Potential and distribution of Vitex sp and Peronema canescens Jack as anti–COVID 19 plants in East Kalimantan Province, Indonesia

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Abstract. Vitex sp and Peronema canescens Jack have long been known by local people in East Kalimantan Province as traditional medicines for fever, cold, diarrhea, hypertension and malaria. Now it is widely used as an alternative medicine for Covid 19 whose symptoms are fever and colds. Although the use of anti-Covid-19 drugs should be studied further, it is very important to know information on the potential and distribution of Vitex sp and Peronema canescens Jack in East Kalimantan. This research was conducted by collecting vegetation data from the seedling level to the tree level, using inventory method on research plots that were established scattered on secondary dryland forest cover in East Kalimantan with purposive sampling technique measuring 20 x 100 meters. The results showed there were 54 individuals of Vitex sp with 36 individuals at the tree level, 16 individuals at the pole level and 2 individuals at the sapling level. Based on density, the distribution of Vitex sp commonly found at the pole vegetation level. Peronema canescens Jack totaled 66 individuals with details of 29 individuals at the tree level, 25 individuals at the pole level, 7 individuals at the sapling level and there were 5 individuals at the seedling level. Based on density, the distribution of Peronema canescens Jack was found at the seedling and sapling levels. The stand volume of Vitex sp is 19.66 m³, with the average of potential volume of 3.61 m³ ha⁻¹ and the highest potential is at the pole level. The stand volume of Peronema canescens Jack is 8.99 m³, with an average of potential volume of 3.22 m³ ha⁻¹, and the highest potential is at the pole level at 5.26 m³ ha⁻¹. The presence of Vitex sp and Peronema canescens Jack trees in secondary dryland forest in East Kalimantan can be a genetic resource for the cultivation of Vitex sp and Peronema canescens Jack trees as anti-COVID 19 plants in East Kalimantan.

1. Introduction
The use of forest plants as traditional medicine has long been practiced by people all over the world, including in Indonesia. The community uses traditional medicines as anti-Covid-19 drugs because in addition to the benefits that are believed to help relieve symptoms due to the Covid-19 virus, they are inexpensive, due to conditions in certain areas that have limited access to health. Related to the corona pandemic that has occurred throughout the world including Indonesia for the last 2 (two) years, local communities in East Kalimantan Province have also used forest plants as traditional medicines to treat
diseases caused by the Covid-19 virus. Two types of forest plants that are sought after by local communities in East Kalimantan are Laban (Vitex sp) and Sungkai (Peronema canescens Jack).

Laban (Vitex sp) is a type of forest plant that is believed to contain phytochemicals that can relieve symptoms associated with patients who are infected with the SARS-CoV-2 virus such as fever, cough and aches and pains. Setyowati (2010) mentions that young Sungkai (Peronema canescens Jack) leaves are used by the Tunjung Dayak community in Lamin Telihan and Lamin Pulut villages in Kenohan District to treat fever, Sungkai root to treat aches and pains while Laban leaves (Vitex pinnata L.) for medicine [1]. dysentery. Fongnzossie et al., (2021) stated that Vitex simplicifolia leaves can treat cough, fever and muscle pain because they contain alkaloids, tannins, terpenoids and phenolics [2]. Pandi-perumal et al., (2020) stated that Vitex negundo has the possibility of fighting the SARS-CoV-virus because it is able to inhibit the activity of the HIV virus [3]. Meanwhile, Vitex trifolia which grows in East Africa, France and Polynesia can be used as an anti-inflammatory drug in the lungs. potent immunomodulators and antivirals for SARS [4].

Meanwhile, the administration of young Sungkai leaves (Peronema canescens Jack) with a dose of 0.5625 mg/kg body weight was able to increase growth immunity by increasing leukocytes 36% [5].

Information on the potential and distribution of medicinal plants for anti-COVID 19 from forest resources is very important to know, but there is limited data and information on this research. This research is to determine the potential and distribution of Vitex sp and Peronema canescens Jack as anti-COVID 19 plants in East Kalimantan Province.

2. Materials and methods
2.1. Research site
The research was conducted between 2019–2020 in secondary dryland forest cover in East Kalimantan. According to the 2016 landcover map, the total remaining natural forest in East Kalimantan is 6,508,998 ha. It consists of primary dryland forest, secondary dryland forest, primary mangrove forest, primary swamp forest, secondary mangrove forest and secondary swamp forest. And secondary dryland forest area is 4,018,093 hectares or about 61.7% of the total area of natural forest.

