Ethnobotanical study of medicinal plants used for treating urinary tract problems in eastern Indonesia

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Abstract. Indonesia is one of the wealthiest countries in biological resources that have potential as medicinal plants. Medicinal plants can be an alternative in treating diseases such as urinary tract problems by the people of eastern Indonesia. The study aims to evaluate the use of medicinal plants for various urinary tract problems in east Indonesia, including their efficacy and safety based on the literature review. This research was conducted by interview method and field survey. The data were collected from traditional health practitioners in eastern Indonesia. Data were analyzed using Frequency of Citation (FC) and the Use value (UV). The results showed a total of 222 plants species belonging to 78 families were identified for treating urinary tract problems in east Indonesia. The most prevalent of these was the Euphorbiaceae family. The species which had the highest value were Orthosiphon aristatus (FC 12.52%, UV 0.31), Sericocalyx crispus (FC 7.80%; UV 0.19), Phyllanthus niruri (FC 6.35%; UV 0.16) were the vast majority commonly used plant species in the treatment of urinary tract problems. The most common parts used were leaves (44.87%) and herbs (10.66%). The ethnomedicinal flora in east Indonesia is quite diverse for treating urinary tract problems.

1. Introduction
Indonesia is one of the wealthiest countries in biological resources that have potential as medicinal plants. Medicinal plants have an important role in Indonesian society. They have used the use medicinal plants for a long time ago. Interestingly, medicinal plant research, mainly phytomedicines, has increased worldwide. It is especially seen in developed countries such as Indonesia [1]. The knowledge of medicinal plants had been passed down from generation to generation for each ethnicity [2]. The concept of local knowledge empirically based drug discovery has been around for a long time. While in some cases, the direct relationship between traditional local use of plants and modern medicine is complex [3].

East Indonesia region has special geographical conditions compared to other areas. Most of these areas are remote areas. Inhabitants of remote areas have a lower interest in health care facilities compared to urban areas. They prefer to use medicinal plants due to their easy availability as compared to chemical pharmaceuticals. Of course, this condition is greatly influenced by geographic access such as travel time and distances [4,5]. Hence, the plants are highly valued as sources of medicine by remote area communities [6].

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Most of the world’s population uses plants remedies for its primary health care. Because of its reliability, less toxicity, eco-friendly and straightforward [7]. The presence of various bioactive components of medicinal plants is considered to relate to pharmacological activities, which have essential effects from treating mild to severe diseases [8]. For example, urolithiasis is a significant health problem in many countries. Indonesia has a high incidence of urolithiasis [7]. Urolithiasis is one urinary tract problem that is commonly complained about by communities. The risk factor of urolithiasis consists of genetic factors, metabolic disturbances (excess oxalate synthesis), food, and environmental factors [9]. Several symptoms of urolithiasis are painful, requiring hospitalization and reducing the quality of life, leading to a decline in the socioeconomic community [10].

Documentation about medicinal plants plays a significant role in discovering a large variety of medicinal plants. In addition, the primary data of medicinal plants in Indonesia is still rare, especially information about the types of medicinal plants. Hence, Ethnobotanical research has been used to explore local knowledge of medicinal plants as part of each ethnicity’s local wisdom, which can then be developed into new therapeutic resources. This study is also known as Research Medicinal Plants and Herbs (RISTOJA). This research was carried out for three years. The study aims to evaluate the use of medicinal plants for treating urinary problems in east Indonesia, including their efficacy and safety based on a literature review.

2. Methods

2.1. Description of the study area

The study area extended from West Nusa Tenggara province and Papua province, including Sulawesi and Maluku islands. West Nusa Tenggara lies between latitudes 8° 10’ and 9° 5’ (North-South Longitude), 115° 46’ and 119° 5’ (West – East Longitude). On the other hand, Papua province lies at 4° 16’ S 138° 4’ E. The climate of West Papua and Papua provinces is tropical, with rainfall varying in each region. Maluku islands which are greatly influenced by the presence of vast marine have a tropical monsoon climate. West Nusa Tenggara, East Nusa Tenggara, Sulawesi, and Maluku island were Wallace regions, meaning that it has a mix of both Indomalayan and Australasian species[11]. Wallace region is a biogeographic region between Asiatic and Australian flora and faunas showing a high degree of endemism organism [12]. The Wallace Line is an imaginary line that stretches from the Makassar Strait to the Sulawesi Sea to distinguish biogeographically between East and West [13].

