Standardization Bark of *Cinnamomum burmannii* Nees Ex Bl. from Five Areas of Indonesia

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ABSTRACT

Background: The *Cinnamomum burmannii* Nees ex Bl species is a native plant that grows in many places in Indonesia. The bark of *Cinnamomum burmannii* Nees ex Bl (*C. burmannii* bark) in Indonesia is commonly used as a medicinal ingredient, but information related to specific and non-specific parameters of *C. burmannii* bark from several regions in Indonesia is very limited. **Objective:** To investigate the standardization *C. burmannii* bark from five areas of Indonesia. **Methods:** Determination of non-specific parameters and specific parameters of *C. burmannii* bark and metabolite profile of essential oil of *C. burmannii* bark **Results:** We found there are differences in the nature of *C. burmannii* bark from five regions in Indonesia. **Conclusion**: It can be concluded that *C. burmannii* bark from Mount Kerinci is the best. *C. burmannii* bark from Mount Kerinci showed that it had the strongest odor and the highest water-soluble extract and alcohol soluble extract as well as the highest essential oil content and the highest cinnamaldehyde content.

Key words: *Cinnamomum burmannii* Nees Ex Bl., Standardization, non-specific parameters, specific parameters, cinnamaldehyde, metabolite profiling.

INTRODUCTION

The *C. burmannii* is a native plant that grows in many places in Indonesia. The Central Statistics Agency (*Badan Pusat Statistik*) reported states that the production of *C. burmannii* bark plantations called "cassiavera" or "Indonesian cassia", or "padang kaneel" or batavia cassia produced as much as 91.5 thousand tons in 2015.[1] *C. burmannii* bark is widely used in *jamu* (traditional medicines Indonesia), food additives, cosmetics and has significant economic value especialy around Mount Kerinci a volcano in Sumatra island of Indonesia. *C. burmannii* is a small evergreen tree up to 15 m tall, having subopposite leaves and red young leaves.[2,3] Many studies that prove the pharmacological benefits shown by *C. burmannii* bark include antibacterial, antidiabetic, analgesics, antioxidants, lowering cholesterol levels and anti-inflammatory.[4,5]

Plant secondary metabolites are chemicals synthesized by plants that are prepared to defend themselves from pathogens and face environmental challenges such as seasons, climate and geography.[6] Secondary metabolites produced by plants can be used as a source of food additives, medicines and food supplements to improve human health. The influence of genetic, morphogenetic, and environmental factors, greatly influences biosynthesis and the amount of secondary metabolites. Various genetic, ontogenic, morphogenetic and environmental factors can influence biosynthesis. Environmental factors are the amount of sun exposure, temperature, amount and condition of groundwater, fertility and salinity.[7,8]

C. burmannii bark from Indonesia can be obtained from various islands in Indonesia. Biotic factors affect the type and number of secondary metabolites synthesized by plants including fungal, bacterial and viral infections. Insects attacking plant parts, planting densities and surrounding plant species that cause symbiotic mutualism, parasitism or commensalism[9] therefore, a comparative analysis of *C. burmannii* bark from various islands in Indonesia is needed. It is hoped that this research can provide information to those who need it and add data base related to *C. burmannii* bark.

Standardization of *C. burmannii* bark that is used as raw material for products such as food, traditional medicine, cosmetics and pharmaceutical preparations is important. The quality of raw materials must be relatively constant, controlled, and the quality of the product can be guaranteed. The herbal quality parameters are listed in the Indonesian Materia Medika and Indonesian Herbal Pharmacopoeia.[10,11] *C. burmannii* bark from various plant regions namely from Mount Lawu in Central Java, Mount Meratus in South Kalimantan, East Lombok on the island of Lombok, Mount Kerinci in Sumatra, and Gorontalo in Sulawesi were examined for the identity, organolepic, macroscopic and microscopic parameters, total ash content, acid insoluble ash content, loos on drying, water content, water soluble extract content, ethanol soluble extract, essential oil content and marker content.[10,12]

MATERIALS AND METHODS

Plant collection

C. burmannii bark obtained from the bark taken directly from the 5 origin areas each of 3 trees aged

10 to 12 years with circumference of tree trunks between 60 to 80 cm from Mount Lawu in the Central of Java, Meratus Mountains in the South Kalimantan, from East Lombok in the Lombok island, Mount Kerinci in the Sumatra island, and from Gorontalo in the Sulawesi island. Determination of plants was carried out at laboratory of the Indonesian Institute of Sciences (LIPI) at Purwodadi East Java. Samples of flower and fruit leaves and bark taken directly from five areas. *C. burmannii* bark is the inner bark of the stem without the outer cork layer with Loss on Drying equal to or less than 10%. The dried *C. burmannii* bark is crushed with a mechanical grinder. Specimens are stored in the Department of Pharmacognosy and Phytochemistry of Universitas Airlangga, Surabaya Indonesia. The instrument used is the Camag TLC Scanner and the WinCATS software version. The stationary phase used is TLC Silica gel 60 F254 plate with mobile phase toluene: ethyl acetate (97:3) for determining of Chromatographic Patterns. Moisture Balance Azcet 50 equipment for determining Loss on Drying. GC-MS analysis was carried out on Agilent 7890B GC and 5977B MSD system and interpretation of mass spectrum GC-MS was conducted using the data base of National Institute Standard and Technology (NIST).

