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Review: Phytochemical Screening, Secondary Metabolites and Biological Activities of Southeast Sulawesi Plants

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Abstract. Southeast Sulawesi is one of the provinces in Indonesia which has a variety of medicinal plants that have been used by its people in treating diseases. The results of research on phytochemical screening and isolation of secondary metabolites from local researchers indicated that the plants from Southeast Sulawesi have the potential to be studied further. Plants from Southeast Sulawesi show pharmacological potential activities that can be developed for the purpose of treating diseases caused by bacteria, fungi, cancer, and as an antioxidants. There are Southeast Sulawesi endemic plants from the *Etlingera* genus that are interesting to explore (phytochemical screening, isolation of pure compounds and pharmacological studies) considering that of the 14 species of Etlingera plants scattered in Southeast Sulawesi, 2 (two) of which have recently been reported, namely *E. elatior* and *E. calophrys*.

Introduction

Since the emergence of the Avian Flu outbreak, Severe Acute Respiratory Syndrome (SARS), and the latest in 2020, COVID-19 that has hit most countries in the world, scientists and researchers are competing to find vaccines as an antidote to the spread of the epidemic infection. In Indonesia, the Ministry of Research and Technology/National Innovation Research Agency (Kemenristek/BRIN) formed the Covid-19 Research and Innovation Consortium which helps the Covid-19 prevention task force team which focuses on research, development, assessment and application in handling the spread of the Covid-19. One of the priority activities is to conduct a review of food or other ingredients that are thought to increase human endurance or immunity, for example research related to herbal plants that have the potential to prevent Covid-19 (Anonymous, 2020).

Indonesia is a country with the largest natural wealth potential in the world with around 300,000 plant species. 9600 species of which are used by the community to treat diseases. However, only about 200 plants are used as raw material for medicine (Bahan Baku Obat/BBO) and only about 4% are cultivated (Herdiani, 2012). This potential that Indonesia has must be guarded so that it can be developed by researchers for further exploration.

Apart from supporting government policies regarding the Covid-19 Research and Innovation Consortium, this is also in accordance with the concerning the National Traditional Medicines policy of the minister of health through the Minister of Health Decree no. 381 / MENKES / SK / III / 2007 (KOTRANAS) which aims to encourage the sustainable use of natural resources and traditional ingredients, ensure the management of Indonesia's natural potential so that it has competitiveness, availability of traditional medicines, and makes traditional medicines as superior commodities.

Traditional medicines are ingredients or ingredients derived from plants, animal materials, mineral substances, galenic preparations, or mixtures of these ingredients which have been used for treatment from generation to generation, and can be applied in accordance with the prevailing norms in society (ethnobotany). The traditional medicine derived from plants is the most common ingredient used by the locals to cure various diseases or increase the body's immunity. The effectiveness of these medicinal plants is the main key for researchers to study

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the active ingredient content through phytochemical screening (secondary metabolite content in plants) so that it can be further studied for modern medicine (patent medicine), including the development of vaccines against various diseases. Traditional medicines derived from plants are the ingredients most widely used by local people to cure various diseases or to increase body immunity. The efficacy of this medicinal plant is the main key for researchers to explore the active substance content through phytochemical screening (secondary metabolite in plants) so that it can be studied further for modern medicine (Patent Medicine) including developing vaccines for various diseases.

Phytochemical screening is one of the preliminary steps in identifying secondary metabolites from natural products. The results of this phytochemical screening provide an overview of the content of compounds present in natural materials so that they can be used as a reference for the analysis of active compounds and for pharmacological purposes. In general, phytochemical studies are carried out based on the ethnobotany approach of plants with the assumption that these plants have active compounds that have biological effects on humans. Phytochemical studies can also be carried out based on taxonomic relationships with the assumption that between one plant and another plant in one kinship will contain a similar composition of chemical compounds.

Southeast Sulawesi is one of the provinces in Indonesia with 1000 plants of traditional medicinal raw material plants that have been used by 12 tribes in Southeast Sulawesi. Research on ethnobotany, ethnomedicine, pharmacology and studies of secondary metabolites in Southeast Sulawesi are increasingly being carried out by researchers as well as local academics. This gives an affirmation that the plants in Southeast Sulawesi have the potential to be studied further. However, until now there have been no researchers or academics who have tried to compile a review of the compound content and pharmacological activity of local plants from Southeast Sulawesi. Therefore, the authors consider the need for a comprehensive study prepared as a review of research results involving phytochemical screening, isolation of secondary metabolites and pharmacological activities of plants from Southeast Sulawesi.