2.2. Ethnopharmacology survey

The study was conducted in 2012, 2015, and 2017, located in all regions of Eastern Indonesia, including several provinces such as West Nusa Tenggara, East Nusa Tenggara, South Sulawesi, and Southeast Asia Sulawesi, North Sulawesi, Central Sulawesi, Maluku, North Maluku, Papua, and West Papua. An ethnomedicinal survey questionnaire-based descriptive study was used. Areas visited included determining informants using the purposive sampling method based on information from traditional community leaders or the local District Health Office. The selected informants were well known in the community due to their long practice of providing services related to conventional health care. The study was a face-to-face questionnaire.

The data were obtained by interview, field survey, and specimen collection. The interview was conducted according to the informants’ local language, and the plant names were listed using scientific names based on the reference book. A semi-structured questionnaire was made to obtain demographic data, medicinal plant species to treat urinary tract problems, plant parts used, and methods used in the remedies.

The study was conducted following the requirements of the declarations of Helsinki, and written informed consent was obtained from the participants. Ethical clearance was accepted by the Ethics Commission of the National Institute of Health Research and Development, Ministry of Health.
2.3. Identification of medicinal plant species
Identification of plant specimens was carried out by a taxonomists team from several universities and the Indonesian Institute of Sciences, then stored in the Herbarium Tawangmanguensis, Karanganyar, Central Java.

2.4. Data analysis
Several plants were be selected. These plants, which were not medicinal plants and unidentified, were excluded. The informant’s characteristics and medicinal plants data were presented descriptively. The quantitative analysis determined how essential and reliable these plants are for treating urinary tract problems. The Frequency of Citation (FC), Used Value (UV), Choice Value (CV), Family Use Value (FUV), and Informants Consensus Factor (IFC) were calculated by using the formula as described below:

2.4.1. The frequency of citation. It was calculated by using the following formula
\[ FC = N_s \times 100 \]
Ns as several times a species was mentioned by traditional healers/a total number of all species were mentioned × 100 [14]

2.4.2. Used value (UV). It was used to prove the relative importance of species known locally, and it can be calculated the following equation:
\[ UV_s = \frac{\sum U}{N} \]
The UV was the use-value of a species; U was the number of citations per species; N was the number of informants [14,15]

2.4.3. Family use value. It was used to obtain the number of informants employing certain species in a particular family. The following equation calculated it:
\[ FUV = \frac{\sum UV_s}{N_s} \]
High values for FUV and UVs indicate that taxa were frequently used as medicine. Where UVs were use-values for all the species within a given family. Ns = total number of species within a given family [15]

2.4.4. Informants consensus factor. It was a valuable assessment tool to evaluate the homogeneity information about medicinal plants to treat urinary problems. Nur is the number of use citations for treating urinary problems, and Nt is the number of taxa used to treat urinary tract problems [16].
\[ IFC = \frac{Nur - Nt}{Nur - 1} \]

2.4.5. The choice value. It was used to appraise medicinal plant species to treat urinary tract problems. The CV was calculated by the following formula[14]:
\[ CV_s = \frac{Pcs \times 100}{Sc} \]
Pcs was the percentage of cited plant species for treating urinary tract problems by informants. Se was the total number of species mentioned for treating urinary tract problems by all informants.

2.5. Study of literature
A literature study on eight of the highest UV plants systematically searched the scientific literature using Pubmed, Scopus, and Google Scholar electronic searching machines was published before August 2021.
3. Results and discussion

3.1. The characteristic of traditional practitioners of informants

The study involved 585 informants of 10 provinces in Eastern Indonesia which is consist of West Nusa Tenggara, East Nusa Tenggara, South Sulawesi, Southeast Sulawesi, North Sulawesi, Central Sulawesi, Maluku, North Maluku, Papua and West Papua. Because several informants were excluded, a total of 188 informants had knowledge of traditional medicine for treating urinary problems. We selected the partitioners who had plenty of patients in the community and had long practice providing services related to traditional health care. All informants were asked to give information about medicinal plant(s) used to treat urinary tract problems and parts of the plants used such as leaves, roots, flowers, stems, and seeds. Half of the informants were 41-60 years old. There were only 7.9% of traditional practitioners from the younger group. This result is similar to other studies showing a gap between younger and older traditional practitioners [17,18].

