MEDICINAL PLANTS USED FOR ANTIHYPERCHOLESTEROLEMIA IN ETHNIC GROUPS OF CELEBES ISLAND, INDONESIA

Pemanfaatan Tumbuhan Obat sebagai Antihiperkolesterolemia di Berbagai Etnis di Pulau Sulawesi, Indonesia

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ABSTRACT

This study aimed to identify the utilization of medicinal plants used by selected traditional healers who met inclusion criteria to treat high cholesterol levels in ethnic groups of Celebes Island, Indonesia. Data collection was carried out through interviews, observation, and sample collection. This study revealed 67 concoction information and identified the use of 48 plant species distributed in 32 families among 39 healers in 20 ethnic groups in Celebes Island. Peperomia pellucida (L.) Kunth (UV=0.21), lamiaceae (15.63%), and leaves (57.35%) were determined as the most prominent species, family, and plant part used. The most widely prescribed rule of use is internal administration (94.03%) with a frequency of 3x1 per day (44.78%) for a week to a month (56.72%). However, conservation efforts must be initiated immediately since more than 50% of healers have yet to cultivate efforts.

Keywords: Peperomia pellucida, folk medicine, local knowledge

ABSTRAK

Studi ini bertujuan untuk mengidentifikasi pemanfaatan tumbuhan obat sebagai terapi hiperkolesterolemia oleh pengobat tradisional terpilih yang memenuhi berbagai kriteria inklusi yang telah ditetapkan di berbagai etnis di Pulau Sulawesi, Indonesia. Pengumpulan data dilakukan melalui wawancara mendalam, observasi dan pengambilan specimen tanaman obat. Hasil studi menunjukkan sebanyak 67 informasi penggunaan ramuan dengan 48 spesies tanaman dan terdistribusi dalam 32 famili telah teridentifikasi dari 39 pengobat tradisional di 20 etnis di Pulau Sulawesi. *Peperomia pellucida* (L.) Kunth (UV=0,21), *lamiaceae* (15,63%), dan daun (57,35%) terdata sebagai spesies, famili dan bagian tanaman yang paling banyak disitasi oleh pengobat tradisional untuk pengobatan hiperkolesterolemia dimana > 94% ramuan digunakan secara internal dengan cara diminum sebanyak 3x1 sehari (44,78%) selama 1-4 minggu (56,72%). Namun demikian, upaya konservasi tumbuhan perlu segera dilakukan mengingat lebih dari 50% spesies terindentifikasi masih dikoleksi dari alam dan belum dibudidayakan.

Kata kunci: *Peperomia pellucida*, obat tradisional, pengetahuan lokal

BACKGROUND

Hypercholesterolemia is described as a condition in which plasma cholesterol levels are excessively high; some literature mentions 200 mg/dl with normal plasma triglycerides, as a consequence of increased cholesterol and apolipoprotein B rich lipoprotein, and can be categorized as primary and secondary hypercholesterolemia (Martinez-hervas & Ascaso, 2018). High serum cholesterol levels are a significant factor in atherosclerosis development, leading to cardiovascular diseases such as coronary heart disease and stroke (Fatimah et al., 2016). The prevalence of hypercholesterolemia in Indonesia population aged more than 15 years in 2013 was

35.9%, whereas the percentage with low HDL, non-optimal LDL and very high triglyceride levels were 22.9, 60.3, and 11.9%, respectively (Nofiartika & Prasetyaningrum, 2020). The prevalence increases with age (Lestari & Sakhnan, 2020). The increase in the incidence of non-communicable diseases is related to lifestyle changes due to modernization, urbanization, globalization, and population growth (Suci & Adnan, 2020).

The importance of medicinal plants use for well-being intention in Indonesian traditional medicine is still high (Sholikhah & Mada, 2016). Celebes Island is one of the big islands in Indonesia in which the ethnic groups still maintain various traditions, one of them is the use of medicinal plants for both prevention and treatment of various diseases, whereas hypercholesterolemia is one of the treated diseases (Arham et al., 2016). *Peperomia pellucida* is recognized as one of the species traditionally widely used for treating gout and rheumatism (Rachmawati & Rantelino, 2018). *P. pellucida* exhibited to contain flavonoids, alkaloids, glycosides, phenols, saponin, steroids, terpenoids, and tannins (Hanani et al., 2017)(Pratiwi et al., 2021)(Raghavendra & Kekuda, 2018). The results of the gas chromatography analysis showed sesquiterpenes as the main component of the essential oil of the leaves and stems of *P. pellucida* (Usman & Ismaeel, 2020)*.* The administration of a single dose of *P. pellucida* ethanol extract in DDY strain mice showed mild acute toxicity with LD_{50} in male and female groups of 15.13 and 11.87 g/kg bw, respectively, which was indicated by a decrease in feed consumption and death of treated animals on the [third] day after administration of the extract (Dewijanti et al., 2014). Ethanol extract of *P. pellucida* from various regions was reported to have a total flavonoid content of 3.807-4.244% (Angelina et al., 2015).