Experimental

In preparing this article review, the authors have used references from research articles relating to the results of phytochemical screening, isolation of secondary metabolites, and the tests of biological activity (pharmacological) of plants from Southeast Sulawesi reported in the last 5 (five) years.

Result and Discussion

General Review of South Sulawesi

Southeast Sulawesi (abbreviated as Sultra) is one of the provinces in Indonesia, which is located in the southeastern part of the island of Sulawesi which is located in the southeastern part of the island of Sulawesi, with its capital city in Kendari. The southeastern province of Sulawesi is located on the southeastern peninsula of the island of Sulawesi , geographically in the southern part of the equator between 02 ° 45 '- 06 ° 15' south latitude and 120 ° 45 '- 124 ° 30' east longitude and has a land area of 38,140 km^2 (3,814,000 ha) and bodies of water (sea) on an area of 110,000 km^2 (11,000,000 ha). Southeast Sulawesi Provinces are South Sulawesi and Central Sulawesi (north), Banda Sea (east), Flores Sea (south), and Bone Bay (west). The province of Southeast Sulawesi is influenced by a humid tropical climate with an average rainfall of 2,000 mm per year. The temperature in the province of Southeast Sulawesi is between 23 ° C and 32 ° C.

Southeast Sulawesi is an area in the southeastern part of the island of Sulawesi that consists of two sub-regions namely the archipelago and the peninsula. This region includes seventeen administrative districts, namely (1) Kendari, (2) Kolaka, (3) Muna, (4) Buton, (5) Konawe, (6) Konawe Selatan, (7) Konawe Utara, (8) Utara Kolaka, (9) East Kolaka, (10) Bombana, (11) Wakatobi (Wanci, Kaledupa, Tomia and Binongko), (12) Bau-Bau, (13) North Buton, (14) Central Buton, (15) South Buton, (16) West Muna and (17) Konawe Islands. Of the 17 districts, only 12 regencies were declared included, as the remaining five districts had just been created as formal administrative areas. The five new districts are the expansion of each district, namely East Kolaka as part of the Kolaka Regency, Konawe Islands as part of the Konawe Regency, West Muna as part of the Muna Regency, Central Buton and West Buton as part of the Buton Regency. All of these districts have several villages near forest areas that have a wide variety of agricultural flora, both in the wild and in local crops, including wild plants that have not been recorded (Suaib and Arma, 2015).

Phytochemical Screening

Some plants of Southeast Sulawesi, whose secondary metabolites had been identified through preliminary phytochemical screening tests were Wualae (Tolaki tribe) from the *Etlingera* genus. In Southeast Sulawesi, this plant is known by various local names, namely Wualae, Wualae

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Nggeke, Susube, and Patikala. The difference in local names is based on the species of *Etlingera* itself. Based on ethnobotany studies, there are 48 *Etlingera* species dispersed in the Sulawesi region, 14 of which are in southeast Sulawesi and are endemic. One of the species endemic to Southeast Sulawesi is *E. c alophry s* (Tolaki: wualae) (sahidin *et al*., 2018). So far, the authors have research articles not related to the phytochemical screening obtained *E. calophrys*.

Etlingera elatior (jack) RM is one of the *Etlinger*a species that grows in southeast Sulawesi. Research related to this plant has been extensively reported, but the source of the plant is from outside of Southeast Sulawesi. Musnina et al (2019) carried out a plant phytochemical screening *E. elatior* (Jack) RM locally obtained from Sambeani village, Abuki District, Konawe (**Table 1**). Phytochemical screening was carried out on rhizome from *E. elatior* fractions of *n*-hexane, ethyl acetate, methanol and ethanol. The results of the phytochemical screening for rhizome showed that the ethanol fraction contained flavonoids, saponins, tannins and terpenoids, the methanol fraction contained alkaloids, saponins and tannins, the ethyl acetate fraction contained flavonoids, tannins and terpenoids, while the *n*-hexane fraction contained only terpenoids.

One of the endemic plants of Southeast Sulawesi, namely Songi (*Dillenia serrata*), which is used as an ingredient in traditional medicinal by the local people, has been carried out by an initial phytochemical screening test on stem by Sabandar *et al.* (2020). The screening results showed that the methanol extract of Songi stem (*Dillenia serrata*) contains tannins, flavonoids, terpenoids and stereoids. The total phenolic and flavonoid content in the methanol extract were 5.92% phenolic and 2.34% flavonoids for each gram of extract, respectively.

