the whole body for asthma. In Java, young leaves of *S. ornata* and *S. willdenowii* are eaten as vegetable and also as depurative or stomachic. *S. willdenowii* is also used in decoction as a protective medicine after childbirth and as an ingredient of tonic as well as to treat skin disease such as itches and ringworm (Winter and Jansen 2003).

In Sumatra and Java, some species of *Selaginella* are used to counter poison, drug fever, washing blood, menstrual blood purifier, eczema and for drug after childbirth (Warintek 2002). In Sumatra, Kalimantan, and Malaya, *S. padangensis* is used as poultice for vertigo and

treated to toothache. In Sumatra and Malaysia, *S. stipulate* is used in decoction as protective medicines after childbirth. In Sumatra, Malaya, and southern Thailand, *S. wallichii* is used in decoction as protective medicines after childbirth. In Malaya, *S. willdenowii* is also given internally as an infusion to treat fever and the ashes is used in liniment for backache (Winter and Jansen 2003). In Kedah, Malaysia, *Selaginella* is used to increase body resistance (Abu-Shamah et al. 2000; Batugal et al. 2004).

In Papua New Guinea, *Selaginella flabellate* Spring is used to treat headaches and fever (Kambuou 1996). In the Philippines, *S. tamariscina* (pakung tulog) is used to treat wounds, bleeding from peptic ulcers or excessive menstruation, and hemorrhoids (PAM 2008). In the mainlands of Southeast Asia, *S. doederleinii* is used as drugs for various diseases and as dietary supplements, while in Laos *Selaginella delicatula* (Desv. ex Poir.) Alston is used to relieve tension (ARCBC 2004). In Indonesia, many species of *Selaginella* is offered in the form of dry powder, both local as *S. plana* and imports from China, in particular as *S. tamariscina* and *S. doederleinii*.

**China.** In China and the neighboring countries, the most widely used species is *S. tamariscina*. The area mentioned is the center of distribution of this species, with quite thorough distribution, both wild and cultivated plants. The checking of Herbarium Bogoriense (BO) collection indicates that in Nusantara, *S. tamariscina* only grows wild on the island of Flores, Sulawesi, and the Philippines (personal observation), while it may be naturalized from cultivated crop in West Kalimantan, which significantly has Chinese population. In China, the dry powder of *S. tamariscina* that has been cooked is used for blood clotting. Decoction of the dry powder used for amenorrhea orally either alone or mixed with some other herbs. For bleeding, in the hemorrhoid and in the uterine bleeding, the dry powder is mixed with some other plants then boiled for drinking. For single use of rectocele (NAS 1975). *S. tamariscina* which contains abundant of amentoflavone has been used for the treatment of advanced cancer in traditional medicine (Lee et al. 2009), and has been used in traditional oriental medicine to blood purify, hematuria, prolapse of the anus and stanching (Carlo et al. 1999). It has also been used as an antioxidant, vasorelaxation, anti-HIV and anti-angiogenesis agent (Lee et al. 2009). *S. tamariscina* is the most useful plant *Selaginella* in traditional folk medicine practiced in China, Hong Kong, Japan and Korea (But et al. 1997). *S. uncinata* which usually grow in southern China is used to fight diseases caused by bacteria, hepatitis infections and tumors. *S. moellendorffii* has been used in traditional Chinese folk medicine for treatment of gonorrhoea, bleeding, jaundice, and acute hepatitis (Shi et al. 2009). *S. doederleinii* has been used for the treatment of cardiovascular diseases (Chao et al. 1987; Lin et al. 1994; Lu et al. 2004) and an anti tumor herb used for lung, nasopharyngeal, and esophageal cancers (Jia 1985) as well as hystero-myoma (Huang 1982).

