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Dracorhodin: A potential marker compound for detecting the presence of dragon's blood resin from *Daemonorops* originated from Indonesia

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Abstract. *Waluyo TK, Wibowo S. 2018. Dracorhodin: A potential marker compound for detecting the presence of dragon's blood resin from* Daemonorops *originated from Indonesia. Biodiversitas 19: 1665-1671.* Dragon's blood typifies as red-colored resin, which is presented by several plant genus, i.e., Dracaena, Daemonorops, Croton, and Pterocarpus. In Indonesia, dragon's blood is originated from Daemonorops which grows scattered in Sumatera and Kalimantan islands. Relevantly, this study was conducted to identify the specific compounds of dragon's blood originated from Indonesia's Daemonorops. Dragon's blood test samples were originated from 16 different towns in Indonesia, which are known as the center of dragon's blood-production. The samples were in powder and solid formation. The compounds of samples were analyzed using GC-MS instrument. Results revealed that dragon's blood in powder and solid formation were inherently similar. Dragon's blood powder was obtained from wet extraction, while dragon's blood solid from dry extraction. Results of chemical analysis on 16 dragon's blood samples disclosed that three compounds were frequently detected associated with dragon's blood presence. Dracorhodin compound was detected in 16 dragon's blood samples i.e 3,4-dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol in 13 samples; and trendione in 9 samples. Accordingly, dracorhodin could serve as the most compound containing in dragon's blood originated from Indonesia's Daemonorops, which could be observed from 16 tested Daemonorops dragon's blood samples from several regions (towns) in Indonesia.

Keywords: Dragon's blood, *Daemonorops*, GC-MS, marker compound, dracorhodin

INTRODUCTION

Jernang (Dragon's blood) typifies as a red-colored resin consecutively belonging to genus *Dracaena* (Dracaenaceae), *Daeomorops* (Aracaceae), *Croton* (Euphorbiaceae) and *Pterocarpus* (Fabaceae) (Pearson and Prendergast 2001). Dragon's blood resin has been widely used as a coloring agent for varnishes, ceramics, marbles, stone-made tools, woods, rattans, paintings, etc. Besides, dragon's blood resin could also be used as drug ingredients, among others for antidiarrheal (Gupta et al. 2008), antimicrobials (Edward et al. 2001; Waluyo and Pasaribu 2015), antivirus (Gupta et al. 2008; Waluyo and Pasaribu 2015), anticancer (Gupta et al. 2008; Alonso-Castro et al. 2012), antiplatelet (Yi 2011), antiinflammation (Gupta et al. 2008; Lopes et al. 2014), antioxidant (Gupta et al. 2008; Lopes et al. 2014) and wound healing (Gupta et al. 2008; Waluyo and Pasaribu 2015; Namjoyan et al. 2015).

The adopted techniques to obtain dragon's blood resin vary depending on the species of their host trees. For example, dragon's blood resin living in the host trees, i.e., *Dracaena cinnabari*, *Croton*, and *Pterocarpus* can be obtained by performing the tapping technique on the stem part of those tree species (Pearson and Prendergast 2001). Meanwhile, for the tree species of *Dracaena cinnabari* Balf.f., dragon's blood resin is acquired using tapping technique as well on the stem part of the tree. Meanwhile, for the species of *Dracaena cochinchinensis* (Lour.) S.C. and *Dracaena cambodiana* Pierre ex Gagnep. both originated from China, it is obtained by inducing *Fusarium proliferatum* fungi at the tree stem and leave parts of those species. Therefore, the infected plant organ will produce dragon's blood resin (Fan et al. 2008; Wang et al. 2010; Ou et al. 2013).