Nearly half of informants had elementary and Junior High School education, followed by uneducated or incomplete elementary. Meanwhile, we know that literacy competency is related to education. In addition, the majority of the people in rural areas are also illiterate[5]. Hence, the loss of medicinal plant knowledge has appeared in several countries [19]. Most informants learned about medicinal plants from family members (57%), followed by experiences (17.4%). The previous study revealed that knowledge of medicinal plants had been orally passed down from family members [19]. Another study had revealed 77% gained knowledge through observing their family members [14]. The threat of loss of acquired knowledge from generation to generation due to transmission between parents and younger generations is not always guaranteed [20,21]. The characteristic of traditional practitioners of informants is listed in Table 1 below.

| Characteristic                        | Number of Informant |
|---------------------------------------|---------------------|
|                                       | Frequency | Percentage (%) |
| Age groups                            |           |                |
| ≤ 40 yr                               | 46        | 7.9            |
| 41-60 yr                              | 297       | 50.8           |
| ≥ 60 yr                               | 242       | 41.4           |
| Education                             |           |                |
| Uneducated/incomplete elementary      | 177       | 30.3           |
| Elementary-Junior High School         | 282       | 48.2           |
| Senior High School                    | 104       | 17.8           |
| Graduate                              | 22        | 3.8            |
| Source of knowledge (the answer can be more 1) |         |                |
| Family member                         | 478       | 57.0           |
| Experience                            | 146       | 17.4           |
| Friend                                | 61        | 7.3            |
| Education                             | 63        | 7.5            |
| Others                                | 90        | 10.7           |

3.2. Medicinal plants used for treating urinary tract problems

This study showed 222 species from 77 families utilized by traditional practitioners to treat urinary tract problems. All of the Latin scientific names of medicinal plants have been verified with www.theplantlist.org. The Use Value (UV) was calculated based on the informants’ citations to assess the relative importance of reported medicinal plants. Its value ranged from 0.005 to 0.311 and is presented in Table 2. It also mentioned part of use, families, choice-value (CV), and Frequency of citation (FC). This study characterized that Orthosiphon aristatus (Bl.) Miq has the higher use value.
(UV=0.311), Followed by *Sericocalyx crispus* (UV=0.194), *Phyllanthus niruri* (UV=0.158), and *Imperata cylindrica* (UV=0.068). There were 151 species of plants cited the least (UV=0.005 each).

