Medicinal plant utilization for hypercholesterolemia by traditional healers in Java island

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Abstract. This ethnomedical study aimed to reveal the medicinal plant utilization as traditional medicine for preventing as well as treating hypercholesterolemia by traditional healers in Java Island including Banten, Yogyakarta, DKI Jakarta, West Java, East Java and Central Java Province of Indonesia. Data was collected based on purposive random sampling among five selected traditional healers in each ethnic in 2015. The results exhibited as of 38 medicinal plant species distributed in 24 families showed to have a pharmacological effect on treating hypercholesterolemia whereas Guazuma ulmifolia Lam. and Zingiberaceae were identified as the most prominent medicinal plant and family used by traditional healers. The most frequent plant part used was leaves (34.5%) followed by rhizomes (17.3%), fruits (12.7%), and others. Most medicinal plants were gained from house yard (37.6%) with planting efforts as of 45.9%. The most prescribed method by traditional healers was by drinking the formula (97.2%) as many as two times a day (59.63%). The study clearly demonstrated whether traditional healers had a pivotal role in overcoming ailments and disease especially hypercholesterolemia in Java Island.

1. Introduction
Hypercholesterolemia is a condition in which total blood cholesterol levels reach 190 mg/dl or higher [1]. Data from the World Health Organization (WHO) states that hypercholesterolemia is estimated to have contributed to the incidence of death by 4.5% (2.6 million deaths). Increased total cholesterol levels are a risk factor for ischemic heart disease and stroke in both developed and developing countries [2]. A reduction in cholesterol levels by 10% can reduce the risk of heart disease by 50% in men aged 40 years [3]. Low cholesterol levels have implications for a lower incidence of coronary heart disease [4]. Ministry of Health Republic of Indonesia data showed that the percentage of high cholesterol recorded in the Integrated Non-Communicable Disease (NCD) Development Post and Community Health Center that has used the NCD surveillance information system by sex is 48.0 and 54.3%, respectively for men and women [1].

Before treating hypercholesterolemic patients, it is necessary to investigate several related matters including physical examination, medical history, clinical examination, and laboratory tests as a basis for investigating the causes of secondary hypercholesterolemia and complications associated with atherosclerosis. Other factors such as smoking history, alcohol consumption, and dietary program are also important to observe regarding the risk of cardiovascular disease and lifestyle changes. Research conducted by [5] showed a positive correlation (p=0.001) between total blood cholesterol levels and central obesity in women aged 45–54 years. A recent systematic review has shown that margarine and
beverages containing sterols or stanols rather than saturated fat can lower plasma cholesterol by up to 10% [4]. The results of research conducted by [6] showed that age and body mass index were risk factors for hypercholesterolemia. The higher the body mass index and the older you are, the higher the risk of increasing blood cholesterol levels.

The main objective of managing dyslipidemia, in this case, hypercholesterolemia, both with pharmacological and non-pharmacological therapy aims to prevent cardiovascular disease, both primary and secondary prevention [7, 8]. Traditional medicine is one of Indonesia's cultural heritage. Traditional medical practices have been carried out by people in various regions of Indonesia [9]. The use of medicinal plants for the prevention and treatment of various diseases has been carried out by people from various generations. The use of various medicinal plants, especially for the treatment of hypercholesterolemia, has been scientifically proven [10–13]. Most of the people who have knowledge and skills in medicine by utilizing medicinal plants are elderly so that if they do not have the next generation to continue their medical practice, it is feared that there will be a loss of both knowledge and skills. Efforts to prevent loss potency of this indigenous local knowledge need to be conducted. Therefore, this study was carrying out to documenting information related to local ethnomedicine knowledge and skill especially for treating hypercholesterolemia from the community represented by selected traditional healers of several ethnicities in Java island, Indonesia.

2. Materials and methods
The study was conducted in 2015 in the ethnic of Banten, Bawean, Betawi, Cirebon, Javanese, Madura, Oising, and Sundanese Priangan ethnic groups, which are distributed in seven provinces on the island of Java, including Banten, Yogyakarta, DKI Jakarta, West Java, East Java, and Central Java. This research has obtained ethical approval from the Health Research Ethics Commission of the Health Research and Development Agency, Ministry of Health of the Republic of Indonesia.