Dragon's blood resin originated from rattan species is the species that belong to the genus *Daemonorops*. The resin results from the secretion of the rattan fruits, adhering to the outer part of fruit skins. Dragon's blood of this plant only exists in Indonesia and Malay Peninsula (Yi et al. 2011). Several rattan species producing dragon's blood resin are among others *Daemonorops draco* BL.; *D. maculata*.; *D. mattanensis* Becc.; *D. micrantus* Becc.; *D. propinquess* Becc.; *D. rubber* BL.; *D. sabut* Becc.; *D. micracanthus* Becc.; *D. didymophylla* Becc.; *D. melanochaetes* Blume.; *D. longipes* Mart.; *D. draconcellus* Becc.; *D. motleyi* Becc., etc (Heyne 1987; Dransfield and Manokaran 1994; Januminro 2000; Waluyo 2013). One of the several simple techniques to obtain dragon's blood resin from rattan species commonly performed by the tribe community residing in Jambi by pounding fresh rattan fruits so that the resin that adheres to the outer fruit skins fall apart or become loose from those skins (Waluyo 2008).

Dragon's blood resin produced from fruits various rattan plant species (*Daemonorops*) grows widely in Nangro Aceh Darussalam province until Lampung province in Sumatera and several regions in Kalimantan. Accordingly, the relevant research was conducted to know the reliable information about the particular chemical

compounds and to obtain the compound entity itself that could have functioned as a convincing marker to detect the presence of dragon's blood particularly from the genus *Daemonorops* originated from Indonesia. Expectedly, the result of the research could be beneficial and use as a reliable reference to distinguish whether the dragon's blood resin is originated rattan or other plant species from Indonesia.

MATERIALS AND METHODS

Materials and equipment

The materials of this research consisted of dragon's blood resin both in powder and in solid/block formation (Figure 2), derived from genus *Daemonorops* seeds (Figure 3), collected from several regions in Indonesia (Figure 1). The solid-shaped dragon's blood resin stuff were collected from the regions in Jambi, West Sumatera, and Kalimantan provinces. The location of 9 samples collection is presented in Table 1. Meanwhile, the powder-shaped of dragon's blood sample was originated from the regions in Aceh (Meulaboh/ML, Lhokseumawe/LS), Sumatera Utara (Medan/MD, Sipirok/SP), and Lampung (Liwa/LW) provinces. In relevant, 7 samples of powder-shaped dragon's blood were collected from 7 (towns) particular sites (towns) in those three regions (Table 1). The chemical used for compound analysis was mainly acetone, while the equipment consisted of consecutively soxhlet extraction apparatus, rotary vacuum evaporator, and GC-MS (Gas Chromatography-Mass Spectrometry) instrument.

The extraction techniques for rattan fruits in the field

Dragon's blood resin was extracted from rattan fruit using dry and wet extraction techniques by the community who reside in three regencies that consisted of Sarolangun/SR, Lhoksemawe/LS, and Meulaboh/ML. The procedure of the extraction as follows:

The wet extraction technique using conventional method

The wet extraction technique was performed by the local community in Lhokseumawe/LS using water as media (Januminro 2000). The rattan fruits were dried under the sun until dry; and were then ponded to easily separate rattan fruit skin from fruit seed. The separated rattan fruit skin was then put into the container filled with water, and stirred or squeezed vigorously so that the resin portion enabled to dissolve in water. Furthermore, the water solution was sieved/filtered using a screen made of sacks or woven plastics. The water filtrate was saved and then placed inside the container; and let them for some duration, until the dragon's blood resin was precipitated or settled down perfectly. It was then dried under the sun (Figure 3).

Table 1. Location origin and shapes of dragon's blood

Origin of location	Province	Forms/ shapes	Code
Meulaboh	Aceh	Powder	ML
Lhokseumawe	Aceh	Powder	LS
Tapaktuan	North Sumatra	Powder	TT
Medan	North Sumatra	Powder	MD
Sipirok	North Sumatra	Powder	SP
Solok	West Sumatra	Solid	SL
Sungaidareh	West Sumatra	Solid	SD
Sarolangun	Jambi	Solid	SR
Muarabungo	Jambi	Solid	MB
Jambi	Jambi	Solid	JB
Palembang	South Sumatra	Powder	PL
Liwa	Lampung	Powder	LW
Pontianak	West Kalimantan	Solid	PT
Sanggau	West Kalimantan	Solid	SG
Putussibau	West Kalimantan	Solid	PS
Murateweh	Central Kalimantan	Solid	MT