**India.** In India, *Selaginella involvens*, *S. rupestris* and *S. tamariscina* var. *pulvinata* are used as tonic to anti ageing (Dixit and Bhatt, 1974; Sequiera 1998; Khare

2007), meanwhile *S. delicatula* is used to cure bellyache, and *S. wightii* to cure infection of bladder (Dixit and Bhatt 1974; Mathew et al. 1999). *S. rupestris* is also used in decoction as sedative. *S. tamariscina* var. *pulvinata* is used in decoction to prevent amenorrhea, hemorrhage effect by pile or prolepses of the rectum. *S. wallichii* is treated in decoction to after childbirth. *S. willdenowii* is used in infusion to cure high fever, while its ash is used for liniment the backache (Khare, 2007). *S. bryopteris* is treated as anti-inflammatory and cures venereal disease (Agarwal and Singh 1999), its usage is also known by local indigenous people, such as Songhati people (Singh et al. 2002).

**Oceania and Asia.** In Vanuatu, *Selaginella firmuloides* Warb is used to assist child birth (Bourdy and Walter 1992). In the eastern part of Russia *S. tamariscina* is used to slow down the aging process (Mamedov 2005). In China and South Korea *S. doederleinii* is used as anticancer drugs (Lee et al. 1992; Lin et al. 1994). In South Korea, *S. tamariscina* which traditionally treated as anti cancer is significantly proved inhibit gastric cancer as showed in cell cycle analysis and other assay (Kim 2007). In Korea, *S. tamariscina* is also used to cure menstrual disorder, bruise, and asthma, while in Sri Lanka it is used to cure headache, paralysis, and to refuse black magic. *S. myosurus* is used to cure asthma, fever and fatigue (Bouquet et al. 1971).

**Africa.** In some African countries, like Zambia and Zimbabwe, *Selaginella imbricata* (Forsk.) Spring ex Decaisne is traded as medicinal ingredients that has lead to threatening its sustainability in nature (vulnerable, VU) (Cunningham 1993; Golding 2002). In Madagascar, *S. fissidentodes* is used for cough (Winter and Jansen 2003).

**Latin America.** In Brazil, *Selaginella convoluta* (Arn.) Spring is used to prevent and treat diseases related to female reproductive system (de Almeida-Agra and Dantas 2004). In Guyana, the ashes of *Selaginella parkeri* (Hook. & Grev.) Spring (= *Selaginella pedata* Klotzsch) is used by putting it hard onto the heel of the baby gently that can help the baby start walking (van Andel 2000). *Selaginella parkeri* and *S. epirrhizos* Spring are also used to treat headaches (DeFilippis et al. 2004). In Mexico, *S. lepidophylla* is used in decoction or infusion to treat kidney stone, gastric ulcers, diarrhea, rheumatism, dyspepsia, cystitis of liver, to facilitate the parting and expulsion of the placenta, to purify the blood (Martinez 1961; Winter and Jansen 2003). In Columbia, *S. asperula* treat to wound, while rhizome of *S. exaltata* is used in decoction for spleen disease and stomach-aches for a prolonged period, while *S. articulate* and *S. pallescens* treat to snake bite. In Venezuela, *S. pallescens* is marketed and used in decoction as an emmenagogue and diuretic, while in Mexico, it treat to gastro-intestinal disorder (Winter and Jansen 2003).

#### Other uses

**Foodstuffs.** In Nusantara (Malesia), the utilization of *Selaginella* as food ingredients is very limited. In the field research, the use of *Selaginella* as food (vegetables) is found only in West Java, ranging from lowlands of Bogor to the area around the mountains of Halimun-Salak. In Bogor, species that is consumed in general is only *S. plana*,

whereas in the plateau region, *S. willdenowii* is also consumed by people. Heyne (1927) notes that in West Java, young buds of *S. plana* can be eaten as vegetables and for medicinal purposes. PAM (2008) notes that in the Philippines, young leaves of *S. tamariscina* can be cooked as vegetable.

