Diversity and potential utilization of medicinal plants in Way Kambas National Park

Denny*, M Wardani and A Susilo

Center for Standardization of Sustainable Forest Management Instruments, Jl. Gunung Batu No. 5, Bogor, Indonesia

*E-mail: dennybppn@gmail.com

Abstract. The lowland forest area of Section I Way Kanan, Way Kambas National Park, possesses abundant medicinal tree species. This study aims to identify the medicinal tree species and their potential uses. Data collection was carried out by an inventory of all tree species by the belt transect method on a 100 m x 10 m. All plants were sampled for the herbarium, recorded, identified, and then analyzed for their usefulness. Data analysis was carried out to obtain the accuracy of scientific names, using the comparative identification approach, comparing herbarium samples from the field with herbarium specimens from Heyne's collection at the Forest Botanical Herbarium, Forest Research and Development Center, Bogor. The identification results using herbarium specimens recorded 24 medicinal tree species of the 20 genera and 20 families. Based on Heyne's Herbarium collection, 13 tree species of the 11 genera and 11 families possess the potential for medicinal and food. Among these species, the community still uses medicinal trees, such as Artocarpus elasticus, Baccaurea bracteata, Bouea oppositifolia and Cinnamomum iners. In general, people use medicinal plants when a family member is sick or used as tonics and supplements to maintain endurance.

1. Introduction
The Way Kanan resort is part of the Way Kambas National Park Office, representing the dry lowland forest ecosystem in Lampung, Sumatra. In the lowland forest area, dry land is dominated by meranti tree species (Shorea leprosula Miq.) with an IVI of 47.76%, rambutan hutan (Mischocarpus sundaicus Blume) with an IVI = 27.19%, and jambon (Eugenia garcinifolia King) with IVI = 20.07%. The diversity index (H') at the tree level is in the high category of 3.08 [1]. With the existence of high tree species diversity, it is necessary to increase conservation management efforts.

The park administration continues to improve management to maintain forest conditions to remain sustainable, given the relatively high threat of deforestation. The rate of deforestation has implications for forest fires occur continuously, thereby eliminating biodiversity [2]. One of the ways to reduce the deforestation rate is to motivate people to interest in forest sustainability. Forest conservation to the community starts with a use-value approach. One of them is through non-timber forest product utilization, especially plants as ingredients for traditional medicine [3]. If forest medicinal plants provide benefits, the community will automatically protect and sustain them [4].

This paper discusses the diversity of forest tree species used by the community as a source of germplasm for traditional medicinal substances in the Way Kambas National Park forest area. In this case, the use of medicinal plants should be followed by cultivation efforts. This paper provides...
information to area managers in developing the utilization of germplasm of tree species as medicinal substances. The information obtained can then be used as a basis for sustainable conservation management and utilization to improve the welfare of communities around the forest.

2. Materials and Methods

2.1. Research location
Data on medicinal plants was obtained from lowland forest and dry land section I Way Kanan, Way Kambas National Park (TNWK). Based on government administration, the research location is in Labuhan Ratu Sembilan Village, Labuhan Ratu District, East Lampung Regency, Lampung Province (Figure 1).

![Image](5)

**Figure 1.** Location of medicinal plants in the Way Kanan forest area, Way Kambas National Park, Lampung.

Geographically the study site lay at 4°37'-5°15' LS and 106°32'-106°52' EL. The topography of the study site at lowlands is flat to undulating, with an altitude of 10 - 50 meters above sea level (asl.). Referring to Schmidt and Ferguson's classification, the climate is B type [6]. The wet months are six months, namely December to June. The annual rainfall is 2000-2500 mm; temperatures range from 24°-34°C [5]. Soil type is a combination of podsolic red, yellow, hydro morph alluvial associations, and gley humus lacustrine.

2.2. Data collection
Data collection was carried out in August 2015 by interviews and field inventory. Interviews with knowledgeable persons in the field while doing plant inventory are conducted to identify the traditional use of the medicinal plant. Two belt transects of (10x100) m each were laid for vegetation inventory (Figure 2) and all plants found on the 5 m left and 5 m right of the transect with a diameter of >5 cm were recorded. In addition, the herbarium samples were taken, and the morphological characters were recorded.

