International Journal of Design & Nature and Ecodynamics
Vol. 16, No. 5, October, 2021, pp. 495-503
Journal homepage: http://iieta.org/journals/ijdne

Ethnopharmacology and Antioxidant Activity Studies of Woody Liana Original Wallacea

Abdul Hapid[1,2*], Mery Napitupulu[3], Muhammad Sulaiman Zubair[4]

[1] Faculty of Forestry, Tadulako University, City of Palu 94118, Indonesia
[2] Doctoral Study Program of Agricultural Science, Postgraduate School, Tadulako University, City of Palu 94118, Indonesia
[3] Science Education Department, Faculty of Teacher Training and Education, Tadulako University, City of Palu 94118, Indonesia
[4] Pharmacy Department, Faculty of Sciences, Tadulako University, City of Palu 94118, Indonesia

Corresponding Author Email: hafid.untad@gmail.com

https://doi.org/10.18280/ijdne.160503

Received: 18 August 2021
Accepted: 24 September 2021

Keywords:
Lore Lindu National Park, Kaili Tribe, liana, ethnopharmacology

ABSTRACT

Lore Lindu National Park is a habitat located in the middle of the Wallacea Region, consisting of various types of medicinal plants, including lianas. This area is surrounded by the Kaili Tribe, which possesses adequate ethnopharmacology knowledge and local wisdom in managing living natural resources. Studies on the medicinal plant species of lianas original Wallacea have not been conducted. Therefore, this study aims to reveal Kaili's ethnopharmacology of woody liana plants and identify the metabolic content and antioxidant activity. This study was carried out at the Lore Lindu National Park with the purposive and snowball sampling methods used to determine the respondents. Furthermore, the Harborne and 2,2-diphenyl-1-picrylhydrazyl (DPPH) methods were used to analyze the phytochemical content and antioxidant activities. The results showed that the Kaili people used the lianas *Poikilospermum suaveolens* (Blume) Merr, *Arcangelisia Flava* (L.) Merr, *Fibrauea Tinctoria* Lour, and *Maclura cochinchinensis* (Lour.) Corner are medicine for treating various types of chronic diseases. The plant's bark and wood are used as medicine by processing boiled/brewed hot water, or by pounded, and smeared over the wound. The phytochemical analysis results showed that alkaloids are contained in all types of lianas, while flavonoids and tannins are found only in 3 types. Meanwhile, the *P. suaveolens* contained saponin, *A. flava* bark extract has potential to be developed as an antioxidant.

1. INTRODUCTION

Sulawesi is one of the largest and most relevant islands in Indonesia. It is biogeographically located in Wallacea. This region consists of Sulawesi, parts of Maluku, Banda, and West Nusa Tenggara islands, with approximately 346,782 km^2 [1-3]. Its uniqueness is due to a variety of plants, animals, and other creatures from Asia and Australia, in addition, this region also serves as an ecological transition area (ecotone) between the 2 continents [4, 5]. Sulawesi also has high biodiversity and species endemicity [6]. This is one of the conservation areas that has not been widely disclosed in Lore Lindu National Park [7]. It is an important part of the tropical rainforest located in the heart of the Wallacea Region. Furthermore, Sulawesi is also designated as a natural and cultural reserve under the United Nations MAB (man and biosphere) program [8, 9]. This initiative is expected to combine the needs and traditional wisdom of the surrounding indigenous people regarding the conservation of natural resources.

However, some indigenous people, such as the Kaili Tribe living around the National Park, possess the local wisdom to manage the life natural resources [10]. Local wisdom, otherwise known as ethnopharmacology knowledge of lianas, is passed down to generations [11]. This starts with introducing plant species, different parts, usage, and medicinal properties [12, 13]. However, this knowledge has not been properly documented through preliminary studies.

This local wisdom is necessary to document certain efforts realized through several studies. Furthermore, it is feared that more germplasm is bound to become extinct due to the ignorance of its benefits and role in human life [12-14]. This species needs to be preserved because it offers a great opportunity to use biological natural resources specifically for non-timber forest products. Various parties also support it, especially universities, in terms of research carried out in medicinal plants, both the types and the contents of the active compound [15]. It is important to disclose that these plants have optimally been used as traditional medicines for generations.

Several similar studies have been carried out regarding the ethnopharmacological studies of indigenous people at partcicular area and around forest area [15-18]. However, the local knowledge possessed by the Kaili's people around the Lore Lindu National Parkabout woody lianas and their antioxidant activity has never been reported. Several woody lianas were traditionally used for treating the cancer disease, diabetes and jaundice that have correlation with the antioxidant drug mechanism. Therefore, it is important to carry out studies to reveal the ethnopharmacology of Kaili's people on the usage of woody liana plants as well as identify the metabolic content and antioxidant activity.

2. METHOD

2.1 Study area

This research was carried out around Lore Lindu National Park, Sigi Regency, Central Sulawesi (Figure 1). Testing of Phytochemicals and Antioxidant Activities were also carried out at the Research Laboratory of Chemistry Department, Faculty of Mathematics and Natural Sciences, Tadulako University.

