Ethnomedicinal properties of orchidaceae by local communities in Lake Toba region, North Sumatera, Indonesia

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Abstract. Orchids are plant species with beauty and medicinal purposes, but, limited exploration has been conducted on potential utilization of Orchidaceae for medicinal purposes. This study aims to describe the local wisdom in utilization of Orchidaceae in traditional medicine and to identify the phyto-chemical content in particular orchid species which utilized for herbal medicine by local communities in the Lake Toba region. The study was conducted through exploration and in-depth interviews with 24 local communities that applied orchids in their traditional medicine in Karo, Simalungun and Toba of North Sumatra during 2020 to 2021. This study also reviewed various phyto-chemical content and safety issues of orchids utilization. The study identified about 23 orchid species from 15 genera as a main therapeutic agent. Various parts or entire plant are various parts of plant including roots, leaves, stems, flowers or entire plant contain phytochemical compounds with anti-inflammatory, anti-oxidant, antimicrobial, antipyretic properties, and applied for various medicinal. Some of well-known orchids are Anoectochilus formosanus and Calanthe triplicata. The entire plants are applied in traditional medicine to smooth the liver, to treat rheumatism, diabetes, bronchitis, wound infection, tonic or detoxification. These activities are due to various bio-active compounds, mainly alkaloids, stilbenoids, dimeric phenanthrenes, flavonoids, triterpenoids, etc. These information have been illustrated the excellent potential of Orchidaceae for novel constituents of therapeutic and herbal medicine.

1. Introduction
Orchids are plant species with exotic beauty, ornamental and medicinal purposes. Several members of the Orchidaceae family have been consumed as nutraceuticals since ancient times [1-3]. Their therapeutic benefits have been realized and utilized in traditional medicine in China and India for remedy of various health problems [1-4]. These plants also have important roles in therapeutic utilization by local communities in Indonesia.

In India, orchids are an important ingredient of ayurvedic formulations, an ancient indian system of medicine [3]. Several orchids species are important ingredients in some classical medicinal formulations [3,5]. Part or entire plant, in paste or boiled form, single or mixed with another food stuffs are used to reduce swelling, remove toxins, repair injured tissue and others [3,5]. Various reports were also explored regarding the orchids application in traditional china medicine as an antipyretic, to relieve rheumatism, traumatic injuries, detoxifying snake bites, and others [1-4]. These show the excellent phytochemical and pharmacological potency associated with the remedy properties from some secondary metabolites contained in these plants. However, as compared to other families of plantae kingdom, limited research...
have been implemented to explore the potential utilization of Orchidaceae for medicinal purposes, especially for domestic communities in Indonesia [1-3].

The application of herbal medicines from orchids in line with holistic medicines has grown rapidly over the last decade [1-3]. Recently, bioactive compounds or phytochemicals derived from plants have received high attention considering their potential as anti-inflammatory, anti-microbial, and antioxidant properties [6]. The pandemic Covid-19 has also increased global consciousness about boosting the immunity through organic products utilization and complementary treatments [7]. However, phytochemical studies on orchids are still limited, especially in the investigation of phytochemicals contained in orchid species as raw materials for new herbal medicines in the future. This condition encourages the rediscovery of local knowledges in the prevention and treatment of diseases using orchid-based herbal medicines.

The objectives of study were (a) to describe the local wisdom in the utilization of orchidaceae family in traditional medicine and (b) to identify the phyto-chemical content in particular orchid species that utilized as raw materials for local medicine by communities in the Lake Toba region, North Sumatra, Indonesia. The information obtained is expected to explore the excellent potential application of orchidaceae for further scientific studies in the discovery of novel natural constituents of therapeutic and herbal medicine interest.

2. Materials and Methods
The study was conducted through exploration and in-depth interviews with 24 local communities that utilized orchids in their traditional medicine in Karo, Simalungun, and Toba of North Sumatra province during mid of year 2020 and early 2021. Local wisdom in the utilization of orchids was verified by observing the morphological characters of identified orchid plants. This study also reviewed previous study according phyto-chemical content and pharmacological activities of identified orchids in herbal medicines.

