Ethnomedicine of forest’s essential oils for respiratory and cardiovascular treatments in Northern Sumatra

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Abstract. The global pandemic Covid-19 has become a worldwide challenge. Many continuous efforts have been conducted to prevent and combat the diseases that attack the human respiratory system. This situation encourages the exploration of potential herbal remedies involving essential oils from forest to boost human immune system. The objectives of study were to explore the traditional application of forest’s essential oils and to identify the phytochemical content of herbal medicines in respiratory and cardiovascular treatments in Northern Sumatra. In-depth interviews were conducted with 27 local people who applied essential oils in their traditional remedies in Karo and Toba, North Sumatra; and Singkil and South Aceh during 2020. The essential oils benefits in Covid-19 treatment were identified by inhaling application to seven positive suspects. The study also reviewed previous findings according the phytochemical content of forest essential oils identified. The study identified twelve forest’s essential oils applied in respiratory and cardiovascular treatments, including Cinnamomum zeylanicum, Dryobalanops aromatica, Eucalyptus sp., Litsea cubeba, Melaleuca cajuput, Myristica fragrans, Styrax sumatrana, Syzygium aromaticum, and Zanthoxylum acanthopodium. The oils were distilled from plant part such as flowers, leaves, fruits, seeds, and barks or extracted from resin. Several phytochemicals with medicinal properties were identified including 1.8-cineole, α-pinene, camphene, eugenol, limonene, linalool, and p-cymene. In aromatherapeutic practices by both inhalation and massage, the phytochemical content gives relaxing effects and improve the respiratory and cardiovascular system. The results also show that inhaling the essential oils also helps Covid-19 patients relieve their breathing, therefore prospective for respiratory treatment. The high stress conditions faced by patients were also reduced by inhaling aromatherapy. The study re-discovered the essential oils benefits for various conditions such as headaches and hypertension, while having high potential as an expectorant and immune system booster.

1. Introduction
Currently, the Covid-19 pandemic has become a worldwide concern. Various strategies are implemented to prevent and combat global diseases that attack the human respiratory system. Unfortunately, no medicines and treatment methods have been found to effectively cure patients infected with the coronavirus. This situation encourages the exploration of potential herbal remedies and complementary therapies involving forest essential oils to boost the immune system, the most important factor for reducing infection due to novel corona virus. This condition encourages the re-discovery of local wisdom in the application of herbal medicines involving forest essential oils to improve the human immune system through the utilization of organic products.
Why essential oils? For centuries, these organic oils have an important role in healing practices for the human body and soul. Some advanced herbal medicine countries such as China and India place essential oils as popular complementary and alternative therapies for many remedy of diseases. [1]. This condition is also applied by local communities in Indonesia; the organic oils are used as therapeutics, aromatics (fragrances), cosmetics, or spiritual practices [2,3].

The essential oil is extracted from particular plant part such as flowers, leaves, fruits, barks, stems, and roots, entire plant or resins produced by plants. The mixture of various phytochemicals produces some certain aromas that keep the environment free from viruses, bacteria, fungi and other disease vectors [4]. This condition supports anti-inflammatory, antiviral, and antibacterial properties along with boosting immunity, altering mood and emotional with a calming effect [1,5], a condition that support the healing process of patients suspected of Covid-19.

The essential oils are used by inhalation, massage or topical practices to the skin, including but rarely taken internally. Massage and inhalation aromatherapy can alleviate stress and refresh a tired body and mind. Previous studies have also explored the potential utilization of essential oils in the remedies of degenerative diseases such as cardiovascular, respiratory problem, and cancer [6]. This situation encourages the exploration of potential herbal remedies involving forest essential oils to boost the immune system in order to prevent and treat respiratory diseases such as Covid-19.

The objectives of study were to (a) explore the traditional application of forest’s essential oils and (b) identify the phytochemical content of herbal medicines in respiratory and cardiovascular treatments in Northern Sumatra. The information obtained is expected to explore the potential applications of essential oils from forest vegetation for further scientific studies in the discovery of new natural constituents that are of interest to therapeutics and herbal medicines, especially for the prevention and cure of suspected Covid-19.