East Kalimantan is geographically located at 4° 24’ North Latitude (NL) and 2° 25’ South Latitude (SL), 113° 44’ East Longitude (EL) and 119° 00’ East Longitude (EL). East Kalimantan has a humid tropical climate with annual rainfall ranging from 1,363 to 2,150 mm. It is strongly influenced by monsoons, i.e. the west monsoon wind between November and April and the east monsoon wind between May and October. Thus, dry season usually occurs in May to October, while the rainy season occurs in November through April. Air temperature also varies with location, depending on altitude and distance from the shore. In general, the average daily temperature in low altitude areas is about 28°C. The average night and day temperature is about 24°C and 32°C respectively. Average air humidity is between 82% and 86%.

East Kalimantan is dominated by pure podsol land, comprising 78.5% of the area, the rest is lithosol (8.75%), alluvial (4.6%), organosol (3.3%), hydride gleisel (1.4%) and several combinations of various other types of soils in small quantities. The topography of East Kalimantan is hilly, with altitude ranging from 0 to 1,500 meters above sea level. Topographically East Kalimantan is dominated by lands with slopes above 40% and altitude less than 500 meters above sea level. Flat areas (0–2% slope) cover 10.7% of the area and are generally found only in coastal areas and large river basins; sloping land (slope of 2–15%) covers 16.16%; hilly land (slope greater than 15%) covers about 73.1% of the total area. Forested areas are generally located on steep slopes.

The research plots were built scattered on secondary dryland forest cover in East Kalimantan Province with a purposive sampling technique as shown in Figure 1.
2.2. Data collection
This research was conducted by collecting vegetation data from the seedling level to the tree level, using an inventory method on research plots with a purposive sampling technique. At each sample plot, diameter of the trees were measured, their scientific names, marked and labelled for long-term monitoring. The plot boundaries were clearly marked with poles in each corner. The circumference at breast height (CBH) or 20 cm above buttresses and total height (H) were measured for each tree in the plot. The DBH is CBH divided by phi value (3.14).

The plot is nested in a rectangular shape by referring to SNI 7724: 2011 (National Stardardization Agency, 2011) as a reference. The main plot is rectangular with a size of 20 m x 100 m. This plot is a plot for tree measurement. In the plot size 20 m x 100 m there is a subplot 10 m x 10 m for pole measurement, subplot 5 m x 5 m for measurement of sapling, and subplot 2 m x 2 m for seedling measurements. The shape and size of plots used for data collection in the field is shown in Figure 2.
2.3. Data analysis

For this study, quantitative data analysis technique was used. Descriptive statistics methods such as densities, frequencies, abundance, dominance, relative frequencies, relative abundance, relative dominance and important value index were used to analyze the data collected for species of *Vitex* sp and *Peronema canescens* Jack with diameter limit 10 cm in each sample plot. Data analysis was carried out using data analysis tools in Microsoft Excel program.

Stand mass is expressed in the number of individuals and the average volume of wood per hectare (m$^3$ ha$^{-1}$). The number of individuals was calculated based on vegetation level and diameter class. The volume of the tree is calculated using the formula:

\[
V = \frac{1}{4} \pi d^2 hf
\]

Where: \( V \) = branch-free tree volume, \( \pi = 3.14 \), \( d \) = diameter at breast height of tree, \( f \) = form factor (default = 0.6)

Stand potential includes the potential number of trees (N ha$^{-1}$) and the potential stand volume (m$^3$ ha$^{-1}$). Presentation of potential volume is expressed based on diameter class.

To calculate the Importance Value Index (IVI) of each species in the research area first the basal area and dominance of each species were calculated as:

\[
BA = \pi r^2 \quad \text{or} \quad BA = \frac{\pi d^2}{4}
\]

Dominant most conspicuous and abundant species in the studied area and calculated as:

\[
\text{Dominance} = \frac{\text{Total basal area of the species}}{\text{Total sampled area}}
\]

Where: \( BA = \) basal area, \( \pi = 3.14 \), \( d = \) diameter at breast height of tree, \( r = d/2 \)

Relative dominance (RDom) of a species is determined by the value of the basal cover. Relative dominance is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.
Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the sampling units studied is divided by the total number of sampling units studied. Density is calculated by the equations:

\[
\text{Density} = \frac{\text{Total number of individuals of the species in all sampling units studied}}{\text{Total number of sampling units studied}}
\]  

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all species and can be calculated:

\[
\text{Relative density} = \frac{\text{Density of species}}{\text{Total density of all species}} \times 100
\]