World Health Organization announced that 90% of Southeast Asia member states declared the lack of research data as one of the difficulties faced related to traditional medicine practices in their countries. Indigenous traditional medicine, both knowledge and practice, may depend privately on past experience and observation handed down orally from generation to generation with less documentation and threatened to be lost by age and access limitations (World Health Organization, 2019). Therefore, documentation must be done to preserve and protect such information for future generations(Pramanik, 2019)(Anyaoku et al., 2015). This study was conducted to document the use of *P. pellucida* and other medicinal plants for anti-hypercholesterolemia by healers among twenty ethnic groups in Celebes Island of Indonesia.

METHODS

Study area

Province of South Sulawesi, Central Sulawesi, Southeast Sulawesi and North Sulawesi in Celebes Island were the locations of this study, which was carried out during 2015 and 2017. Totally, there were twenty ethnic groups distributed in those five provinces; they were Padoe, Seko, Wotu, Pattae, Pattinjo, Balaesang, Bungku, to Manui'i, Tialo, Lalaeo, Wana, Molongkuni, Ondae, Pekurehua, to Badaya, Balantak, Kaledupa, Mekongga, Ratahan and Minahasa ethnic groups.

Data Collection

Directly interview based on a structured questionnaire among selected traditional healers was conducted in each ethnic of Celebes Island. The questionnaire provided data on demography, sources of knowledge and healers skills, other treatment methods, vernacular plant names, plant origin, plant part used, plant habitat, treated disease, symptoms of the disease, herbs used, the dosage used, preparation method, the administration route, and some other information. Selected

traditional healers must meet the required criteria: they have both knowledge and treatment skills using medicinal plants, indigenous acculturated or people of the ethnic, the most famous healer and recognized by the community. Direct observation and specimen collection were run after the interview. The collected specimen was identified and kept in Herbarium Tawangmanguensis B2P2TOOT. The ethical approval was gained from the Health Research Ethics Commission of the Health Research and Development Agency, Ministry of Health of the Republic of Indonesia.

Data analysis

The data gained from the study was reposited in the Data Management Laboratory of the National Institute of Health Research and Development. The data request procedure follows the standard procedure established by the Laboratory of Data Management. Data quantification was carried out by analyzing parameters of use value and plant part value with the following formula:

$$UV = \sum U/n \hspace{4cm} \text{(Ayyanar \& Ignacimuthu, 2011)}$$

UVs : Use Value
UVis : Number of uses mentioned for a species
Ni : Total number of respondents interviewed

Plant Part Percentage (PPV) was also used as data quantification to calculate the plant part (stems, leaves, roots, fruit, bark, wood, flowers) used percentage for treatment of high cholesterol levels by healers.

$$PPV\,(\%) = (\Sigma RU\,(plantpart) / \Sigma RU)\; x\; 100 \hspace{2cm} \text{(Ayyanar \& Ignacimuthu, 2011)}$$

RESULTS AND DISCUSSION

Selected informants and ethnic groups

This present study was carried out in all provinces on the island of Celebes, where as many as 39 traditional healers among 20 ethnic groups met the criteria of having knowledge and skills of anti-hypercholesterolemia treatment by utilizing medicinal plants. Table 1 shows that most of the informants came from Central Sulawesi. Central Sulawesi was reported to have twelve indigenous ethnic groups and is enriched with many tribal immigrants which resulted in life aspects diversity including the way of health maintaining (Andriansyah et al., 2018).
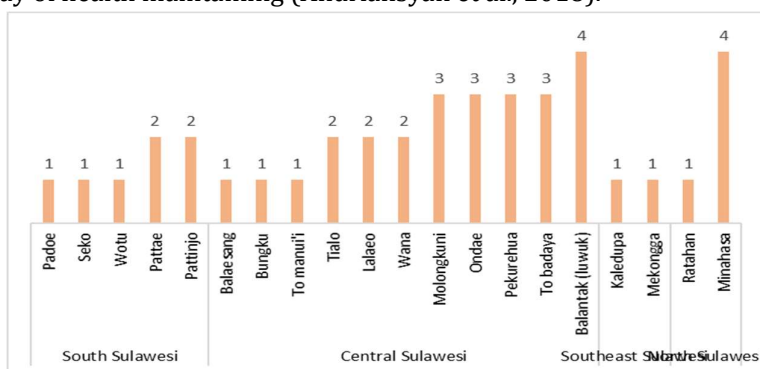