Phytochemical screening of plants that are believed to be medicines for the Muna tribe in Southeast Sulawesi to cure diseases has been carried out by Ihsan *et al* (2019). They conducted research on a plant known as Lansau, a traditional medicinal plant from the Muna tribe of Southeast Sulawesi which is used based on the spiritual philosophy of the Muna tribe adopted from Islamic mysticism. Phytochemical screening was carried out on 44 kinds of Lansau (table 2) obtained from Oe Nsuli Village, Kabangka District, Muna Regency, Southeast Sulawesi using the Thin Layer Chromatography technique (TLC).

In Kendari city, the capital of Southeast Sulawesi Province itself, several traditional medicinal plants have been tested for preliminary phytochemical screening. Some samples of medicinal plants studied were *Eichhornia crassipes* (water hyacinth), Javanese wood (*Lannea coromandelica*), Chinese ketapang (*Cassia alata* L), miana (*Coleus scutellarioides* L), pineapple (*Ananas comosus* (L.) (Mappasomba et al., 2019) , Paria (*Momordica charantia* L.), celery (*Apium graveolens* L.), starfruit (*Averrhoa bilimbi* L.), tamarind (*Tamarindus indica* L.), and guava bol (*Syzygium malaccense* L. Merr) (Mappasomba et al., 2020). The results of the secondary metabolite phytochemical screening test showed that starfruit contains flavonoids and tannins, celery contains flavonoids and saponins, guava contains flavonoids, tannins and saponins, paria contains flavonoids and alkaloids, and acids contain flavonoids, tannins and saponins (table 3 and table 4).

Table 1. The results of the phytochemical screening from Wualae (*Etlingera elatior*) rhizomes (Musnina *et al.,* 2019).

Secondary metabolites	Ethanol extract	fraction			
		***n*- hexane**	**Ethyl acetate**	**Methanol**	**Ethanol**
Alkaloids	+	- -	- -	+	- -
Flavonoids	+	- -	+	- -	+
Saponins	+	- -	- -	+	+
Tannins	+	- -	+	+	+
Terpenoids	+	+	+	- -	+

Secondary Metabolites

Secondary metabolites were isolated from plant origin in southeast Sulawesi, namely yakuchinone A (1), acidic *p*-hidroksibenzoate (2) and stigmasterol (3), which were isolated from the strain *Etlingera calophrys* , which is found in the village of Wolasi, South Konawe, Southeast Sulawesi (Sahidin *et al.,* 2017). Yakuchinone A and p-hydroxybenzoic acid were first isolated from the genus *Etlingera* . The compound (5E, 6E) 5-ethylidene-7-formyl-6,7-dihydroxymethylhept-6-enoate (4) from the chloroform fraction of the plant *Usnea longissima* was obtained from Kendari (Maulidiyah et al., 2016). Three aromatic compounds were isolated and identified from *Etlingera elatior* fruits obtained from Sambeani Village, Kab. South Konawe, namely vanilate acid (5), *p*-hydroxibenzoate acid (6) and acidic kumarate (7) (Sahidin et al., 2019). Two flavonoids 5,7,4'-trihydroxy-3 '(3-metilbut-2-enyl) -3-metoksiflavon (8) and makarangin (9) are isolated from the *Macaranga involucrata* originating in Central Buton, Southeast Sulawesi (Ilimu and Shah, 2019).

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Table 2. Phytochemical screening of 44 kinds of Lansau (Ihsan et al., 2019)