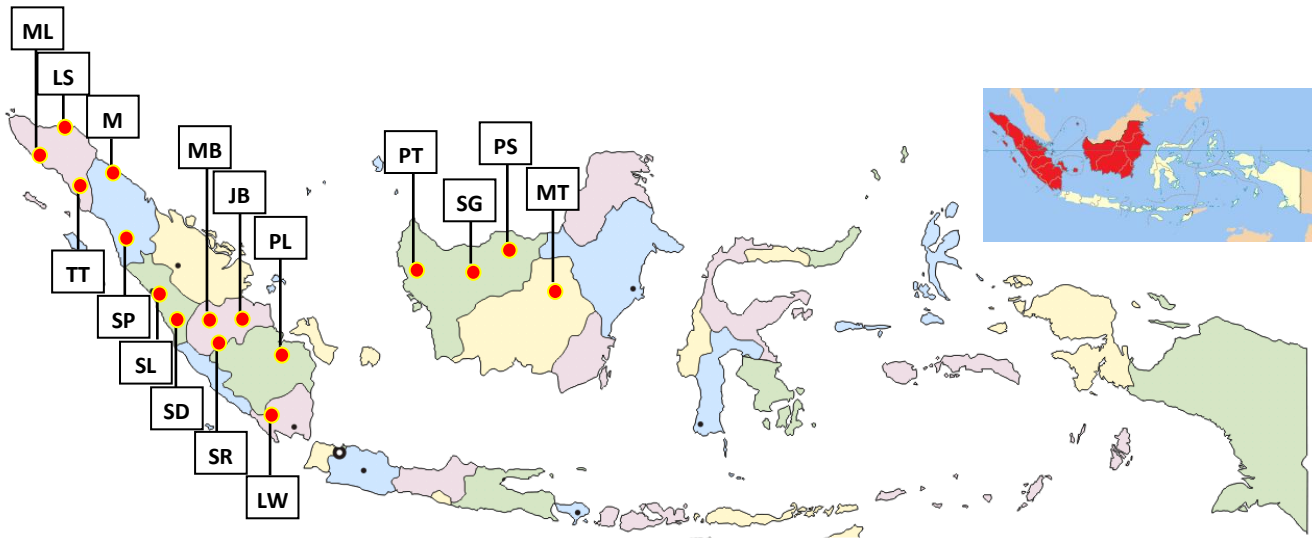


Figure 1. A map featuring the origin for location of dragon's blood resin. Abbreviation of the cities refer to Table 1

A B

Figure 2. Dragon's blood resin stuffs. A. Solid shape; B. Powder shape

A B

Figure 3. Rattan fruits from the genus *Daemonorops*. A. Rattan fruits that still contained dragon's blood resin at their outer skin; B. Rattan fruit that no longer contained dragon's blood resin at their outer skin (after being extracted)

Wet extraction using machineThe extraction technique conducted in Meulaboh/ML could also be categorized as wet extraction, which was only slightly different from the technique performed by the community in Lhokseumawe/LS. Rattan fruits were put into a cylinder-shaped container or tube already filled with water (Figure 4). Afterward, the cylinder-shaped tube was revolved vigorously until the fruit resin dissolved completely in water. Furthermore, the water portion was separated through the sieving; and the obtained filtrate was let stand for some duration for resin precipitation. Afterward, the resin was separated from the water, which was then dried under the sun.

Dry extraction technique

Dry extraction technique was conducted by pounding the fresh rattan fruits (Figure 5) to powder shape. Modern mechanical equipment can be used to speed up this process, as presented in Figure 6 (Waluyo 2008). Furthermore, the resulting dragon's blood powder was kept inside plastic containers/bags; and not long afterward, the powder would be hardened/solidified. The chemical used for compound analysis was mainly acetone, while the equipment consisted of consecutively soxhlet extraction apparatus, rotary vacuum evaporator, and GC-MS (Gas Chromatography-Mass Spectrometry) instrument.