Figure 1. Selected informants and ethnic groups owned anti-hypercholesterolemia medicinal plants in Celebes Island

Of the 39 healers who treated high cholesterol, more than 70% of healers employed additional treatment methods besides medicinal plants. These were massage, spiritual therapy, supernatural therapy, fracture therapy, and other therapy methods, in which massage (56%) was determined

as the most frequent supporting method practiced by the healers. As reported by Gitawati *et al*. (2015), muscle pain around the back part of the neck was the most subjective complaint experienced by hypercholesterolemia patients; thus, massage therapy was a remarkably beneficial additional therapy for reducing the muscle pain severity (Gitawati et al., 2015). Although massage is not included in the standard procedure for treating hypercholesterolemia, it is a safe, non-invasive treatment that may assist patients in managing the stress of their symptoms (Schroeder et al., 2014). Another study also exhibited that massage therapy significantly reduced pain, anxiety, muscular tension, and improved relaxation (Braun et al., 2012). Massage benefits the body by escalating blood circulation, increasing muscle and skin temperature, raising parasympathetic activity, decreasing pain and inducing relaxation through biomechanical, neurological and physiological mechanisms (Gasibat & Suwehli, 2017).

Use Value (UV) and Medicinal Plant Utilized
Each plant has its own vernacular name, plant family, plant part used, way of preparation and administration route, and completed with varied data on safety and toxicity gained from former studies. As shown in Table 1. 48 species of medicinal plants were collected and identified, distributed in 32 families and already utilized by traditional healers in Celebes Island to treat high cholesterol levels among their patients for both healing and prevention.

Table 1. Medicinal plants utilized for anti-hypercholesterolemia in Celebes Island

No.	Plant species	Vernacular name	Family	Plant parts	Use Value	Way of preparation
1	*Acalypha vahliana* Mull. Arg.	Londol londol	*Euphorbiaceae*	Root	0.03	Wash and boil ingredients with 1 L of water until it boils, drink 3x1/day for 1 month, no chili sauce while drinking the concoction
2	*Aglaonema* Sp. Cf	Mantilaso	*Araceae*	Leaf	0.03	Take and heat it over the flame, paste it on the sore part by massaging
3	*Allium cepa* L.	Bawang merah	*Amaryllidaceae*	Tubers	0.03	Mix one tuber with three turmeric, mash finely, add 2 tablespoons of coconut oil, mix well, read the prayer, rub on the sore part 1x/day
4	*Allium tuberosum*	Kucai	*Amaryllidaceae*	Leaf	0.05	Boil a handful of leaves with 3 cups of water it remains 2 cups, drink 2x/day for 1 week
5	*Alstonia scholaris* (L.) R.	Kampangar	*Apocynaceae*	Stembark, Leaf	0.03	Boil with 1 L of water until it boils, drink 3x/day for 2 weeks
6	*Annona muricata* L.	Sirikaya, Nangga landa, Sirsak	*Annonaceae*	Leaf	0.1	Wash and boil 13 old leaves with 2 cups of water until it remains a cup, drink 2x/day before eating, no fatty, oily and coconut milk foods consume
7	*Anredera cordifolia*	Binahong	*Basellaceae*	Leaf	0.03	Boil 3, 5 or 7 old leaves with 3 cups of water until remains 1 cup, drink 2x/day for 1 month
8	*Apium graveolens* L.	Sederei, seledri	*Apiaceae*	Leaf	0.03	Take 6 raw leaf midribs, eat directly 2x a day, morning and night until healed
9	*Arenga pinnata* (Wurmb) Merr.	Enau	*Arecaceae*	Root	0.03	Boil ingredients with 1 L of water until it boils, drink 3x/day as much as 1/2 cup for 1 month
10	*Bombax ceiba* L.	Londol londol	*Malvaceae*	Stembark	0.03	Boil all ingredients with 1 L of water until boiling, drink 3x/day 1/3 cup for 2 weeks
11	*Brucea javanica* (L.) Merr.	Kayu kambing	*Simaroubaceae*	Stembark	0.03	All ingredients are boiled, and the water is drunk 3 times a day 1/3 cup for 2 weeks
12	*Cheilocostus speciosus* (J.Koenig)	Tebu hutan, Tawo'o	*Costaceae*	Stem	0.05	Take and dredge the inside 3 or 5 stems, squeeze, strain and discard the pulp, drink the juice 3x/day 1/2 to 1 cup