Determination non specific parameters of dried bark of plant[10]

Determination of Loss on Drying (LOD)

LOD is weight reduction of material after drying in specified drying method[10]. LOD was carried out on 5 gram of powder dried at a temperature of 105 ° C to a constant with Moisture Balance Azcet 50.

Determination of water content

Determination of water content was done using the Azeotropy method (distilation Toluena): Place in the dry flask *C. burmannii* bark powder 20 grams. Place about 200 ml of toluene in the flask, connect the apparatus. Fill the receiving tube with toluene poured through the top of condenser. Heat the flash gently for 15 minutes. Distill until all of the water has passed over. Determination of water content was done by the distillation method with water-saturated toluene reagents. The volume of water was observed after water and toluene separate completely. Water content was calculated in % v/w.[10]

Determination of total ash

Accurately 2 g of *C. burmannii* bark powder was put into a dried and pre-weighing porcellain crucible, the sample was burned in the air atmosphere until free of carbon, and weighing the porcelain crucible after cooled to room temperature in a desiccator. Total ash content was calculated against the weight of the test material, expressed % w/w

Determination of acid insoluble ash content

Boil the ash obtained as directed under *Total Ash Determination* with 25 mL of 3 N hydrochloric acid for 5 minutes. The insoluble matter on an ashless filter washed with hot water, ignite until a constant weigh. Acid insoluble ash concentration was calculated to the material weight in % w/w.[12]

Determination specific parameters of dried bark of plant[10]

Organoleptic

The statements "odorless", "practically odorless", "a faint characteristic odor", or variations there of, were determined by observation after the material has been exposed to the air for 15 minutes. Freshly opened package of apportion of about 25 g of the article to an open evaporating dish of about 100 ml capacity.

Microscopic test

The test was carried out under a microscope and the degree of magnification was adjusted to the need to study the anatomy and histology of *C. burmannii* bark and determine the fragments that exist in *C. burmannii* bark powder. Fluorogucine HCl and choralhydrate reagents were used in this test.

Water soluble extract

Weigh carefully about 5 g of powder of *C. burmannii* Nees ex Bl bark. Enter into the glass-stoppered conical Flask, add 100 mL of saturated chloroform water, insert a stopper into the flask, shaking frequently for the first 6 hours, and then allowing to stand for 18 hours. Filtered and 20 mL filtrate evaporated to dryness in a flat disc, swallowed, and dried at 105°C to constant weight. Water soluble extract levels was expressed in %.

Ethanol soluble extract

Weigh carefully about 5 g of powder that has been dried in the air. Put in the glass-stoppered conical Flask, add 100 mL of 95% ethanol, insert a stopper into the flask, shaking frequently for the first 6 hours, and then allowing to stand for 18 hours. Filtered quickly to avoid ethanol evaporation. 20 mL filtrate evaporated to dryness in a flat disc, swallowed and dried at 105°C to constant weight. Ethanol soluble extract levels was expressed in %.

Determination of chromatographic patterns[12]

Thin layer chromatography was conducted using Toluent P - ethyl acetate (97:3 v/v) as a mobile phase and Silica gel 60 F254 as a stationary phase. Test solution: 1 g of powder plus 10 mL ethanol, soaked while shaking on a water bath for 10 minutes. The filtrate was separated and put into a 10 mL volumetric flask, then ethanol to 10 ml is added. Comparative solution: 1% Cinnamaldehyde in ethanol. Detection: UV 254

Applied the test solution and the comparison solution, about 1.5 cm to 2 cm from the lower edge of the plate, and let it dry and eluted. Then the plates were observed at 254 nm ultraviolet wavelengths. Measured and recorded the distance of each point from the application point and recorded the wavelength for each point observed. Determined the value of Rf. observed and compared the chromatogram of the test material with a comparative chromatogram.

Determination of volatile oil

Carefully weigh 2 grams of material estimated to contain 0.3 mL of volatile oil, transfer into a 1 L round bottom flask, add 200 to 300 mL of distilled water, connect the flask with a cooler and scale burette. Heat the flask on an air-bath to give slow and regular distillation. After the distillation was completed, leave the system for at least 15 minutes, record the volume of volatile oil in the burette. The volatile oil consentration was calculated in % v/w.

Determination of cinnamaldehyde concentration

A standard solution of 10 μL cinnamaldehyde in a 10.0 mL volumetric flask was added with ethanol. 1 gram powder weighed in 10.0 mL volumetric flask plus 4 mL ethanol was extracted using ultrasonic for 10 minutes and added ethanol to 10.0 ml. The extract test solution was then filtered and the extract was transferred into vials. The instrument used was Camag TLC Scanner and the WinCATS software version. The stationary phase used was TLC Silica gel 60 F254 plate. The mobile phase used was Toluene P : ethyl acetate (97:3 v/v).

For the production of standard curves of Cinnamaldehyde, a 2 μL, 4 μL, 6 μL, 8 μL spot was carried out from a standard solution. Spotted

extract test solution as much as 6 μL with 3 replications per area. Method validation was tested for selectivity, detection limit, accuracy, % recovery and precision. Qualitative inspection was carried out by spotted the standards and 5 samples from all regions of origin. Mobile phase used was toluene: ethyl acetate (97:3)[12] . The detection limit was carried out by spotted the seven standard working solutions of Cinnamaldehyde variations in the application variation of 2 μL, 4 μL, 6 μL, 8 μL, 10 μL, 12 μL, and 14 μL on the TLC plate. Calculated equation of the regression line expressed by the equation y = bx + a, obtained slope = b. To determine the linearity, 2 μL, 4 μL, 6 μL, 8 μL, 10 μL, 12 μL, and 14 μL were spotted with standard Cinnamaldehyde on TLC silica gel plates. The stain obtained was observed with a densitometer at maximum wavelength. Calculated how much linear regression between content and area of the stain.