![Image](153)

**Figure 2.** Belt transect of 100 m long.
The literature search was carried out based on data on herbarium vouchers of medicinal trees in Way Kanan forest with a trunk diameter of >5 cm. The materials used for processing herbarium specimens were alcohol 70%, (40x60) cm transparent plastic bags, newspaper, label paper, raffia rope, tape). The equipment used consists of a compass, altimeter, meter, Global Positioning System (GPS), machetes, scissors, cameras, and stationery.

2.3. Data analysis
The accuracy of the scientific name is obtained by identifying herbarium specimens from the field based on the identification key. Then proceed with comparative identification by comparing sample collections of the herbarium from Heyne’s collection at the Forest Botanical Herbarium, Forest Research and Development Center, Bogor. Finally, tree morphological characters description were analyzed using a descriptive approach while the traditional medicinal use by literature studies.

3. Results and Discussion

3.1. Medicinal tree species
Based on the exploration result in the Way Kanan forest of the Way Kambas National Park and the identification results of the herbarium samples, 24 tree species having medicinal properties were recorded, consisting of 20 genus and 20 families. Tree species and plant parts used for medicine are presented in Table 1.

| No. | Scientific name | Local name | Used part | Treatment for |
|-----|-----------------|------------|-----------|---------------|
| 1   | *Adina polycephala* Benth. | Nango | Bark | Soreness, stamina |
| 2   | *Artocarpus elasticus* Reinw. ex Blume | Torop | Bark, sap, leave | Family Planning, Diarrhea, intestinal worms |
| 3   | *Aquilaria malaccensis* Lamk. | Kayu alim | Bark, inner wood | Diarrhea, malaria, smallpox |
| 4   | *Baccaurea bracteata* Muell. Arg.* | Kecapi | Bark, fruit | Ringworm, sprue |
| 5   | *Baccaurea racemosa* (Reinw.) Muell. Arg.* | Bera mata | Bark, leave | Menstrual laxative, diarrhea |
| 6   | *Bouea oppositifolia* (Roxb.) Meissn.* | Raman burung | Root, fruit | Fever, cough phlegm, |
| 7   | *Canarium denticulatum* Blume * | Kayu asem | Bark, leave | Antibacterial |
| 8   | *Champereia manillana* (Blume) Merr.* | Aseman | Leave, root | Rheumatism, boils |
| 9   | *Cinnamomum iners* Reinw. * | Teja | Bark | Worm medicine, wounds |
| 10  | *Cratoxylum cochinchinense* (Lour.) Blume * | Tancang | Root, bark, twig | Diarrhea |
| 11  | *Cratoxylum formosum* (Jack) Dyer * | Geronggang | Sap, bark, leave | Scabies, burns, water fleas |
| 12  | *Dillenia excelsa* (Jack) Gilg ** | Simpur batu | Sap, leave, bark | Malaria, toothache |
| 13  | *Dillenia obovata* (Blume) Hoogl. *** | Simpur talang | Bark, leave | Anti-bacterial, anti-fungal |
| 14  | *Erythroxylum cuneatum* (Miq.)Kurz * | Mitis | Root, bark, leave | Beriberi, back pain |
| 15  | *Eurycoma longifolia* Jack. ** | Pasak bumi | Root, bark | Malaria, intestinal |
| No. | Scientific name                         | Local name | Used part        | Treatment for                        |
|-----|----------------------------------------|------------|------------------|-------------------------------------|
| 16  | Flacourtia rukam Zool. & Mor. *        | Rukam      | Root, leave, fruit | Worms, tonic                        |
| 17  | Garcinia dioica Blume **               | Kandis     | Fruit            | Antioxidant                         |
| 18  | Lophopetalum beccarianum Pierre **    | Teluntup   | Root             | Headache/dizziness                  |
| 19  | Microcos tomentosa Sm. *               | Deluak     | Root, fruit      | Cough, thrush                       |
| 20  | Mischocarpus sundaicus Blume *        | Rambutan hutan | Root, leave        | Cough, malaria, diabetes           |
| 21  | Polyalthia laterifolia King **        | Bebai      | Root, Bark, leave | Skin infection                      |
| 22  | Pternandra coerulescens Jack *        | Benaun     | Root, leave, twig | External medicine for skin diseases |
| 23  | Shorea leprosula Miq. ***             | Meranti babi | Bark, leave      | Antibacterial                       |
| 24  | Shorea ovalis (Korth.) Blume ***      | Meranti kuyung | Bark             | Antioxidant                         |