No.	Plant species	Vernacular name	Family	Plant parts	Use Value	Way of preparation
13	*Chromolaena odorata* (L.)	Ewobesi	*Asteraceae*	Herbaceous parts	0.03	Take 1 handful of young stalks of material, boil with 3 cups of water until remains 2 cups, drink 1x/day until healed
14	*Clerodendrum paniculatum* L.	Tarantang	*Lamiaceae*	Leaf	0.03	Boil 3 or 5 leaves with 2 cups of water, drink 2x/day 1 cup
15	*Cucumis sativus* L.	Ketimun jepang	*Cucurbitaceae*	Fruit	0.03	Take 1 piece of material, peel the skin, grate, squeeze, and drink 1x/day for a week
16	*Cuminum cyminum* L.	Jintan	*Apiaceae*	Seed	0.03	One tablespoon cumin powder, 1/4 temulawak rhizome, 2 cm white turmeric, 12 bay leaves, boil all ingredients, drink 2x/day
17	*Curcuma longa* L.	Kunyit	*Zingiberaceae*	Rhizome	0.03	Three rhizomes and 1 clove of red onion, finely mash, add 2 tablespoons of coconut oil, mix well, rub it on the affected part 1x/day
18	*Curcuma zanthorrhiza* Roxb.	Temulawak	*Zingiberaceae*	Rhizome	0.03	1/4 temulawak rhizome, 2 cm white turmeric, 12 bay leaves, 1 tablespoon cumin powder, boil all ingredients, drink 2x/day
19	*Curcuma zedoaria* (Christm.) Roscoe	Kunyit putih	*Zingiberaceae*	Rhizome	0.03	2 cm white turmeric, 12 bay leaves, 1/4 temulawak rhizome, 1 tablespoon cumin powder, boil all ingredients with 300 ml of water until remains 200 ml, drink 2x/day
20	*Cymbopogon nardus*	Sriwangi	*Gramineae*	Herba	0.03	Boil mixed ingredients with 2 cups of water until remaining 1 cup, drink 1/2 cup for 3 days
21	*Dendrobium crumenatum* Sw.	Anggrek	*Orchidaceae*	Stem	0.03	Take the stems, peel the skin, cut them into 5 parts with a size of 1 cm, and boil with 3 L of water until the remaining half
22	*Dimocarpus longan* Lour.	Baddo	*Sapindaceae*	Leaf	0.03	Prepare 5 leaves, add 3 tarantang leaves, boil with 2 cups of water, drink 2x a day 1 cup
23	*Drynaria quercifolia*	Barangkakap	*Polypodiaceae*	Stem	0.03	Take and peel the skin, cut it into 5 parts with a size of 1 cm, and boil with 3 L of water
24	*Euphorbia heterophylla* L.	Rakot kangkong	*Euphorbiaceae*	Herba	0.05	Boil 9 leaves with 1 L of water until it boils, drink the water 3x/day as much as 1/2 cup
25	*Garcinia mangostana* L.	Manggis	*Clusiaceae*	Rind	0.03	Cut 6 rind into thin slices, dry, and boil with 1.5 cups of water until remains 1 cup, drink 1x/day
26	*Hyptis capitata* Jacq.	Talo talo, Jukut pandul	*Lamiaceae*	Leaf	0.03	Take 3, 5 or 7 old leaves, 3 old chlorophyll leaves, 3 talo-talo leaves, boil with 3 cups of water until the remaining 1 cup, drink 2x/day for 1 month
27	*Lannea coromandelica*	Kayu jawa	*Anacardiaceae*	Leaf	0.03	Boil 3 young leaves with 1 cup of water until boiling, after cold drink 1-2x/day.
28	*Morinda citrifolia* L.	Bangkudu, mengkudu	*Rubiaceae*	Seed	0.03	Mix 50 seeds of *M. citrifolia* fruit with 2 handfuls of *Z. officinale*, finely ground and sifted. Mix 2 tablespoons of powder *M. citrifolia* and 1/2 tablespoon *Z. officinale*, brewed with 1/2 cup hot water, strain and drink
29	*Moringa oleifera* Lam.	Kelor	*Moringaceae*	Leaf	0.03	Boil a handful of leaves with 3 cups of water until remains 1 cup, drink 2x/day for 2 weeks
30	*Muntingia calabura* L.	Gersen	*Muntingiaceae*	Leaf	0.03	Dry and boil a handful of leaves with 4 cups of water until it remains 3 cups, drink 3x/day
31	*Musa × paradisiaca* L.	Loka yambon	*Musaceae*	Other parts	0.03	Burn the banana heart and discard the charred part, grate the ingredients, squeeze and take the water, add salt and drink
32	*Orthosiphon aristatus* (Bl.) Miq.	Kumis kucing	*Lamiaceae*	Leaf	0.03	Wash and boil ingredients with 1 L of water until it boils, drink the water 3x/day, as much as 1/2 cup for 1 month.