3. Results and Discussion
The results identified at least 23 orchid species from 15 genera as a main therapeutic agent, including Acampe, Anoectochilus, Apostasia, Appendicula, Arundina, Bulbophyllum, Calanthe, Dendrobium, Liparis, Oberonia, Papilionanthe, Phaius, Phalaenopsis, Rhynchostylis, and Spathoglottis. Various parts of the plant including roots, leaves, stems, flowers, or the entire plant were used as anti-microbial, anti-inflammatory, anti-pyretic, anti-diabetic, immuno-modulatory, pain relieving, wound healing, etc.

Some of well-known orchids are jewel orchid (Anoectochilus formosanus) and Guru ni Hambing (Calanthe triplicata). The entire plant of jewel orchid was utilized as an antipyretic, treat liver problems, and detoxification from snake bites and other venomous animals. This terrestrial orchid is also utilized for treating waist and knee pains. Meanwhile, the root of C. triplicata was crushed and applied topically to reduce arthritic pain, back pain, and traumatic injuries. The pseudobulbs were boiled and consumed orally for diuretic, diarrhea, and toothache treatments. In Table 1 traditional applications of some orchids as herbal medicine in the Bataknes community are listed whereas in Figure 1 some medicinal orchid plants have been shown.

In another orchid species, the entire plants or separate parts include roots, leaves or stems, single, or mixed with another food stuffs were also applied to remedy some of the disease symptoms or to treat rheumatism, diabetes, diarrhea, bronchitis, or as a tonic to strengthen the body. The plant parts are usually boiled and drunk regularly until the symptoms reduce. Some orchids with remedy properties for these symptoms include Acampe rigida, Calanthe triplicata Liparis nervosa, Pholidota imbricate, Rhynchostylis retusa, and Spathoglottis plicata.
Table 1. Traditional applications of various essential oils.

| No | Species | Plant part | Concoction | Disease/ symptom | Processing | Treatment |
|----|---------|------------|------------|------------------|------------|-----------|
| 1  | *Acampe rigida* (Banana orchid) | entire plant | mixed | as a tonic to strengthen body | boiled | drink orally |
| 2  | *Aneectochilus formosanus* (Jewel orchid) | entire plant | single use | blood circulation and pain, liver, detoxification (snake bites), waist and knee pain | boiled | orally, topical |
| 3  | *Apostasia nuda* (Grass orchid) | roots | mixed | diarrhea | boiled | orally, topical |
| 4  | *Appendicula cornuta* (Si sarsar bulang) | stems | mixed | folk medicine for fever | juiced | orally, topical |
| 5  | *Arundina graminifolia* (Anggrek bamboo) | pseudobulbs | mixed | bleeding from knife wounds, rheumatic, trauma and snake bites | crushed, boiled | topical |
| 6  | *Bulbophyllum cariniflorum* | roots | mixed | to induce abortion during the first trimester | dried, boiled | orally |
| 7  | *Bulbophyllum reptans* (Anggrek batu) | roots | mixed | phlegm, improves appetite, digestion, dry throat respiratory infections | crushed | topical |
| 8  | *Bulbophyllum vaginatum* (Anggrek batu) | entire plant | mixed | swellings, removes toxins, abscesses, dislocated bones, rheumatism, backache, fractures, diarrhea, toothache to stops coughs and asthma | pulverized, pasted, boiled | topical |
| 9  | *Calanthe masuca* (Long spur prawn spine orchid) | entire plant | single use | bleeding, cramps, coughs, skin infection, snake bites, rheumatic, fever, sores, distension, ulcers, abdominal pain, coughs, sore throat | pasted, boiled | topical |
| 10 | *Calanthe triplicata* (Guruni hambing) | roots | mixed | to treat boils and infected wounds | pulverized poultice | topical |
| 11 | *Dendrobium appendiculartum* (Claw dendrobium) | entire plant | single use | painful joints | pasted | topical |
| 12 | *Dendrobium crumenatum* (Anggrek merpati) | pseudobulbs | single use | fever caused by small abscesses, cholera | crushed, boiled | topical |
| 13 | *Dendrobium indivisum* (Bamboo grass Cymbidium) | entire plant | mixed | headache | boiled | topical |
| 14 | *Liparis bootanensis* (Bamboo grass Cymbidium) | entire plant | mixed | fever, sores, distension, ulcers, abdominal pain, coughs, sore throat | boiled, pasted | orally |
| 15 | *Liparis nervosa* (Thunb.) Lindl. | entire plant | mixed | to treat boils and infected wounds | pulverized poultice, boiled | topical |
| 16 | *Oberonia lycopodioides* (Skat lidah buaya) | entire plant | mixed | painful joints | pasted | topical |
| 17 | *Papilionanthe hookeriana* (Anggrek pensil) | stem, leaves | mixed | swelling | crushed | topical |
| 18 | *Papilionanthe teres* (Anggrek pensil) | entire plant | single use | dislocated bones, fever, coughs and colds, fever, detoxification, dysentery | pasted, boiled | topical |
| 19 | *Phaius tankervilleae* (Anggrek api) | pseudobulbs | mixed | fractures, sores, infected wounds, headaches, backache, chest pain | poultice, boiled | topical |
| 20 | *Phalaenopsis anabilis* (Anggrek bulan) | roots, leaves | single use | dislocated bones, fever, fractures, rheumatism, wounds | poultice, boiled | topical |
| 21 | *Pholidota imbricate* | leaves | single use | fever, coughs and colds | poultice | topical |
| 22 | *Rhynchostylis retusa* (Anggrek lilin) | entire plant | mixed | bloody diarrhea | boiled | topical |
| 23 | *Spathoglottis plicata* (Anggrek songkok) | entire plant | single use | Rheumatism, earache | Paste, juiced | topical |
Apart from being consumed orally, some orchids were also utilized topically for detoxification due to snake bites, swelling, bone dislocation, and skin infections. Roots, stems, leaves or pseudobulbs were crushed into a paste, or juiced and rubbed on the affected part of the body. The orchids species for this treatment include *Anoectochilus formosanus, Arundina graminifolia, Calanthe triplicata*, *Liparis nervosa, Oberonia lycopodioides, Papilionanthe teres*, and *Phaius tankervilleae*.