2.1. Data collection
Data was collected through direct interview among selected traditional healers in each ethnic on Java island. The interview was based on a structured questionnaire conducted by a competent research team. The traditional healers selected in this research were those who met the inclusion criteria that had been set up, including having knowledge and treatment skills using medicinal plants, were indigenous people of the ethnic or who had been acculturated, and were recognized their abilities by the surrounding community. Local plant names, plant origin, plant part used, plant habitat, and matters related to the treated disease as well as herbs used included symptoms of the disease, herbs used, the dosage used, preparation method and the administration route were information that provided in the questionnaire. In addition to interviews with traditional healers, direct observation, and specimen collection of medicinal plants mentioned by traditional healers were also carried out and used for the treatment of hypercholesterolemia. Furthermore, the identification of medicinal plants was carried out by a team of plant identification experts and the specimen was stored in the form of herbarium which is collected at the Medicinal Plant and Traditional Medicine Research and Development Center (MPTMRDC).

2.2. Data analysis
This research was conducted with qualitative and quantitative approaches. The qualitative approach was carried out through the collection of Research on Medicinal Plants and Herbs (Ristoja) which was carried out by the Indonesian Ministry of Health, CQ the Health Research and Development Agency in 2012, 2015, and 2017, especially in Java island, distributed in six provinces of Indonesia (Banten, Yogyakarta, DKI Jakarta, West Java, East Java, and Central Java). The data collection procedure follows the data request standard procedure that has been established by the Data Management Laboratory of the Health Research and Development Agency. Data quantification is carried out by setting parameters, including use-value, plant part use, and family use-value, with the following calculations:
2.3. Use Value (UV)
To calculate the use-value of a medicinal plant that was used as an anti-hypercholesterolemia by traditional healers in Java Island.

\[ UVs = \frac{\sum UVis}{ni} \]  

Note: \[14\]
- UVs: use value
- UVis: number of uses mentioned for a species
- ni: total number of respondents interviewed

2.4. Family Use Value (FUV)
Calculating the use-value of a family that is used as medicine by traditional healers on the island of Java.

\[ FUV = \frac{\sum UVs}{(ns)} \]  

Note: \[14\]
- FUV: use value for a Family
- ns: total number of species in a particular family

2.5. Plant Part Value (PPV)
The calculation of the percentage of the part utilized (stems, leaves, roots, fruit, bark, wood, flowers) is carried out on plants that are used as medicine. The percentage determination is as follows:

\[ PPV(\%) = \left( \frac{\sum RU \text{ (plantpart)}}{\sum RU} \right) \times 100 \]  

Information: \[14\]
- PPV: value of plant parts used
- RU: usage amount quoted for each plant part

3. Results and discussion
This study demonstrates the importance of documenting local ethnomedicinal knowledge and medical skills by utilizing medicinal plants, especially those that grow in the surrounding home-yards and other accessible areas of growth. In some areas, the use of traditional medicine by utilizing medicinal plants plays a very crucial role, influenced by several things, including modern health care that does not have adequate and equitable health services, limitations on the financial condition related to rapid population growth, and poor economic performance \[15, 16\].

3.1. UV and medicinal plant utilized
As shown in Table 1, as of 38 species of medicinal plants were identified, distributed in 24 families, and already used by traditional healers in Java island to treat high cholesterol levels in their patients for both healing and prevention. Each plant has its own ways of preparation and administration route as well. More than 97% of anti-hypercholesterolemia formulas were used for internal rather than external uses (2.8%).