No.	Lansau Extract	Plant tissue	Secondary Metabolites				
			Alkaloids	Flavonoids	Tannins	Saponins	Terpenoids
1	Sandana (*Pterocarpus indicus*)	Leaves	- -	+	++	- -	- -
2	Katabha-tabhako (*Blumea sp.*)	Leaves	++	++	++		
3	Sambiloto (*Andrographis paniculata*)	Leaves	+++++	+	- -	++	+++
4	Kambadhawa (*Sesbania grandiflora*)	Leaves	- -	+++	- -	- -	+
5	Lakoora (*Eleusine indica*)	Herbs	- -	- -	+	+	- -
6	Kerseni (*Muntingia calabura*)	Leaves	+	++	+	+	+
7	Kusambi (*Schleichera oleosa*)	Leaves	- -	++	+	+	+++
8	Dana (*Imperata cylindrical*)	Rhizomes	- -	- -	+	++	++
9	Bhea (*Areca catechu*)	Seeds	+	- -	+	++	+
10	Radhawali (*Tinospora crispa*)	Cortex	+	- -	+	- -	+
11	Katimboka (*Drynaria sparsisora*)	Cortex	- -	- -	+	- -	- -
12	Ladha (*zingiber sp*)	Rhizomes	- -	+	- -	+	- -
13	Kumbou (*Artocarpus teysmannii* Miq.)	Cortex	- -	+	- -	- -	- -
14	Kaghuse-ghuse (*Dalbergia stipulacea* Roxb)	Leaves	+	+	+	+	+
15	Wonta (*Scleria laevis* Retz)	Leaves	+	+	- -	+	- -
16	Komba-komba (*Chromolaena odorata* Miq.)	Leaves	+	+	- -	+	+
17	Patiwala Ngkadea (*Lantana camara* L.)	Leaves	- -	+	+	+	+
18	Tongkoea (*Alstonia scholaris*R.Br.)	Leaves	+	+	- -	+	+
19	Gondu (*Crescentia cujete* L.)	Leaves	+	+	- -	- -	- -
20	Saubandara (*Senna alata* Roxb.)	Leaves	+	+	+	+	+
21	Bumalaka (*Psidium guajava* L.)	Leaves	+	+	- -	+	+
22	Kulidawa (*Tectona grandis* L.f.)	Cortex	- -	- -	+	- -	- -
23	Kumis kucing (*O. stamineus* B.)	Leaves	+	+	+	+	+
24	Rogili (*P. betle*)	Leaves	- -	+	+	- -	+
25th	Padamalala (*C.citratus*)	Leaves	- -	+	+	- -	+
26	Ntanga-ntanga (*Jatropha curcas)*	Leaves	- -	+	+	+	- -
27	Kasape (*F. stroblifera*)	Leaves	- -	+	+	+	+
28	Kalamandinga (*L. leucocephala*)	Leaves	- -	+++	++	++	- -
29	Rogo (*P. cardifolia*)	Leaves	- -	+	++	- -	+
30	Tulasi (*O. tenuiflorum*)	Herbs	- -	+	+++	+	+
31	Kabote- bote (*R. tuberose*)	Leaves	+	+	+	- -	- -
32	Kaembu-embu (*B. balsamifera*)	Leaves	- -	+	+++	++++	+
33	Kula (*A. altilis*)	Leaves	- -	+	++	- -	+
34	Bhangkudu (*M. Citrifolia* L)	Fruits	- -	- -	- -	+	+

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35	Kamena-mena (*Clerodendrum* sp.)	Leaves	+	+	+	- -	- -
36	Patirangka (*Impatiens balsamina* L)	Leaves	- -	- -	+	+++	- -
37	Soni (*Dillenia* cf. *Celebica* H.)	Leaves	- -	+	+	+	+
38	Katapi(*Sandoricum koetjape* Merr.)	Leaves	+++	+	+	+	+
39	Libbho (*Ficus septica* Burn.f.)	Leaves	- -	+++	- -	- -	- -
40	Ghontoghe (*Kleinhovia hospita* L.)	Leaves	+	- -	- -	- -	- -
41	Daru (*Averrhoa bilimbi* L.)	Leaves	+	+	+	+	- -
42	Lansale (*Hyptis capitata* Jacq.)	Leaves	- -	+	- -	- -	+
43	Kaghai-ghai (*phyllanthus niruri* L.)	Leaves	- -	+	+	- -	+
44	Sirikaya (*Annona muricata* L.)	Leaves	++	+	+	+	- -

Table 3 . The results of phytochemical screening of traditional medicinal plants in Kendari City (Mappasomba *et al.,* 2019)

Sample	Plant tissue	Secondary metabolites				
		Alkaloids	**Flavonoids**	**Terpenoids**	**Saponins**	**Tannins**
E. crassipes	roots	- -	- -	- -	1	
(Water hyacinth)	leaves	- -	5	- -		1
	flowers	- -	1	- -	1	1
L. coromandelica H.	roots	1	- -	- -	2	2
(Javanese wood)	leaves	1	4	0	2	2
	flowers	- -	5	- -	1	2
C. alata L.	roots	1	- -		1	1
(Chinese ketapang)	barks	1	1	- -	1	1
	leaves	- -	4	1	1	1
	flowers	1	1		1	- -
	fruits	1	1	- -	1	1
C. scutellaroides L.	roots	1	1	- -	2	2
(Miana)	Trunk	1	1	- -	2	1
	leaves	1	3	- -	1	1
	flowers	1	1	- -	1	1
A. comocus L.	roots	- -	- -	- -	2	1
(Pineapple)	leaves	1	2	- -	1	2
	barks	- -	2	- -	- -	1

Table 4. Test results for secondary metabolite compounds in Kendari medicinal plants (Mappasomba *et al.,* 2020)