2. Materials and Methods
The exploration and in-depth interviews with 27 local peoples who utilized essential oils in their herbal medicine were conducted in the Batak communities in Karo and Toba, North Sumatra; and Acehnese in Singkil and South Aceh during 2020. The efficacy of this organic oil in Covid-19 treatment was identified through application to seven selected positive patients with low to moderate symptoms in North Sumatra. All Covid-19 cases diagnosed between May and October 2020 using 1-2 weekly telephone interviews. The initial testing in the application of essential oil combinations was carried out independently by inhalation for more than seven days by measuring respondent's level of preference for the sensation of inhaling essential oils to relief breathing. Comparison between positive patients who applied and did not apply essential oils was not carried out in this study. Information about traditional application of essential oils as herbal medicines was verified according to identified pharmacology activities. This study also reviewed various literatures regarding phytochemical constituents and safety issues of forest vegetation applied in herbal medicine.

3. Results and Discussion
3.1. Local herbal application
The study identified twelve forest’s essential oils applied in respiratory and cardiovascular treatments, i.e. ylang-ylang (Cananga odoratum – Annonaceae); cinnamon (Cinnamomum sp. – Lauraceae); camphor oil (Dryobalanops aromatic – Dipsocarpaceae); eucalypt oil (Eucalyptus spp. – Myrtaceae); fennel oil (Foeniculum vulgare – Apiaceae); may chang (Litsea cubeba – Lauraceae); cajuput (Melaleuca spp. – Myrtaceae); nutmeg (Myristica fragrans – Myristicaceae); sandalwood (Santalum album – Santalaceae); benzoin (Styrax sumatrana – Styracaceae); clove oil (Syzygium aromaticum – Myrtaceae) and Sichuan pepper oil (Zanthoxyllum acaanthopodium – Rutaceae).

Essential oil was extracted from almost plant parts such as leaves, flowers, fruit, bark, stems, and resins (Table 1). Leaf distillation is a common method for obtaining essential oils such as eucalyptus, cajuput and may chang oil, although oil production can also be carried out through extraction of benzoin resin from endemic styrax trees [7] and camphor oil from Dryobalanops aromatic [3,8]. Certain fruits
or seeds such as Sichuan pepper [9], nutmeg, and fennel also contain essential oil, significantly. Flowers of ylang-ylang, may chang, cajuput, nutmeg, clove and Sichuan pepper were distilled for oil production. Meanwhile, the essential oil in woody part was produced from sandalwood timber. Besides being distilled, certain plant parts, especially the leaves and fruit were boiled to produce essential oils.

Table 1. Local herbal utilization of certain essential oils from forest.

| No | Essential oils                        | Plant part | Concoction | Disease/ symptom                      | Processing | Treatment      |
|----|--------------------------------------|------------|------------|--------------------------------------|------------|----------------|
| 1  | *Cananga odoratum* (Ylang-ylang)     | Flower, leaves | mixed      | hypertension, anxiety, malaria, stomach ailments, asthma, gout, rheumatism | Boiled, distilled | massage, inhaled |
| 2  | *Cinnamomum sp.* (cinnamon)          | Barks      | mixed      | digestive problem, blood sugar, blood circulation, immunity, depression | Boiled, distilled | massage, inhaled |
| 3  | *Dryobalanops aromatica* (Camphor)   | Resin, oil | single use | relaxing fragrance, digestive problems, muscle joint pain, inflammation, insect bites, itching | Distilled | massage, inhaled |
| 4  | *Eucalyptus sp.* (Eucalypt)           | Leaves     | Single use | respiratory problems (coughs, colds, sore throats, decongestants), joint pain, digestive problems, respiratory systems, relaxation, wound infection, snake bite | Boiled, distilled | massage, inhaled |
| 5  | *Foeniculum vulgare* (Fennel)        | Seeds      | Single, mixed | insect bites, cough                   | Boiled, distilled | massage, orally |
| 6  | *Litsea cubeba* (May chang)          | Leaves, oils | Single use | cold, nasal congestion, flu, respiratory problem, sinus infections | Boiled, distilled | massage, inhaled |
| 7  | *Melaleuca cajuput* (cajuput)        | Leaves, oils | Single use | Insomnia, upset stomach              | Boiled, distilled | massage, orally |
| 8  | *Myristica fragrans* (Nutmeg)        | Flower, fruits, oils | Single use | cough, sore throats, mucus, headaches, cholesterol, diabetes, liver | Distilled | massage, inhaled |
| 9  | *Santalum album* (sandalwood)        | Wood, oils | Single, mixed | skin infections, bleeding and swelling, aromatherapy | Maceration, distilled | massage, inhaled |
| 10 | *Styrax sumatrana* (benzoin)         | Resins     | single use | Reduce stress, liver, tuberculosis, blood circulation, headache, detoxification, immunity | Boiled, distilled | massage, inhaled |
| 11 | *Syzygium aromaticum* (Clove)        | Bud, flower, fruits | mixed |          | Boiled, distilled | massage, inhaled |
| 12 | *Zanthoxylum aconitopodium* (Sichuan pepper) | Fruits, seeds | single use | dental disorders, dyspepsia, scabies, antimicrobial | Boiled, distilled | massage, orally |

Similar to herbal medicine practices, essential oils were applied as single oil or mixed with various other herbal oils, depending on the symptoms of the disease to be cured. Some of the commonly used herbal mixtures include ginger, cardamom, cumin, and betel leaf have been clinically proven. The compositions of these various herbs complement to each other thereby enhancing their medicinal properties.