**Ornamental plants.** The utilization of *Selaginella* as an ornamental plant is found in West Java. For example, some sellers of ornamental plants in Bogor, including the Mekarsari Park at Cileungsi once sold *Selaginella* sp.1. which allegedly was an introduced species as for ornamental plants, whereas in the Sringanis Garden and Medicinal Plant Garden of Karyasari *S. plana* and *S. willdenowii* were once sold as medicinal plants. According Sastrapradja and Afriastini. 1985, *S. ornata* is planted in Bogor as an ornamental plant, although the stem is easily broken, so it must be treated with caution. The field research shows that in Kejiwan village, Wonosobo subdistrict, Wonosobo district, *S. ciliaris* was left to grow wild or they were planted in cemeteries to cover the surface of the soil to avoid scouring of rain urging the growth of other weeds, and also to beautify the cemetery. In Bogor Botanical Garden, *S. rothertii* is used as the land cover on the part of the collection of *Selaginella* species. In Wonosobo, *Selaginella singalanensis* Hieron was found as a new record with huge potential for land cover crops, because it can be grown in the surface of the soil quickly to cover the land, and can appear in blue metallic color on shaded conditions, such as *S. willdenowii*.

According to the author's observation (ADS 2008), about 10-15 species *Selaginella* potential as an ornamental plant, and comes from Java, Sumatra, Papua, Lombok and Bali, and can grow well in the experiment field in Java located in the highlands (Wonosobo, 700-800 m asl) and in the lowlands (Bogor, 200-250 m asl), but some species can grow well only in the highlands, such as *S. opaca* and *S. remotifolia*. Some remaining species only grow well in lowlands, such as *S. rothertii* whose seedlings are obtained from the Bogor Botanical Gardens and Bogor Agricultural University at Darmaga Campus. *S. rothertii* is an endemic plant of West Java, which is generally easily found in lowland that is moist and open, but there are also variants found in the highland. Observations of *Selaginella* collections of Herbarium Bogoriense indicate that this species ever found wild in Cibodas Botanical Gardens and the Puncak area in general. One species, i.e. *S. willdenowii* is endemic in western Java, grown naturally from Banten eastward to Mount Slamet, it grows well in Wonosobo, Central Java, but cannot beat the growth of other species, and on the contrary it grows dominant species in the experimental garden of Bogor. This plant has a bluish appearance that very attractive for ornamental plants. *Selaginella* is very attractive as an ornamental plant leaves, given his appearance can be quite diverse. In one species, sometimes there are various shapes and shades of leaves, for example *S. ornata*, so that in the past this species was divided into several species. Khare (2007) states that in India, *S. rupestris* is used as an ornamental plant.

**Crafts materials.** According to de Winter and Jansen (2003) reported several species of *Selaginella* can be used

as craft material. But in this field of research such a thing is not found and no support from also other libraries. One reason possibly because the habit of *Selaginella* tend to be brittle and easily broken. Some species are thought to have high chemical levels even curl when dried and not suitable for crafting, such as *S. involvens*.

**Socio-cultural (traditional).** In Gabon, *Selaginella myosurus* (Sw.) Alston is used for rituals or for other cultural aspects (Sassen and Wan 2006). There are no records for the utilization of *Selaginella* for the purpose of customs in Nusantara. Field observations in several batik shops and museums in Solo, and visits to the library palace of Solo kingdoms did not find any real pattern designs inspired from *Selaginella*, although there are some designs that are inspired from other ferns.

**Other utilization.** Other utilization, i.e. as food wrappers is found in Manokwari, West Papua. In these locations there are several species of leafy *Selaginella* that is wide enough to be used to wrap the sago, fruits, or other crops from the forest or fields.

Medicinal benefit of *Selaginella* gives opportunity for commercial effort. In Southeast Asia a wide variety of drug materials is exported and imported; *Selaginella* are bought and sold as drugs, and used either alone or sometimes, mixed. In Indonesia, several *Selaginella* is marketed as dry herbs or dry powder, both local species such as *S. plana* and *S. willdenowii*, and imported species, especially *S. tamariscina* and *S. doederleinii*. In Bangkok, Thailand imported *S. tamariscina* is widely marketed in traditional medicinal shops (Nitta et al. 1980). In Zambia and Zimbabwe, wild collection of *S. imbricata* threatens the sustainability in nature (Cunningham 1993; Golding 2002). In Mexico, the popularity of *S. lepidophylla* has been resulted in legislation to regulate collection from the wild (Winter and Jansen 2003).