Remarks: *) Multy benefit medicinal plants, **) unknown traditional medicinal properties, ***) less-known medicinal ingredients

Table 1 shows 24 tree species as medicinal ingredients, with various uses of plant parts and treatment. Six species are medicinal plants with lesser-known utilization: Dillenia excelsa, Eurycoma longifolia, Garcinia dioica, Lophopetalum beccarianum and Mischocarpus sundaicus. Based on the literature study, three species hold potential antioxidants and anti-bacteria, namely Shorea leprosula, Shorea ovalis [7, 8], and Dillenia obovata. According to research results, bark and leaf extracts of D. obovata have the potential for conventional antimicrobial drugs which, are usually associated with side effects and high toxicity [9, 10]. These three species traditionally have not been used by local communities.

Medicinal forest tree species have traditional medicinal properties for various uses. Before use, the plant parts must be processed to form the correct ingredients. The ingredient usually consists of several medicinal plant parts [11].

Each region has unique knowledge that differs from other regions on ingredients, such as medicinal plant species, parts used, processing methods, etc. [12]. So it is not surprising if certain species are not used in one region but are used by other areas and vice versa. Knowledge about medicinal plants is obtained from generation to generation from their ancestors.

Based on community information, medicinal plants are usually collected or taken directly from the forest. It is usually done when a family member is sick and used as a tonic and supplement to maintain endurance. However, harvesting plants directly from the forest poses a risk of species extinction. In addition, there are no government regulations governing limits on the collection of medicinal plants from forests.

### 3.2. Multi-benefit medicinal plants

Thirteen tree species traditionally have many benefits and are still often used by communities around the forest. The following are the descriptions and the uses of each tree species with traditional medicinal properties in Way Kambas National Park.

#### 3.2.1. Adina polycephala Benth. (nango)

The trunk is straight cylindrical with cracked bark without sap and scaly, dark gray outer skin, yellowish-grey inner bark, white sapwood. Single leaf opposite glossy green, elliptical shape, lengthwise 10-15 cm, width 4-6 cm; pointed, has flat-shaped stipules, clear leaf grooves. Compound flowers gathered in a ball-shaped slightly yellowish.
Stew of bark and stem are taken by the elderly as a stamina medicine to relieve lethargy. Heyne [13] states that bark exerts a stimulating effect on the elderly and eliminates severe lethargy. In addition, this species contains glycosides, in vitro cytotoxic, anti-inflammatory, antioxidant, anti-HIV, neuroprotective and anti-diabetic activities [14].

3.2.2. Artocarpus elasticus Reinw. ex Blume (torop). The tree reaches 45-65 m high with the bole free from branches up to 30 m, the diameter 0.5-1.2 m, dark gray outer bark, smooth, white sap if injured. Leaves arranged spiral, rough, stiff, hairy, leaf blade oval to ellipse, 15-60 cm x 10-35 cm, rounded or pointed base, flat-leaf edge, tapered tip; The veins rise upward, 12-14 pairs of lateral vertebrae, Stipula hugs the stalk, stalk length 4-10 cm. Compound flower, unisexual.

Bark decoctions are utilized to limit birth by drinking one glass of boiled water a day and drank for three days in a row. Bark decoction is also effective in treating stomach pain. While the sap can treat diarrhea, leaf decoction can be used as warm medicine. In addition, the leaves also have good antioxidant activity [15].