As with the herbal medicine practice, the parts of orchid plant were mixed with various other herbs depending on the symptoms of disease to be a remedy. Some herbal blends include ginger, cinnamon, cardamom, cumin, betel leaf, and others that have been clinically proven. The compositions of these various herbs are complementary to each other thereby enhancing their medicinal properties. These huge benefits in traditional medicine open up opportunities for the Orchidaceae family utilization as novel drugs.

### 3.1. Phytochemical contents and potential application

These medicinal activities are due to various bio-active compounds contained, mainly flavonoids, triterpenoids, steroids, stilbenoids, dimeric phenanthrenes, and essential oils (Table 2). These compounds are anti-inflammatory, antimicrobial, anthelmintic, and antiplatelet properties [4,6,8], and cytotoxic to particular cancer cells [9,10].

One of orchid with anti-inflammatory and diuretic properties is *Arundina graminifolia*, a terrestrial orchid that is often found in Styrax forest garden in the Toba district. This orchid is also identified to have high anti-bacterial properties. Moreover, the crushed bulbous stems are applied to remedy the skin cracks in India. In traditional Dai medicine in China, this orchid is known as ‘Wen Shang-hai’, a famous detoxifying herb for all ailments [4]. Furthermore, the pseudobulb or entire plant are processed either fresh or dried for medicinal herbs to treat hepatitis, urinary tract infections, oedema, detoxifying of snake bites, and reducing rheumatic pain in Hongkong. In traditional medicine of China, entire plant (9-15 g) were boiled and consumed to reduce bruising, rheumatism, abdominal pain, jaundice, pulmonary tuberculosis, and external bleeding [11]. These medicinal activities are due to phytochemical contents contained including rundinin, isoarudinin, isoarundinin; lusianthrin, flavanthrin; flavidin; batatasin, arundinol phenanthrene [14].