## CONCLUSION

*Selaginella* has been used traditionally to treat wounds and bleeding such as menstruation, uterine disorders and other internal injuries. It is also used as a tonic to improve fitness and to expand life span. Several species of *Selaginella* are also used as food (raw vegetables), ornamental plants, handicrafts materials as well as socio-cultural and packaging materials. The utilization of *Selaginella* is very limited compared to the number of species and the potential benefits of the medicine, so it requires further ethnobotanical and phytochemical researches.

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## REFERENCES

- Abu-Shamah Z, Faridz ZF, Rizal MK, Fadhilah ZW, Abdullah I. 2000. Ethnobotanical study in Kuala Nerang, Kedah. In: Chang YS, Mohtar M, Bramaniam V, Abu-Samah Z (eds). Towards bridging science and herbal industry: Proceedings of the Seminar on Medicinal and Aromatic Plants. Forest Research Institute Malaysia, Kepong, Kuala Lumpur, 12-13 September 2000.
- Agarwal SS, Singh VK. 1999. Immunomodulators: a review of studies on Indian medicinal plants and synthetic peptides; part 1. medicinal plants. Pinsa 65 (3&4): 179-204
- Ahmad F bin, Raji H. 1992. Medicinal plants of the Murut community in Sabah. In: Ghazzaly I, Siraj O, Murtedza M. (eds.). Forest biology and conservation in Borneo. Centre for Borneo Studies. Kota Kinabalu.
- Alderwereld van Rosenburgh CRWK van. 1915a. Malayan fern allies. Department of Agriculture, Industry, and Commerce. Batavia.
- Alderwereld van Rosenburgh CRWK van. 1915b. New or interesting Malay ferns 7. Bull Jard Bot Buitenzorg 2 (20): 1-28.
- Alderwereld van Rosenburgh CRWK van. 1916. New or interesting Malay ferns 8. Bull Jard Bot Buitenzorg 2 (23): 1-27.
- Alderwereld van Rosenburgh CRWK van. 1917. New or interesting Malay ferns 9. Bull Jard Bot Buitenzorg 2 (24): 1-8.
- Alderwereld van Rosenburgh CRWK van. 1918. New or interesting Malay ferns 10. Bull Jard Bot Buitenzorg 2 (28): 1-66.
- Alderwereld van Rosenburgh CRWK van. 1920. New or interesting Malay ferns 11. Bull Jard Bot Buitenzorg 3 (2): 129-186.
- Alderwereld van Rosenburgh CRWK van. 1922. New or interesting Malay ferns 12. Bull Jard Bot Buitenzorg 3 (5): 179-240.
- Al-Janabi S. 2001. Medicinal plants, biodiversity for health-care. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). Eschborn, GE.
- Alston AHG. 1935a. The *Selaginella* of the Malay Islands: I. Java and the Lesser Sunda Islands. Bull Jard Bot Buitenzorg 3 (13): 432-442.
- Alston AHG. 1935b. The Philippines species of *Selaginella*. Philippines J Sci 58: 359-383.
- Alston AHG. 1937. The *Selaginella* of the Malay Islands: II. Sumatra. Bull Jard Bot Buitenzorg 3 (14): 175-186.