Accuracy was carried out by means of 1 gram of powder macerated with ethanol for 24 hours and rinsed 3 times. The extract obtained was dried in a cup, put into a 10.0 mL volumetric flask with ethanol solvent and added standard solution of Cinnamaldehyde and ethanol added to the exact mark and shake until homogeneous. Spotted solution on TLC plate. Spotted 4 standard solutions of cinnamaldehyde, 3 sample solutions, and 3 recovery solutions of 6 μL each. The TLC plate was developed in a saturated chamber and further observed with a densitometer at maximum wavelength.

The precision was calculated from the *C. burmannii* bark extract test solution being applied on 60 F254 silica gel TLC plates 6 times each 6 μL and eluted with selected solvents. The stain obtained was observed with a densitometer at maximum wavelength. From the area obtained, it can be calculated the standard deviation (SD) and relative standard deviation (RSD)/coefficient of variation (CV). Calculated equation of the regression line expressed by the equation.

$$y = bx + a$$

$$CV = \frac{SD}{\bar{x}} \times 100\%$$

y = dependent variable, x = independent variable, b = Slope, a = y-Intersep

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

Characterization of essential oil of *C. burmannii* bark

Every 3 kg *C. burmannii* bark powder was distilled with water steam distillation for 6 hours with 5 liters of water. Filtrate (water phase) which contains the essential oil was added 20 mg NaCl per liter and shaken until dissolved and the essential oils obtained were collected. The collected essential oils were purified by adding Na2SO4 to remove the remaining water dropplet in the essential oil.[13] Distillation was carried out on 9 kg bark powder from each region. The collected essential oils were stored in brown glass bottles in a tightly closed condition at 4°C until used.

Metabolite profile of essential oil of *C. inamomum burmannii* bark from 5 areas observed with analytical techniques using GC-MS. GC-MS analysis was carried out on Agilent 7890B GC and 5977B MSD system and interpretation of mass spectrum GC-MS was conducted using the data base of National Institute Standard and Technology (NIST). The following conditions: agilent column 19091S-433UI HP-5ms Ultra Inert -60 ° C-325 ° C (350 ° C): 30 mx 250 μm x 0.25 μm , run time 30 min, initial oven temperature 100 ° C, hold time 2 min, post run 0°C, program rate 5°C value 200°C hold time 8 min, equilibration time 0.1 min, max temperature 325 ° C. front injector syringe size 10 μl, injection volume 1 μ, front ss He in split mode, heater 300°C, pressure 10,523 psi, total flow 14 ml/min. split ratio 10: 1 split flow 10 ml/min, out MSD initial 100°C pressure 10,523 psi flow1ml/min average velocity 37,293 cm/sec, hold time 1.3407 min.

The research can be presented on research flowchart as shown on figure 1.

RESULTS AND DISCUSSION

The results of macroscopic and microscopic analysis can be shown on figures 2 and 3, and data of proximate analysis of *C. burmannii* bark from 5 areas can be presented on table 1.

Interpretation of mass spectrum GC-MS was conducted using the data base of National Institute Standard and Technology (NIST).The relative concentration of each compound in essential oil was quantified based on the peak area integrated by the analysis program.

Standardization of medicinal plants is an important step in conducting research and development of natural medicines to ensure the quality and safety of drug preparations[14]. Non-specific parameters are easily observed but not so with specific parameters such as observations of plant morphology which are relatively easy to observe and recognize, while biochemical adaptation of plants due to environmental differences

Table 1: Data of analysis proximate in *C. burmannii* bark from 5 Areas*.

No.	Origin area	Mount Lawu, Java Island	Mountains Meratus, Kalimantan Island	East Lombok, Lombok Island	Mount Kerinci, Sumatra Island	Gorontalo, Sulawesi Island	Requirements
	Parameter	**%**	**%**	**%**	**%**	**%**	**%**
1	Loss on drying	8.744 ± 0.199	7.446 ± 0.321	8.714 ± 0.316	9.601 ± 0.355	6.717 ± 0.363	≤ 10.0
2	Water content	8.00 ± 0.50	5.00 ± 0.50	7.50 ± 0.50	8.83 ± 1.26	4.33 ± 0.29	≤ 10.0
3	Total ash content	4.22 ± 0.01	5.46 ± 0.04	4.73 ± 0.02	4.12 ± 0.01	3.92 ± 0.02	≤ 10.5
4	Acid insoluble ash levels	0.15 ± 0.01	0.27 ± 0.02	0,24 ± 0.02	0,12 ± 0.03	0,47 ± 0.07	≤ 0.3
5	Water soluble extract levels	10.07 ± 0.02	7.07 ± 0.03	10.79 ± 0.35	12.03 ± 0.02	10.73 ± 0.51	≥ 4.0
6	Ethanol soluble extract levels	23.26 ± 0.92	18.15 ± 0.01	23.66 ± 0.90	30.62 ± 0.54	24.68 ± 0.51	≥16.0
7	Essential oil levels	1.00 ± 0.00003	0.50 ± 0.00001	1.00 ± 0.00006	1.50 ± 0.00009	0.50 ± 0.00003	≥ 0.42
8	Cinnamaldehyde levels	0.660 ± 0.052	0.577 ± 0.046	0.727 ± 0.110	0.731 ± 0.070	0.607 ± 0.021	≥ 0.56