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**Figure 1.** Some medicinal orchid plants.
### Table 2. Phytochemical compounds and potential application in several orchidaceae species.

| No | Species                          | Phytochemical contents                                                                 | Potential application                                                                 |
|----|----------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1  | *Acampe rigida*                  | flavonoids, hydroxybenzoic acid, cyanogenic glycosides, hydroxybenaldehyde, methoxymethyl phenol [12] | Applied as a tonic; roots and leaves for relieve muscles and joints pain, to promote blood circulation, to cure traumatic injuries and fractures [12]. |
| 2  | *Anoectochilus formosanus*       | alkaloids, flavonoids, terpenoids, glycosides, and steroids [13]                      | As antipyretic, detoxification; to treat tuberculosis, bronchitis, diabetes, kidney infection, cramps, stomach problem, snake bites. |
| 3  | *Apostasia nuda*                 | Alkaloid, lack of information                                                         | to treat diarrhoea, remedy for sore eyes [13]. |
| 4  | *Appendicula cornuta*            | Alkaloid, lack of information                                                         | folk medicine, used as a medicine for whitlow. |
| 5  | *Arundina graminifolia*          | rundinin, isoorudinin, isoorundinin; lusianthridin, flavanthrin; flavidin; batatasinarundinol phenanthrene [14] | Anti-inflammatory, diuretic, anti-bacterial; hepatitis, snake bites, oedema, rheumatic; abdominal pain, tuberculosis [14] |
| 6  | *Balbophyllum cariniflorum*      | Glycosides, flavonoids, saponins, tannins, terpenoids, steroids, quinine, coumarin [15] | to induce abortion during the first trimester |
| 7  | *Balbophyllum reptans*           | Phenanthrenes: coelonin, confusarin, flavanthrin, reptanthrin, isoreptanthrin.        | To increases appetite, aids digestion, relieves dry throat and clears phlegm.           |
| 8  | *Balbophyllum vaginatum*         | stilbenoids, phanenthro furan, dihydrophanentrenes, bibenzyls, phanenthrofuran [14] | Phenanthrenes investigated for anti-tumour activity; to treat respiratory infections and fractures; anti-inflammation, hair tonic, to cure dandruff |
| 9  | *Calanthe masuca*                | Alkaloids, flavanoids, phenol, tannins, saponins, steroids, terpenoids, carboxycyclic acid, glycoside and mucilage [16] | as anodyne; to remove toxins, to treat swelling, abscesses and repair injured tissue, dislocated bones [11] [16] |
| 10 | *Calanthe triplicata*            | phenol, alkaloid, flavonoid and tannin [8]                                             | Diuretic, rheumatism, diarrhoea, toothache, backache and traumatic injuries, gastrointestinal disorders. |
| 11 | *Dendrobium appendiculatum*      | Alkaloids, tannin [17]                                                                | The entire plant nourish the lungs, to stop coughing, to heal asthma and tuberculosis [11,17]. |
| 12 | *Dendrobium crumenatum*          | Alkaloids, flavonoids [17,18]                                                         | to treat abscesses, boils, swelling in the outer ear; to treat cholera [17,18] |
| 13 | *Dendrobium indivisum*           | Alkaloids, tannin                                                                     | to treat headache |
| 14 | *Liparis bootanensis*            | Alkaloids, flavonol, glycosides [19]                                                  | to heal tuberculosis, to treat fever, ulcers, enlarged lymph node, abdominal pain [19] |
| 15 | *Liparis nervosa*                | Nervosin, lindelofidine, nervosinic acid, nervogenic acid, [11] pyrrolizidine alkaloids [20]. | Antioxidant, anti-cancer [20], antibacterial, antipyretic, reduce bleeding; coughs, rheumatic; skin infection and snake bites; anti-inflammation, stomach disorders and ulcers [11]. |
| 16 | *Oberonia lycopodioides*          | Alkaloids, flavonoids [21]                                                            | to treat boils and infected wounds [21] |
| 17 | *Papilionanthe hookeriana*       | Alkaloids, flavonoids [3,11]                                                          | to treat painful joints |
| 18 | *Papilionanthe teres*            | Eucomic acid and vandaterosin [3,11]                                                  | anti-aging to remedy age-related disorders; to improve blood flow, reduce swelling, fever, coughs and colds. |
| 19 | *Phaius tankervilleae*           | Alkaloids, phytanthrin, tryptanthrin [3,11]                                           | cytotoxicity against human cancer cell; anti-tussive, detoxification; dysentery; infected wounds, abscesses, contraceptive purposes. |
| 20 | *Phalaenopsis amabilis*          | alkaloid, phalaenopsine [3,11]                                                        | to treat headaches, backache, chest pain; shampoo, a poultice for insect bites. |
| 21 | *Pholidota imbricata*            | dihydrophanenthe (imbricatin), coelonin [3,11]                                        | Bacteriostatic; induce menstrual flow, diuresis; to treat ulcers; to relieve navel, abdominal, rheumatic, fractures |
| 22 | *Rhynchostylis retusa*           | alkaloid, terpenoids, flavonoids, tannins, steroids, coumarins, amino acids [3,11,22] | rheumatism, diarrhea, asthma, cramps, tuberculosis, infantile epilepsy, vertigo, palpitations, kidney stones, menstrual disorders [3,11,22] |
| 23 | *Spathoglottis plicata*          | alkaloids, flavonoids, saponins, and tannins anthraquinones, cardenolides, bufadienolides [15] | to treat rheumatism, earache; to promote countenance [15] |
Another orchid, *Liparis nervosa* contains nervosine [3,11]; the compound was identified cytotoxicity against human cancer cells [20]. The alkaloids contained in this orchid are also anti-bacterial, antifungal and antioxidant [11]. The crushed root or entire plant are also identified as an antipyretic and applied to muscle cramps, coughs, and rheumatic pains. This beautiful orchid is also processed as an emollient for traumatic injuries, to reduce inflammation, skin infections, remedy swellings, and detoxification of snake bites [3,11].

