Drying and quality performance of dragon blood’s resin 
(Daemonorops sp.) exposed to solar and oven drying

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Abstract. Dragon blood’s resin is obtained by extracting the dragon blood’s fruit with organic 
or non-organic solvents. Following extraction, drying process is usually carried out to dry the 
wet resin. The drying techniques used is assumed to affect not only the drying performance but 
also the quality of the dragon blood’s resin, in particular its active ingredient content 
(dractorhodin). The purpose of this study was to measure and compare the effect of solar and 
oven drying on the drying performance and quality of dragon blood’s resin. The oven 
temperature used was 60°C. Both drying techniques were executed until the resin dried which 
was indicated by color change and its easiness to rupture. The results showed that solar drying 
of dragon blood required shorter time (210 minutes) with higher drying rate (0.25%/minute) than 
the oven drying process which need 250 minutes to finish with a drying rate of 0.14%/minute. 
Except the ash content of solar dried resin, other post-drying quality parameters of dragon blood 
resin from both drying techniques have met the Indonesia standard for trading purpose (SNI 
8663:2018). Further statistical analysis confirmed that the drying techniques applied 
significantly affected the drying rate and post-drying quality values of dragon blood’s resin.

1. Introduction
Dragon blood’s resin is a secondary metabolite obtained from the extraction process of dragon blood’s 
fruit (Daemonorops sp.). In Indonesia there are several types of resin-producing dragon blood’s that 
are widely hunted by dragon blood’s farmers, including dragon blood’s Daemonorops didymophylla 
Becc., Daemonorops melanochaetes Blume., Daemonorops longipes Mart., Daemonorops draco BL., 
and Daemonorops sp. [1]. This species is one of prospective non timber forests product. The market for 
dragon blood’s resin is very wide overseas, so that exporters and collectors are competing to find dragon 
blood’s resin from various islands in Indonesia. The spread of dragon blood’s produced in Indonesia 
island dragon blood’s include Java, Kalimantan, Sulawesi and Sumatra.

The main uses of dragon blood’s resin are for the health sector including for wound healing, 
antidiabetic, anti-inflammatory, pro-proliferative and antimicrobial [2,3]. In Indonesia tribe (Anak 
Dalam and Talang Mamak tribes) dragon blood’s is used as a remedy for treating wounds because of its 
anti-hemorrhagic, anti-inflammatory and healing properties [4]. In addition, dragon blood’s resin is also 
used as a natural coloring agent.

Currently, dragon blood’s resin is generally still obtained by hunting in the forest. There are still a 
few who practice the dragon blood’s resin cultivation technique. Farmers collect the dragon blood’s 
fruit, then sell it directly to collectors or do the extraction themselves. The extraction technique carried 
out by the community is still simple, resulting in the quality of the dragon blood’s resin being varied.
Following the extraction activity, drying process is usually applied to dry the wet resin. The common practice is by naturally dry the resin under direct sun which results in an unstable resin quality. This practice, however, raises concern as some biological destroying organisms could interfere the drying process and thus contaminate the resin or even destroy the quality. Decrease in resin quality is caused by poorly maintained moisture content and a change in resin color. The moisture content and physical properties of the jernang resin from the farmers tend to have a high degree of variability.

This is an example of the quality performance of jernang by farmers [5]. Information on the quality of five types of jernang resin includes bird jernang (*Daemonoros didymophylla*), umbut jernang (*Daemonorops melonochaetes*), rambai jernang (*Daemonorops draco*), kalamuai jernang (*Daemonorops longipes*) and quail head jernang (*Daemonorops* sp.) Carried out by the farmer. The physical properties of the 5 types of jernang show that the moisture content ranges from 3-5%, the impurities level from 4-6%, ash content from 0-2% ash content and melting point from 85-105°C.

This study proposes the application of solar dryer and oven as substitute to air drying practice of dragon blood’s resin. The drying techniques used is assumed to affect the qualities of the resin. On the other hand, up to now, no study has been conducted so far on any aspects of drying process of dragon blood resins, include its effect on the resin quality. Therefore, it is important to do research to determine the effect of drying on the quality of dragon bloods. This study thus aimed to obtain and then compare the data and information on drying performance and final drying quality of dragon blood’s resin being exposed to solar and oven drying techniques.

2. Materials and Methods

2.1. Materials and equipment

This study used dragon blood’s rattan fruits from Java Island of Indonesia. Other materials used include methanol, etc. Tools and equipment used include oven, solar dryer, analytical balance, square pan, aufhauser, etc.

2.2. Time and venue

The collection of Dragon blood’s rattan fruits (including its twigs and leaves) was carried out in Ciamis region, West Java Province in October 2020. The resin extraction and drying process were carried out in November-December 2020 at Center of Forest Products Research and Development (CFPRD), Bogor, West Java. Several quality parameters, such as ash content, moisture content and impurity, were tested at CFPRD, whilst dracorhodin level was tested at the Laboratory of Independent Jernang Test, Tangerang, Banten Province.