| Scientific names                  | parts                  | Family     | FC(%) | UV  | CV  |
|-----------------------------------|------------------------|------------|-------|-----|-----|
| *Abelmoschus esculentus* (L.) Moench | leaf, herb             | Malvaceae  | 0.181 | 0.005 | 0.001 |
| *Abelmoschus manihot* (L.) Medik.  | leaf, herb             | Malvaceae  | 0.907 | 0.023 | 0.005 |
| *Abras precatorius* L.            | herb                   | Leguminosae| 0.181 | 0.005 | 0.001 |
| *Acalypha indica* L.               | leaf, root, other      | Euphorbiaceae| 1.452 | 0.036 | 0.008 |
| *Acanthaceae ilicifolia* L.       | leaf                   | Acanthaceae| 0.181 | 0.005 | 0.001 |
| *Acacia calamus* L.               | leaf                   | Acacia     | 0.181 | 0.005 | 0.001 |
| *Adenanthera pavonina* L.         | leaf                   | Leguminosae| 0.181 | 0.005 | 0.001 |
| *Ageratum conyzoides* L.          | leaf                   | Compositae| 0.181 | 0.005 | 0.001 |
| *Allium cepa* L.                   | tuber                  | Amaryllidaceae| 0.363 | 0.009 | 0.002 |
| *Allium sativum* L.                | rhizoma                | Amaryllidaceae| 0.181 | 0.005 | 0.001 |
| *Allium schoenoprasum* L.         | leaf                   | Amaranthaceae| 0.181 | 0.005 | 0.001 |
| *Annona squamosa* L.              | leaf                   | Annonaceae | 0.181 | 0.005 | 0.001 |
| *Anredera cordifolia* (Ten.) Steenis | leaf                 | Basellaceae| 0.181 | 0.005 | 0.001 |
| *Antiaris toxicaria* Lech.         | bark                   | Moraceae   | 0.181 | 0.005 | 0.001 |
| *Arcangelisia flav** (L.) Merr.** | root                   | Menispermaceae| 0.181 | 0.005 | 0.001 |
| *Archidendron clypearia* (Jack) I.C.Nielsen | bark             | Meliaceae  | 0.181 | 0.005 | 0.001 |
| *Areca catechu* L.                 | leaf, other            | Areca     | 0.544 | 0.014 | 0.003 |
| *Arenga pinnata* (Warb) Merr.     | root                   | Areca     | 0.726 | 0.018 | 0.004 |
| *Artocarpus altilis* (Park.) Fosberg | leaf, bark        | Moraceae  | 0.907 | 0.023 | 0.005 |
| *Asparagus sp. Cj*                | umbi                   | Asparagaceae| 0.181 | 0.005 | 0.001 |
| *Averrhoa bilimbi* L.             | leaf                   | Oxalidaceae| 0.363 | 0.009 | 0.002 |
| *Azadirachta indica* A.Juss.      | leaf                   | Meliaceae  | 0.363 | 0.009 | 0.002 |
| *Basella alba* L.                 | stem                   | Basellaceae| 0.181 | 0.005 | 0.001 |
| *Blumea balsamifera* (L.) DC.     | leaf                   | Compositae| 0.726 | 0.018 | 0.004 |
| *Brenynia sp. Cj*                 | leaf                   | Phylanthaceae| 0.181 | 0.005 | 0.001 |
| *Broschia javanica* (L.) Merr.    | leaf                   | Simaroubaceae| 0.181 | 0.005 | 0.001 |
| *Bryophyllum pinnatum* (Lam.) Oken | leaf                 | Crassulaceae| 0.181 | 0.005 | 0.001 |
| *Bulbophyllum* sp.                | fruit                  | Orchidaceae| 0.181 | 0.005 | 0.001 |
| *Caesalpinia bonducella* (L.) Roxb. | root               | Leguminosae| 0.181 | 0.005 | 0.001 |
| *Calamus sp. Cj*                  | leaf                   | Areceae   | 0.181 | 0.005 | 0.001 |
| *Callicarpa longifolia* Lam.      | leaf                   | Lamiaceae  | 0.181 | 0.005 | 0.001 |
| *Calotropis gigantea* (L.) W.T. Aiton | leaf                | Apocynaceae| 0.181 | 0.005 | 0.001 |
| *Carica papaya* L.                | leaf, root             | Caricaeae  | 0.363 | 0.009 | 0.002 |
| *Cassia filiformis* L.            | herb                   | Lauraceae  | 0.181 | 0.005 | 0.001 |
| *Catharanthus roseus* (L.) G.Don  | leaf, root, tuber      | Apocynaceae| 1.089 | 0.027 | 0.006 |
| *Centella asiatica* (L.) Urb.     | leaf, stem, root       | Apataceae  | 1.815 | 0.045 | 0.010 |
| *Centrostemma pubescens* Benth.   | stem                   | Leguminosae| 0.181 | 0.005 | 0.001 |
| *Cinnamomum burmannii* (Nees & T.Nees) Blume | bark                | Lauraceae  | 0.181 | 0.005 | 0.001 |
| *Citrus aurantifolia* (Christm.) Swingle | fruit    | Rutaceae  | 0.363 | 0.009 | 0.002 |
| *Citrus japonica* Thumb.          | fruit                  | Rutaceae  | 0.181 | 0.005 | 0.001 |
| *Cladodendron ciliatum* DC.       | leaf                   | Cleomaceae | 0.181 | 0.005 | 0.001 |
| *Cladophora viscosa* L.           | leaf                   | Cleomaceae | 0.181 | 0.005 | 0.001 |
| *Cladophora cymosissum*          | leaf                   | Lamiaceae  | 0.181 | 0.005 | 0.001 |
| *Cladophora chinesee* (Osbeck) Mabb. | leaf           | Lamiaceae  | 0.181 | 0.005 | 0.001 |