| Family   | MP number | Species                  | Use value | Plant parts | Preparation                                                                 |
|----------|-----------|--------------------------|-----------|-------------|-----------------------------------------------------------------------------|
| Acanthaceae | 2         | Andrographis paniculata  | 0.25      | leaves, herbs | all ingredients are boiled with 2 liters of water until it boils. For prevention take a glass of formula per day for 5 days. One recipe is used for 5 days, add water when it was out of stock |
| Family            | Code | Species                          | Parts    | Method                                                                 |
|-------------------|------|----------------------------------|----------|------------------------------------------------------------------------|
| Annonaceae        | 2    | Annona muricata L.              | 0.25 leaves | Mix one handful of *A. muricata* leaves with other formula components, boiled with 3 cups of water until the water becomes 1 glass, filtered and drink 2 times per day |
|                   | 1    | Steliechocarpus burahol (Blume) Hook.f. & Thomson | 0.125 leaves | Take some *S. burahol* leaves, boiled with 2 glass of water and drink for 3 to 4 days |
| Apiaceae          | 1    | Centella asiatica (L.) Urb.     | 0.125 leaves | All ingredients were boiled with 1500 ml, filter, wait until reached room temperature, drink a glass 2 timer per day. Make the new one after 5 days until got the positive effects |
| Apocynaceae       | 1    | Parameria laevigata (Juss.) Moldenke | 0.125 cortex | All ingredients were given in the form of simplicia and used for 10 days. Each simplicia was divided into 5 parts, 1/5 part of simplicia is boiled in 15 cups of water until it boils, wait until 6-7 cups remain and the formula was ready to drink |
| Asparagaceae      | 1    | Dracaena angustifolia (Medik.) Roxb. | 0.125 leaves | Take 10 pieces of *D. angustifolia* leaves, clean, mashed, and isolate the filtrates. Add a glass of boiled water, drink for a week |
| Asteraceae        | 2    | Blumea balsamifera (L.) DC.      | 0.25 leaves | Take 3 pieces of *B. balsamifera* leaves and other compositions, broken and crushed. Then boil with 4 cups water until 2 cups remain. Drink two times per day for eleven days. |
|                   | 1    | Eupatorium sp.                  | 0.125 leaves | Take one handful of *Eupatorium* sp leaves, clean, mash, add 1/4 teaspoon of salt, stick on the tingling body parts leave it overnight |
|                   | 1    | Tridax procumbens (L.) L.       | 0.125 herbs | Mix ingredients with 3 cups of water, boil until boiling and leave the volume of the remaining two cups, drink morning and evening for 2 weeks |
|                   | 1    | Vernonia amygdalina Delile       | 0.125 leaves | 8 pieces *V. amygdalina* leaves boiled with 2 cups of water until the remaining 1 cup and drunk. The recipe applies for one drink. |
| Elaeocarpaceae    | 1    | Muntingia calabura L.           | 0.125 fruits | Take ripe *M. calabura* fruits, eat 1 time a day as many as 10 pieces |
| Fabaceae          | 1    | Arachis hypogaea L.             | 0.125 others | Take a half kilogram of *A. hypogaea* beans, clean, boil with 1 liter of water, heat until boiling. The cooking water is taken twice a day... |
| Lamiaceae         | 4    | Orthosiphon aristatus (Bl.) Miq. | 0.5 leaves | All ingredients are washed clean, boiled with 6 cups of water, drink after it cools as much as 2x1 cups per day. The pulp is boiled again by adding boiled water like the first stew, after the flavor of the stew is gone the pulp is discarded and replace it with a new stew |
| Menispermacae     | 1    | Tinospora tuberculata Beumée ex K.Heyne | 0.125 stems | not stated |
| Family       | Species and Name                        | Quantity | Part Used | Description                                                                 |
|--------------|----------------------------------------|----------|-----------|------------------------------------------------------------------------------|
| Moraceae     | *Artocarpus altilis* (Parkinson ex F.A.Zorn) Fosberg | 0.125    | leaves    | 8 pieces of *A. altilis* leaves were boiled with 2 cups of water until the remaining 1 cup and then drunk. The recipe applies for one drink period. |
| Myrtaceae    | *Eugenia uniflora* L.                  | 0.125    | leaves    | Not stated                                                                  |
|              | *Syzygium polyanthum* (Wight) Walp.    | 0.125    | leaves    | 7 *S. polyanthum* leaves and other materials were washed, boiled in 2 cups of water until boiling and only 1 glass left, drink twice a day morning and evening |
| Oxalidaceae  | *Averrhoa bilimbi* L.                  | 0.5      | leaves, fruits | Take *A. carambola* fruits, puree, take water, add a little salt, and drink |
|              | *Averrhoa carambola* L.                | 0.125    | fruits    | All ingredients are boiled with 1500cc of water until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed. |
| Phyllanthaceae | *Phyllanthus acidus* (L.) Skeels         | 0.25     | leaves, others | All ingredients are boiled with 1500cc of water until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed. |
| Plantaginaceae | *Plantago major* L.                  | 0.125    | herbs     | Not stated                                                                  |
| Poaceae      | *Coix lacryma-jobi* L.                 | 0.125    | fruits    | All ingredients are boiled with 1500cc of water until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed. |
|              | *Cymbopogon citratus* (DC.) Stapf      | 0.125    | stems     | Take 3 pieces of *C. citratus* leaves, boil with 1 pan of water, use for bathing after the concoction getting cool for twice a day in the morning and evening |
| Punicaceae   | *Punica granatum* L.                   | 0.125    | bulbs     | All ingredients are boiled with 3 cups of water until the remaining 1 cup. Take 1x a day. The effect will start to be felt after 3 days |
| Rhamnaceae   | *Maesopsis eminii* Engl.               | 0.125    | leaves    | Take 10 pieces of *M. eminii* leaves from 1 branch, boil and add 2 cups of water and wait until the remaining 1 cup of water, cool, drink 2 days for 1 month |
| Rubiaceae    | *Morinda citrifolia* L.                | 0.125    | fruits    | Take 500 gr of *M. citrifolia* and *A. carambola* fruits, blender then boil with 2 liters of water, after boiling mix with boiled brown sugar, strain, enter the bottle and drink twice a day |
| Rutaceae     | *Murraya paniculata* (L.) Jack         | 0.5      | leaves, others | All ingredients are boiled with 1500cc of water until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed. |
| Sterculiaceae | *Guazuma ulmifolia* Lam.              | 0.625    | leaves    | All ingredients are dried, weigh 10 gr for each, boil with 1 liter of water and wait until the volume remains 4 cups, strain and drink 3 times a day |
Thymelaeaceae 3 Phaleria macrocarpa (Scheff.) Boerl. 0.375 pulps, bulbs Basic ingredients for 1 recipe added with 3 slices of P. macrocarpa, boil with 3 cups of water when boiling the fire is reduced and wait until the remaining 1 glass of water, strain and drink 3 times a day until healed or about 1 month

