INTRODUCTION

Jernang (Dragon’s blood) typifies as a red-colored resin consecutively belonging to genus Dracaena (Dracaenaceae), Daemonorops (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. dracocellus 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, Lhokseumawe/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).

| 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*
Wet extraction using machine
The 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:

\[
\text{Acetone extract (resin content), } \% = \frac{A}{B} \times 100
\]

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%.
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
WALUYO & WIBOWO – Dracorhodin of Daemonorops originated from Indonesia

Dracorhodin of Daemonorops originated from Indonesia 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 Dietermann 2010), whereas many species of the genus Daemonorops are grown in Indonesia. Daemonorops acehensis in Aceh province (ML, LS, TT), Daemonorops uschedravettiana 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, trendione 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                        |

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).
| Chemical compounds | Retention time (minute) | ML (%) | LS (%) | SL (%) | TT (%) | MD (%) | SP (%) | SD (%) | MB (%) | SR (%) | JB (%) | PL (%) | LW (%) | PT (%) | SG (%) | PS (%) | MT (%) | No. identified chemical compounds |
|--------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------------------------|
| 4-Hexadecanoic acid| 8.638                   | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 4                              |
| 4-Vinyl-2-methoxy-phenol | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| 4-Propionylphenol   | 7.408                   | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| 4,6-Dimethyl-2-isopropyl phenylglycol | 6.224            | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| 4-Methyl-1,3-benzene diol | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| Methyl esters palmitic acid | 7.408                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| Triphenyl phosphate | 10.139                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| 4'-Methoxy-4-methyl-1,3-benzene diol | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| 5-Methoxy-4-methyl-1,3-benzene diol | 6.224                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| Koigal | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Methyl esters palmitic acid | 7.408                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 2                              |
| Viridiflorone | 10.139 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| N-Hexadecanoic acid | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| Aromadendrene | 11.028 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 16-Octadecenoic methyl ester | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| 2-Hydroxy cyclopentadecanone | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| 9-Octadecenoic acid | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| Linoleic acid | 17.236 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Linoleic acid ethyl ester | 17.236 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Diepoxysene-1-oxide | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Heptadecene- (8)-carbonate- (1) | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| 4,6-Dimethyl-2-isopropyl phenylglycol | 7.170                  | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | 3                              |
| Olealdehyde | 17.236 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Dodecyl succinic anhydride | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 1,3-DiPhenylbenzo [f] | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 3,7-Trimethyldecane | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Linoleic acid | 17.236 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Triphenyl phosphate | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 2-Monooleine glycerol | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 3,4-Dihydro-5-methoxy-6-methyl-2-phenyl-2H-1-benzopyran-7-ol | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| (Z)-9,17-Octadecadienoate | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 1,8-Dihydroxy-3-methoxy-6-methyl-anthaquinone | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 4- (4-Ethylcyclohexyl-1-pentyl-cyclohexene | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 9,12-Octadecadiene-1-ol | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 9,10-Didurocto decanoic acid | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 4-Hydroxy-3,3,4-tri methoxy stilbene | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 2,6,10,14-Tetramethyl-pentadecane | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Dracorhin 3,5-dimethoxy benzylbenzoic acid | 7.170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |

**Remarks:** ML: Meulaboh, LS: Lhokseumawe, TT: Tapaktuan, MD= Medan, SP: Sipirok, SL: Solok, SD: Sungaidereh, 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.

ACKNOWLEDGEMENTS

The authors thank Syaifudin Agam, Chairman of the Dragon’s blood Association of Indonesia, for valuable information on several regions in Indonesia producing the dragon’s blood materials.