3.2.3. Baccaurea bracteata (Reinw. ex Blume) Muell.Arg. (kecapi). The tree is small to medium-sized, with buttresses 30-40 m high and up to 70 cm in diameter. Single leaf, leaves gathering at the ends of twigs, oval to elliptical leaf shape, tapered leaf base, pointed to tapered tip, leaf surface slightly dark green, size 3-6 cm x 8-15 cm, rather large brown leaf stalk, and swollen near the base of the leaf blade, leaf buds brown-rust color.

Bark decoction to treats ringworm. The fruit taste is sweet and sour and can be used to treat heartburn [16].

3.2.4. Baccaurea racemosa (Reinw. ex Blume) Muell.Arg. (bera mata). Small to medium-sized trees, 10-25 m high, 25 cm in diameter, erect stems, brownish-white coarse. Single leaf, scattered position, oval shape, a serrated edge, pointed tip, rounded base, pinnate, 7-20 cm long, 3-7½ cm wide, ± 2 cm long. Compound interest, unisexual, on stems or branches, is yellow. It has berry fruit, round, ± 2 cm in diameter, still young green after dark yellow.

Utilization is done by boiling the leaves to get filtered water to drink to cure a menstrual laxative and diarrhea. In addition, the sweet-sour taste fruits are used as a kitchen spice for the sour taste of pickles. The fruit also has antioxidant activity [17].

3.2.5. Bouea oppositifolia (Roxb) Meissn. (raman burung). Tree reach up to 43 m high and 89 cm in diameter, bark gray, light brown to purple-brown, cracked. Single leaves, such as skin-shaped elliptical, ovate, 2-15 cm long and 1-5 cm wide, the leaves are white when young, then gradually turn dark green. Inflorescences are panicles; appear in the axilla of the leaves. The fruit is stone type, slightly rounded, 2.5-5 cm in diameter.

Utilization of root decoction is as a fever medicine. In Thailand, the fruit can be eaten raw, like pickles, or cooked, and the fresh leaves have the potential to have antidiarrheal and analgesic properties [18].

3.2.6. Champereia manillana (Blume) Merr. (aseman). It is a small tree, between 4-8 m and sometimes up to 20 m in height, 5-12 cm in diameter, smooth pale bark, cream-white wood. Single leaf, oval leaves, oval or lanceolate, measuring 6-16 cm x 2-8 cm, heart-shaped stipules or round eggs, 2 cm long, circular stipules, tapered leaf tips, the round or hanging base of leaves. Fruit is round to ovoid, with orange to red seeds.

The leaves are used as a poultice to cure boils. Poultices made from leaves and roots collision are used to treat headaches and stomach aches. In Malaya and Mindanao, root stew is traditionally used to eliminate rheumatism. Young leaves and fruit can be eaten as vegetables [19]. The leaves have antinociceptive activity, antimicrobial and immunostimulant properties [20].

3.2.7. Cinnamomum iners Reinw. ex Blume (teja). Tree reach up to 24 m high and 60 cm in diameter. Bark grayish brown, smooth, with lenticels. Sitting opposite, stiff like skin, elliptical or elongated,
short tapered tip, three-leaf bones, leaf size 5-30 x 2.5-13 cm. Flowers whitish, 5-7 mm long. Fruit oblong in carpel with a size of 1.5 x 1 cm.

Bark decoctions are used for worm medicine. While bark poultice is used as an external medicine for wounds, bark and leaves can be used as a spice or food flavoring. This species is also often grown as an ornamental plant [19]. The wood extract also has antifungal and antimicrobial properties [21].

3.2.8. *Cratoxylum cochinchinense* (Lour.) Blume (*tancang*). Bush to tree, thorny at the base of the trunk, up to 30 m in diameter, bark smooth, pale or scaly, gray-brown. Single leaf opposite, elongated or elliptical to ovate, 3-10.5 cm long and 1-4 cm wide, with 2-5 mm stalks. Inflorescences with leaf buds. Heterodistylos flowers.