| No.	Plant species	Vernacular name	Family	Plant parts	Use Value	Way of preparation
33	*Peperomia pellucida* (L.) Kunth	Salada, Bou-bou,	*Piperaceae*	Leaf	0.21	Boil a handful of leaves with 1 cup of water, drink 2x a day, morning and evening for 1 week
34	*Phaleria macrocarpa*	Mahkota dewa	*Thymelaeaceae*	Leaf	0.03	Cut leaves into small pieces, dry in the sun, boil with enough water, strain, cool and drink
35	*Physalis angulata* L.	Lappo-lappo	*Solanaceae*	Leaf	0.03	Boil 1/2 handful leaves with 2 cups of water until it boils, cool and drink 3x/day 1 cup
36	*Physalis minima* L.	Parapauluon, Hoa-hoa	*Solanaceae*	Leaf	0.1	Boil leaf with 1 L of water until it boils, drink 3x/day 1/2 cup for 1 month.
37	*Piper betle* L.	Sirih	*Piperaceae*	Leaf	0.03	Heat the leaf over a flame, paste it on the sore part, massage it or take a bath using warm water.
38	*Premna cordifolia* Roxb.	Leve undoro, Daun arogo	*Lamiaceae*	Leaf	0.03	Boil 3 leaves with 2 cups of water until remains 1 cup, drink after it cools down
39	*Premna serratifolia* L.	Arogo	*Lamiaceae*	Other parts	0.03	Boil 6 shoots with 2 cups of water until remains 1 cup, drink for 1 week
40	*Sandoricum koetjape*	Ketapi	*Meliaceae*	Stembark	0.03	Boil dry bark with water until it boils, drink until healed
41	*Solanum torvum* Sw.	Palolang panggalak	*Solanaceae*	Leaf	0.03	Take 3 young leaves, boil with 2 cups of water until the remaining 1 cup, drink 2-3 times a day
42	*Spermacoce laevis* Lam.	Rumput asutrali	*Rubiaceae*	Leaf	0.03	Boil the leaves with 1.5 cups of water until the remaining 1 cup, drink 2x/day for 5 days
43	*Spondias pinnata*	Kedondong	*Anacardiaceae*	Leaf	0.03	Wash and eat 7 young leaves directly 3x/day or by cooking them into vegetables and fish dishes
44	*Symphytum officinale* L.	Serba guna	*Boraginaceae*	Leaf	0.03	Boil 7 leaves with enough water until it boils, drink 4x/day 1 cup for 1 week-1 month
45	*Syzygium polyanthum* (Wight) Walp.	Salam, Daun salam	*Myrtaceae*	Leaf	0.05	Mix and boil 12 leaves, 1/4 temulawak rhizome, 2cm white turmeric, 1 tablespoon cumin powder with 300 ml of water, drink 2x/day
46	*Tamarindus indica* L.	Sampalu	*Fabaceae*	Leaf	0.03	Mashed finely 5 handful leaves, add 1/2 cup hot water, strain and drink 3x/day for 1 week
47	*Vernonia amygdalina*	Daun klorofil	*Asteraceae*	Leaf	0.05	Boil a handful of leaves with 3 cups of water until remains 2 cups, drink 2x/day for 1 week
48	*Zingiber officinale* Roscoe	Loia, Jahe	*Zingiberaceae*	Tubers	0.03	Dry 2 handfuls of *Z. officinale.* Mix with 50 seeds of *M. citrifolia* fruit, finely ground and sifted, mix 2 tablespoons of powder *M. citrifolia* and 1/2 tablespoon *Z. officinale*, brewed with 1/2 cup hot water, strain and drink.
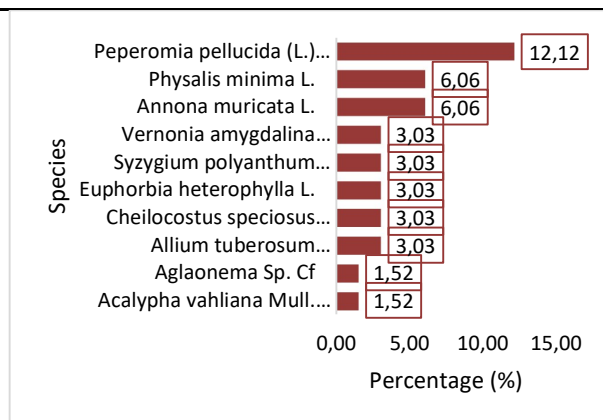
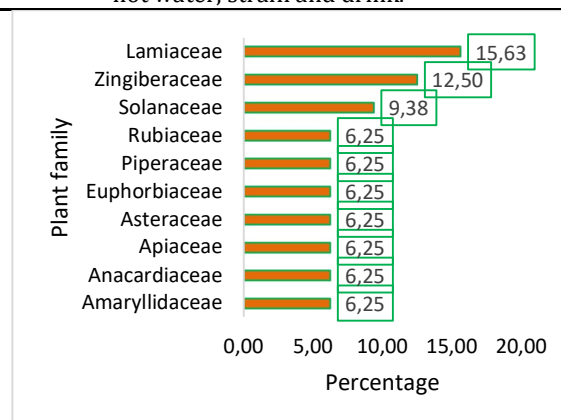**Figure 2.** The ten highest species used by healers