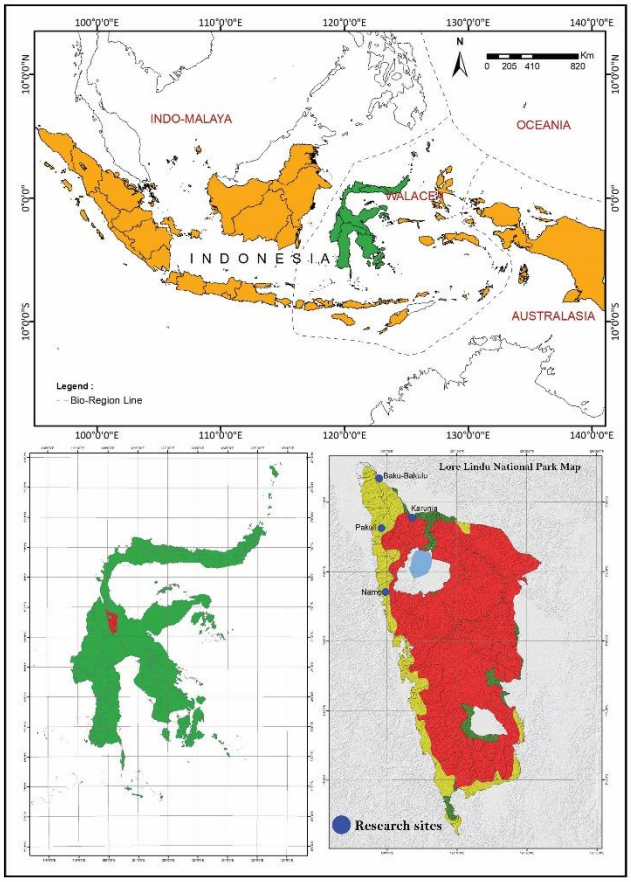

Figure 1. Research site map

2.2 Literature study

A literature review was carried out to obtain preliminary information on the research location, especially the Kaili tribe living around and within the LLNP area. This data collected was further used to determine the research locations [19].

2.3 Determination of sample (respondent)

The purposive and snowball sampling methods were used to select the respondents from the Customary Chief and "Sando" because they were the most knowledgeable on the use of lianas medicinal plants. Besides, the midwives, traditional healers, and the community were also interviewed [18]. This was carried out directly and indirectly (Open-ended and semi-structured interviews) [20].

2.4 Interviews

Meanwhile, the selected respondents were interviewed. In the first stage, the informants were asked about the use of lianas in natural medicine. However, certain specific information was obtained through more complex questions. They were asked to explain the disease being treated, the method of preparation, and the types of medicinal plants used [18, 20].

2.5 Preparation and identification of herbarium samples

Afterward, data was obtained from the residents by carrying out semi-structured interviews followed by specimen collection [17]. It was directly carried out at the location where the lianas grew, assisted by a key informant. All lianas samples used were collected and further identified. The Herbarium process adopted the "Scweinfurt method" technique [21, 22]. Furthermore, the determination analysis was carried out at the Herbarium Celebense (CEB) of Tadulako University, Palu, and the LIPI Biology Research Center, Bogor [19].

2.6 Simplicia preparation

The preparation process starts with cleaning, drying, and grinding. In addition, dirty, fresh lianas were washed using clean running water. Before drying, the sample was weighed to determine the wet biomass, and then it was dried in a place protected from direct sunlight to avoid damage to the bioactive compounds [23]. The lianas were ground with a hammer mill and blender, then filtered to obtain uniformly dry granules, and afterward put in a plastic bag, which was labeled and then weighed with an analytical balance and stored in a dry place for further extraction [24].

2.7 Extraction

This research was carried out using the extraction method by weighing 250 grams of simplicial with 1000 mL of ethanol in a ratio of 1: 4 (w/v) added to the solution. The results of the maceration process were further filtered with Whatman 42 filter paper to produce filtrate and residue. Immersion was carried out 3 times until the filtrate was almost clear. It was then concentrated with a vacuum rotary evaporator at 40°C to obtain a crude extract in paste form [25, 26].

2.8 Phytochemical analysis

This qualitative analysis was carried out to determine the bioactive components contained in each medicinal plant extract solvent. It included tests for alkaloids, triterpenoids, steroids, saponins, phenols, flavonoids, and tannins. The analytical procedure applied is based on the method [27].

2.8.1 Alkaloid

The alkaloid test was carried out by dissolving some samples in a few drops of 2 N sulfuric acid, which was tested by Dragendorff's and Meyer's alkaloid reagents. A positive test result was obtained when reddish-orange and yellowish-white precipitates are formed with Dragendorff's and Meyer's, respectively [27].

2.8.2 Flavonoid

Approximately 0.1 mg magnesium powder, 0.4 ml amyl alcohol (a mixture of 37% hydrochloric acid and 95% ethanol with equal volume), and 4 ml alcohol were added and shaken until homogenous. The result was a positive reaction indicated by the formation of a red, yellow, or orange color on the amyl alcohol layer [27].

2.8.3 Tanin

Some samples were extracted with 20 ml of 70% ethanol. 1 ml of the resulting solution was added to 2 drops of 5% FeCl3 solution. A positive reaction is indicated by the formation of a green or green-blue color [27].

2.8.4 Saponin (foam test)

Saponins are detected with the foam test, which is carried out in hot water. Stable foam is continuously seen for 5 minutes and does not disappear even when a drop of 2 N HCl is added [27].

2.8.5 Triterpenoid and steroid

Some samples placed in a dry test tube were dissolved in 2 ml of chloroform, with 10 and 3 drops of acetic anhydride and concentrated sulfuric acid added to the mixture. A positive reaction is indicated by the immediate formation of a red solution, which turns either blue or green afterward [27].

2.9 Antioxidant activity test with DPPH method

Antioxidant activity was evaluated using 2,2-diphenyl-1-pikrilhidrazil (DPPH) method as our previous research [28]. The concentrations of the extracts used were 25, 50, 75, and 100 ppm. 3 ml of each concentration was pipetted and mixed with 1 ml of 100 μM DPPH solution. The mixture was incubated for 30 minutes in the dark, while the absorbance was measured using a UV-Vis spectrophotometer at a maximum wavelength (517 nm). Besides, 3 repetitions were carried out at each concentration. Vitamin C was used to compare a series of concentrations, namely 2, 4, 6, and 8 ppm.

3. RESULTS & DISCUSSION

3.1 Diversity of liana medicinal plants

Based on the interviews with community leaders of the Kaili tribes and Sando, it was discovered that 4 types of lianas are used as medicinal ingredients. The identification was carried out at the Herbarium Bogoriense, Biological Research Center, Indonesian Institute of Sciences, and these are shown in Table 1. The interviews and field surveys prove that the community, especially the Kaili, have long used plants such as lianas to produce traditional medicine. Their efficacy is generally used as a cure for chronic diseases such as cancer, diabetes and jaundice. Furthermore, the types of diseases, plant parts, and methods of processing of woody lianas as medicines are shown in Table 2.