Traditionally, the essential oil has been used for various diseases and disorders of body function. Generally, essential oils are applied to treat wounds and skin infections, antidote to venomous bites, treat coughs, fevers, scabies, relieve muscle pain, indigestion, and bloating. Certain essential oils are also applied as local medicines for anti-rheumatism, dyspepsia, constipation, malaria and some degenerative diseases such as hypertension, diabetes, and liver disorders. Stress, insomnia, asthma, and some respiratory disorders can also be cured through the application of essential oil aromatherapy.

As herbal medicine, essential oils are utilized through massage, steam bathing, cosmetic, olfactory or psycho aromatherapy. Particular essential oils are also taken internally at certain doses. Some
essential oils such as sandalwood oil, ylang-ylang, may change, camphor, benzoin, and nutmeg oil were applied by massage therapy to get the healing effects.

3.2. Phytochemical contents and potential application

Most of the pharmacology activities were verified by their phytochemical compounds in almost plant parts. Previous related studies have represented the potential of essential oils as raw materials for herbal medicines (Table 2).

Table 2. Phytochemical compounds and potential application of essential oil from forest.

| No | Species                        | Phytochemical contents                                                                 | Potential application                                               |
|----|--------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 1  | Cananga odoratum (Ylang-ylang) | 1.8-cineole, bornyl acetate, camphene, geraniol, geranyl acetate, linalool, limonene, linalyl acetate, ocimene, myrcene, p-cymene [10] | treating depression, high blood pressure, anxiety, antimicrobial, anti-inflammatory, antidiabetic, antifertility |
| 2  | Cinnamomum zeylanicum (cinnamon) | cinnamaldehyde, cinnamyl acetate, cinnamyl alcohol, cinnamic acid, eugenol, cinnamaldehyde, phellandrene dan methyleugenol [11] | anti-inflammatory, antiplatelet, improve blood circulation, cardiovascular disease, antiviral, boost immunity, depression, stabilize blood sugar |
| 3  | Dryobalanops aromatica (Camphor) | a-pinene, b-caryophyllene, limonene, 1.8-cineole, and p-cymene [12] | relaxing, inflammation, relieve respiratory problem, increase immune system, itching, irritation, relieve muscle and joint pain. |
| 4  | Eucalyptus sp. (Eucalypt)       | α-pinene; limone; cycooctadiene; 1.8 cineole; cyclohexansa; α-terpinyl asetat; phenol; butylhydroxy-toluena; sironelol; propil myristat; propilteradekanout; octadecanoic acid [13] | antimicrobial activities, digestive, endocrine, reproductive, and respiratory problems |
| 5  | Foeniculum vulgare (Fennel)     | α-pinene, limone, α-fenchone, t-anethol, and fenchol [14] | anti-bacteria, the antidote to insect bites; cough medicine |
| 6  | Litsea cubeba (Maychang)        | citronellol, limonene, eucalyptol and α-terpineol d [15] | colds, flu, sinus infections, nasal congestion, and respiratory problems |
| 7  | Melaleuca cajuput. (cajuput)    | α-terpinolene, aromadendrene, limonene, ocimene, β-pinene, β-myrcene, 1.8-cineole, γ-terpinene, β-selinene, caryophyllene, β-elemene [16] | lowering blood pressure, detoxify, diuretic |
| 8  | Myristica fragrans (Nutmeg)     | sabinene, β-pinene, α-pinene, myristicin, limonene, β-phellandrene, terpine, myrcene, terpinolene, α-terpineol, p-cymene, safrrole, eugenol, α-thujene, β-caryophyllena, α-copaene, citronellol. [17] | cold, cough, bronchitis, fever, urinary tract infections, liver, heatstroke, headache, cardiovascular disease,18 |}

In aromatherapy applications, most of the aromas of essential oils give a relaxing effect. Camphor oil has been recognized potential for treating respiratory system problems by clearing the lungs as well as improving blood circulation and the immune system. Inhaling camphor oil also improves the nervous system and calms the mind [21]. Through massage therapy, the oil extracted from the resin of Dryobalanops aromatica is used to relieve muscle and joint pain, insect bites, inflammation, itching, rashes, sprains and irritation.