| *Cladophora japonicum* (Thumb.) Sweet | leaf         | Lamiaceae  | 0.181 | 0.005 | 0.001 |
| *Coccinia grandis* (L.) Voigt     | root                   | Cucurbitaceae| 0.181 | 0.005 | 0.001 |
| *Cocos nucifera* L.               | pulp, other            | Areca     | 0.907 | 0.023 | 0.005 |
| *Cordia variegatums* (L.) Runph. ex A.Juss. | root | Euphorbiaceae| 0.181 | 0.005 | 0.001 |
| *Cordia sp. cf*                   | stem                   | Boraginaceae| 0.181 | 0.005 | 0.001 |
Crescentia cujete L. leaf Bignoniaceae 0.181 0.005 0.001
Crinum asiaticum L. leaf Amaryllidaceae 0.363 0.009 0.002
Croton sp. leaf Euphorbiaceae 0.181 0.005 0.001
Cucurbita moschata Duch. leaf Cucurbitaceae 0.181 0.005 0.001
Curcuma longa L. rhizome Zingiberaceae 1.815 0.045 0.010
Curcuma sp. Cj rhizome Zingiberaceae 0.181 0.005 0.001
Curcuma zanthorrhiza Roxb. rhizome, leaf Zingiberaceae 1.270 0.032 0.007
Curcuma zedoaria (Christm.) Roscoe rhizome Zingiberaceae 0.363 0.009 0.002
Cymbopogon citratus (DC.) Stapf herb Poaceae 0.181 0.005 0.001
Cymbopogon nardus (L.) Rendle herb, bark, root, other Poaceae 0.726 0.018 0.004
Cytandra longifolia (Wavra) Hillebr. ex C.B.Clarke herb Gesneriaceae 0.181 0.005 0.001
Datura metel L. leaf Solanaceae 0.181 0.005 0.001
Dendrophthoe pentandra (L.) Miq. leaf Loranthaceae 0.363 0.009 0.002
Dendrophthoe sp. leaf Loranthaceae 0.181 0.005 0.001
Desmodium gangeticum (L.) DC. leaf Leguminosae 0.181 0.005 0.001
dioscorea macroleafia De Wild. & T.Durand root Dioscoreaceae 0.181 0.005 0.001
Dischidia nummularia R.Br. fruit Apocynaceae 0.181 0.005 0.001
Dracaena angustifolia (Medik.) Rosb. bark Asparagaceae 0.363 0.009 0.002
Durio zibethinus L. bark Malvaceae 0.181 0.005 0.001
Eclipta prostrata (L.) L. leaf Compositae 0.181 0.005 0.001
Elephantopus mollis Kunth leaf Compositae 0.181 0.005 0.001
Elephantopus scaber L. leaf Compositae 0.181 0.005 0.001
Erythrina subumbraea (Hasak.) Merr. bark Leguminosae 0.181 0.005 0.001
Euphorbia glyptotermna Engelm. herb Euphorbiaceae 0.181 0.005 0.001
Euphorbia heterophylla L. other Euphorbiaceae 0.181 0.005 0.001
Euphorbia hirta L. leaf, stem, root, herb, other Euphorbiaceae 2.541 0.063 0.014
Euphorbia pulcherrima Willd. ex Klotzsch leaf Euphorbiaceae 0.181 0.005 0.001
Fatia japonica (Thunb.) Degne. & Planch. bark Araliaceae 0.181 0.005 0.001
Fibraurea tinctoria Lour. bark Menispermacae 0.181 0.005 0.001
Ficus altissima Blume bark Moraceae 0.181 0.005 0.001
Ficus racemosa L. bark Moraceae 0.181 0.005 0.001
Ficus septica Burm.f. bark Moraceae 0.544 0.014 0.003
Ficus variegata Bl. bark Moraceae 0.363 0.009 0.002
Flacourtia rakam Zoll. & Moritzi leaf, stem Salicaceae 0.181 0.005 0.001
Flagellaria indica L. root Flagellariaceae 0.181 0.005 0.001
Floccopoa scandens Lour. leaf Commelinaceae 0.181 0.005 0.001
Garage floribunda Decne. leaf Burseraceae 0.181 0.005 0.001
Gnetum gnemon L. leaf Gnetaceae 0.181 0.005 0.001
Gossypium hirsutum L. leaf Malvaceae 0.363 0.009 0.002
Graptophyllum pictum (L.) Griff. leaf Acanthaceae 0.181 0.005 0.001
Gymnara procumbens (Lour.) Merr. leaf Compositae 0.181 0.005 0.001
Hibiscus rosa-sinensis L. leaf Malvaceae 0.181 0.005 0.001
Hibiscus tiliaceus L. leaf Malvaceae 0.544 0.014 0.003
Hyptis capitata Jacq. leaf Lamiaceae 0.181 0.005 0.001
Imperata cylindrica (L.) Raesusch. root, herb, other Poaceae 2.722 0.068 0.014
Inisia sp. leaf Leguminosae 0.181 0.005 0.001
Ipomoea mauritiana Jacq. root Convolvulaceae 0.181 0.005 0.001
Ipomoea pes-caprae (L.) R. Br. leaf Convolvulaceae 0.181 0.005 0.001
Ipomoea sp. Cj root Convolvulaceae 0.181 0.005 0.001
Irora chinensis Lam. leaf Rubiaceae 0.181 0.005 0.001
Jasminum sambuc (L.) Aiton leaf, flower Oleaceae 0.363 0.009 0.002
Jatropha carcas L. root Euphorbiaceae 0.544 0.014 0.003
Jatropha gossypifolia L. root Euphorbiaceae 0.181 0.005 0.001
Justicia gendarussa Burm. f. leaf, herb Acanthaceae 0.363 0.009 0.002
Kamptera fistula galang L. rhizoma Zingiberaceae 0.181 0.005 0.001
Kleiniova hospita L. leaf, root, bark Malvaceae 0.726 0.018 0.004
Knepa sp. bark Myristicaceae 0.181 0.005 0.001
Lannea coromandelica (Hoout.) Merr. leaf, root, bark Anacardiaceae 0.181 0.005 0.001
Lansium parasiticum (Osbeck) K.C.Salhni & Bnett bark Meliaceae 0.181 0.005 0.001
Laportea interrupta (L.) Chew other Urticaceae 0.181 0.005 0.001
Laportea pedunculatis (Wedd.) Chew leaf Urticaceae 0.181 0.005 0.001
Lansia spinosa (L.) Thwaites fruit Arecaceae 0.181 0.005 0.001
Leu inducia (Burm.f.) Merr. leaf Vitaceae 0.181 0.005 0.001
Loranthus sp.1 root Loranthaceae 0.544 0.014 0.003