Table 1. Liana medicinal plants used by the Kaili Tribe around Lore Lindu National Park

Local Name	Latin Name	Tribe
Bajakah	*Poikilospermum suaveolens* (Blume) Merr	Urticaceae
Akar Kuning	*Arcangelisia Flava* (L.) Merr	Menispermaceae
Bakang Kuni	*Fibrauea tinctoria* Lour	Menispermaceae
Bangkaila	*Maclura cochinchinensis* (Lour.) Corner	Moraceae

Table 2. Parts of plants used, uses, and processing methods of woody liana medicinal plants

Latin Name	Part of Plants	Uses	Processing Methods
P. Suaveolens	Stem (Bark)	Breast cancer	The fresh bark is pounded and put on the sore breast.
	Stem (Bark)	Breast tumor and cancer, Kidney	The stems are cut into small pieces of 1/4 kg, and boiled in 1 liter of water for relatively 15 to 20 minutes, filtered afterward, and drunk twice a day.
	Stem water	Stamina boost	The water extracted from the stem is drunk directly.
A. Flava	Stem (Bark and Wood)	Jaundice, Cancer, and Diabetes	The stems are cut into small pieces and boiled in water until the amount is reduced by half. It is cooled and drank 3 times a day.
	Stem water	Stamina boost	The water extracted from the stem is drunk directly.
F. Tinctoria	Stem (Bark and Wood)	Malaria, Internal injuries	The stems are cut into small pieces and boiled in 3 cups of water till it is reduced to 2 cups. Cool and drink 3 times a day
M. cochinchinensis	Stem (Bark)	Wound from sharp objects, itchy rash	The bark is ground and then applied to the wounds or itchy body parts.
	Stem (Bark)	Kidney	The wood is cleaned or peeled from its skin and then cut into small pieces and boiled in 3 cups of water for 15 minutes. Cool and drink twice a day.

P. suaveolens (Blume) Merr (Figure 2) is a liana plant from the Urticaceae species, the Kaili tribe refers to it as Bajakah, forest rope, and roots. This type of species is found in the Lore Lindu National Park area, especially in secondary forests or open areas. It is widespread in the Malesia region, including India, southern China, and Indonesia [29]. The interview showed that this plant is widely used to treat the chronic diseases such as breast tumors, cancer, and kidney and also as stamina enhancers. This species is also used as an anti-fever by the indigenous tribes of Sumatra [30]. The leaves of *P. Suaveolens* are used for the treatment of gastric ulcers in Sambas and Sarawak, Malaysia. However, in Sabah and Negeri Sembilan, this species is used as an after childbirth and eye pain treatment, respectively [29]. The plant parts used are the stems (wood and bark) and water extracted from it, however, in other areas, such as in South Sulawesi, the leaves are also used as medicine [31]. In East Kalimantan, the fruit serves as a medicine for cervical cancer and itching [32]. Meanwhile, there are 3 ways to process *P. suaveolens*. First, the wood is boiled, and the water drunk afterward. Second, fresh skin is pounded and then applied to the diseased (cancer) part. Finally, water extracted from the stem serves as a stamina-enhancing drug.

A. Flava is a type of liana species that is widely used (Figure 3). It is also known as *akar Kuning betina*. This species is relatively 20 m long and is commonly found in lowland forests approximately 1500 m above sea level (asl). The leaves are as thick as the human skin, oval in shape, blunt, relatively 7 to 20 cm wide, glossy upper surface, and have long stalks. The flowers are 2-sided with small sizes arranged in a glabrous

series of approximately 20 to 50 cm, besides the crown lobed is greenish-white or yellowish-white, while the wood is yellow [33, 34]. Based on the interviews, the stem was widely used by Kaili for the treatment of diabetes, jaundice, and cancer. In Kalimantan, especially the Dayak tribe, it is used to treat jaundice, digestion, intestinal worms, tonic, fever, menstrual laxative, and canker sores [35, 36]. The water extracted from the stem is used to increase stamina. It is processed by cutting the stem into small pieces and boiled for approximately 15 to 20 minutes, after which it is filtered and drunk.

Figure 2. *Poikilospermum suaveolens* (Blume) Merr. (Urticaceae)

Figure 3. *Arcangelisia Flava* (L.) Merr. (Menispermaceae)

Figure 4. *Fibrauea tinctoria* Lour. (Menispermaceae)

The third liana also used by Kaili Tribe is *F. tinctoria* (Figure 4). It belongs to the climbing species from the Menispermaceae family, often found in open and slightly shaded lower mountainous forests in Sumatra, Java, Kalimantan, Sulawesi, Halmahera, Philippines, Thailand, Indochina, and Malaya [37-39]. In some areas, such as Kalimantan and Sumatra, this plant is also known as yellow root [33]. Based on the interviews carried out, some people refer to it as Bakang Kuni. In Kaili, the stem is used for the treatment of malaria and internal wounds. In Kalimantan and Sumatra, it is also used for the treatment of various diseases such as headaches, diarrhea, diabetes, dysentery, malaria, and back pain [40, 41]. The method of processing *F. Tinctoria* is similar to that of *A. Flava*, which involves cutting the stems into small pieces, adding 1 litre of water, and boiling for 20 minutes, afterward filter and drink it.

The last type of liana used is the *M cochinchinensis* (Figure 5). This species belongs to the family Moraceae, it is adorned with straight, curvy, small branches with thorny ends (usually only in juvenile trees). It also possesses very small distichous or spirally arranged, pinnately veined lamina, free or fused stipules, lateral to semi-amplexicaul leaves. Inflorescences are usually solitary, in leaf axils or on short shoots, often with yellow glands. Its habitat includes lowland forest, mainly at the edges of mangroves and riverbanks. This species is also found in secondary forests, although rarely discovered, at elevations that are relatively 1800 m [42, 43]. In accordance with the interview, only a few parts of the plant are used as medicine. The wood and stem are used for the treatment of kidney and skin diseases such as itching. Some people use it as an anti-infective medicine for wounds caused by sharp objects. The results obtained show that the Karbi tribe uses the bark in Assam and India to treat jaundice [42-45].