Figure 1: Standardization scheme.
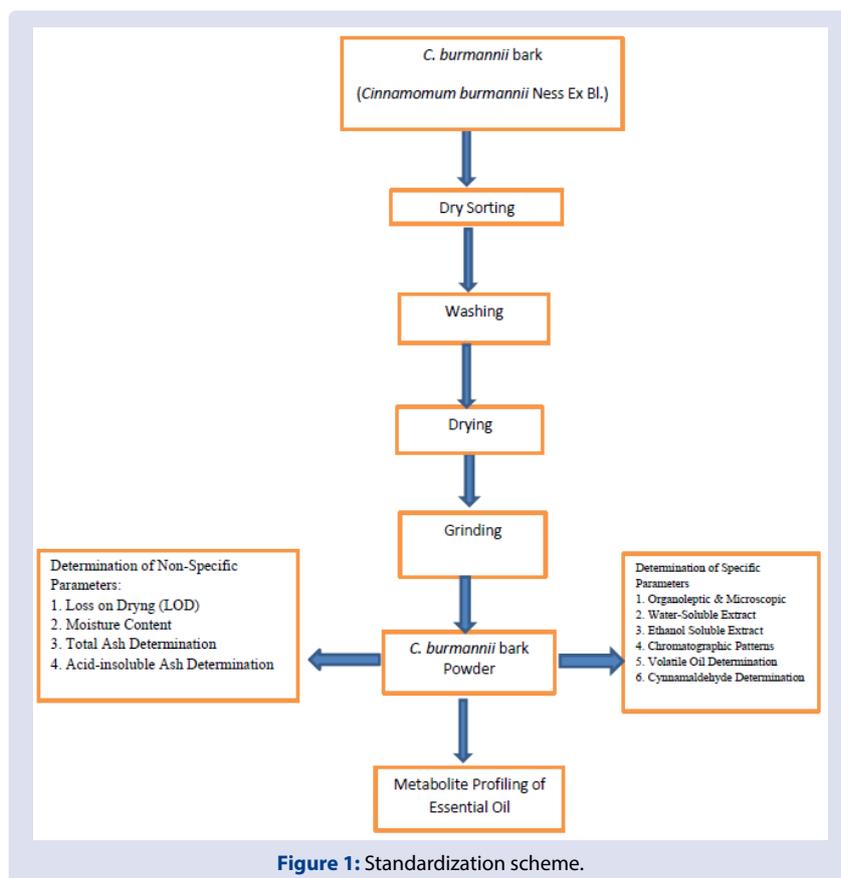
is relatively difficult to observe and not yet fully understood. It has been proven that the diversity of the environment in which it grows causes differences in the number of secondary metabolites. Individual environmental differences can selectively increase or reduce the content of several secondary metabolites in *C. burmannii* bark. Different environments also have the potential for various types of secondary metabolites. Thus, it can be concluded that *C. burmannii* bark from various regions has different potential. This can produce bark that has different taste, odor, chemical content and pharmacological effects.

The results of this study are *C. burmanii* Nees ex Bl. can grow well on five different islands but produce different bark from both specific and non-specific parameters and the amount of cinnamaldehyde. Conformity with the type of soil where the cultivation is very important, because it can increase the productivity of plantation crops. In general *C. burmannii* plants can grow well in areas with an altitude of 500 to 1,200 meters above sea level. Suitable soil types are andosol and sandy and loose clay.[15] Andosols are one of 30 soil groups in the FAO classification system. Andosol soil types are very porous, dark soils developed from solum material from volcanic origin rather thick, brownish gray to black, high organic content, dusty texture, crumb structure, loose consistency and greasy, slightly acidic, high basic saturation and moderate absorption, high humidity, moderate permeability and sensitive to erosion.[16] Andosol soils are found from islands in Indonesia, but are found in forested upland areas.

One of the locations in Karanganyar Regency, Central Java Province. Karanganyar Regency of longitude and latitude, Karanganyar is located between 110°40" – 110°70" east longitude and 70°28" - 70°46" south latitude. Karanganyar has temperature 22°C – 31°C and has tropical climate. The day of rain for 2017 are 210 days and rainfall meanly 8.390 mm, which is highest on November and December and lowest on August The which has a lot of *C. burmannii* trees is in the village of Sukuh, Berjo, Ngargoyoso Sub Regency, namely in the K.G.P.A.A.

Mangkunagoro I Forest Park on the western slopes of Lawu Mountain which is managed by the Forest Research and Management Center for Forest Parks (BPTP Tahura). This area is located at the foot of Mount Lawu with a height of ± 1000 MASL (meters above sea level) in Sukuh Sub Village, Berjo Village, Ngargoyoso District, Karanganyar Regency.[17,18]

The *C. burmannii* bark producing region in South Kalimantan is the Hulu Sungai Selatan Regency. Hulu Sungai Selatan is located in the center of South Kalimantan Province (2 ° 29'59 'to 2 ° 56´10' ' south latitude and 114 ° 51'19´´ to 115 ° 36´19´´ east longitude). *C. burmannii* is most widely planted in Loksado and Padang Batung which are located along the Meratus ridge.[19] The climate in Hulu Sungai Selatan Regency is classified as isothermal tropical rain with hot drought. The temperature is 27.55°C - 29.39°C. Loksado is an area where *C. burmannii* is widely grown with a height of ± 400 MASL. Harvest of *C. burmannii* bark in 2018 is 2,445 tons. Rainfall was received at 89 mm - 532 mm while the lowest amount occurred in July.[20,21]