Sample	Plant tissue	Secondary metabolites				
		Alkaloids	Flavonoids	Tannins	Saponins	Terpenoids
Averrhoa bilimbi L.	roots	- -		+	- -	- -
(Star fruit)	Trunk	- -		+	- -	- -
	leaves	- -	+	- -	- -	- -
Apium graveolens L (celery)	roots	- -	- -	- -	- -	- -
	Trunk	- -	- -	- -	- -	- -
	leaves	- -	+	- -	+	- -
Syzygium malaccense L. Merr	roots	- -	- -	+	- -	- -
(Guavenbol)	Trunk	- -	- -	+	- -	- -
	leaves	- -	+++	+	+	- -
Momordica charantia L.	roots	- -	- -	- -	+	- -
(Pariah)	Trunk	+	- -	- -	- -	- -
	leaves	++	++		- -	- -
Tamarindus indica L (tamarind)	roots	- -	+	++	+	- -
	Trunk	- -	+	++	+	- -
	leaves	- -	++	- -	- -	- -

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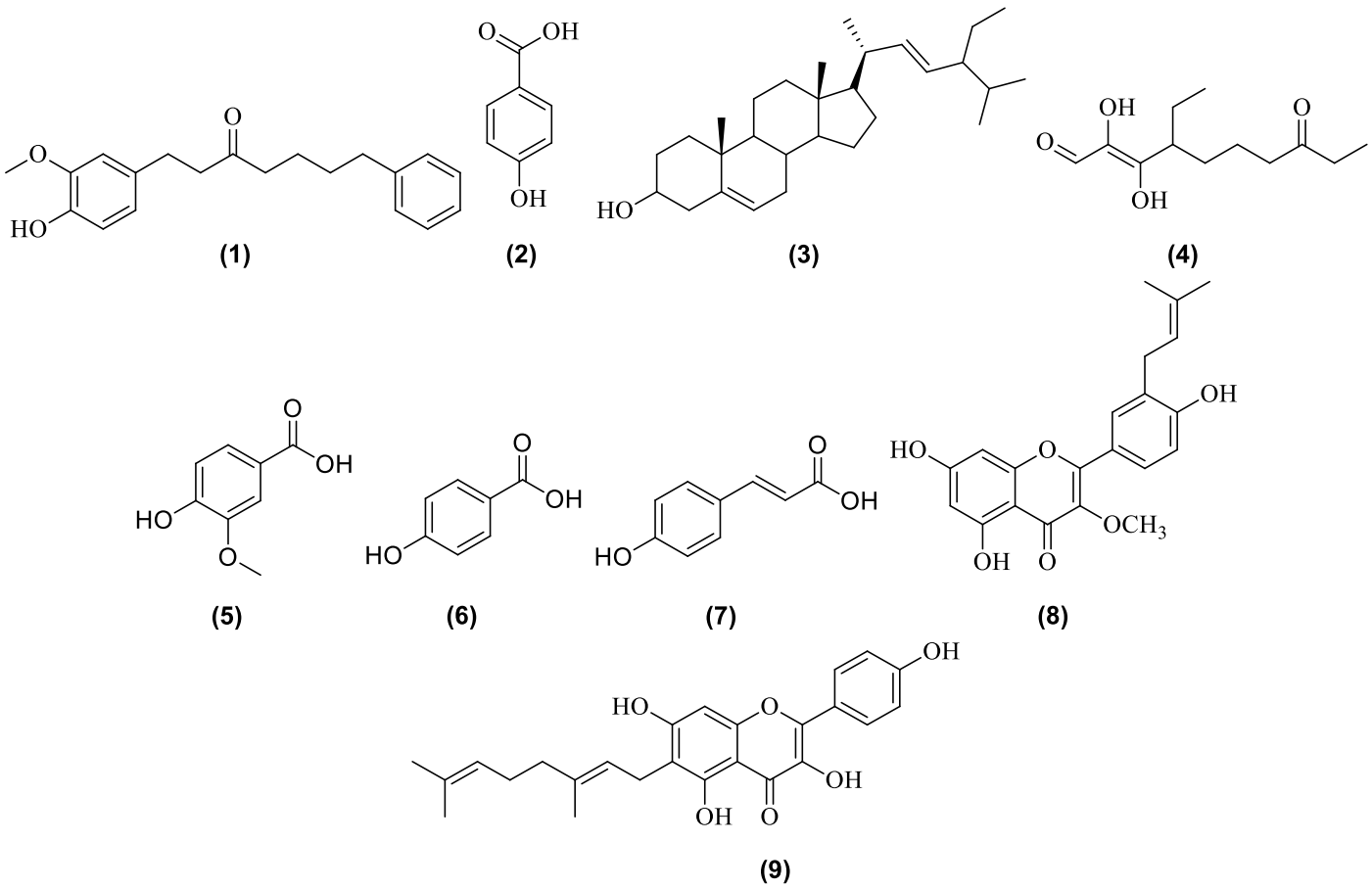