Furthermore, sandalwood oil from Santalum album wood distillation contains santalol, a bioactive compound that benefits for the treatment of cardiovascular diseases, colds, coughs, bronchitis, fever, throat, liver and gallbladder disorders, urinary tract infections, gonorrhoea and relieve headaches [20].
Benzoin oil one of the historic oils and commonly used in traditional medicine contains many phytochemical compounds [19] with distinctive and pleasant odour. The oil extracted from styrax resin is well recognized as antiseptic, and applied to preventing and treating skin infections, applied to stop minor skin bleeding and reduce swelling, treat boils, dry and cracked skin, prevent acne and aging. Recently, benzoin oil is prospective for treating respiratory tract problems such as cough, bronchitis decongestants, sore throat, flu, overcome flatulence, as well as preventing and overcoming stress [22].

Cajuput and eucalypts are common essential oils in daily remedy. Cajuput oil contains ocimene, -pinene, limonene, 1.8-cineole, terpinene, myrcene, terpinolene, terpineol, terpinyl acetate, l-caryophyllene, humulene, selinene, aromadendrene, elemene, and solvanol [16]. Meanwhile, eucalypts oil contains phytochemicals such as pinene; limone; 1.5-cyclooctadiene; 1.8-cineole; cyclohexane; terpinyl acetate; phenols; butylhydroxy-toluene; citronellol; propyl myristate; propyltetradecanoate; octadecanoic acid [13]. Recently, 1.8-cineole received high attention for its benefits as an anti-viral, anti-bacterial and anti-fungal, and expectorant, therefore it is prospective for the respiratory tract treatment in Covid-19 suspects [21].

3.3. Preliminary testing on Covid-19 patients
The benefits of essential oils in Covid-19 treatment were verified through their application to seven selected positive patients. The combination of essential oils such as sandalwood, benzoin, lavender, fennel, and Eucalyptus was applied to respondents by inhalation for more than seven consecutive days. Essential oil application promotes healing of all seven selected positive patients. Although it was not compared with no application, the average patient recovery rate is ten to nineteen days after application, faster than global recovery rate. A study of 3000 confirmed Covid-19 patients found 80% of people had recovered within one month of the onset of illness, over 90% recovered within 2 months and 93% within 3 months [23]. There are significant concerns about the difference in symptoms of Covid-19 patients, but this study was limited to volunteers with mild to moderate symptoms, therefore this finding may bias recovery estimates.

Furthermore, respondents' response to the sensation of inhaling essential oils showed a relaxing effect and helped relieve a congested respiratory system. In this concern, inhaling essential oil blend helps ease the breathing of all Covid-19 patients. High stress conditions faced by patients could also be reduced through pleasant aroma that evokes enthusiasm and feelings of pleasure [24], a condition which favors the healing of Covid-19 patients.

Despite there are no scientific evidence that certain phytochemical compounds can stop the spread of the corona virus, the application of certain essential oils such as cajuput and eucalypts with a high content of 1.8 cineole is proven to boost the immune system and relieve breathing, desirable conditions in Covid-19 treatment. Eucalyptol may represent potential treatment to act as corona virus inhibitor [25].

The specific character of essential oils is their similar structure with real human hormones [1]. This supports the body's biochemical changes. The process comprises the compound of essential oils aroma into biological signal receptors in the nose and transmitted to the limbic and hypothalamus of the brain through the olfactory bulb. These signals induce the brain to release serotonin and endorphins for altering mood and pleasure feeling [1,26].

4. Conclusion
The study identified huge potential of forest’s essential oils applied in respiratory and cardiovascular treatments. The organic oils were distilled from various parts of the plant with medicinal phytochemicals properties including 1.8-cineole, a-pinene, camphene, eugenol, limonene, linalool, and p-cymene. In aromatherapy practices both inhalation and steam bathing, these essential oils have relaxing effects and improve the respiratory and cardiovascular system. The results also show the potential inhibitor of Covid-19 from forest’s essential oils. Inhalation of essential oils helps relieve breathing with relaxing effect, therefore prospective for respiratory treatment of Covid-19 patients. This study also re-discovers the benefits of essential oils in various treatments such as headaches, hypertension, and their high potential as an expectorant and immune system booster.
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