Frequency describes the distribution of a species throughout the stands. It is determined by calculating the percentage of plots in a sample area on which a given species occurs [6]. It was studied by sampling the study area at several places at random and recorded the name of the species that occurred in each sampling units. It is calculated by the equation:

\[
\text{Frequency} = \frac{\text{Number of sampling units in which the species occurred}}{\text{Total number of sampling units studied}}
\]

Relative frequency is the number of occurrences of a species, as a percentage of the total occurrences of all species [6].

\[
\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100
\]

Relative frequency (RF), relative density (RD) and relative dominance (RDom) were calculated to measure the Importance Value Index (IVI).

\[
\text{IVI} = RF + RD + RDom
\]

The importance value index indicates the importance of individual tree species in the land use systems. It is composite index based on the relative measures of species frequency, abundance and dominance [7]. This index were used to determine the overall importance of each species in the community structure.

3. **Results and discussion**

3.1. **Floristic composition of Vitex sp**

Since 2019 to 2020, 34 sample plots have been established for the inventory of Vitex sp in the secondary dryland forest of East Kalimantan. The 34 plots are located in Briwe Village-Paser Regency (BRIWE), Loa Haur Special Purpose Forest Area-Kutai Kartanegara Regency (BDK), Kutai National Park-East Kutai Regency (TNK) and Sungai Wain Protected Forests-Balikpapan City (HLSW). The recapitulation of the distribution of the sample plots that have been established is presented in Table 1.
Table 1. Number of *Vitex* sp inventory plots in secondary dryland forest in districts/cities in East Kalimantan Province.

| Site Location      | Number of plots by plot size (m²) | Number of Plots | Percentage |
|-------------------|-----------------------------------|-----------------|------------|
|                   | 4                   | 25              | 100        |
| HLSW, Balikpapan  | 12                  | 12              | 12         | 48 | 35.3 |
| BDK, Kutai Kartanegara | 5               | 5               | 5           | 20 | 14.7 |
| TNK, Kutai Timur  | 12                  | 12              | 12         | 48 | 35.3 |
| BRIWE, Paser      | 5                   | 5               | 5           | 20 | 14.7 |
| Number of Plots   | 34                  | 34              | 34         | 34 | 136 | 100.0 |

Based on the results of the inventory and analysis of field data, the number of individuals at each level of vegetation in the study area can be seen in Table 2.

Table 2. Number of individuals for each vegetation level within research plots.

| Site Location       | Level vegetation | Total |
|---------------------|------------------|-------|
|                     | Seedlings | Saplings | Poles | Trees |
| HLSW, Balikpapan    | 226       | 62       | 32    | 435   | 128   |
| BDK, Kutai Kartanegara | 36    | 29       | 19    | 44    | 156   |
| TNK, Kutai Timur    | 402       | 75       | 16    | 231   | 755   |
| BRIWE, Paser        | 77        | 26       | 7     | 46    | 724   |
| Number of individuals | 741     | 192      | 74    | 756   | 1763  |

Table 2 shows that the number of individuals at each location depending on the number of sample plots were established. It can be seen that the condition of secondary dryland forest in HLSW and TNK has a very high diversity of vegetation levels compared to Kutai Kartanegara and Paser. The condition of the sample plots in HLSW and TNK is close to the climactic conditions and approaches to the condition of primary dry land forest.

Data analysis resulted that from the total of 34 sample plots were established at the research site, *Vitex* sp was found in 24 sample plots. *Vitex* sp is one of the medicinal trees that can be found in secondary dryland forest, this is in line with the results of research by [8] which stated that Laban tree (*Vitex* sp) as one of the medicinal trees found in young secondary forest and old secondary forest in kerangas forest of South Barito District, Central Kalimantan. Number of *Vitex* sp trees according vegetation levels at the study site is shown in Table 3.

Table 3. Number of *Vitex* sp trees according vegetation levels at the research location.

| Site Location       | Vegetation levels | Total |
|---------------------|-------------------|-------|
|                     | Seedlings | Saplings | Poles | Trees |
| BDK, Kutai Kartanegara | -        | -        | 1     | 10    | 11    |
| BRIWE, Paser        | -        | 1        | 6     | 1     | 8     |
| HLSW, Balikpapan    | -        | -        | 4     | 11    | 15    |
| TNK, Kutai Timur    | -        | 1        | 5     | 14    | 20    |
| Number of individuals | -        | 2        | 16    | 36    | 54    |

Table 3 shows that there are 54 individuals of *Vitex* sp found at the research location. None of *Vitex* sp seedling were found in the field. There were 36 individuals or about 66.7% with a diameter of more
than 20 cm and at the tree level, 16 individuals with a diameter of more than 10 cm and less than 20 cm or at the pole level and there are two individuals at the sapling level. The data shown that based on density, the distribution of *Vitex* sp at the study site was more commonly found at the pole vegetation level.