Figure 1. The Compound structure isolated from plants from Southeast Sulawesi

Pharmcological Activities

Pharmcological activity tests have been reported on several plants from Southeast Sulawesi. the antibacterial activity of the *U. longissima* moss plant with the diffusion method using disc paper showed that chloroform extract inhibited the growth of *Eschercia coli* ATCC3521, *Staphylococcus auerus* and *Salmonella typhi* YCTC at concentrations of 100 ppm, 250 ppm, 500 ppm and 1000 ppm with weak resistance . While the isolated compounds (4) (5E, 6E) 5-ethylidene-7-formil-6,7-dihydroxy methyl hept-6-enoate inhibited the growth of E. coli ATCC 35218 at concentrations of 100, 250, 500, and 1000 ppm with weak resistance and inactive on *S.auerus* ATCC25923 (Maulidiyah *et al,* 2016). The results of the oxidant test from the methanol extract of *Etlingera calophrys* stems and the three pure compounds (compounds 5-7) showed free radical scavenging activity with the maximum inhibitory concentration (IC_{50}), respectively 38.36, 39.07, 46.60, and 153.4. µg / mL, compared with ascorbic acid with an IC_{50} value of 10.53 µg / mL (Sahidin *et al,* 2017). The anti-fungal activity of *Candida albians* ATCC 10231 in the ethyl acetate fraction of *E. Elatior* rhizomes (**Table 5**) shows a moderate category (Musnina *et al,* 2019).

Table 5 . The results of the measurement of the diameter of the ethyl acetate fraction of the inhibition area of Wualae against the fungus *Candida albicans* ATCC 10231 (Musnina et al., 2019)

Fungus	Treatment	Concentration	Inhibition (mm)	Category
Candida albicans ATCC 10231	Ethyl cetate fraction	100 mg / ml	9.75	Moderate
		50 mg / ml	9.5	Moderate
		25 mg / ml	8.75	Moderate
		12.5 mg / ml	8	Moderate
	Control (+)	0.1 mg / ml	26	Very strong
	Control (-)	10%	0	Not active
	DMSO 10%	10%	0	Not active

Sabandar *et al.* (2020) reported the results of the antioxidant test of songi stem bark from Southeast Sulawesi using the DPPH method. Methanol extract and organic fractions (ethyl acetate and methanol) from songi stem

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bark had DPPH free radical scavenging activity of 48.2–59.7% and reduction of iron ions (0.8–3.4 µg µg equivalent to the amount of trolox) at a concentration of 100 µg/mL. In addition, the methanol fraction of songi stalks had 50.3% inhibiting activity of the xanthine oxidase enzyme. Sahidin *et al* (2019) reported that the methanol extract of E. elatior fruit and 3 isolated compounds (compounds 5-7) had the ability to inhibit *Bacillus subtilis, Eschercia coli, Pseudomonas aeruginosa, S. Enterica, Staphylococcus aureus, Streptococcus mutans* Table 6.

Table 6 . Antibacterial inhibition zone of methanol extract and isolated compounds (5-7) from *E. elatior* fruits (Sahidin *et al.,* 2019)

Microbes	Inhibition zone (mm), [sample] = 100 µg / ml				
	MeOH extract	Compound 5	Compound 6	Compound 7	Chloramphenicol
B. subtilis	0.03 ± 0.18	0.00 ± 0.00	0.17 ± 0.18	0.25 ± 0.12	15.30 ± 0.58
E. coli	0.02 ± 0.24	0.38 ± 0.18	0.83 ± 0.14	1.25 ± 0.28	10.60 ± 0.34
P. aeruginosa	0.03 ± 0.22	0.80 ± 0.32	0.17 ± 0.26	1.00 ± 0.14	9.71 ± 0.38
S. enterica	0.03 ± 0.18	3.88 ± 0.54	0.63 ± 0.20	1.00 ± 0.14	12.70 ± 0.22
S. aureus	0.02 ± 0.10	0.00 ± 0.00	0.50 ± 0.24	1.25 ± 0.32	6.25 ± 0.78
S. mutans	0.03 ± 0.14	3.46 ± 0.38	0.67 ± 0.26	2.50 ± 0.22	15.60 ± 0.66