Lygodium flexuosum (L.) Sw. root Schizaceae 0.181 0.005 0.001
Lygodium microphyllum (Cav.) R. Br.  leaf Schizaceae 0.181 0.005 0.001
Maccaranga subpeltata K.Schum. & Lauterb. root Euphorbiaceae 0.181 0.005 0.001
Mallotus paniculatus (Link.) M.A. leaf Euphorbiaceae 0.363 0.009 0.002
Mallotus macrostachys (Miq.) Mill. Arg. leaf Euphorbiaceae 0.181 0.005 0.001
Mallotus mollissimus (Geiseler) Airy Shaw leaf Euphorbiaceae 0.181 0.005 0.001
Mangifera indica L. bark Anacardiaceae 0.181 0.005 0.001
Melanelepis multiglandulosa (Reimv. ex Blume) Rchb. & Zoll. leaf Euphorbiaceae 0.181 0.005 0.001
Melandera biflora (L.) Wild leaf Compositae 0.181 0.005 0.001
Merremia pellata (L.) Merr. bark Comvolvulaceae 0.181 0.005 0.001
Merremia umbellata (L.) Hallier f. leaf Comvolvulaceae 0.181 0.005 0.001
Microcos antisdesmifolia (King) Barret bark Tilaceae 0.181 0.005 0.001
Morinda citrifolia L. leaf, bark, fruit Moringaceae 0.907 0.023 0.005
Moringa oleifera Lam. root, bark Moringaceae 0.363 0.009 0.002
Musa sp. stem Musaceae 0.181 0.005 0.001
Myristica fragrans Houtt. rind, fruit Myristicaceae 0.726 0.018 0.004
Myrmecodia pendans Merr. & Perry tuber Rubiaceae 0.363 0.009 0.002
Myrmecodia tuberosa Jack rind Rubiaceae 0.181 0.005 0.001
Ocimum basilicum L. leaf Lamiaceae 0.181 0.005 0.001
Ocimum tenuiflorum L. leaf Lamiaceae 0.363 0.009 0.002
Opuntia sp. Cf leaf Cactaceae 0.181 0.005 0.001
Orthosiphon aristatus (Bl.) Miq. other Lamiaceae 12.523 0.311 0.067
Pandanus tectorius Parkinson ex Du Roi root Pandanaceae 0.363 0.009 0.002
Passiflora foetida L. leaf Passifloraceae 0.363 0.009 0.002
Peperomia pellucida (L.) Kunth herb Piperaceae 0.181 0.005 0.001
Peristrophe bivalvis (L.) Merr. herb Acanthaceae 0.181 0.005 0.001
Perssea americana Mill. leaf Lauraceae 0.726 0.018 0.004
Phaleria macrocarpa (Schoff.) Boerl. pulp Thymelaeaceae 0.181 0.005 0.001
Phyllanthus amarus Schumach. & Thonn. herb, other Phyllanthaceae 0.544 0.014 0.003
Phyllanthus niruri L. leaf, stem, root, flower, fruit, seed, Phyllanthaceae 6.352 0.158 0.034
Phyllanthus sp. leaf Phyllanthaceae 0.181 0.005 0.001
Phyllanthus urinaria L. leaf, stem, root, other Phyllanthaceae 1.089 0.027 0.006
Physalis angulata L. leaf, fruit, herb Solanaceae 0.907 0.023 0.005
Physalis minima L. fruit, herb, other Solanaceae 0.726 0.018 0.004
Phytolacca americana L. root Phytolaccaceae 0.181 0.005 0.001
Picria fel-terrae Lour. herb Linderiaceae 0.181 0.005 0.001
Piper betle L. leaf Piperaceae 0.544 0.014 0.003
Piper retrofractum Vahl leaf Piperaceae 0.181 0.005 0.001
Plagiochlaena grandis R. Br. bark Nyctaginaceae 0.181 0.005 0.001
Plantago major L. leaf, herb Plantaginaceae 0.363 0.009 0.002
Poeoanthus scutellaroides (L.) R Br. leaf Lamiaceae 0.544 0.014 0.003
Pluchea indica (L.) Less. leaf Asteraceae 0.181 0.005 0.001
Pogostemon sp. Cf leaf Lamiaceae 0.181 0.005 0.001
Pokikospermum cordifolium (Barg.-Petr.) Merr. bark Urticaceae 0.181 0.005 0.001
Polygynum sp. leaf, stem Polygonaceae 0.363 0.009 0.002
Polyscias diversifolia (Blume) Lowry & G.M.Plunkett leaf Araliaceae 0.181 0.005 0.001
Polyscias fruticosa (L) Harms bark Araliaceae 0.181 0.005 0.001
Pongamia pinnata (L) Pierre root Fabaceae 0.181 0.005 0.001
Portulaca oleracea L. other Portulacaceae 0.181 0.005 0.001
Pseudolephantopus spicatus Rohr ex Gleason root Astereaceae 0.181 0.005 0.001
Psidium guajava L. leaf Myrtaceae 0.907 0.023 0.005
Pterocarpus indicus Wild. leaf Leguminosae 0.181 0.005 0.001
Pterocymbium javanicum R.Br. bark Sterculiaceae 0.181 0.005 0.001
Rhincanthus nasutus (L) Kurz leaf Acanthaceae 0.181 0.005 0.001
Raellia tuberosa L. leaf Acanthaceae 0.181 0.005 0.001
Scaevola taccada (Guernt.) Rosb. leaf Goodeniaceae 0.181 0.005 0.001
Scleria sumatrensis Retz. leaf, other Cyperaceae 0.363 0.009 0.002
Scirrula atropurpurea (Blume) Danse leaf, stem Loranthaceae 0.363 0.009 0.002
Scirrula furvina (Jack) Danse leaf Loranthaceae 0.181 0.005 0.001
Scirrula parasitica L. stem Loranthaceae 0.181 0.005 0.001
Senna multijuga (Rich.) H.S.Irwin & Barneby root Fabaceae 0.181 0.005 0.001
Senna sp. Cf bark Fabaceae 0.181 0.005 0.001
The relative importance of plant species to treat particular diseases locally has been signified with the Use value (UV) [22,23]. The most cited plants might indicate informants’ consciousness to use them as the leading choices for treating urinary tract problems[24]. Meanwhile, the least of use-value of certain species does not imply that it was less efficacy. It might be caused by ignorance of informants about related knowledge or inaccessibility of the plants[18].