Determination of resin content

The resin content determination followed the standard procedure of ASTM D297-9318. 5 g dragon's blood sample was extracted with acetone using soxhlet apparatus. The process of extraction was for 6 hours or until the solution was clear. The extracts were then concentrated using rotary vacuum evaporator. The percentage of acetone extract (resin content) was calculated as follows:

$$\text{Acetone extract (resin content), \%} = (A/B) \times 100$$

Where:
A: Grams of extract
B: Grams of sample used

Identification of compounds in dragon's blood resin

The concentrated resin solution was further analyzed using GC-MS instrument, adopted from electron-attacking ionization method at the gas chromatograph of GC-17A (SHIMADZU) type, which was set up tandemly with mass spectrometry device of MS QP 5050A type, using capillary column, DB-5 ms (J&W) (silica 30 m x 250 µm x 0,25 µm), with column temperature operated at 50 °C (zero minute) until 290 °C with 15 °C/minute rate, involving helium carrier gas at fixed pressure (7.6411 psi) and using Wiley 7N, year 2008 as database.

RESULTS AND DISCUSSION

Resin contents

Acquiring the values of resin content was necessary to assess the purity of dragon's blood resin. Results of analysis on resin content were disclosed in Table 2. The resin content in solid-shaped dragon's blood (SL, SD, SR, MB, JB, PT, SG, PS, and MT) varied about 83.79-93.62%. Meanwhile, resin content in powder-shaped dragon's blood (ML, LS, TT, MD, PL, and LW) ranged about 94.90-97.44%; which was relatively higher than the resin content in solid-shaped dragon's blood. The lower resin content of the solid-shaped dragon's blood material were strongly attributed to the presence of debris and other contaminants such as rattan fruit skin (Waluyo 2008).

The resin contents of dragon's blood materials from all the tested samples were quite high, reaching above 80% (Table 2). Based on Indonesia's National Standard (BSN 2010), those entire of dragon's blood samples belonged to the super quality category with the content minimally reaching about 80%.

Figure 4. Wet extraction technique. A. Extraction using water media, B. Filtering process, C. Drying process under the sun

Figure 5. Technique for dry extraction of dragon's blood

Figure 6. Equipment for the extraction of dragon's blood resin

Identification of Dragon's Blood compounds

Results of GC-MS analysis of all (16) dragon's blood resin stuff samples (Tables 1 and 2**),** showed that 42 chemical compound had been identified (detected). Those compounds almost had similarities in chemical formula and chemical structure corresponding to 42 types of standard reference's compounds with 80% of similarity index. (Table 3). Out of those 42 chemical compounds, 3 (three) compounds were mostly detected or abundantly present in the dragon's blood samples. Those three compounds

consisted of dracorhodin followed by 3,4-dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol and trendione (Table 3). Dracorhodin was detected in all of samples of dragon's blood stuff; while 3,4-dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol was found in 13 samples; followed by, trendione was found in 9 samples (Figure 7).

Dracorhodin turned out to be the only one of 42 compounds which were detected in all 16 samples of dragon's blood stuff (Table 3). Accordingly, dracorhodin could be found as a major compound of dragon's blood resin in *Daemonorops* (rattan genus). This result was different with dragon's blood resin originated from China (genus *Dracaena*), which contained loureirin as major active compound, so that could be used as a marker compound for the presence of the dragon's blood resin (Gupta et al. 2008; Jia et al. 2014).