East Lombok Regency in West Nusa Tenggara Province is a Regency located at the eastern end of Lombok Island. One of the sub-Regencys is Pringgasela, which has a village called Pangadengan whose inhabitants plant *C. burmannii*. Pangadengan Village has an elevated sea level position of 355 MASL. Rainfall was received in Pringgasela average 173.75 mm while the lowest amount occurred in May & June.[22]

Kerinci Regency has a tropical climate, with significant rainfall. The average temperature is 26.9°C. Rainfall was received at 2000 mm - 2500 mm. The average rainfall is 2,347 mm. The entire geographical area is located at coordinates between 1º41 'south latitude to 2º56' latitude, and 101º08 'east to 101º50' east longitude. Kerinci Regency has an elevated sea level position of between 725 to 1500 MASL.[3]

Gorontalo is one of the provinces on the island of Sulawesi. Gorontalo consis of 6 regency. Gorontalo regency have temperature 21°C - 35,4°C.

No.	Region of origin of *C. burmannii* bark	*C. burmannii* bark	Powder of *C. burmannii* bark	Organoleptic
1	Mount Lawu, Central of Java, Java Island			yellowish brown, has a distinctive odor
2	Meratus Mountains, South Kalimantan, Kalimantan Island			Yellowish brown, the thinnest, has a distinctive odor
3	East Lombok, Lombok Island			Red chocolate, slightly sweet taste, has a distinctive odor
4	Mount Kerinci, Jambi, Sumatra Island			The strongest odors, reddish brown, has a distinctive odor
5	Gorontalo, Sulawesi Island			Thick, dark brown, bitter taste than others. has a distinctive odor

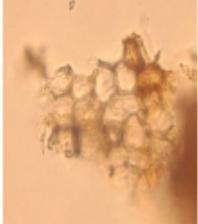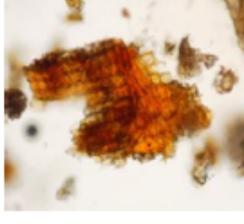**Figure 2:** Macroscopic figure of *C. burmannii* bark from 5 areas.

No.	Region of origin of *C. burmannii* bark	Parenchyma, Sclerenchyma with oil globules	Isolated sclerenchyma	Stone cells
1	Mount Lawu, Central of Java, Java Island			
2	Meratus Mountains, South Kalimantan, Kalimantan Island			
3	East Lombok, Lombok Island			
4	Mount Kerinci, Jambi, Sumatra Island			
5	Gorontalo, Sulawesi Island			
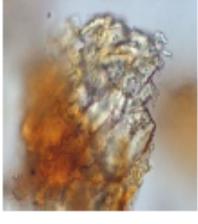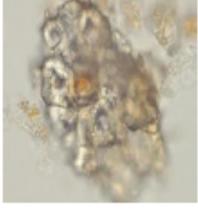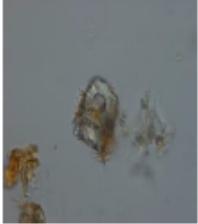
Figure 3: Microscopic figure of *C. burmannii* bark from 5 areas.

Mobile phase   : Toluen : Ethyl acetate (97 :3)
Stationary phase   : Silica gel 60 F$_{254}$
Note
A. *C. burmannii* bark from Mount Kerinci, Sumatra
B. Standard of Cinnamaldehyde
C. *C. burmannii* bark from Mount Lawu, Java
D. *C. burmannii* bark from Meratus Mountains, Kalimantan

Figure 4: Cinnamaldehyde in the extract of *C. burmannii* bark with TLC.

Figure 5: Cinnamaldehyde in the extract of *C. burmannii* bark with TLC.

Table 2: Data of analysis Metabolic Profiling of Essential Oil *C. burmannii* bark from 5 Areas.