The Kaili tribe has been utilizing these medicinal plants for generations. The *M. Ochinchinensis* species is generally cut into small pieces and added to 3 cups of water, which is boiled for approximately 15 to 20 minutes, filtered, and drunk. The bark is usually ground until smooth and then applied on the itchy body part or the wound caused by a sharp object. The Kaili medicinal plants' manufacturing process is almost similar to that of the Dayak, Mandar, Bugis, and Sundanese in Kalimantan, West, and South Sulawesi, and West Java, respectively.

Figure 5. *Maclura cochinchinensis* (Lour.) Corner. (Moraceae)

3.2 Phytochemical Analysis of Liana Medicinal Plants

Phytochemical analysis provided an initial description relating to the class of chemical compounds contained in the plant extracts [46]. The analysis results of 8 from 4 types of lianas are shown in Table 3.

3.2.1 Alkaloid

Alkaloids are nitrogenous organic compounds derived from plants. In addition, they have various pharmacological properties. This includes morphine, coxine, atropine, kikine, and caffeine [47]. The test showed that all extracts (100%) of

positive lianas contained numerous alkaloid compounds. Historically, it has been used as medicine by the indigenous people for thousands of years [48]. It is also regarded as a secondary metabolic compound that plays a large role in plant physiological activities used in the field of medicine [49, 50].

Similar results were also obtained in the research carried out by D. Rumouw (2017) [14] on medicinal plants used by indigenous people living around the Sahedaruman Protected Forest Area, which all tested (100%) positive for alkaloid compounds. Furthermore, medicinal plants used in the Bima Regency, West Nusa Tenggara Province, are 90% positive and contain alkaloid compounds.

3.2.2 Flavonoid

Flavonoids are the largest class of natural phenolic compounds because they have several unreplaced hydroxyl groups or sugar, that tends to dissolve in polar solvents such as ethanol, methanol, butanol, acetone, dimethyl sulfoxide, dimethylformamide, and water [49]. The phytochemical results showed that 5 out of the eight (8) samples or 62.50% of lianas were positive flavonoid compounds. However, 1 of the samples, the bark of *P. Suaveolens* was identified to contain a lot of flavonoids. In addition, a sample of *P. suaveolens* contains moderate flavonoids. Furthermore, 3 samples, namely the *P. Suaveolens*'s bark, A. *Flava*, and *M. cochinchinensis* woods contained slight flavonoids. These compounds have anti-cancerous and tumor cell properties [50]. Furthermore, extracts that positively contained flavonoids were used for the treatment of cancer by the Kaili tribe. The flavonoid contained in liana is thought to act as an anti-cancer.

3.2.3 Tanin

Tannins are polyphenolic compounds that have a fairly high molecular weight (greater than 1000) and tend to form complexes with proteins. It is found in vascular plants and angiosperms, especially in woody tissues. Animals avoid most plants that contain a lot of tannins because of their astringent taste, which serves as a form of defense [51, 52]. The results showed that 6 or 75% of the positive samples contained tannin compounds. Besides, 3 of the bark samples, namely, *P. suaveolens*, *A. Flava*, and *M. cochinchinensis* were detected to contain moderate tannin compounds. Meanwhile, 3 similar wood samples contained slight tannin compounds. These compounds are obtained from various plant extracts, which possess anti-cancer and anti-microbial properties [53, 54]. Based on the results, the different lianas types used by the Kaili tribe were detected to contain tannin used as kidney, cancer, and tumor medicines.

3.2.4 Saponin

Saponins are a type of glycoside found in plants. It is a complex group of natural compounds with large molecular masses [55, 56]. The results showed that only 1 sample, approximately 12.50% of P. suaveolens' was positive in terms of containing saponin compounds. However, 7 of the samples lacked these compounds. According to [57], saponins are found in monocot (such as in the families Agavaceae, Dioscoreaceae, and Liliaceae) and dicot plants (namely in the families Araliaceae, Fabaceae, and Caryophyllaceae). Although several studies have reported that relatively 1.5 to 23% are also found in plant roots, it is also found in leaves [58]. Saponin compounds in various medicinal plants have been globally proven to possess anti-cancer and other pharmacological properties [54, 59].

3.2.5 Steroid/ Terpenoid

The structure of this compound is quite diverse. The difference is due to the presence of a functional group attached to the oxidized carbon ring [60]. The results showed that none of the samples contained steroids or terpenoids, and this implies cholesterol-lowering and anticarcinogenic effects, which acts as an anti-cancer. The results of other studies also reported that steroid compounds in plants tend to prevent ovarian, breast, prostate, and colon cancer because they possess antioxidant potentials, are hypoglycemic, and tend to inhibit the thyroid [61, 62].

Table 3. Phytochemical analysis of liana medicinal plants

Types	Part Used	Alkaloid	Flavonoid	Tanin	Saponin	Steroid/ Terpenoid
P. Suaveolens	Bark	+++	+	++	+	-/-
	Wood	+++	++	+	-	-/-
A. Flava	Bark	+++	-	++	-	-/-
	Wood	+++	+	+	-	-/-
F. Tinctoria	Bark	+++	-	-	-	-/-
	Wood	+++	-	-	-	-/-
M. cochinchinensis	Bark	+++	+++	++	-	-/-
	Wood	+++	+	+	-	-/-

Information: +++ = Many compounds detected, ++ = Medium compounds detected, + = Fewer compounds detected,