Decoction of roots, bark, and twigs are used for cold medicine and diarrhea. In Thailand, a decoction of roots and stem bark is used as a drink ingredient for daily consumption and has antimalarial, diuretic, and cytotoxic properties [19]. In addition, this species is also known to have antioxidant and antibiotic activity [22, 23].

3.2.9. *Cratoxylum formosum* (Jack) Benth. & Hook.F. ex Dyer. (*geronggang*). The tree reaches up to 23 m high, 39 cm in diameter. Gum (latex) stems ranging in color from white to yellow. The leaves are paired with concise, clear leaf veins. The flowers are around 15 mm in diameter, with pinkish-purplish in color. The fruit is a capsule 15 mm long and will burst filled with numerous flat-winged seeds.

Bark decoctions are used for abdominal pain medication, sap on the stems to treat wounds, chewed leaves for burns. In China, young shoots are used as vegetables and young leaves are brewed as a substitute for tea and effectively relieve fever, stomachache, colds, diarrhea, and tonic [24].

3.2.10. *Erythroxylum cuneatum* (Miq.)Kurz. (*mitis*). It is shrubs to trees, 12-18 m high, 45 cm in diameter. Single leaf, alternating, lanceolate with a size of 5-11 x 2-3 cm. The flowers are light green to light yellow. The resulting fruit is oval and red when ripe.

Root decoction for kidney medicine and bark extracts for external medicine for thiamin deficiency and rheumatism. Leaf mash for a poultice for women who have had a miscarriage. The leaves can also be used as vegetables [25]. The use of this type as a drug is known not to cause side effects and the leaves extract possesses both antioxidative and anti-inflammatory properties [26].

3.2.11. *Flacourtia rukam* Zoll. &Mor. (*rukam*). Tree reach up to 20 m high with trunk and branches, usually grooved or bent. On the stem, some spines can reach 10 cm in length. Single-leaved, oval-shaped leaves between 10-18 cm long and 4-9 cm wide. Unisexual flowers, in the form of bunches with few flowers.

The utilization of leaf extracts is to compress eye inflammation, raw fruit for diarrhea, and dysentery drugs. In the Philippines, root decoction is used in women after childbirth. The fruit is eaten as a salad, and the young red shoots are eaten as fresh vegetables [19, 27].

3.2.12. *Microcos tomentosa* Sm. (*rambutan hutan*). Shrub or tree reaches up to 20 m with a diameter of 40 cm, a cylindrical trunk, gray to brown, peeling fibrous bark, hairy twigs. Single leaf, hairy on both sides, seated opposite, elliptical or inverted oval leaves, serrated leaf edges, tapered leaf tips, stipules are falling early-compound interest, bisexual. The fruit is round to elliptical, with a diameter of 2.5 cm.

Utilization of root decoction for cough medicine and has antipyretic activity. In Sulawesi, the fruit is eaten, and the fruit is used to remove toxins in the body, while the stew of the fruit can relieve diarrhea [28]. This type also has potential as a source of anticancer agents [29].

3.2.13. *Pternandra coerulescens* Jack (*benaun*). A small tree reaches up to 14 m with a diameter of 12 cm. Single leaves opposite, stipules absent. Flowers in the armpits form short bundles or panicles-smooth round fruit 5 mm in diameter blue-purple.
Boiled leaves and roots treat itchy skin. The fruit in Kalimantan is eaten and used as an external medicine to treat skin diseases [30]. In Pahang, Malaysia, it is used as a poultice for testicular inflammation or hydrocele and as a vomiting drug [31].

4. Conclusion
In Way Kambas National Park, 24 forest tree species were identified as having medicinal properties, consisting of 20 genus and 20 families. Among them, 13 species are still often used by the community. People use medicinal plants to cure sick family members or use them as tonics and supplements to maintain endurance. Knowledge about medicinal plants is obtained from generation to generation from their ancestors.

It is crucial to motivate forest communities to plant medicinal forest tree species outside the conservation area. It is expected that the community can sustainably utilize medicinal tree species and the germplasm of medicinal tree species in the Way Kambas National Park area will remain sustainable.