- Alston AHG. 1940. The *Selaginella* of the Malay Islands: III. Celebes and the Moluccas. Bull Jard Bot Buitenzorg 3 (16): 343-350.
- Alston, AHG. 1934. The genus *Selaginella* in the Malay Peninsula. Gard Bull Strait Settl 8: 41-62.
- Andrade-Cetto A, Heinrich M. 2005. Mexican plants with hypoglycaemic effect used in the treatment of diabetes. J Ethnopharmacol 99: 325-348.
- ARCBC. 2004. Checklist of medicinal plants in Southeast Asia. ASEAN Regional Centre for Biodiversity Conservation. Manila.
- Batugal, PA, Kanniah J, Young LS, Oliver JT (eds). 2004. Medicinal plants research in Asia, Vol 1: The framework and project workplans. International Plant Genetic Resources Institute-Regional Office for Asia, the Pacific and Oceania (IPGRI-APO). Serdang, Selangor DE, Malaysia
- Bensky D, Clavey S, Stöger E. 2004. Chinese herbal medicine; materia medica. 3rd ed. Eastland Press. Seattle, WA.
- Bodeker C, Bodeker G, Ong CK, Grundy CK, Burford G, Shein K. 2005. WHO global atlas of traditional, complementary and alternative medicine. World Health Organization. Geneva.
- Bouquet A, Cave A, Paris R. 1971. Plantes medicinales du Congo-Brazzaville (III) plantes medicinales et phytotherapie. Tome 5 (2): 154-158
- Bourdy G, Walter A. 1992. Maternity and medicinal plants in Vanuatu I. the cycle of reproduction. J Ethnopharmacol 37: 179-196
- But PPH, Guo JX, Kimura T. 1997. International collation of traditional and folk medicine: northeast Asia, part II. World Scientific Pub Co Inc, Hong Kong
- Camus JM. 1997. The genus *Selaginella* (Selaginellaceae) in Malesia. In Dransfield J (ed). Plant Diversity of Malesia III: 59-69.
- Caniago I, SF Siebert. 1998. Medicinal plant ecology, knowledge and conservation in Kalimantan, Indonesia. Econ Bot 52 (3): 229-250.
- Carlo GD, Masclo N, Izzo AA, Capasso F. 1999. Flavonoids: Old and new aspects of a class of natural therapeutic drugs. Life Sci. 65: 337-353
- Chang C-Y, Chen X-D, Xiao X-Y, Lin R-C. 2000. Studies on micromorphology and its significance in anatomy and identification of *Selaginella*. J Medic Anal 20 (2): 75-78.
- Chao LR, Seguin E, Tillequin F, Koch M. 1987. New alkaloid glycosides from *Selaginella doederleinii*. J Nat Prod 50 (3): 422-426
- Chikmawati T, Miftahudin. 2008. Biodiversitas dan potensi marga *Selaginella* sebagai anti oksidan dan anti kanker [Laporan Penelitian]. LPPM IPB. Bogor.
- Chikmawati T, Setyawan AD, Miftahudin. 2008. Phytochemical content of *Selaginella* plant extracts on the island of Java. 8<sup>th</sup> Seminary and Congress of Indonesian Association of Plant Taxonomy (PTTI). Cibinong Science Center, Bogor-Indonesia, 21-23 October 2008. [Indonesia]