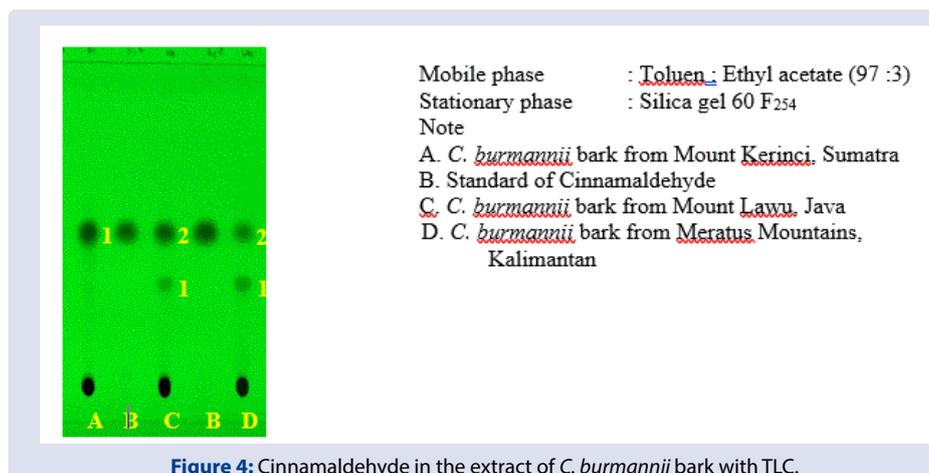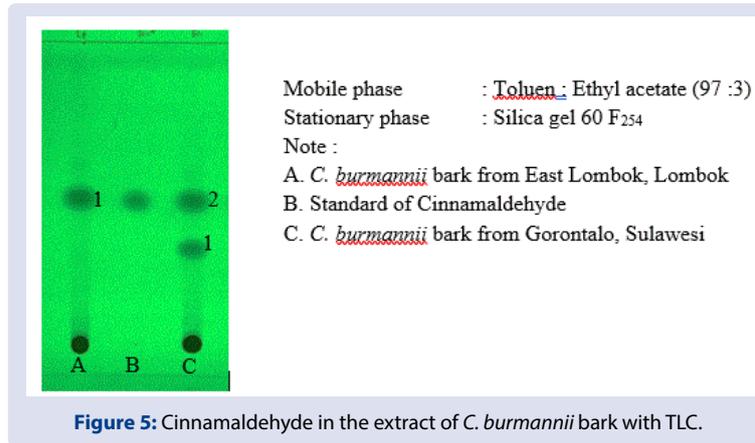| No.	Compound	Concentrations of the compounds in essential oil (%)				
		Mount.lawu Java	Mounts Meratus Kalimantan	East Lombok Lombok	Mount Kerinci Sumatra	Gorontalo Sulawesi
1	2 -methyl-5-(1-methylethyl)-Bicyclo(3.1.0)hex-2-ene	0.00	0.00	0.00	0.00	0.25
2	α-Pinene	2.31	1.82	0.00	0.00	0.00
3	(1S)-2,6,6-Trimethylbicyclo(3.1.1)hept-2-ene	0.00	0.00	0.00	0.00	3.03
4	Champhene	0.68	0.34	0.00	0.00	0.41
5	Benzaldehyde	1.12	1.39	0.00	1.35	0.89
6	β-Pinene	1.11	0.74	0.00	0.00	0.97
7	1-methyl-3-(1-methylethyl)-Benzene	0.00	0.00	0.00	0.00	1.02
8	O-Cymene	0.87	0.29	0.00	0.00	0.00
9	D-Limonene	1.36	1.47	0.00	0.00	1.34
10	Eucalyptol	9.62	3.74	0.34	1.46	8.01
11	γ.-Terpinene	0.00	0.00	0.00	0.00	0.32
12	Linalool	4.1	2.06	4.19	7.13	5.39
13	2 methyl Benzofuran	0.00	0.22	0.00	0.00	0.00
14	Camphor	0.69	0.00	0.00	0.00	0.36
15	1-methyl-1H-Pyrrolo (2,3-b)pyridine	0.00	0.22	0.00	0.00	0.00
16	Benzenepropanal	1.34	1.30	5.05	4.04	0.95
17	endo-Borneol	0.84	0.34	0.48	0.44	0.44
18	Terpinen-4-Ol	3.45	1.49	0.56	0.62	3.86
19	α-Terpineol	3.16	1.48	1.48	1.24	2.71
20	(E)-Cinnamaldehyde	40.43	36.75	46.31	46.77	28.5
21	3-Phenylpropanol	0.00	0.22	0.00	0.00	0.00
22	Bornyl acetate	1.53	0.73	1.01	1.3	0.88
23	(E) 3-phenyl-2-Propen-1-Ol	0.3	0.25	0.00	0.37	0.00
24	Hydrocinamic acid	0.00	0.00	0.00	0.23	0.00
25	α-Terpinyl acetate	0.86	0.00	0.00	0.00	0.00
26	2-Carene	0.00	0.31	0.00	0.38	0.24
27	Eugenol	0.00	0.00	1.07	0.66	0.00
28	trans-.β.-Terpinyl butanoat	0.00	0.00	0.00	0.00	0.39
29	α-Cubebene	0.00	0.00	0.00	0.00	0.32
30	Octahydro-1,7a-dimethyl-5-(1-methylethyl)-,(1S-(1.α.,2.α.,3a.β.,4.α.,5.α.,7a.β.,85*))-1,2,4-Metheno-1H-indene	0.34	0.75	0.00	0.33	0.52
31	Ylangene	0.40	0.37	0.63	1.09	0.24
32	Copaene	4.11	6.38	2.24	3.18	6.75
33	Aromadendrene	0.21	0.49	0.39	0.39	0.37
34	Octahydro-4-methyl-8-methylene-7-(1-methylethyl)-, (1S-(1.α.,3a.beta.,4.alpha.,7,α.,7a.β)) 1,4-Methano-1H-indene	0.00	0.00	0.00	0.00	0.16
35	(1S,5S)-2-Methyl-5-(*-6-methylhept-5-en-2-yl)biciclo(3.1.0)hex-2-ene	0.00	0.00	0.00	0.00	0.20
36	trans-α-Bergamotene	1.14	4.03	0.41	0.30	3.16
37	Caryophyllene	2.31	2.54	6.71	6.52	2.95
38	Coumarin	2.01	1.67	0.00	0.00	1.63
39	cinamyl ester Acetic acid	3.97	5.47	1.43	2.01	3.42
40	1a,2,3,4,4a,5,6,7b-oktahydro-1,1,4,7-tetramethyl-, (1aR-(1a.α.,4.α.,4a.β.,7b.α.))-1H-Cycloprop(e)azulene	0.00	0.00	0.00	0.62	0.00
41	(1R,3aS,8aS)-7-Isopropyl-1,4-dimethyl-1,2,3,3a,6,8a-hexahydroazulene	0.00	0.00	0.26	0.00	0.00
42	Isoledene	0.00	0.00	0.86	0.00	0.00
43	Humulene	0.39	0.65	1.22	0.91	0.84
44	1R,4aS,8aR)-1=Isopropyl-4,7-dimethyl-1,2,4a,5,6,8a-hexahydronaphthalene	0.00	0.00	0.00	0.00	0.52