Table 4. Antioxidant activity analysis of woody liana medicinal plant

Plants	Part Used	Antioxidant Activity		
		Inhibition Percentage (%) ± SD (1000 µg/mL)	IC_{50} (µg/mL) ± SD	Category
P. suaveolens	Bark	27.57 ± 0.07^{d}	154.14 ± 0.33^{c}	Weak
	Wood	29.18 ± 0.13^{f}	186.35 ± 0.82^{f}	Weak
A. Flava	Bark	40.43 ± 0.07^{i}	100.31 ± 0.16^{b}	Strong
	Wood	35.49 ± 0.14^{h}	172.24 ± 0.80^{d}	Weak
F. Tinctoria	Bark	21.60 ± 0.09^{b}	198.83 ± 0.23^{h}	Weak
	Wood	34.44 ± 0.05^{g}	208.06 ± 1.92^{j}	very weak
M. cochinchinensis	Bark	25.28 ± 0.03^{c}	197.27 ± 0.70^{g}	Weak
	Wood	21.24 ± 0.09^{a}	203.02 ± 1.12^{i}	very weak
Control +	Vitamin C	52.90 ± 0.05^{j}	45.00 ± 0.29^{a}	very strong

The mean values followed by different letters show a significant difference at the level of $\alpha = 5\%$

3.3 Antioxidant activity of woody liana medicinal plants

Antioxidant activity was measured with the DPPH free radical scavenging method (2,2-diphenyl-1- picrylhydrazyl). The test principle is based on the donation of hydrogen atoms from the substance being tested to the DPPH radical and a non-radical compound diphenyl picrylhydrazine because the electrons become paired and the color changes from purple to yellow [63]. Furthermore, when the DPPH solution reacts with a compound that tends to donate a hydrogen atom, the purple color in the solution disappears as it is reduced by antioxidants. The DPPH radical showed maximum absorption at 517 µm (purple) [64]. The results are shown in Table 4.

IC50 is a number that indicates the concentration of the extract in terms of inhibiting the oxidation process by 50%, therefore, the smaller the value, the higher the antioxidant activity. It is expected that free radicals are captured by antioxidant compounds in the less concentrated samples [63].

The results of 8 liana extracts that obtained the best IC50 value was *A. Flava*. Its bark extract has the least IC50 value of 100.31 ppm and is significantly different from other samples. According to Molyneux [63], extracts with IC50 values below 50 ppm are categorized as very strong antioxidants. Subsequently, those with a value of relatively 50 ppm to 100 ppm are also categorized as strong antioxidants. Meanwhile, values between 100 ppm to 150 ppm are categorized as moderate antioxidants. However, supposing the value is relatively between 150 ppm to 200 ppm, they are categorized as weak antioxidants. In addition, assuming the value is above 200 ppm, it is categorized as very weak antioxidants. Based on this category, *A. Flava* bark extract was included in the strong antioxidant category. Therefore, it was the only sample that had the best antioxidant potential. The results are consistent with the research carried out by Suratno et al. [65] on the antioxidant activity of *A. Flava* from Central Kalimantan with IC50 = 136.81 ppm. The other liana values were included in the weak and very weak categories. Subsequently, 5 liana extracts belong to the category of weak antioxidants or have IC50 values between 150 ppm and 200 ppm. The bark and wood extracts of P. Suaveolens were realized as 154,14 ppm and 186,35 ppm, respectively. The bark extract of *A. flava*, *M. cochinchinensis*, and *F. tinctoria* are 172,24 ppm, 197,27 ppm, and 198,83 ppm. There were 2 samples of lianas extract with very weak antioxidants or IC50 above 200 ppm; the wood extract of *M. cochinchinensis* and *F. tinctoria* with the IC50 of 203,02 ppm, and 208,06 ppm, respectively.

The differences in antioxidant activity are usually related to the content of phenolic compounds or flavonoids. Consequently, phenol and flavonoid compounds usually have positive contribution to antioxidant activity, therefore, the higher the levels, the better the antioxidants [66]. The preliminary study carried out on liana extract reported that the content of flavonoid compounds did not influence high antioxidant activities. This is because the A. Flava bark extract has the best IC50 value and the results have negative correlation with the flavonoid compounds. This is in addition to other secondary metabolites, such as alkaloids, terpenoids, and organic sulfur components that act as natural antioxidants [67]. Carrot – navel orange marmalade could be a suitable source of antioxidants [68].

4. CONCLUSIONS

The Kaili tribe living around Lore Lindu National Park uses lianas *P. suaveolens*, *A. flava*, *F. tinctoria*, and *M. cochinchinensis* as a medicine for treating various types of diseases. The water extracted from *P. suaveolens*, *A. flava*, and *F. tinctoria*, either boiled or brewed, were used to treat chronic diseases including cancer, tumor, malaria, and diabetes. Meanwhile the bark of *M. cochinchinensis* was pounded and smeared on the wound. The results showed that all types of lianas contained alkaloids. However, three species contain flavonoids and tannins, while only one species contains saponins. The antioxidant activity showed that *A. Flava* bark extract is a potential antioxidant.

ACKNOWLEDGMENT

The authors are grateful to the Head and staff of the Lore Lindu National Park Center for supporting this research. The authors are also grateful to Muhammad Fajri for helping in sampling and manufacturing herbarium.

REFERENCES

[1] Ali, J.R., Heaney, L.R. (2021). Wallace's line, Wallacea, and associated divides and areas: History of a tortuous tangle of ideas and labels. Biological Reviews, 96(3): 922-942. https://doi.org/10.1111/brv.12683

[2] Zulkaidhah, Z., Malik, A., Hapid, A., Hamka, H., Hariyanty, H., Rahman, N. (2021). The diversity of termite species on natural forest and agroforestry land in Sulawesi tropical forests in Indonesia. Annals of Silvicultural Research, 46(2). http://dx.doi.org/10.12899/asr-2228.