- Cunningham AB. 1993. African medicinal plants: setting priorities at the interface between conservation and primary health care. People and Plants Working Paper 1. UNESCO. Paris.
- Dalimartha S. 1999. Atlas of Indonesian medicinal plants. Trubus Agriwidy. Yogyakarta. [Indonesia]
- de Almeida-Agra C, Dantas IC. 2004. Identificacao dos fitoterapicos indicados pelos raizeiros e utilizados pelas mulheres no combate a enfermidades do aparelho geniturinario na cidade de Campina Grande - PB Paraiba. Universidade Estadual da Paraiba. Paraiba.
- DeFilipps RA, Maina SL, Crepin J. 2004. Medicinal plants index of the Guianas (Guyana, Surinam, French Guiana). Smithsonian Institution. Washington, DC.
- Dixit RD, Bhatt GK. 1974. Ferns: a much neglected group of medicinal plants II. J Res Indian Med 9: 59-68.
- DNP. 1992. Dictionary of natural products. Chapman and Hall. New York.
- Duke JA, Bogenschutz-Godwin MJ, du Cellier J, Duke P-AK. 2002. Handbook of medicinal herbs. 2<sup>nd</sup> ed. CRC Press. Boca Raton.
- Erdelen WR, Adimihardja K, Moesdarsono H, Sidik. 1999. Biodiversity, traditional medicine and the sustainable use of indigenous medicinal plants of Indonesia. Indig Knowl Dev Mon 7(3): 3-6.
- Farnsworth NR, Akerele O, Bingel AS, Soejarto DD, Guo Z. 1985. Medicinal plants in therapy. Bull World Health Organ 63: 965-981.
- Gentry AH. 1993. Tropical forest biodiversity and the potential for new medicinal plants. In: Kinghorn AD, Balandrin MF (eds). Human medicinal agents from plants. American Chemical Society. Washington, DC.
- Golding JS (ed). 2002. Southern African plant red data lists. SABONET. Pretoria.
- Hanum IF, Hamzah N. 1999. The use of medicinal plant species by the Temuan Tribe of Ayer Hitam forest, Selangor, Malaya. Pertanika J Trop Agric Sci 22 (2): 85-94.
- Harada K, Rahayu M, Muzakkir A. 2002. Medicinal plants of Gunung Halimun National Park, West Java, Indonesia. Biodiversity Conservation Project -JICA, PHPA & LIPI. Bogor.
- Heyne K. 1927. De nuttige planten van Nederlands-Indie. 2nd ed. Vol. 1. Departement van Landbouw, Nijverheid en Handed in Nederlands-Indie. 's-Gravenhage.
- Huang CD. 1982. Guizhi Fuling Wan in treating 60 cases of hystero-myoma. New Trad Chin Med 10: 24-26.
- Huang T-C. 2006. Flora of Taiwan. Vol. 6. 2nd ed. National University of Taiwan, Taipei
- Jansen L. (1993) Indigenous knowledge systems in health care: A traditional medical system in Indonesia. [Thesis]. University of Amsterdam. Amsterdam.
- Jerny AC. 1990. Selaginellaceae. In: Kubitzki K, KU Kramer, PS Green (eds). The Families and Genera of Vascular Plants, 1. Pteridophytes and Gymnosperms. Springer. Berlin.
- Jia K. 1985. Prevention and treatment of carcinoma in traditional Chinese medicine. Commercial Press. Hong Kong.