45	γ-Muurolene	2.31	4.62	2.50	1.52	2.74
46	(1R,4R,4aS,8aR)-4,7-Dimethyl-1-(prop-1-en-2-yl)-1,2,3,4,4a,5,6,8a-octahydronaphthalene	0.00	0.00	0.81	0.65	0.00
47	α- Muurolene	1.59	3.76	3.42	3.55	2.68
48	(+)-epi-Bicyclosesquiphellandrene	0.00	0.00	0.23	0.00	0.00
49	1-(1,5-dimethyl-4-hexenyl)-4-methyl-Benzene	0.00	0.00	2.03	0.83	0.00
50	(1R,4aS,8aR)-1-Isopropyl-4,7-dimethyl-1,2,4a,5,6,8a-hexahydronaphthalene	0.00	1.12	0.00	0.00	0.52
51	δ-Selinene	0.00	0.00	0.85	0.00	0.00
52	Epizonaren	0.00	0.88	0.35	0.00	0.00
53	decahydro-4a-methyl-1-methylene-7-(1-methylethenyl)-,(4aR-(4a.α.,7α.,8a.β.)) Naphthalene	0.22	0.35	0.45	0.29	0.30
54	1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-(1.α.,4a.β.,8a.α.)-(+/-.)-Naphthalene	0.00	0.00	0.00	0.28	0.16
55	6 -ethenyl-6-methyl-1-(1-methylethyl)-3-(1-methylethylidene)-Cyclohexene	0.00	0.21	0.00	0.00	0.00
56	β-Bisabolene	0.31	0.28	0.99	0.63	0.27
57	1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-(1S-cis)-Naphthalene	2.81	5.39	5.04	3.55	4.40
58	Cubenene	0.22	0.81	0.63	0.00	0.45
59	α-Calacorene	0.31	0.99	1.41	0.00	0.52
60	Caryophyllene oxide	1.73	0.85	0.00	2.54	1.03
61	Caryophyllenyl alcohol	0.00	0.00	0.88	0.42	0.00
62	1,2,3,3a,4,5,6,7-octahydro-1,4-dimethyl-7-1-methylethenyl)-, (1R-(1.α.,3a.β.,4.α.,7.β.))-Azulene	0.00	0.00	0.23	0.00	0.00
63	Tetradecanal	0.21	0.47	0.76	0.50	0.48
64	3,4-dimethyl-3-Cyclohexen-1-carboxaldehyde	0.00	0.00	0.00	0.00	0.22
65	1-ethyl-5-methyl-Pyrazole-4-carboxaldehyde	0.00	0.00	0.00	0.29	0.00
66	Di-epi-1,10-cubenol	0.00	0.00	0.00	0.00	0.44
67	Epicubenol	0.00	0.00	0.00	0.00	0.00
68	2-Acetyl-6-methoxynaphthalene	0.00	0.24	0.46	0.27	0.00
69	Selina-3,7(11)-diene	0.00	0.00	0.27	0.00	0.00
70	1,2,3,4,4a,5,6,7-octahydro-.α.,.α.,4a,8-tetramethyl-,(2R-cis)-2-Naphthalenemethanol	0.00	0.00	0.25	0.00	0.00
71	τ-Cadinol	0.00	0.00	0.99	0.67	0.00
72	Methyl 5 -acetyl-2-methoxybenzoate	0.00	0.00	0.43	0.32	0.00
73	Humulane-1,6-dien-3-ol	0.25	0.00	0.00	0.00	0.00
74	Di-epi-1,10-cubenol	0.34	0.00	0.46	0.34	0.00
75	2-Isopropyl-5-methyl-9-methylene-Bicyclo(4.4.0)dec-1-ene	0.47	0.00	0.00	0.00	0.00
76	τ-Muurolol	0.00	0.97	0.83	0.00	0.69
77	Copaene	0.00	0.38	0.00	0.00	0.22
78	α-Cadinol	0.31	0.56	0.00	0.67	0.31
79	cis-,α.-Co[paene-8-ol	0.00	0.00	0.00	0.31	0.00
80	Alloaromadendrene oxide-(1)	0.00	0.00	0.00	0.29	0.00
81	(2S)-2-((1R,3aR,4R,5S,7aS)-1,7a-Dimethyloctahydro-1H-1,2,4-(Epimethanetriyl)inden-5-yl)propan-1-ol	0.00	0.20	0.28	0.00	0.00
82	4-Isopropyl-6-methyl-1-methylene-1,2,3,4-tetrahydronaphthalene	0.00	0.21	0.00	0.00	0.00
83	1,6-dimethyl-4-(1-methylethyl-Naphthalene	0.00	0.23	0.00	0.00	0.00