Figure 3. The most cited plant families identified

Peperomia pellucida was admitted as the most mentioned species used for overcoming high cholesterol levels by traditional healers in Celebes Island, represented by the highest use value as well as use percentage of 0.21 and 12.12%, respectively, as revealed in Table 1 and Figure 2. This finding differed from a former study that reported that Guazumae and Murrayae folium were the most widely prescribed herbal compositions for hyperlipidemia patients based on medical records in several healthcare facilities in Indonesia (Gitawati et al., 2015). The place and local traditions were some factors that affected the empirical uses of this species. *P. pellucida* is a species from the Piperaceae plant family commonly found in moist and loose areas, owning hundreds of chemical compositions and extensively traditionally used for health purposes (Pratiwi et al., 2021). Related to utilizing this species for treating hypercholesterolemia, several pharmacological studies have reported the efficacy of aqueous extracts and ethanolic extracts of *P. pellucida* in lowering uric acid levels (Kartika et al., 2016). Oral administration of ethanol extract of *P. pellucida* 300 mg/kg bw for 14 days significantly reduced the total and LDL cholesterol of the test rats. This is related to the flavonoid content in the extract which can reduce lipid peroxidase activity (Rachmawati & Rantelino, 2018). Short-term administration of *P. pellucida* methanol extract decreased the cholesterol, triglycerides and phospholipids serum levels of treated Swiss Albino mice (Sultana et al., 2016).

From a total of 32 plant families determined in this current study, Lamiaceae was acknowledged as the most cited family by traditional healers, followed by the families of *Zingiberaceae, Solanaceae, Rubiaceae, Piperaceae,* and other families as indicated by a family plant value of 15.63% as shown in Figure 4. This is in accordance with the results of research conducted by Islami (Islami et al., 2017) in which *Lamiaceae* is the largest family used for medicinal purposes in Central Sulawesi. Lamiaceae is one of the most essential herbal families with 250 genus and a massive number of species (7000 species) and has bioactive compounds corresponding to its bioactivities. A large number of species of the Lamiaceae family can grow in various ecosystems and have a varied diversity (Stankovic, 2020). Modulated ability in pain therapy through analgesic activity was reported as one of the pharmacological activities of species from the *Lamiaceae* family. Fortunately, most species do not show significant toxic symptoms (Uritu et al., 2018).
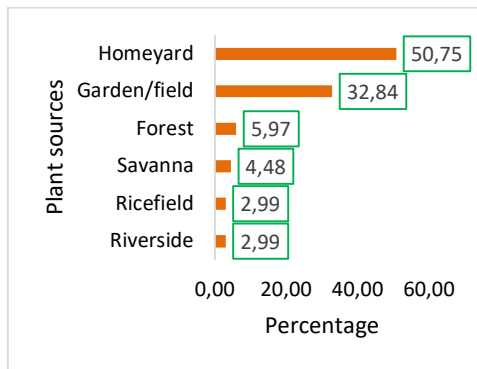