Furthermore, some of Dendrobium orchid include *D. appendiculatum* [17], *D. crumenatum*, *D. insivisum* [18], *D. amoenum*, *D. crepidatum*, *D. moniliforme*, *D. longicomu* [23], and *D. nobile* were identified containing phytochemical and bioactive compounds as an antitumor, antioxidant, antitoxin properties. The entire plant of *D. appendiculatum* were identified containing medicinal compounds for lung disease, coughs, to treat tuberculosis, coughs and asthma. The alkaloids and flavonoids were identified efficacious for treating abscesses, boils, swelling of the outer ear and for treating cholera [17,18].

Orchids also have the potential as raw materials for cancer drugs [9,10,17,20]. Phytanthrin A and tryptanthrin compounds in *Phaius tankervillae* showed cytotoxicity properties against human cancer cells [20]. Furthermore, the pseudobulbs boiled water have antitussive properties to prevent cough, to treat fever, to relieve swellings and dysentery [3]. In West Java, the entire plant are crushed and applied to infected wounds, as well as to relieve abscess pain. Moreover, it is reported that smoked flowers of orchid species are eaten for contraceptive purposes in the southern highlands of Papua New Guinea [11]. Finally, the information about these phytochemical contents and pharmacological activities have been illustrated the excellent potential of orchidaceae for further scientific studies in the discovery of novel natural constituents of therapeutic and herbal medicine interest.

4. Conclusion
The results identified at least 23 orchid species from 15 genera as main therapeutic agent, including *Acampe*, *Anoectochilus*, *Apostasia*, *Appendicula*, *Arundina*, *Bulbophyllum*, *Čalanthe*, *Dendrobium*, *Liparis*, *Oberonia*, *Papilionanthe*, *Phaius*, *Phalaenopsis*, *Rhynchostylis*, and *Spathoglottis*. Various parts of plant including roots, leaves, stems, flowers or entire plant contain phytochemical compounds with anti-inflammatory, anti-oxidant, antimicrobial, antipyretic properties, and applied for various medicinal purposes including to treat rheumatism, diabetes, liver problem, bronchitis, wound infection, detoxification and as a tonic to strengthen the body. These activities are due to various bio-active compounds contained, mainly alkaloids, stilbenoids, dimeric phenanthrenes, flavonoids, triterpenoids, steroids, etc. Information about these phytochemical contents and pharmacological activities have been illustrated the excellent potential of orchidaceae for further scientific studies in discovery of novel natural constituents of therapeutic and herbal medicine interest.

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