[3] Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature, 403(6772): 853-858. https://doi.org/10.1038/35002501

[4] Lohman, D.J., de Bruyn, M., Page, T., von Rintelen, K., Hall, R., Ng, P., Shih, H.T., Carvalho, G.R., von Rintelen, T. (2011). Biogeography of the Indo-Australian archipelago. Annual Review of Ecology, Evolution, and Systematics, 42: 205-226. https://doi.org/10.1146/annurev-ecolsys-102710-145001

[5] Ramadhanil, R., Gradstein, S.R. (2004). Herbarium Celebense (CEB) dan Peranannya dalam Menunjang Penelitian Taksonomi Tumbuhan di Sulawesi. Biodiversitas, 5(5): 36-41. https://doi.org/10.13057/biodiv/d050107

[6] Clough, Y., Abrahamczyk, S., Adams, M.O., et al. (2010). Biodiversity patterns and trophic interactions in human-dominated tropical landscapes in Sulawesi (Indonesia): plants, arthropods and vertebrates. Berlin: Springer Berlin Heidelberg, 2010. https://doi.org/10.1007/978-3-642-00493-3_2

[7] Munawir, A., June, T., Kusmana, C., Setiawan, Y. (2019). Dynamics factors that affect the land use change in the Lore Lindu National Park, Indonesia. in Sixth International Symposium on LAPAN-IPB Satellite, 2019, 11372: 113721E. https://doi.org/10.1117/12.2542812

[8] Noguchi, R., Soekmadi, R., Hikmat, A., Kusmana, C., Ahamed, T. (2021). Reconciling livelihoods and conservation for rattan sustainable harvesting in Lore Lindu National Park, Indonesia. Small-scale Forestry, 20(2): 175-197. https://doi.org/10.1007/s11842-020-

09463-4
[9] Purwaningsih, P., Yusuf, R. (2005). Species composition and vegetation structure in Pakuli area, Lore Lindu National Park, Central Sulawesi. Biodiversitas Journal of Biological Diversity, 6(2).
[10] Acciaioli, G. (2012). Conservation and community in the Lore Lindu National Park (Sulawesi): Customary custodianship, multi-ethnic participation, and resource entitlement. Community, Environment and Local Governance in Indonesia, Routledge, pp. 103-133.
[11] Anugrahsari, I., Sardjono, M.A., Fitriyah, N., Golar, G. (2020). Social contracts: pillars of community conservation partnerships in Lore Lindu National Park, Indonesia. Forest and Society, 4(1): 115-126. https://doi.org/10.24259/fs.v4i1.8682
[12] Kadir, M., Karmoker, J., Alam, M.R. (2015). Ethnopharmacological survey of medicinal plants used by traditional healers and indigenous people in Chittagong hill tracts, Bangladesh, for the treatment of snakebite. Evidence-Based Complementary and Alternative Medicine. https://doi.org/10.1155/2015/871675
[13] Mirdeilami, S.Z., Barani, H., Mazandarani, M., Heshmati, G.A. (2011). Ethnopharmacological survey of medicinal plants in Maraveh Tappeh Region, North of Iran. Iranian Journal of Plant Physiology, 2(1): 325-336.
[14] Rumouw, D. (2017). Identifikasi Dan Analisis Kandungan Fitokimia Tumbuhan Alam Berkhasiat Obat Yang Dimanfaatkan Masyarakat Sekitar Kawasan Hutan Lindung Sahedaruman (Identification and Analysis of Natural Product Fitokimia Content the Drugs Use of the Community Around the. Jurnal LPPM Bidang Sains dan Teknologi, 4(2): 53-66.
[15] Kusuma, I.W., Kuspradini, H., Arung, E.T., Aryani, F., Min, Y.H., Kim, J.S., Kim, Y. (2011). Biological activity and phytochemical analysis of three Indonesian medicinal plants, Murraya koenigii, Syzygium polyanthum and Zingiber purpurea. Journal of Acupuncture, 4(1): 75-79. https://doi.org/10.1016/s2005-2901(11)60010-1
[16] Cakilcioglu, U., Khatun, S., Turkoglu, I., Hayta, S. (2011). Ethnopharmacological survey of medicinal plants in Maden (Elazig-Turkey). Journal of Ethnopharmacology, 137(1): 469-486. https://doi.org/10.1016/j.jep.2011.05.046
[17] Güneş, S., Savran, A., Paksoy, M., Koşar, M. (2017). Ethnopharmacological survey of medicinal plants in Karaisalı and its surrounding (Adana-Turkey). Jurnal of Herbal Medice, 8: 68-75. https://doi.org/10.1016/j.hermed.2017.04.002