3.2. Floristic composition of *Peronema canescens* Jack

Since 2019 to 2020, 27 sample plots have been established for the inventory of *Peronema canescens* Jack in the secondary dryland forest of East Kalimantan. The 27 plots are located in Briwe Village-Paser Regency (BRIWE), Rantau Layung Village (RLY)-Paser Regency, and Soeharto’s Hill Forest Park-Kutai Kartanegara Regency (BST). The recapitulation of the distribution of the sample plots that have been established is presented in Table 4.

**Table 4.** Number of *Peronema canescens* Jack inventory plots in secondary dryland forest in districts/cities in East Kalimantan Province.

| Site Location          | Number of plots by plot size (m²) | Number of Plots | Percentage |
|------------------------|-----------------------------------|-----------------|------------|
|                        | 4 25 100 2000                      |                 |            |
| BRIWE, Paser           | 5 5 5 20                          | 18.5            |
| RLY, Paser             | 10 10 10 40                        | 37.1            |
| BST, Kutai Kartanegara| 12 12 12 48                        | 44.4            |
| Number of Plots        | 27 27 27 108                       | 100.0           |

Based on the results of the inventory and analysis of field data, the number of individuals at each level of vegetation in the study area can be seen in Table 5.

**Table 5.** Number of individuals for each vegetation level on research plots in each district/city in East Kalimantan Province.

| Site Location          | Level vegetation | Total |
|------------------------|-------------------|-------|
|                        | Seedlings | Saplings | Poles | Trees |       |
| BRIWE, Paser           | 77        | 26       | 7     | 46    | 156   |
| RLY, Paser             | 102       | 43       | 23    | 128   | 296   |
| BST, Kutai Kartanegara| 189       | 67       | 47    | 118   | 421   |
| Number of individuals  | 368       | 136      | 77    | 292   | 873   |

Table 5 shows that the number of individuals at each research location is not much different. It can be seen that the conditions in each research location are almost similar. Data analysis resulted that from the total of 27 sample plots were established at the research site, *Peronema canescens* Jack was found in 26 sample plots. On the research plot in BST, Kutai Kartanegara has the highest total number of *Peronema canescens* Jack trees, this is because the BST area has been used as a forest plantation ecosystem as a rehabilitation effort with one species of plant is *Peronema canescens* Jack. Number of *Peronema canescens* Jack trees according vegetation levels at the study site is shown in Table 6.
Table 6. Number of *Peronema canescens* Jack trees according vegetation levels at the research location.

| Site Location          | Vegetation levels               | Total |
|------------------------|---------------------------------|-------|
|                        | Seedlings | Saplings | Poles | Trees |
| BRIWE, Paser           | 2         | -        | 1     | 6     | 9     |
| RLY, Paser             | -         | 4        | 7     | 15    | 26    |
| BST, Kutai Kartanegara| 3         | 3        | 17    | 8     | 31    |
| Number of individuals  | 5         | 7        | 25    | 29    | 66    |
| Plot area (ha)         | 0.01      | 0.07     | 0.27  | 5.40  |
| Density (individuals ha⁻¹) | 463.0   | 103.7    | 92.6  | 5.4   |

Table 6 shows that there are 66 individuals of *Peronema canescens* Jack found at the research location. There were 29 individuals or about 43.9% with a diameter of more than 20 cm and at the tree level, 25 individuals or about 37.9% with a diameter of more than 10 cm and less than 20 cm or at the pole level, 7 individuals at the sapling level and there are 5 individuals at the seedling level. The data shown that based on density, the distribution of *Peronema canescens* Jack at the study site was more commonly found at the seedling and sapling levels.

3.3. Potential and distribution of *Vitex* sp

The distribution and potential of *Vitex* sp trees based on tree diameter classes at the study site are shown in Table 7. From Table 7, it can be seen that the largest distribution of diameter classes is in the 20–29.9 cm diameter class with total of 26 trees. The trees with a diameter class above 40 cm and seedling level were not found, it is because the competition for the tree canopy from other tree species on the side.