- Kambuou RN. 1996. Papua New Guinea: country report to the FAO International technical conference on plant genetic resources. FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17-23 June 1996.
- Kazahara S. 1986. Medicinal herb index in Indonesia. PT. Eisai Indonesia. Jakarta.
- Khare CP (ed). 2007. Indian medicinal plants; an illustrated dictionary. Springer. Berlin.
- Kim CY, Yang DH, Kang JW, Hwang EH. 2007. Korean medicine, complementary and alternative medicines (CAM) therapy after gastrectomy of gastric cancer in a hospital. *J Korean Oriental Med* 28 (3): 86-99
- Lee IR, Song JY, Lee YS. 1992. Cytotoxicity of folkloric medicines in murine and human cancer cells. *Korean J Pharmacog* 23, 132-136.
- Lee JS, Lee MS, Oh WK, Sul JY. 2009) Fatty acid synthase inhibition by amentoflavone induces apoptosis and antiproliferation in human breast cancer cells. *Biol Pharm Bull* 32 (8): 1427-1432
- Lin L-G, Zhang Q-Q, Huang Y-Q. 1991. Pteridophyta. In: Lin L.-G. (ed.). *Flora Fujianica*. 2nd ed. Fujian Science and Technology Press. Fuzhou.
- Lin R, Skaltsounis A-L, Seguin E, Tillequin F, Koch M. 1994. Phenolic constituents of *Selaginella doederleinii*. *Planta Medica* 60 (2): 168-170.
- Lopez-Saez JA, Perez-Alonso M, Negueruela AV. 1994. Biflavonoids of *Selaginella denticulata* in Spain. *Naturforsch* 49c: 267-270.
- Lu YP, Chen YG, Wen J. 2004. A new bioflavone *Selaginella doederleinii*. *Yunnan Zhiwu Yanjiu* 26 (2): 226-228.
- Ma L-Y, Wei F, Ma S-C, Lin RC. 2002. Two new chromone glycosides from *Selaginella uncinata*. *Chinese Chem Lett* 13 (8): 748-751.
- Macilwain C. 1998. When rhetoric hits reality in debate on bioprospecting. *Nature* 392: 535-540.
- Mamedov N. 2005. Adaptogenic, geriatric, stimulant and antidepressant plants of Russian Far East. *J Cell Mol Biol* 4: 71-75.
- Martinez M. 1961. Plantas medicinales. 5th ed. Ediciones Botas. Mexico DF.
- Mathew PJ, Mathew D, Unnithan CM, Pushpangadan P. 1999. Ethnomedical information of some Pteridophytes of Kerala sector of Western Ghats. In: Sasikumar B, Krishnamurti B, Rema J, Ravindren PN, Peter KV (eds). *Biodiversity conservation and utilization of spices, medicinal and aromatic plants*. Indian Institute of Spices Research. Calicut.
- MOSPP. 1993. Indonesian country study in biological diversity. Ministry of State for Population and Environment. Jakarta.
- NAS. 1975. Herbal pharmacology in the People's Republic of China. Printing and Publishing Office National Academy of Sciences. Washington, DC.
- Nasution RE. 1993. Buku 1 : Tumbuhan obat. Prosiding Seminar dan Lokakarya Nasional Etnobotani II. Yogyakarta 24-25 Januari 1995. Puslitbang Biologi LIPI, Fakultas Biologi UGM, Ikatan Pustakawan Indonesia dan Ikatan Pustakawan Indonesia (IPI). Jakarta.
- Nitta A, Pecharaply D, Amatayakul T. 1980. A comparative study of crude drugs in Southeast Asia, part XI: Chinese drug materials in Bangkok. *Southeast Asian Studies* 18 (1): 124-153
- PAM. 2008. Pakong tulog, *Selaginella tamariscina*, resurrection fern: herbal medicinal plants. Manila. Philippine Alternative Medicines. [www.stuartschange.com/Pakongtulog.html](http://www.stuartschange.com/Pakongtulog.html)
- Raskin I, Ribnicky DM, Komarnytsky S, Ilic N, Poulev A, Borisjuk N, Brinker A, Moreno DA, Ripoll C, Yakoby N, O'Neal JM, Cornwell T, Pastor I, Fridlender B. 2002. Review: Plants and human health in the twenty-first century. *Trends Biotechnol* 20 (12): 522-531.
- Riswan S, Sangat-Roemantyo H. 2002. Jamu as traditional medicine in Java, Indonesia. *South Pacific Study* 23 (1): 1-10.
- Sassen M, Wan M. 2006. Biodiversity and local priorities in a community near the Ivindo National Park Makokou, Gabon. Project IRET/CENAREST and CIFOR. Makokou/Ipasa, Gabon.