References
[1] Wardani M, Astuti I and Heriyanto N M 2017 Analisis vegetasi jenis-jenis Dipterocarpaceae di kawasan hutan seksi I Way Kanan, Taman Nasional Way Kambas, Lampung Bul. Kebun Raya 20(1) 51-64
[2] Ardhana I P G 2016 The impact of deforestation on biodiversity loss in Indonesia Jurnal Metamorfosa 3(2) 120-129
[3] Kissinger, Zuhud E A, Latifah K, Darusman and Siregar I Z 2013 Keanekaragaman Jenis tumbuhan obat dari Hutan Kerangas Jurnal Hutan Tropis 1(1) 17-23
[4] Kissinger, Zuhud E A M, Latifah K, Darusman and Siregar I Z 2013 Penapisan senyawa fitokimia dan pengujian antioksidan ekstrak daun pohon merapat Combretocarpus rotundatus Miq. dari Hutan Kerangas JPHH 31(1) 9-18
[5] BPS-Statistics of Lampung Timur Regency 2021 Lampung Timur Regency in Figure 2021 Lampung Indonesia BPS-Statistics of Lampung Timur Regency
[6] Schmidt F H and Ferguson J H A 1952 Rainfall type based on wet and dry period ratios for Indonesia with Western New Guinea (Verh. No.) Jakarta Direktorat Metereologi dan Geofisika
[7] Hastuti N and Wardani M 2020 Identifikasi senyawa kimia potensial berkhasiat obat dari kulit batang Shorea ovalis (korth.) Blume menggunakan analisis gas kromatografi MFF 24(3) 72–76
[8] Sudarajat S, Susanto D and Kartika R 2016 Phytochemicals analysis and antibacterial activity of the leaf of red meranti, Shorea leprosula (Dipterocarpaceae) Nusantara Bioscience 8(1) 111–116
[9] Thoopitianrat T, Chaveerach A, Sudmoon R, Tanee T, Liehr T and Babayan N 2017 Screening of phytochemicals and toxicity of medicinal plants, Dillenia species, reveals potential natural product resources Journal of Food Biochemistry 41(3)
[10] Yap P S X, Chong Y T E, Wongb Y Y, Limb X Y, Ang J H, Goh H S L, … Lim S H E 2013 Antibacterial and antifungal testing of the different extracts of Dillenia obovata ( Blume ) Hoogl WJPPS 2(5) 3946-62
[11] Julius and Muswita 2013 Eksporasi pengetahuan lokal tentang tumbuhan obat di suku Batin, Jambi Journal Biospecies 6(1) 28-37
[12] Wartika Y, Yunia R and Ramadhanil R 2015 Kajian etnobotani pada masyarakat adat Rongkong di Desa Rinding Allo Kecamatan Limbong Kabupaten Luwu Utara Sulawesi Selatan Jurnal Biocelebes 7(1) 48-60
[13] Heyne K 1987 Tumbuhan berguna indonesia Jilid I-IV Terjemahan: Badan Penelitian dan Pengembangan Kehutanan (Badan Penelitian dan Pengembangan Kehutanan, Ed.) (1st ed.) Jakarta Yayasan Sarana Wana Jaya
[14] Zhang Y, Gan M, Li S, Wang S, Zhu C, Yang Y, … Shi J 2010 Chemical constituents of stems and branches of *Adina polycephala* China Journal of Chinese Materia Medica **35**(10) 1261-71

[15] Santos C M M and Silva A M S 2020 The antioxidant activity of prenylflavonoids *Molecules* MDPI AG

[16] Zuhud E A M, Siswaoyo E, Hikmat S A and Adhiyanto E 2014 Buku acuan umum tumbuhan obat Indonesia Jilid X Jakarta *Dian Rakyat* p 273

[17] Fitri A, Andriani M, Sudarman A, Toharmat T, Yonekurac L, Tamura H and Ramli N 2016 Screening of antioxidant activities and their bioavailability of tropical fruit byproducts from Indonesia *Int J Pharm Pharm Sci* **8**(6) 96–100