[18] Roosita, K., Kusharto, C.M., Sekiyama, M., Fachrurozi, Y., Ohtsuka, R. (2008). Medicinal plants used by the villagers of a Sundanese community in West Java, Indonesia. Journal of Ethnopharmacology,115(1): 72-81. https://doi.org/10.1016/j.jep.2007.09.010
[19] Gailea, R., Bratawinata, A.A., Pitopang, R., Kusuma, I.W. (2016). The use of various plant types as medicines by local community in the enclave of the Lore-Lindu national park of Central Sulawesi, Indonesia. Global Journal of Research on Medicinal Plants & Indigenous Medicine, 5(1): 29.
[20] Pieroni, A., Quave, C., Nebel, S., Heinrich, M. (2002). Ethnopharmacy of the ethnic Albanians (Arbëreshë) of northern Basilicata, Italy. Fitoterapia, 73(3): 217-241. https://doi.org/10.1016/S0367-326X(02)00063-1
[21] Nelson, G., Sweeney, P., Sweeney, L.E., et al. (2015). Digitization workflows for flat sheets and packets of plants, algae, and fungi. Applications in Plant Sciences, 3(9): 1500065. https://dx.doi.org/10.3732/apps.1500065
[22] Forman, L., Bridson, D. (1989). The Herbarium Handbook. Royal Botanic Gardens Kew.
[23] Putranti, R.I. (2014). Skrining fitokimia dan aktivitas antioksidan ekstrak rumput laut Sargassum duplicatum dan Turbinaria ornata dari Jepara. Doctoral dissertation, Universitas Diponegoro, Semarang, 2014.
[24] Wadood, A., Ghufran, M., Jamal, S.B., Naeem, M., Khan, A., Ghaffar, R. (2013). Phytochemical analysis of medicinal plants occurring in local area of Mardan. Biochem Anal Biochem, 2(4): 1-4. http://dx.doi.org/10.4172/2161-1009.1000144
[25] Seebaluck, R., Gurib-Fakim, A., Mahomoodally, F. (2015). Medicinal plants from the genus Acalypha (Euphorbiaceae)-A review of their ethnopharmacology and phytochemistry. Journal of Ethnopharmacology, 159: 137-57. https://doi.org/10.1016/j.jep.2014.10.040
[26] Ramadanil, R., Damry, D., Rusdi, R., Hamzah, B., Zubair, M.S. (2019). Traditional usages and phytochemical screenings of selected zingiberaceae from Central Sulawesi, Indonesia, Pharmacognosy Journal, 11(3): 505-510. http://dx.doi.org/10.5530/pj.2019.11.80
[27] Harborne, J.B. (1987). Metode fitokimia: penuntun cara modern menganalisis tumbuhan / oleh J.B.Harborne; penerjemah, Kosasih Padmawinata, Iwang Soediro.
[28] Sulastri, E., Zubair, M.S., Anas, N.I., Abidin, S., Hardani, R., Yulianti, R. (2018). Total phenolic, total flavonoid, quercetin content and antioxidant activity of standardized extract of Moringa oleifera leaf from regions with different elevation. Pharmacognosy Journal, 10(6): 104-108. http://dx.doi.org/10.5530/pj.2018.6s.20
[29] Sudarmono, S. (2018). Biodiversity of medicinal plants at Sambas Botanical Garden, West Kalimantan, Indonesia. Journal of Tropical Life Science, 8(2): 238115. http://dx.doi.org/10.11594/jtls.08.02.04
[30] Adi, M.B.S., Susanti, D., Wijaya, N.R. (2020). Antifever medicinal plants on native ethnics on Sumatra Island. Journal of Complementary Medicine Research, 11(1): 19-33. http://dx.doi.org/10.5455/jcmr.2020.11.01.04
[31] Hartati, H., Habil, M., Suryani, A.I., Sahribulan, S. (2020). Analisis Fitokimia Ekstrak Tumbuhan Poikilospermum suaveolens. in Seminar Nasional Biologi, 1(1): 365-370.
[32] Kusuma, I.W., Sari, N.M., Murdiyanto, Kuspradini, H. (2016). Anticandidal activity of several plants used by Bentian tribe in East Kalimantan, Indonesia. in AIP Conference Proceedings, 2016, 1755(1): 40002. https://doi.org/10.1063/1.4958477
[33] Heyne, K. (1987). Tumbuhan berguna Indonesia jilid III. Badan Litbang Kehutanan. Jakarta, vol. 631.
[34] Widyatmoko, D., Zich, F. (1998). The Flora of Bukit Tigapuluh National Park, Kerumutan Sanctuary, and Mahato Protective Reserve, Riau, Indonesia. Indonesian Botanic Gardens, 1998.
[35] Noorcahyati, N., Sulandjari, S., Dewi, W.S. (2016). Asosiasi Akar Kuning (Fibraurea Tinctoria Lour.) Dengan Tumbuhan Berpotensi Obat Di Samboja, Kalimantan Timur. Jurnal Hutan Tropis, 4(3): 232-239.
[36] Suzuki, T., Kiyotani, T., Maeda, M., Katayama, T., Tomita-Yokotani, K., Syafii, W., Muladi, S. (2011).