Umbelliferae 1 Foeniculum vulgare Mill. 0.125 seeds All ingredients are boiled with 1500cc of water using until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed.

Zingiberaceae 2 Alpinia galanga (L.) Willd. 0.25 fruits Boil the mixture with 3 cups of water, let it boil and wait until the volume is reduced to only 2 cups of water, drink twice a day morning and evening for 2 weeks After that, the pulp is discarded and replace it with a new mixture until healed.

2 Amomum compactum Soland. Ex Malon 0.25 fruits All ingredients are boiled with 1500cc of water using until it boils, after cold drinking 2x1 glass per day. One concoction for 5 days. After that, the pulp is discarded and replace it with a new mixture until healed.

1 Curcuma aeruginosa Roxb. 0.125 rhizome not stated
1 Curcuma longa L. 0.125 rhizome not stated
1 Curcuma mangga Valeton & Zijp 0.125 rhizome not stated
1 Curcuma zanthorrhiza Roxb. 0.125 rhizome not stated
1 Curcuma zedoaria (Christm.) Roscoe 0.125 rhizome not stated
1 Zingiber montanum (J.Koenig) Link ex A.Dietr. 0.125 rhizome not stated

Guazuma ulmifolia Lam. from the family of Sterculiaceae was identified as the most prominent medicinal plants showed by use-value (UV), which was utilized by traditional healers in Java island followed by Orthosiphon aristatus, Murraya paniculata, Averrhoa bilimbi, and other identified medicinal plants as shown in Figure 1 with the highest UV as of 0.625 indicated that G. ulmifolia has the optimal benefit value compared to other plants, especially for the treatment of hypercholesterolemia on the island of Java conducted by traditional healers.

G. ulmifolia appears to have a broad spectrum of activity on several ailments. Various parts of this plant were reported to have many pharmacological activities such as antidyslipidemia, cytotoxic, antibacterial, antifungal, antihyperglycemic, antimicrobial, astringent, anti-inflammatory, and many others. G. ulmifolia contains alkaloids, tannins, saponins, flavonoids, terpenoids, cardiac glycosides, steroids which are of medicinal importance [17, 18]. It was claimed as a therapeutic plant owning various chemical compositions [19]. Kumar also [18] reported whether the main constituents of its essential oils were eugenol. There are several mechanisms of action related to the activity of eugenol as an anti-hypercholesterolemia agent. It was reported that eugenol in combination with atorvastatin able to improve superoxide dismutase and catalase activities as well as lipid profiles both in liver and kidney tissues of hyperlipidemia-induced rats [20]. Amani [21] declared that eugenol lowered
in insignificant of total cholesterol, low-density lipoproteins, atherogenic index, steatosis, and hepatic inflammation in the liver, alanine aminotransferase, and alkaline phosphatase, increased hepatomegaly, high-density lipoproteins, and triglycerides. Eugenol affected in down-regulation of transient receptor potential vanilloid (TRPV1) channels in the liver but did not inhibit hepatic 3-hydroxy-3-methyl-glutaryl-CoA reductase on experimental rats.