Table 7. Number of trees, volume and potential volume of *Vitex* sp according diameter classes at research plots within secondary dryland forest cover in East Kalimantan Province.

| Diameter class (cm) | Number of Trees | Sum of Trees Volume (m³) | Sum of Potential Volume (m³ ha⁻¹) | Average of Potential Volume (m³ ha⁻¹) |
|---------------------|-----------------|--------------------------|----------------------------------|--------------------------------------|
| 0 - 1.9             | -               | -                        | -                                | -                                    |
| 2 - 9.9             | 2               | 0.01                     | 3.16                             | 1.58                                 |
| 10 - 19.9           | 16              | 1.08                     | 108.26                           | 6.77                                 |
| 20 - 29.9           | 26              | 10.31                    | 51.55                            | 1.98                                 |
| 30 - 39.9           | 10              | 8.26                     | 41.30                            | 4.13                                 |
| >40                 | -               | -                        | -                                | -                                    |
| Total               | 54              | 19.66                    | 204.27                           | 3.61                                 |

Based on the calculation of the stand volume in the research area obtained 19.66 m³. The largest stand volume was found at the tree-level vegetation with a diameter above 20 cm, and the smallest stand volume was at the sapling vegetation level.

Table 7 shows that trees in the diameter class 10–19.9 cm have the largest potential volume per hectare although in number of trees (N) are less than the diameter class 20–29.9 cm. This is because the volume of stands in small plot when increased to a hectare unit, the results becomes greater. The average of potential volume of *Vitex* sp at the study site was 3.61 m³ ha⁻¹, with the highest potential is at the pole level with a diameter class of 10–19.9 cm.
3.4. Potential and distribution of Peronema canescens Jack

The distribution and potential of Peronema canescens Jack trees based on tree diameter classes at the study site are shown in Table 8. The Table shows that the largest distribution of diameter classes is in the 20–29.9 cm diameter class with total of 26 trees. The trees with a diameter class above 40 cm and seedling level were not found, it is because the competition for the tree canopy from other tree species on the side.

| Diameter class (cm) | Number of Trees | Sum of Trees Volume (m$^3$) | Sum of Potential Volume (m$^3$ ha$^{-1}$) | Average of Potential Volume (m$^3$ ha$^{-1}$) |
|---------------------|-----------------|----------------------------|------------------------------------------|------------------------------------------|
| 0 - 4.9             | 8               | 0.02                       | 22.65                                    | 2.83                                     |
| 5 - 9.9             | 4               | 0.05                       | 19.80                                    | 4.95                                     |
| 10 - 19.9           | 25              | 1.32                       | 131.52                                   | 5.26                                     |
| 20 - 29.9           | 22              | 3.89                       | 19.45                                    | 0.88                                     |
| 30 - 39.9           | 5               | 1.78                       | 8.90                                     | 1.78                                     |
| >40                 | 2               | 1.94                       | 9.72                                     | 4.86                                     |
| Total               | 66              | 8.99                       | 212.03                                   | 3.22                                     |

Based on the calculation of the stand volume in the research area obtained 8.99 m$^3$. The largest stand volume was found at the tree-level vegetation with a diameter above 20 cm, and the smallest stand volume was at the seedling and sapling vegetation level.

Table 8 shows that trees in the diameter class 10–19.9 cm have the largest potential volume per hectare and the highest number of trees (N). This is because the volume of stands in small plot when increased to a hectare unit, the results becomes greater. The average of potential volume of Peronema canescens Jack at the research plots is 3.22 m$^3$ ha$^{-1}$, with the highest potential is at the pole level with a diameter class of 10–19.9 cm, which is 5.26 m$^3$ ha$^{-1}$.

4. Conclusion

There are 54 individuals of Vitex sp found at the research plot, with 36 individuals at the tree level, 16 individuals at the pole level and 2 individuals at the sapling level. Based on density, the distribution of Vitex sp at the study site was more commonly found at the pole vegetation level.

There are 66 individuals of Peronema canescens Jack found at the research plot, with 29 individuals at the tree level, 25 individuals at the pole level, 7 individuals at the sapling level and there are 5 individuals at the seedling level. Based on density, the distribution of Peronema canescens Jack at the study site was more commonly found at the seedling and sapling levels. The stand volume of Vitex sp in the research plot was 19.66 m$^3$, with the average of potential volume was 3.61 m$^3$ ha$^{-1}$ and the highest potential was at the pole level. The stand volume of Peronema canescens Jack in the research plot was 8.99 m$^3$, with an average of potential volume was 3.22 m$^3$ ha$^{-1}$, and the highest potential was at the pole level at 5.26 m$^3$ ha$^{-1}$.

Based on the research results, the presence of Vitex sp and Peronema canescens Jack trees in secondary dryland forest in East Kalimantan can be a genetic resource for the cultivation of Vitex sp and Peronema canescens Jack trees as anti-COVID 19 plants in East Kalimantan.
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