[18] Islam M A, Bari M S, Taher M A, Chowdhury A, Hossain M K and Rashid M A 2020 Antidiarrheal and analgesic activities of *Bouea oppositifolia* (Roxb.) Adelb. in experimental Animal Model *Bangladesh pharm j* **23**(2) 167–171

[19] Fern K 2014 Useful tropical plants database (Online Accessed: 21-Jan-2021) Available: http://tropical.theferms.info/

[20] Ragasa C Y, Ng V A S, Ulep R A, Brklijača R and Urban S 2015 Chemical constituents of *Champeria manillana* (Blume) Merrill *Der Pharmacia Lettre* **7**(7) 256–261

[21] Mustaffa I N, Mhd Ramle S F, Adenam N M, Awalludin M F, Zaudin N A C, Abdul Hamid Z A and Hermawan A 2020 Potential of *Cinnamomum iners* wood as antimicrobial agent *In IOP Conference Series: Earth and Environmental Science* **596** 12026 IOP Publishing Ltd.

[22] Al Akeel R, Al-Sheikh Y, Mateen A, Syed R, Janardhan K and Gupta V C 2014 Evaluation of antibacterial activity of crude protein extracts from seeds of six different medical plants against standard bacterial strains *Saud J Biol Sci* **21**(2) 147–151

[23] Natrsanga P, Jongaramruong J, Rassamee K, Siripong P and Tip-pyang S 2020 Two new xanthones from the roots of *Cratoxylum cochinchense* and their cytotoxicity *J Nat Med* **74**(2) 467–473

[24] Jevapatarakul D, T-Thienprasert J, Payungporn S, Chavalit T, Khamwut A and T-Thienprasert N P 2020 Utilization of *Cratoxylum formosum* crude extract for synthesis of ZnO nanosheets: Characterization, biological activities and effects on gene expression of nonmelanoma skin cancer cell *Biomedicine and Pharmacotherapy* **130**(2020) 110552

[25] Slik F 2009 Plants of Southeast Asia (Online Accessed: 21-Jan-2021) Retrieved from http://www.asianplant.net

[26] Li L S, Chiroma S M, Hashim T, Adam S K, Mohd Moklas M A, Yusuf Z and Rahman S A 2020 Antioxidant and anti-inflammatory properties of *Erythroxylum cuneatum* alkaloid leaf extract *Heliyon* **6**(6) 1-8

[27] Silalahi M and Nisyawati 2018 The ethnobotanical study of edible and medicinal plants in the home garden of Batak Karo sub-ethnic in north Sumatra, Indonesia *Biodiversitas* **19**(1) 229-238

[28] Arini D I D and Kinho J 2015 Diversity of medicinal plants on coastal forest in Tangkoko Natural Reserve *Jurnal Wasiyan* **2**(1) 1-8

[29] Subarnas A, Diantini A, Rizky A, Zuhrotun A, Yamazaki C, Nakazawa M and Koyama H 2012 Antiproliferative activity of primates-consumed plants against MCF-7 human breast cancer cell lines *Journal of Medical Research* **1**(4) 38-43

[30] Setyowati F M, Riswan S and Susiarti S 2011 Etnobotani masyarakat dayak ngaju di daerah timpah Kalimantan Tengah *JTL* **6**(3) 502-10

[31] Eswani N, Kudus K, Nazre M and Noor A G A 2010 Medicinal plant diversity and vegetation analysis of logged over hill forest of Tekai Tembeling Forest Reserve, Jerantut, Pahang *Journal of Agricultural Science* **2**(3) 189-210
Acknowledgments
This research was funded by the Forest Research and Development Center of the 2017 Indonesian National Budget. In addition, the author would like to thank Anggi Maulana, Giry Waldy Rusmawan, and Edi Laksana for data collection and ideas that were developed in discussions.

Author’s contribution
All authors contributed equally to this work as the main contributor.