There is only one Informant Consensus Factor (ICF) in this study. This factor indicates information’s homogeneity. The plants are chosen randomly when this factor is close to 0. On the contrary, this factor is close to 1 when the data is frequently exchanged between informants[22,25,26]. The ICF was 0.60, and this factor was classified as moderate. Hence. It signifies an adequate exchange of information about medicinal plants for treating urinary tract problems between informants.

Figure 1. The highest number of Family Use Value (FUV)
The family having high FUV were Euphorbiaceae (FUV= 6.31), Malvaceae (FUV=5.86), and Compositae (5.41), as enlisted Figure 1. The relative importance of family to underline plant families that have more utilizes than randomly estimated can be revealed by the family use value (FUV)[18]. Based on the result, 14 species were employed as traditional medicine, including *Acalypha indica* L., *Codiaeum variegatum* (L.) Rumph. ex A.Juss, *Croton sp*, *Euphorbia glyptosperrma* Engelm, *Euphorbia heterophylla* L, *Euphorbia hirta* L, *Euphorbia pulcherrima* Willd. ex Klotzsch, *Jatropha curcas* L, *Jatropha gossypifolia* L, *Macaranga subpeltata* K.Schum. & Lauterb, *Mallotus paniculatus* (Lmk.) M.A, *Mallotus macrostachyus* (Miq.) Müll. Arg, *Mallotus mollissimus* (Geiseler) Airy Shaw, *Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll. The Family Use Value (FUV) can help determine most species’ favorable ecological conditions and adaptations [21].