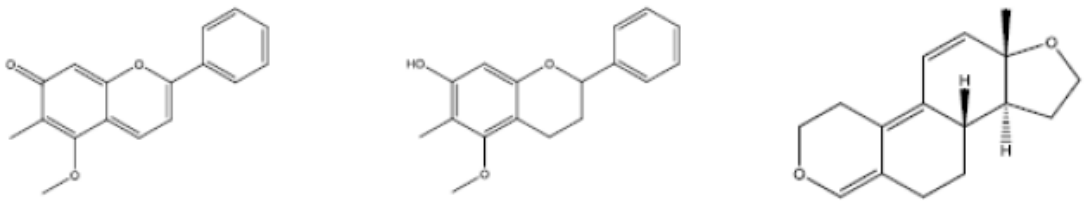
Until now dracorhodin was identified as an active compound in the species of *Daemonorops draco* BL. (Gupta et al. 2008, Baumer and Dietermenn 2010), whereas many species of the genus *Daemonorops* are grown in Indonesia. *Daemonorops acehensis* in Aceh province (ML, LS, TT), *Daemonorops uschdraweitiana* in North Sumatra (MD, SP), *Daemonorops brachystacliys* and *Daemonorops draco* in Jambi and West Sumatera (SR, MB, JB, SD, SL), *Daemonorops siberutensis* in South Sumatra and Lampung (PL, LW), *Daemonorops micracantha* and *Daemonorops didymophylla* are mostly found in Kalimantan (PT, SG, PS, MT) (Rustiami et al. 2004; Purwanto et al. 2005). Thus, it is suspected that all of the genera of *Daemonorops* contain dracorhodin compounds.

Dracorhodin typified as a derivative of anthocyanin's flavonoid compounds, which rendered the dragon's blood resin stuffs to exhibit their specific colors (Melo et al. 2007; Shi et al. 2009). Those specific-colored dragon's blood resin stuff were utilized as coloring agent for art items of the 15th century (Baumer and Dieterman 2010). The outstanding color of dracorhodin was due to the presence of double or triple bond system inside its molecules, which were intricately conjugated and further, in general, afford antioxidant actions. These compounds were obtained from research of methanol extract as well as ethyl acetate extract of dragon's blood resin exhibited antioxidant activities (Waluyo and Pasaribu 2013). Furthermore, the particular compounds belonged to anthocyanin group tended to have anticancer activities. The free radical as one of factors causing cancer diseases were able to be caught by the system of conjugated double or triple bonds in anthocyanin (Amin and Mousa 2010). Other benefits of anthocyanin's flavonoid compounds were as antimicrobials, antivirus, and antitumor agents; and able to perform cytotoxic activities (Gupta et al. 2008; Edward et al. 2001; Alonso-Castro et al. 2012; Waluyo and Pasaribu 2015).

In addition, dracorhodin was also apparently efficacious to cure lung cancer diseases. This was strongly indicated that the use of darcorhodin perchlorate (inherently the synthetic dracorhodin) could overcome lung cancer diseases (Zhang et al. 2015). In chemical structure, 3,4-dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol compound resembled a lot those of dracorhodin. Accordingly, it could also serve as an effective marker compound, besides dracorhodin. Meanwhile, tendione is typified as a prohormone compound belonging to the steroid groups, which were utilized a lot by sports fan person, particularly bodybuilders (Parker et al. 2012).

Table 2. Resin contents of dragon's blood

Origin of location	Forms/ shapes	Resin contents (%) (Mean ± SD, n = 3)
Meulaboh (ML)	Powder	95.50 ± 1.70
Lhokseumawe (LS)	Powder	94.90 ± 0.92
Tapaktuan (TT)	Powder	97.44 ± 0.82
Medan (MD)	Powder	97.08 ± 1.39
Sipirok (SP)	Powder	95.73 ± 1.51
Solok (SL)	Solid	93.62 ± 1.22
Sungaidareh (SD)	Solid	87.45 ± 1.84
Sarolangun (SR)	Solid	84.29 ± 1.93
Muarabungo (MB)	Solid	86.91 ± 1.51
Jambi (JB)	Solid	92.33 ± 2.09
Palembang (PL)	Powder	95.84 ± 2.94
Liwa (LW)	Powder	95.38 ± 1.49
Pontianak (PT)	Solid	86.14 ± 2.22
Sanggau (SG)	Solid	87.69 ± 2.23
Putussibau (PS)	Solid	83.79± 2.64
Murateweh (MT)	Solid	92.00 ± 3.09



Dracorhodin

3,4-dihydro-5-methoxy-6-methyil-2-phenyl-2H-1-benzopyran-7-ol

trendione

Figure 7. Structure of dracorhodin and 3,4-dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran (Shi et al. 2009); trendione (Parker et al. 2012).