Note: 100 µ g / ml: vanillic acid (1) - 0.59 µ M; Acid p-hydroxybenzoic acid (2) = 0.72 µM; p-coumaric acid (3) = 0.61 µM; Chloramphenicol = 0.31 µM

Table 7. LC50 value of each 44 kinds of Lansau (Ihsan et al., 2019)

No.	Lansau	Plant parts	% Mortality					LC50 (µg / ml)
			0	100	250	500	1000	
1.	Ladha	Rhizome	3	33.33	40	63.33	70	172.070
2	Kumbou	Cortex	0	13.33	16.66	26.66	36.66	1199.856
3.	Sau Bandara	Leaves	3	36.66	46.66	46.66	66.66	203.434
4	Wonta	Herbs	0	11.30 p.m.	26.60	30th	33.33	1281.795
5.	Kaghuse-ghuse	Leaves	0	46.66	56.66	66.66	86.66	60.235
6	Gondu	Leaves	0	13.33	16.66	26.66	30th	1234.170
7	Komba-komba	Leaves	0	33.33	40	50	76.66	270.439
8	Patiwala Ngkadea	Leaves	3	36.66	43.33	73.33	90	38,330
9.	Tongkoea	Leaves	3	16.66	11.30 p.m.	26.66	30th	2085.246
10	Bumalaka	Leaves	0	13.33	16.66	23.33	26.66	1038.785
11	Kulidawa	Cortex	0	16.66	23.33	26.66	30th	1731,681
12	Bhangkudu	Fruit	0	6.6	10	26.6	30th	2659.724
13	Kamena-mena	Leaves	0	26.6	33.3	36.6	50	1288.053
14	Patirangka	Leaves	0	3.3	16.6	26.6	40	1449.126
15	Soni	Leaves	0	40	43.3	60	63.3	272,368
16	Katapi	Leaves	0	3.3	6.6	16.6	30th	2524,423
17	Libho	Leaves	0	46.6	50	66.6	93.3	155.607
18	Ghontoghe	Leaves	0	3.3	10	33	40	1234.572
19	Daru	Leaves	0	10	23.3	40	46.6	1003,310
20	Lansale	Leaves	0	43.3	56.6	60	73.3	156,000
21	Kaghai-ghai	Leaves	0	43.3	60	83.3	93.3	132.023
22	Sirikaea	Leaves	0	63.3	76.6	90	93.3	51,046
23	Sandana	Leaves	0	26.67	26.67	63.33	73.33	354,498
24	Kataba-tabako	Leaves	0	23.33	60	86.67	96.67	177,577
25	Sambiloto	Leaves	0	3.33	36.67	80	100	268,512
26	Kambadhawa	Leaves	0	6.67	13.33	56.67	56.67	625.879
27	Lakoora	Herbs	0	3.33	13.33	56.67	23.33	3383,633
28	Kerseni	Leaves	0	26.67	46.67	63.33	83.33	252.252
29	Kusambi	Leaves	0	33.33	46.67	56.67	63.33	316,567
30	Dana	Rhizome	0	26.67	60	86.67	100	168.467
31	Bhea	Seeds	0	3.33	33.33	96.67	100	234,429
32	Radhawali	Cortex	0	3.33	16.67	76.67	86.67	323.53
33	Katimboka	Cortex	0	3.33	20th	63.33	67.67	450,535
34	Kumis kucing	Leaves	0	6.6	33.3	43.3	46.6	608.30
35	Rogili	Leaves	0	6.6	10	16.6	20th	1834.793
36	Padamalala	Leaves	0	16.6	16.6	30th	33.3	153.987
37	Ntanga-ntanga	Leaves	0	13.3	20th	23.3	30th	1155.567
38	Kasape	Herbs	0	23.3	26.6	50	53.3	512,408

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39	Kalamandinga	Leaves	0	33.3	43.3	100	100	83,676
40	Rogo	Leaves	0	10	13.3	26.6	43.3	933,583
41	Tulasi	Herbs	0	26.6	30th	46.6	53.3	537.030
42	Kabote-bote	Leaves	0	6.6	6.6	26.6	20th	1394.647
43	Kaembu-embu	Leaves	0	16.6	13.3	33.3	43.3	871.417
44	Kula	Leaves	0	16.6	16.6	30th	33.3	1300.518

Table 8. Results of the calculation of the LC50 value for each plant partially (Mappasomba et al., 2019)