- Sastrapradja S, Afriastini JJ. 1985. Kerabat paku. LBN-LIPI. Bogor.
- Sato M, Ramarathnam N, Suzuki Y, Ohkubo T, Takeuchi M, Ochi H. 1996. Varietal differences in the phenolic content and superoxide radical scavenging potential of wines from different sources. *J Agric Food Chem* 44: 37-41.
- Schumacher T. 1996. Plants used in medicine. In: Whitten T, Whitten J (eds). *Indonesian heritage plants*. Buku Antar Bangsa. Jakarta.
- Seigler DS. 1998. Plant Secondary Metabolism. Dordrecht. Kluwer.
- Sequiera KM. 1998. Diversity, systematics, distribution, and taxonomy of epiphytic pteridophytes of Kerala part of Western Ghats, South India. *Indian Fern J* 15: 106-130.
- Setyawan AD, Darusman LK. 2008. Review: Biflavonoid compounds of *Selaginella* Pal. Beauv. and its benefit. *Biodiversitas* 9 (1): 64-81. [Indonesia]
- Setyawan AD. 2008. Species richness and geographical distribution of Malesian *Selaginella*. 8th Seminary and Congress of Indonesian Plant Taxonomy Association ("PTTI"), Cibinong Science Center, Bogor-Indonesia, 21-23 October 2008;
- Shi S, Zhou H, Zhang Y, Huang K. 2008. Hyphenated HSCCC-DPPH for rapid preparative isolation and screening of antioxidants from *Selaginella moellendorffii*. *Chromatographia* 68: 173-178
- Sidik. 1994. The current status of jamu, and suggestions for further research and development. *Indig Knowl Dev Mon* 2 (1): 13-15.
- Singh AK, Raghunashi AS, Singh JS. 2002. Medical ethnobotany of the tribals of Sonaghati of Sonbhadra district, Uttar Pradesh, India. *J Ethnopharmacol* 81 (1): 31-41
- Soedibyo M. 1989. Philosophy of herbal medicine as a point of traditional medicine development. 2<sup>nd</sup> Symposium on Cosmetics and Traditional Medicine. Department of Health, GoI. Jakarta. [Indonesia]
- Soedibyo M. 1990. Javanese traditional medicine. Congress Traditional Medicine and Medicinal Plants. Denpasar, Bali, Indonesia, October 15-17 1990.
- Sofowora A. 1982. Medicinal plants and traditional medicine in Africa. Spectrum Books. Ibadan Nigeria.
- Stepp JR, Moerman DE. 2001. The importance of weeds in ethnopharmacology. *J Ethnopharmacol* 75, 25-31.
- Stepp JR. 2004. Review: The role of weeds as sources of pharmaceuticals. *J Ethnopharmacol* 92: 163-166.
- Sutarjadi. 1990. Assessment and development of the science of Indonesian herbal medicine. Symposium on Improving the Image and Benefits of Herbal and Traditional Medicine and Health Security of the Human Body. Airlangga University. Surabaya. [Indonesia]
- Tryon RM, Tryon AF. 1982. Fern and allied plants, with special reference to Tropical America. Springer. New York.
- Uluk A, Sudana M, Wollenberg E. 2001. Ketergantungan masyarakat Dayak terhadap hutan di sekitar Taman Nasional Kayan Mentarang. Cifor. Bogor.
- van Andel TR. 2000. Non-timber forest products of the North-West District of Guyana. Part I & Part II (A field guide). Tropenbos-Guyana Programme. Georgetown, Guyana.
- Wang P-S, Wang X-Y. 2001. Pteridophyte. In: Wang P-S (ed). *Flora of Guizhou*. Guizhou Science and Technology Press. Guiyang.
- Warintek. 2002. CD-ROM Feeding the nation, second series. <http://ftp.ui.edu/bebas/v12/data/top.htm> [Indonesia]
- Wijayakusuma HM. 2004. Overcoming and preventing lung cancer naturally. <http://cybermed.cbn.net.id> [Indonesia]
- Winter WP de, Jnasen PCM. 2003. *Selaginella* Pal. Beauv. In: de Winter WP, Amoroso VB (eds). *Plant resources of South-East Asia* 15 (2) Cryptogams: ferns and fern allies. Backhuys. Leiden.
- Zuhud EAM, Ekarelawan, Riswan S. 1994. Indonesian tropical forests as a source of medicinal plant genetic diversity. In: Zuhud EAM, Hary (ed). 1994. Preservation of the utilization of medicinal plant diversity of Indonesian tropical forests. Faculty of Forestry IPB-LATIN. Bogor. [Indonesia]