Table 3. Compounds which were found and identified in 16 samples of dragon's blood resin stuff

Chemical compounds	Retention time (minute)	Samples of dragon's blood stuff (each corresponded to their location origin)																No. identified chemical compounds
		ML (%)	LS (%)	SL (%)	TT (%)	MD (%)	SP (%)	SD (%)	MB (%)	SR (%)	JB (%)	PL (%)	LW (%)	PT (%)	SG (%)	PS (%)	MT (%)	
ρ Vinilguaiacol	5.794	-	-	-	0.23	-	-	-	-	-	-	1.58	1.25	0.30	-	-	0.83	5
α Cubebene	5.995	-	-	-	-	0.02	0.04	-	-	-	-	-	-	-	-	-	-	2
4-Vinil-2-methoxy-phenol	6.038	-	-	-	0.09	-	-	-	-	-	-	-	-	0.07	-	-	0.10	3
α Copaene	6.225	-	-	-	-	0.07	0.05	-	-	-	-	-	-	-	-	-	-	2
Isopiperitenone	7.053	-	-	-	0.03	-	-	-	-	-	-	-	-	0.05	-	-	0.12	3
α Amorfene	7.170	-	-	-	-	0.02	0.06	-	-	-	-	-	0.06	-	-	-	-	3
Vianole	7.313	0.01	-	-	-	-	-	-	-	-	-	0.02	0.12	-	-	0.03	-	4
δ Cadinene	7.480	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-	2
Diethyl phthalate	8.034	-	-	0.10	-	-	-	-	0.04	-	0.10	0.10	0.24	-	0.22	0.47	-	7
(+)-Spatulenole	8.235	-	-	-	-	0.05	0.08	-	-	-	-	-	-	-	-	-	-	2
5-Methoxy-4-methyl-1,3-benzenediole	8.638	-	-	0.03	-	-	-	-	-	-	-	-	-	-	0.04	0.12	0.10	4
Koiganal	10.139	-	-	-	-	0.01	0.02	-	-	-	-	-	-	-	-	-	-	2
Methyl esters palmitic acid	10.332	0.05	0.03	-	-	0.02	0.07	-	-	-	-	-	-	-	-	-	-	4
Viridoflorene	10.415	-	-	-	-	-	-	-	0.01	-	0.01	0.02	0.04	-	-	-	-	4
N-Hexadecanoic acid	10.651	-	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	1
Aromadendrene	11.028	-	-	-	-	-	-	0.13	-	0.03	-	-	-	0.09	-	0.12	0.08	5
16-Octadecenoic methyl ester acid	11.465	-	0.06	-	-	0.13	-	-	-	-	-	-	-	-	-	-	-	2
2-Hydroxy cyclopentadecanoneone	11.473	-	-	-	0.09	-	-	-	-	-	-	-	-	0.05	-	-	0.07	3
9-Octadecenoic acid	11.742	-	-	-	-	0.77	1.01	-	-	-	-	-	-	-	-	-	-	2
(E)-9-Octadecenoic acid	11.767	0.10	-	-	1.87	-	-	-	-	-	-	-	-	1.77	-	-	0.94	4
Linoleic acid ethyl ester	11.784	0.70	0.80	0.05	-	-	-	-	-	-	-	-	-	-	0.12	0.35	-	5
Diepisedrene-1-oxide	12.128	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	1
Heptadecane- (8)-carbonate- (1)	12.245	0.07	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	2
4a,8-Dimethyl-2-isopropyl perhydronaphtalene	12.622	0.18	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	2
Olealdehyde	12.631	-	0.30	-	-	0.41	0.20	-	-	-	-	-	-	-	-	-	-	3
Dodecyl succinic anhydride	12.849	-	-	-	-	0.22	0.32	-	-	-	-	-	-	-	-	-	-	2
1,3 Diphenylisobenzofuran	12.916	-	-	0.54	-	-	-	-	-	-	-	-	-	-	0.35	1.08	-	3
7-Pentadiene	12.983	0.09	1.10	-	0.63	1.06	2.02	-	-	-	-	-	-	0.85	-	-	1.65	7
Linoleic acid	12.168	0.70	-	-	1.19	-	0.40	-	-	-	-	-	-	2.05	1.60	0.21	1.92	7
Triphenyl phosphate	13.269	-	-	-	-	-	-	-	-	-	-	0.36	0.50	-	-	-	-	2
2-Monooleine glycerol	13.369	-	-	-	-	-	-	1.05	1.10	-	-	-	-	-	-	-	-	2
3,4-Dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol	13.520	5.30	5.19	11.26	-	3.71	0.40	4.57	2.84	5.10	-	7.19	5.20	2.92	3.06	1.12	-	13
(Z)-9,17-Octadecadienoate	13.626	-	-	-	1.50	1.15	0.25	-	-	-	6.53	-	-	-	-	-	-	4
1,8-Dihydroxy-3-methoxy-6-methyl-anthraquinone	13.855	-	-	-	-	-	-	1.13	1.43	1.07	-	-	-	0.27	-	-	1.19	5
4- (4-Ethylcyclohexyl-1-penthyl-cyclohexene	14.099	0.58	0.24	-	1.26	1.50	2.86	-	-	-	-	2.01	1.37	-	-	-	-	7
Trendione	14.267	5.23	4.28	-	-	-	-	3.30	3.10	4.50	1.75	-	1.25	1.15	-	-	1.07	9
9,12-Octadecadiene-1-ol	14.787	-	-	-	3.78	-	-	-	-	-	-	-	-	-	-	-	-	1
9.10 Dideutero octadecanoic acid	14.904	1.56	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
4-Hydroxy-3,3,4-tri methoxy stilbene	14.913	-	-	-	3.16	-	-	-	-	-	-	-	-	-	-	-	-	1
2,6,10,14-Tetramethyl-pentadecane	15.424	-	-	-	-	-	-	1.58	1.03	1.20	-	3.14	2.23	0.05	-	-	0.34	7
Dracorhodin	15.785	6.29	5.87	5.93	4.56	3.05	4.07	4.06	2.47	4.24	1.36	0.28	2.65	0.67	2.21	1.26	0.91	16
4-Methoxy-6-methyl-2- (3',5'-dimethoxy benzyl)benzoic acid	17.236	-	-	-	0.84	-	-	-	-	-	-	-	-	0.08	0.56	-	0.16	4