Plant	Network	LC_{50} (µg/ml)
E. crassipes	Root	530.161
(Water hyacinth)	Leaf	388.670
	Flower	345.199
L. coromandelica H.	Root	122.194
(Javanese wood)	Bark	120,573
	Leaf	521.217
C. alata L.	Root	1062,960
(Chinese ketapang)	Bark	223.095
	Leaf	1049,352
	Flower	1079.233
	Fruit	1116.823
C. scutellaroides L.	Root	605,480
(Miana)	Trunk	1030.293
	Leaf	1510, 415
	Flower	127,495
A. comocus L.	Root	205.076
(Pineapple)	Leaf	221,469
	Bark	358,323

Table 9 . The results of the antibacterial activity test of herbs in Kendari againts *E. coli* and *S. A ureus* (Mappasomba et al., 2020)

Sample	Network	*E. coli*		*S. aureus*	
		Exclusion zone diameter (mm)	Category*	Zone inhibition area (mm)	Category
A. bilimbi L.	Roots	15	Very active	10	Moderate
(Starfruit)	Stems	- -	Not active	- -	Not active
	Leaves	- -	Not active	- -	Not active
A. graveolens L (celery)	Roots	10	Moderate	- -	Not active
	Stems	- -	Not active	- -	Not active
	Leaves	- -	Not active	- -	Not active
S. malaccense L. Merr (malay	Roots	15	Very active	13	Very active
Apple)	Stems	13	Very active	15	Very active
	Leaves	- -	Not active	- -	Not active
M. charantia L.	Roots	- -	Not active	- -	Not active
(Bitter melon)	Stems	1	Weak	2	Weak
	Leaves	1	Weak	3	Moderate
T. indica L (tamarind)	Roots	3	Moderate	3	Moderate
	Stems	2	Moderate	3	Moderate
	Leaves	- -	Not active	0.5	Weak

A total of 44 kinds of Lansau used by the Muna tribe have been reported to have cytotoxicity activity using the Brine Shrimp Letality Test (BSLT) method using Artemia salina (Ihsan *et al,* 2019). This test is an initial toxicity test to identify the anticancer activity of a substance. The extract is toxic (toxic) when the LC_{50} value is <1000 µg / mL. The results showed that of the 44 samples tested, 27 were toxic. The sample that had the smallest LC_{50} value was the leaves of *Lantana camara L.* (38,330 µg / mL) while the sample that showed the largest LC_{50} was *Eleusine indica L.* leaves (3383,633 µg / mL) (Table 7).

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From the area of the capital of Southeast Sulawesi, city of Kendari, precisely in Poasia sub-district, 18 samples of medicinal plants toksisitasinya were tested against larval shrimp *Artemia salina* Leach. (BST method). Of the 18 samples of medicinal plants, 12 were toxic (Table 8) with an LC value of $_{50}$ ~ 1000 µg / ml. The sample with the smallest LC $_{50}$ value was *L. Coromandelica* stem bark (120.573 µg / ml). The highest LC $_{50}$ value was leaves of *C. scutellaroides* L. (1510, 415 µg / ml) (Mappasomba *et al*., 2019). Bitter melon (*Momordica charantia* L.), celery (Apium graveolens L.), starfruit (*Averrhoa bilimbi* L.), tamarind (*Tamarindus indica* L.), and malay apple (Syzygium malaccense L. Merr) obtained from community cultivation gardens in Poasia and Kambu Subdistricts, Kendari City, Southeast Sulawesi showed inhibitory activity against E. coli and S. aureus bacteria (Table 9). The roots of starfruit were very active against E. coli bacteria with an inhibition zone diameter of 15 mm. Root and guava stem extracts were very active against E. coli bacteria with an inhibition zone diameter of 15 mm and 13 mm. Guava stem extract is also very active against S. aureus bacteria with an inhibition zone diameter of 13 mm and 15 mm (Mappasomba et al., 2020).

Conclusion

Plants from Southeast Sulawesi have the potential to be studied further, especially in phytochemical screening studies (secondary metabolites) and the isolation of their pure compounds. Plants from Southeast Sulawesi that have been studied show pharmacological potential that can be developed for the purpose of treating diseases caused by bacteria, fungi, cancer, anti-radicals (antioxidants). There are Southeast Sulawesi endemic plants from the *Etlingera* genus that are interesting to explore (phytochemical screening, isolation of pure compounds and pharmacological studies) considering that of the 14 species of Etlingera plants, 2 (two) of which were recently reported, namely *E. elatior* and *E. calophrys.*

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Conflict of Interest

The authors disclose no conflicts.

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