3.2. Family use value
Of the 24 plant families identified in this study, it was reported that the Zingiberaceae was the largest group of plant families used by traditional healers to treat high cholesterol, followed by the families of Sterculiaceae, Oxalidaceae, Asteraceae, and other families as indicated by a family plant value of 9.25% as shown in Figure 2. This is slightly different from the results of research conducted by Islami [22] in which Lamiaceae is the largest family used for medicinal purposes in Central Sulawesi. Zingiberaceae is the largest family in the Zingiberales order which has more than 1,300 species, spread over many regions and the most dominant in Southeast Asia. Zingiberaceae rhizome extract contains many essential oils, including terpenes, alcohol, ketones, flavonoids, and phytoestrogens which are used as medicine. Zingiberaceae thrive in various habitats so that it is easy to find and utilize [23-24].

![Figure 1. The top ten medicinal plant used by traditional healers.](image1)

![Figure 2. The most prominent of plant families identified.](image2)

![Figure 3. The gained source of utilized medicinal plants.](image3)

![Figure 4. The cultivation status of utilized medicinal plants.](image4)

As presented in Figure 3, medicinal plants utilized in this study area were gained from the home yard, buying from the market or neighborhood, picking from the garden, forest, field, and some other sources. The home yard was the most accessed place by traditional healers in Java island for obtaining and collecting the herbs sample with the percentage as of 37.6%. each region has its local wisdom in traditional medicine. This is mostly influenced by various conditions, both cultural, economic, and soil fertility in the area so that it affects the types of medicinal plants that can grow, develop, and utilized by communities [25]. From the study results, it could be seen that the percentage of medicinal plants...
cultivated and not cultivated by traditional healers on Java island was almost the same, as shown in Figure 4. This condition was in accordance with the study carrying out in Tanah Bumbu Regency, South Kalimantan whereas most people used medicinal plants from cultivation and plant themselves [26]. This was also in line with the previous study results reported on whether there was currently an increasing trend of medicinal plant production in the Asian region from wild gathering to cultivation system [27]. Developing medicinal plant cultivation is necessary in order to support the environment that remains sustainable and keep the medicinal plants remain. The most common crops grown in Java are species from Zingiberaceae family [28].

3.3. Plant part value

There was various plant part utilized by traditional healers in Java island, they were leaves, rhizome, fruits, stem barks, seeds, herbs, stem, pulps, and roots (Figure 5). Leaves were recognized as the most common plant part used with the total percentage as of 34.5%. This result was in accordance with the report by Mulyani [9] whereas leaves were notified as the highest plant part used in West Java Province. The most widely used parts are the leaves, bark, flowers, fruit and rhizome, sap, and all parts of the plant in South Kalimantan [26]. The utilization of leaves as a plant part is one form of plant conservation efforts. Leaves constitute a substantial portion of the biomass produced by plants compared to roots, fruits, and flowers [29]. The use of leaves as medicine does not have a negative impact on these plants [30], moreover harvesting the leaves also causes no detrimental effect on the plant compared to the roots or the entire plant collection [16].

Generally, people use medicinal plants for treatment using unstandardized doses and dosages, for example, the use of multiple leaves, a handful of roots, a finger of rhizome, and so on. Likewise, what happened to traditional healers in several ethnic groups in Indonesia, including those on the island of Java. As with conventional medicine, the accuracy of the ingredients, the dosage, the rules of use, the way of preparation greatly affects the effects of the ingredients consumed [31, 32]. As shown in Figure 6, in this study, the most traditional herbal medicine recommended by traditional healers was twice a day where most of the ingredients given were in fresh form and without much post-harvest treatment. As reported on the previous research, it was also revealed whether only a few plants are used without post-harvest processing in South Kalimantan Province [26].

4. Conclusions

The results exhibited as of 38 medicinal plant species distributed in 24 families showed to have a pharmacological effect on treating hypercholesterolemia whereas Guazuma ulmifolia Lam. and Zingiberaceae were identified as the most prominent medicinal plant and family used by traditional healers. The most frequent plant part used was leaves (34.5%) followed by rhizomes (17.3%), fruits (12.7%), and others. Most medicinal plants were gained from house yard (37.6%) with planting efforts as of 45.9%. The most prescribed method by traditional healers was by drinking the formula (97.2%)
as many as two times a day (59.63%). The study clearly demonstrated whether traditional healers had a pivotal role in overcoming ailments and disease especially hypercholesterolemia in Java Island.

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