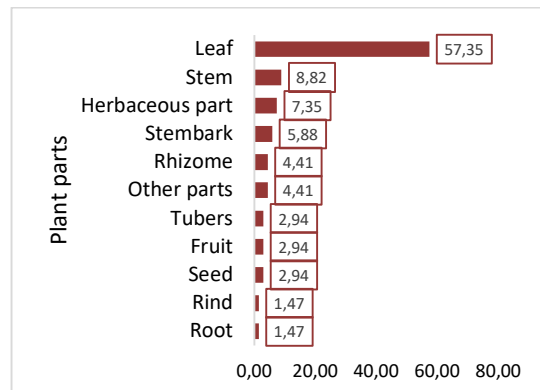**Figure 4.** The gained source of utilized medicinal plants

Figure 5. Plant part used by traditional healers

The utilized medicinal plants were mostly gained by healers from the home yard with a percentage of 50.75%, followed by garden, forest and other habitats as seen in Figure 4. This finding was in accordance with the cultivation status informed by healers, whereas 47% of species were cultivated. Nevertheless, more than 50% of species were uncultivated yet by the healers in Celebes Island. The fact that greater utilization and greater convenience in the consumption of

medicinal plants affected the increased demand for raw materials enforced an effort to provide sufficient stock of each species, and cultivation is the best way to secure the continuity of the supply (Sangat & Larashati, 2002). The home yard is land around the house, which is generally planted with various plants and is vital in meeting daily family needs, including medicinal plants and even for income generation (Amrullah et al., 2017). Maintaining plant diversity in the home yard can support the sustainability of the future (Prihatini et al., 2018).

Plant Part Value (PPV)

Most traditional healers in Celebes Island tend to employ leaves rather than other plant parts namely stem, herbaceous part, stembark, rhizome, tubers, fruit, seed, rind, and root to treat hypercholesterolemia among patients, indicated by plant part value for as of 57.35% as revealed in Figure 5. Former studies also reported the most frequent use of leaves (Awang-Kanak, 2021). Bioactive constituents such as alkaloids, flavonoids, saponins and phenolics in leaves exhibited pharmacological and physiological activities (Friday et al., 2011). Moreover, leaves were commonly available in more significant amounts and regarded as the least destructive form of harvesting plants (Rabgyal & Pelden, 2021). The selective harvesting method is essential to preserve the natural populations (Rokaya et al., 2017).

More than 94% of anti-hypercholesterolemia formulas were used for internal use rather than external uses (6%) nor inhalation with a frequency of 3x1 per day (44.78%) for a week to a month (56.72%) (Figure 8). Internal or oral route of administration is the first choice of medication since it is simple, economical, and convenient, minimizing visits to the healers and increasing patient compliance (Ruiz & Montoto, 2018). Of the 67 documented formulas, more than 50% were in a single composition, and the rest were in a combination form. In the combination form, traditional medicine can have both synergistic and contraindicated effects. The accuracy of the administration route, dosage form, time and method of use, as well as the accuracy of the selection of materials are several factors that affect the safety and efficacy of medicinal plants and traditional medicines (Keskin, 2018).

CONCLUSION

This study revealed 67 concoction information and identified the use of 48 plant species distributed in 32 families among 39 healers in 20 ethnic groups in Celebes Island. *P. pellucida* (UV=0.21), *lamiaceae* (15.63%), and leaves (57.35%) were determined as the most prominent species, family, and plant part used. The most widely prescribed rule of use is internal administration (94.03%) with a frequency of 3x1 per day (44.78%) for a week to a month (56.72%). However, conservation efforts must be initiated immediately since more than 50% of healers have yet to cultivate efforts.

ACKNOWLEDGEMENTS

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