Figure 6: Metabolite Profiling of five Essential Oil of *C. burmannii* bark from: Mount Lawu Java Island Mountains Meratus, Kalimantan Island, East Lombok, Lombok Island, Mount Kerinci, Sumatra Island, Gorontalo, Sulawesi Island.

Whereas the highest rainfall is in December, which is 246 mm. One of the *C. burmannii* bark producing villages is Dulamayo Utara Village of Telaga Biru Sub Regency. *C. burmannii* in Dulamayo Utara village is planted among clove, coffee and candlenut plants. Location has a height of ± 600 MASL and temperature 26,9°C -27,8°C.[23,24]

From the results of research on *C. burmanii* bark from 5 different areas and islands, it can be concluded that those who produce *C. burmannii* bark from Mount Kerinci is the best. *C. burmannii* bark from Mount Kerinci showed that it had the strongest odor and the highest water-soluble extract and alcohol soluble extract as well as the highest essential oil content and the highest cinnamaldehyde content. This might be due to the favorable climate and geographical conditions of Mount Kerinci namely temperature, the amount of rain that is almost all year round.[25] The *C. burmannii* bark from the islands of Lombok and Java has many similarities, although there are many differences in geographical features. *C. burmannii* bark from Gorontalo and from Kalimantan produces the lowest essential oils and the lowest cinnamaldehyde, this is possible because *C. burmannii* still planted unintensively. *C. burmannii* from these two islands has the least essential oil content.

CONCLUSION

In general, the results concluded from this study indicate that all five areas plants of *C. burmannii* have shown difference properties on spesific, non specific properties and metabolite profiling. Most of the activity of this plant is due to their essential oils. The results of this study indicate that the standarisation of this plant, showed that *C. burmannii* bark from mount of Kerinci had the strongest odor and the highest water soluble extract and alcohol soluble extract as well as the highest essential oil content and the highest cinnamaldehyde content.

ACKNOWLEGMENT

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GRAPHICAL ABSTRACT
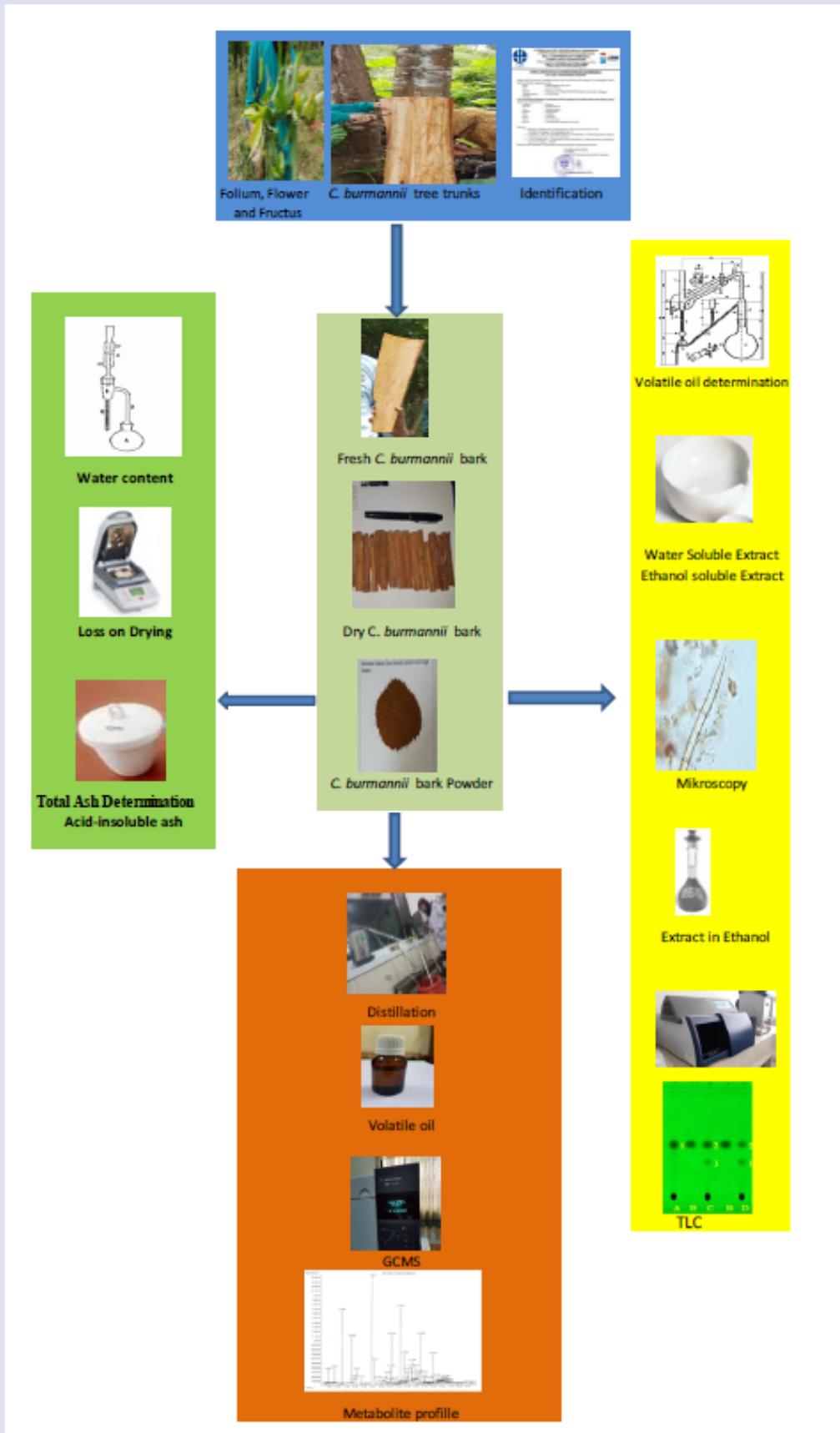
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