REFERENCES

Alonso-Castro AJ, Ortiz SE, Dominguez F. 2012. Antitumor effect of Croton lechleri Mull. Arg. (Euphorbiaceae). J. Ethnopharmacol 140: 438-442.
Amin A, Mousa M. 2007. Merits of anticancer plants from the Arabian Gulf Region. Cancer Ther 5: 55-66.
ASTM. 2002. Standard Test Methods for Rubber Product-Chemical Analysis. D297-93. Easton, MD, USA.
Badan Standarisasi Nasional. 2010. SNI 1671: 2010 Getah jernang. Jakarta. [Indonesian]
Baumer U, Dieterman P. 2010. Identification and differentiation of dragon’s blood in works of art using gas chromatography/mass spectrometry. Anal Bioanal Chem 397 (3): 1363-1376.
Dransfield J, Manokaran N. 1994. Plants Resource of South-East Asia. No. 6. rattans. PROSEA, Bogor.
Edward HGM, Oliveira LFC, Quye A. 2001. Raman spectroscopy of coloured resins used in antiquity: dragon’s blood and related substances. Spectrochimica Acta Part A 57: 2831-2842.
Fan, LI, Tu PF, He JX. 2008. Microscopical study of original plant of Chinese drug “Dragon’s blood” Dracaena cochinchinensis and distribution and constituents detection of its resin. J. Chin.Med.Mat 33: 1112-1117.
Gupta D, Bleakley B, Gupta RK. 2008. Dragon’s blood: Botany, chemistry and therapeutic uses. J. Ethnopharmacol 115: 361-380.
Heyne K. 1987. Tumbuhan Berguna Indonesia Jilid I. Badan Litbang Departemen Kehutanan, Jakarta. [Indonesian]
Jannamini CFM. 2000. Rotan Indonesia. Kanisius, Yogyakarta. [Indonesian]
Jia YF, Yi T, Chui MS, Zhu L, Wan LP, Ya ZZ, Zhao ZZ, Hu BC. 2014. A systematic review of the botanical, phytochemical and pharmacological profile of Dracaena cochinchinensis, a plant source of the ethnomedicine “dragon’s blood”. Molecules 19: 10650-10669.
Lopes M, Saffi J, Echeverriagaray S, Henriques JAP, Salvador M. 2004. Mutagenic and antioxidant activities of Croton lechleri sap in biological systems. J Ethnopharmacol 95: 437-445.
Melo JM, Sousa M, Parola AJ, Melo JSS, Catarino F, Marcelo J, Pina F. 2007. Identification of 7,4-dihydroxy-5-methoxy flavilium in “dragon’s blood”: To be or not to an anthocyanin. J Eur Chem 13 (5): 1417-1422.
Namjlayan F, Kiashi F, Moosavi ZB, Saffari F, Mahmalzadeh BS. 2015. Efficacy of Dragon's blood cream on wound healing: A randomized, double-blind, placebo controlled clinical trial. J Trad Compl Med 6 (1): 37-40.
Ou LC, Wang XH, Zhang CH. 2013. Production and characterization of dragon’s blood from leaf blades of Dracaena cambodiana elicited by Fusarium proliferatum. Industr Crops Prod 45: 230-235.
Parker JA, Webster JP, Kover SC, Kolodziej P. 2012. Analysis of trenbolone acetate metabolites and melengestrol in environmental matrices using gas chromatography-tandem mass spectrometry. Talanta 99: 238-246.
Pearson J, Prendergast DV. 2001. Collection Corner: Daemonorops, Dracaena and Other Dragon’s blood’s economic. Botany. 55: 474-477.
Prumwanto Y, Polosakan R, Susiarti S, Waluyo EB. 2005. Ekstraktivisme Jernang (Daemonorops spp.) Dan Kemungkinan Pengembangannya : Studi Kasus di Jambi, Sumatra, Indonesia. Laporan Teknik Bidang Botani, Pusat Penelitian Biologi-LIPI, Bogor. [Indonesian]
Rustiiani H, Setyowati FM, Kartawinata K. 2004. Taxonomy and uses of Daemonorops draco (Wild.) Blume. J Trop Ethnobiol 1 (2): 65-75.
Shi J, Hu R, Lu Y, Sun C, Wu T. 2009. Single-step purification of dracorhodin from dragon’s blood resin Daemonorops draco using high-speed counter current chromatography combined with pH modulation. J Sep Sci 32: 4040-4047.
Waluyo TK. 2008. Traditional extraction technique and analysis on properties of Jambu Dragon’s Blood. J For Prod Res 26 (1): 30-40.
Waluyo TK, Pasaribu G. 2013. Antioxidant and antiaggregation activities of Dragon's Blood. J For Prod Res 31 (4): 306-315.
Waluyo TK. 2013. Comparative study on physico-chemical properties of 5 dragon’s blood species. J For Prod Res 31 (2): 141-150.
Waluyo TK, Pasaribu G. 2015. Antifungal, antibacterial and wound healing activity of dragon’s blood extracts. J For Prod Res 33 (4): 377-385.
Wang XH, Zhang CH, Wang Y, Gomes-Laranjo J. 2010. Screen of microorganisms for inducing the production of dragon’s blood by leaf of Dracaena cochinchinensis. Lett Appl Microbiol 51 (5): 504-510.
Yi T, Chen HB, Zhao ZZ, Yu ZL, Jiang ZH. 2011. Comparison of the chemical profile and anti-platelet aggregation effects of two "Dragon’s Blood" drugs used in traditional Chinese medicine. J Ethnopharmacol 133: 796-802.
Zhang GX, Sun M, Zhang YF, Hua PY, Li X, Cui RJ, Zhang XY. 2015. Dracorhodin perchorlate Induces G1/G0 Phase arrest and mitochondria-mediated apoptosis in SK-MES-1 human lung squamous carcinoma cells. Oncol Lett 10: 240-246.