As presented in Figure 2, The most used plants for treating urinary tract problems were leaves, followed by roots and herbs. The reason for leaves as the primary plant material for the preparation of traditional medicines is their easy availability both as ingredients and drug preparation. Furthermore, leaves are also the site of photosynthesis so that they might have a high content of metabolites [27].

**Figure 2.** The proportion of medicinal plant part of used treating urinary problems

**Table 3.** The result of the literature study on the eight most important medicinal plants

| Scientific names                      | Family    | Reference                                      | Description                                                                 |
|---------------------------------------|-----------|------------------------------------------------|-----------------------------------------------------------------------------|
| Orthosiphon aristatus (Bl.) Miq        | Lamiaceae | [27]                                           | Markedly reduced CaOx crystal formation led to anti-nephrolithiasis agent[28,29], mechanism of EEOS in the treatment of stone disease from the lipid molecular level[30]. |
| Sericocalyx crispus (L.) Bremek        | Malvaceae | [31]                                           | The acute toxicity of *Sericocalyx crispus* orally administered to rats in 1, 2, and 5 g/kgbw was safe, and that no drug-related toxicity was detected[31]. |
| Phyllanthus niruri L.                  | Phyllanthaceae | [32]                  | *Phyllanthus niruri’s* extract can inhibit CaOx crystal aggregation and interferes with calculus growth in the early stage[33,34]. The antispasmodic and relaxant effects of *Phyllanthus* on contractile tissue[35,36]. No adverse acute or chronic toxic effects of *P.niruri* were reported[37,38]. *Phyllanthus* has bioactive compounds which can decrease diabetic nephropathy progression to chronic renal failure[39]. Administration of *Phyllanthus niruri* for three months can remove 3 mm of calculi in nephrolithiasis patients[40]. Can be used to normalize urinary calcium levels and decrease the recurrence of nephrolithiasis[41]. |
| Imperata cylindrica (L.) Raeusch       | Poaceae   | [21]                                           | Diuretic and anti-inflammatory effect[42,43]. Both prophylactic and curative effects in dissolving stones in vivo[29]. The ethanol extract of *Imperata cylindrica* has the effect of dissolving calcium kidney stones in vitro[44]. |
| Euphorbia hirta L.                     | Euphorbiaceae | [35]                  | Low back pain[45], inhibiting the formation of struvite crystals[46] in vitro, significant antiarthritic potential against calcium oxalate kidney stones in vitro[47,48]. |
| Centella asiatica (L.) Urb.            | Apiaceae  | [36]                                           | Diuretic[49,50], anti-inflammatory[51], anti urolithiatic agent in study ethnomedical[52]. |
| Curcuma longa L.                       | Zingiberaceae | [53]                  | Potential nephroprotective agents[53] Dissolve kidney stone, diuretic[50]. |
This study showed eight species of plants that had a high level of UV (Table 3). Their species have several benefits for treating urinary tract problems. Besides anti-urolithiasis agents, several of them can be employed to improve renal function. Aqueous-ethanolic extracts have diuretic activity in vivo in rats. Diuretics can also be prophylactic agents for urolithiasis due to their significant role in regulating kidney function and lightening the urinary risk factors for stone formation. Hence, Orthosiphon aristatus being commonly used for dissolving kidney stones. Several studies revealed its hypouricemic activity in rats leading to the formation of oxalate crystals [57]. Asian countries usually consumed Orthosiphon aristatus as a treatment for dysuria and eliminated kidney bladder[58]. Phyllanthus niruri is a medicinal plant that has the second-highest species use value after Orthosiphon aristatus. In addition, it belongs to the Euphorbiaceae family that was the highest Family Use Value (FUV). The Phyllanthus niruri had the highest efficacy in dissolving calculi ≤ 3 mm, located in the middle or upper calyx [59]. Moreover, it also has anti-inflammatory, anti-hyperuricemic, and diuretic properties. Phyllanthus niruri is beneficial for Patients with specific urinary metabolic changes such as hyperuricosuria and hyperoxaluria, which are typically involved in forming urinary calculi. [38]. The nephroprotective activity of Phyllanthus niruri has been investigated in Diabetic Nephropathy patients [39].

There were several instances where Datura metel, Croton sp was employed as part of urinary tract problems formulation, even though They were of poisonous plants in an ethnomedicinal study in Zimbabwe [60]. Orthosiphon aristatus and Phyllanthus niruri both have high UV so it can be concluded that both plants have been long known and used by informants in Eastern Indonesia. The literature showed several evaluations on the biological compound has been conducted on such plants.

4. Conclusion
Based on the result, Orthosiphon aristatus and Phyllanthus niruri are the most employed medicinal plants for treating urinary tract problems in eastern Indonesia. Their safety and efficacy have been proven by previous research. Hence, people far from health care facilities can adopt both plants as medication for treating urinary tract problems. Datura metel and Croton Sp are not suggested due to their toxic nature.

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