Furanoditerpenes from Arcangelisia flava (L.) Merr. and their antifungal activity. Phytochemistry Letters, 4(3): 333-336. https://doi.org/10.1016/j.phytol.2011.07.002
[37] Kalima, T. (2021). Potential of akar kuning (Fibraurea tinctoria Laur.) in Peat-Swamp Forests, Kapuas District, Central Kalimantan Province. Jurnal Penelitian Hutan Tanaman, 18(1): 13-34. https://doi.org/10.20886/jpht.2021.18.1.13-34
[38] Mahmoudvand, H., Sharififar, F., Sharifi, I., Ezatpour, B., Harandi, M.F., Makki, M.S., Zia-ali, N., Jahanbakhsh, S. (2014). In vitro inhibitory effect of Berberis vulgaris (Berberidaceae) and its main component, berberine against different Leishmania species. Iranian Journal of Parasitology, 9(1): 28.
[39] Setyawati, A. (2015). Struktur Histologi Hati, Ginjal dan Pankreas Mencit (Mus musculus) Dengan Perlakuan Ekstrak Batang Akar Kuning (Fibraurea tinctoria L.) Selama Organogenesis. IPB University, 2015. http://repository.ipb.ac.id/handle/123456789/79166
[40] Supomo, S., Idriana, I., Eka, A., Indra, Huda, M., Warnida, H. (2021). Aktivitas anti jamur fraksi aktif ekstrak etanol umbi bawang rambut (Allium Chinense G. Don) terhadap Jamur Candida Albicans. JI-KES (Jurnal Ilmu Kesehatan, 4(2): 45-49.
[41] Nursyam, H. (2013). The phytochemistry and the anti-bacterial activity of yellow root (Arcangelisia flava Merr.) against Aeromonas hydrophila. Journal of Biology and Life Sciences, 4(2): 180-190. http://dx.doi.org/10.5296/jbls.v4i2.3683
[42] Berg, C.C. (2005). Flora Malesiana precursor for the treatment of Moraceae 8: other genera than Ficus. Blumea-Biodiversity, Evolution and Biogeography of Plants, 50(3): 535-550. http://dx.doi.org/10.3767/000651905X622815
[43] Manandhar, N.P. (1995). An inventory of some herbal drugs of Myagdi District, Nepal. Economic Botany, 49(4): 371-379. https://doi.org/10.1007/BF02863087
[44] Lin, C.C., Lee, H.Y., Chang, C.H., Yang, J.J. (1999). The anti-inflammatory and hepatoprotective effects of fractions from Cudrania cochinchinensis var. gerontogea. The American Journal of Chinese Medicine, 27(2): 227-239. https://doi.org/10.1142/S0192415X99000264
[45] Yoosook, C., Bunyapraphatsara, N., Boonyakiat, Y., Kantasuk, C. (2000). Anti-herpes simplex virus activities of crude water extracts of Thai medicinal plants. Phytomedicine, 6(6): 411-419. https://doi.org/10.1016/S0944-7113(00)80068-9
[46] Altemimi, A., Lakhssassi, N., Baharlouei, A., Watson, D.G., Lightfoot, D.A. (2017). Phytochemicals: Extraction, isolation, and identification of bioactive compounds from plant extracts. Plants, 6(4): 42. https://doi.org/10.3390/plants6040042
[47] Phillipson, J.D., Roberts, M.F., Zenk, M.H. (2012). The chemistry and biology of isoquinoline alkaloids. Springer Science & Business Media, 2012.
[48] Bribi, N. (2018). Pharmacological activity of alkaloids: a review. Asian Journal of Botany, 1(1): 6. http://dx.doi.org/10.63019/ajb.v1i2.467
[49] Harborne, J.B. (1984). Metode Fitokimia: Penuntun Cara Modern Menganalisis Tumbuhan. Bandung: ITB Bandung, 1984.
[50] Patel, K., Gadewar, M., Tripathi, R., Prasad, S.K., Patel, D.K. (2012). A review on medicinal importance, pharmacological activity and bioanalytical aspects of beta-carboline alkaloid 'Harmine'. Asian Pacific Journal of Tropical Biomedicine, 2(8): 660-664. https://doi.org/10.1016/s2221-1691(12)60116-6
[51] Hagerman, A.E. (2002). Tannin Chemistry. Miami University, Oxford, USA, 2002.
[52] Harborne, J.B. (1996). Metode Fitokimia: Penuntun Cara Modern Menganalisis Tumbuhan (Terjemahan: Kosasih Padmawinata dan Iwang Soediro). Penerbit ITB, Bandung, 1996.
[53] Li, H., Wang, Z., Liu, Y. (2003). Review in the studies on tannins activity of cancer prevention and anticancer. Journal of Chinese medicinal Materials,26(6): 444-448.
[54] Teodor, E.D., Ungureanu, O., Gatea, F., Radu, G.L. (2020). The potential of flavonoids and tannins from medicinal plants as anticancer agents. Anti-Cancer Agents in Medicinal Chemistry, 20(18): 2216-2227. https://doi.org/10.2174/1871520620666200516150829
[55] Bogoriani, N.W. (2008). Isolasi dan identifikasi glikosida steroid dari daun andong (Cordyline terminalis Kunth). Jurnal Kimia (Journal of Chemistry), 2(1): 40-44.
[56] Gunawan, D.H. (2018). Penurunan Senyawa Saponin Pada Gel Lidah Buaya Dengan Perebusan Dan Pengukusan. Jurnal Teknologi Pangan, 9(1): 41-44.
[57] Sparg, S.G., Light, M.E., Van Staden, J. (2004). Biological activities and distribution of plant saponins. Journal of Ethnopharmacology, 94(2-3): 219-243. https://doi.org/10.1016/j.jep.2004.05.016
[58] Nwaoguikpe, R.N., Braide, W., Ezejiofor, T.I.N. (2010). The effect of Aloe vera plant (Aloe barbadensis) extracts on sickle cell blood (HBSS). African Journal of Food Science and Technology, 1(3): 58-63.
[59] Xu, X.H., Li, T., Fong, C.M., Chen, X., Chen, X.J., Chen, X.J., Huang, M.Q., Lu, J.J. (2016). Saponins from Chinese medicines as anticancer agents. Molecules, 21(10): 1326. https://doi.org/10.3390/molecules21101326
[60] Samejo, M., Memon, S., Bhanger, M., Khan, K.M. (2013). Isolation and characterization of steroids from Calligonum polygonoides. Journal of Pharmacy Research, 6(3): 346-349. https://doi.org/10.1016/j.jopr.2013.03.017
[61] Gabay, O., Sanchez, C., Salvat, C., Chevy, F., Breton, M., Nourissat, G., Wolf, C., Jacques, C., Berenbaum, F (2010). Stigmasterol: A phytosterol with potential anti-osteoarthritic properties. Osteoarthritis and Cartilage, 18(1): 106-116. https://doi.org/10.1016/j.joca.2009.08.019
[62] Panda, S., Jafri, M., Kar, A., Meheta, B.K. (2009). Thyroid inhibitory, antiperoxidative and hypoglycemic effects of stigmasterol isolated from Butea monosperma. Fitoterapia, 80(2): 123-126. https://doi.org/10.1016/j.fitote.2008.12.002
[63] Molyneux, P. (2004). The use of the stable free radical diphenylpicrylhydrazyl (DPPH) for estimating antioxidant activity. Journal of Science and Technology, 26(2): 211-219.
[64] Miksusanti, M., Elfita, E., Hotdelina, S. (2012). Aktivitas antioksidan dan sifat kestabilan warna campuran ekstrak etil asetat kulit buah manggis (Garcinia mangostana L.) dan kayu secang (Caesalpinia sappan L.). Jurnal Penelitian Sains, 15(2): 60-69. https://doi.org/10.26554/jps.v15i2.97
[65] Suratno, S., Rizki, M.I., Pratama, M.R.F. (2019). In-vitro study of antioxidant activities from ethanol extracts of

Akar Kuning (Arcangelisia flava). Jurnal Surya Medika (JSM), 4(2): 66-71. https://ssrn.com/abstract=3345757
[66] Ghasemzadeh, A., Ghasemzadeh, N. (2011). Flavonoids and phenolic acids: Role and biochemical activity in plants and human. Journal of Medicinal Plant Research, 5(31): 6697-6703. http://dx.doi.org/10.5897/JMPR11.1404
[67] Al-Jaber, N.A., Awaad, S.A., Muses, H.E. (2011). Review on some antioxidant plants growing in Arab world. Journal of Saudi Chemical Society, 15(4): 293-307. https://doi.org/10.1016/j.jscs.2011.07.004
[68] Fadly, D., Abdul, N.A.R., Muttalib, Y.S., Bohari, B. (2021). Organoleptic properties, proximate compositions, and antioxidant activity of carrot – navel orange marmalade. Open Access Maced J Med Sci, 9(A): 488-492. https://doi.org/10.3889/oamjms.2021.6209