Remarks: ML: Meulaboh, LS: Lhokseumawe, TT: Tapaktuan, MD= Medan, SP: Sipirok, SL: Solok, SD: Sungaidareh, SR: Sarolangun, MB: Muarabungo, JB: Jambi, PL: Palembang, LW: Liwa, PT: Pontianak, SG: Sanggau, PS: Putussibau, MT= Muarateweh

In conclusion, dragon's blood resin stuff is obtained from the extraction process of rattan fruits originated from Indonesia, which belongs to the genus *Daemonorops*. Chemically, there were 42 active compounds found in dragon's blood resin samples in both solid and powder formation. Three out of those 42 compounds were mostly detected and abundantly present in resin contents, of which dracorhodin compound was the highest rank, followed by 3,4-dihydro-5-methoxy-6- methyl-2-phenyl-2H-1-benzo-pyran-7-ol, and trendione. Therefore, dracorhodin may be applied as a most convincing marker compound for the presence of dragon's blood resin stuffs in *Daemonorops* (rattan genus) originated from several regions in Indonesia. It was also presumed that dracorhodin is a major compound, which relates to the widespread uses of dragon's blood resin stuff. These prospective results may confirm dracorhodin as a contained in the dragon's blood resin in rattan species originated from Indonesia. Although, the further research on other compounds (e.g. trendione, etc), which can potentially be used as effective compounds to distinguish the dragon's blood resin stuffs from other countries or other plant species should be done.

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