2.3. Resin extraction

The extraction process of resin from the rattan fruits was carried out by soaking every 1 kg of rattan fruits in 1 litter of methanol for up to 2 hours. Afterwards, the rattan fruits were separated from the soaking water and put aside. The soaking water with the dissolved resin was divided into a number of small containers. After a week, the resin deposits at the base of each container were separated from the remaining water and collected.

2.4. Drying samples preparation

Each drying technique applied used 3 samples, where 1 sample contained of 100 grams of wet resins. Prior to drying process, approximately 2 grams of these 100 grams was taken for estimating the initial moisture content. The remaining resins of each sample (98 grams) was spread evenly, up to 1mm thickness, in a 200 mm x 200 mm square pan.

2.5. Drying process

The drying techniques trialed were solar drying and oven drying at 60°C. The solar drying was carried out in a solar dryer designed and developed by CFPRD (Figure 1). Both drying processes were run until all samples showed several signs of dryness, such as dry surface and red black color of the layer surface. At the end of drying process, the resins were weighed again and data was recorded. Another 2 grams of dry resin from each sample were taken and subjected to gravimetric method to obtain the final moisture
content value estimation. The remaining resins were divided to several quality parameter testing’s which were dracorhodin content, ash content, moisture content and impurity level.

3. Results and Discussion

3.1. Drying performance

Jernang is a lignocellulose material which contains high moisture content when harvested. Drying aims to maintain the quality of the active ingredients contained in jernang resin, so that it can be stored for a long time. The drying method not only affects the drying time but also determines the dry yield of simplicia and its chemical content [6].

Table 1 shows the drying time of dragon blood’s resin dried in a solar dryer was 40 minutes shorter that that dried in the oven at a temperature of 60°C. The drying rate of the resin in solar dryer was also the highest even though the resin’s initial moisture content was higher than the moisture content of resin dried in the oven. Further t-test confirms that the drying techniques did significantly affect the drying rate of dragon blood’s resin.

There are 2 important factors to speed up the drying process of a material which are heat and air circulation. Heat is used to evaporate moisture from the material being dried. The drying process will run faster as the heat increases. Air circulation is used to distribute heat throughout the material surface. The faster the air circulation is, the drying time is getting shorter.

In the solar dryer developed by CFPRD, the solar energy is collected in a zinc material-based collector, thus it does not directly hit the material surface [7]. Therefore, this system is safe for several herbal plants with solar-light sensitive chemical compound [8]. The heat collected in the collector is further circulated to the entire surface of the material by the inhaust fan. The water vapor evaporates from the material is further discharged outside the room by the exhaust fan.

Therefore, the dryer room remains dry. Due to continuous air circulation, therefore the resin could dry faster in the solar dryer than that in the oven. The hot air from the oven only heats the resin surface. However, without the help of a system to accelerate the release of water vapor into the free air, the drying time in the oven took long period. In additions the drying process of simplicia materials in an oven equipped with a blower should well consider the role and level of several factors such as temperature, pressure, and air flow [4]. This is important to do in order to preserve the active substance content in the simplicia as much as possible.

| No | Drying technique | Initial MC (%) | Final MC (%) * | Drying time (minute) | Drying rate (%/minute) |
|----|------------------|----------------|---------------|---------------------|------------------------|
| 1  | Oven 60°C        | 71.77          | 17.36         | 250                 | 0.14                   |
| 2  | Solar drying 40°C| 104.06         | 11.06         | 210                 | 0.25                   |

Remarks: * MC = moisture content, final MC at this stage was determined using the gravimetric method

| Techniques   | N | Mean differences | T-value | P-value |
|--------------|---|------------------|---------|---------|
| Oven 60°C    | 3 | 0.14509          | -10.69  | 0.000   |
| Solar drying | 3 | 0.2480           |         |         |

3.2. Quality performance

The quality of raw materials, post-harvest technology, and production techniques are parameters that determine the safety and quality of the products, especially food and medicinal products. For food and medicinal products, quality assurance is crucial as a product safety standard itself. In a medicinal
product, the active compound needs to be analyzed to maximize the drug benefits. It is usually influenced by several parameters such as moisture content, ash, and impurities from the material.

Table 3 shows the average values of several quality parameters usually being considered for the trading purpose of dragon blood’s resin. Except for the ash content of solar dried resin, other resin quality parameters values from both drying techniques have actually met the trading standard as set in Indonesia national standard SNI 8663:2018 [9]. Nevertheless, it was further noticed that the dracorhodin level, the active chemical compound in dragon blood’s resin, and the final moisture content of solar dried resin was lower than that of the oven-dried resin. On the other hands, the ash content and impurity level of oven dried resin were lower than those observed in solar-dried resin. Further T-tests carried out for each parameter show that the values of all quality parameters were significantly affected by the drying techniques applied (Table 4). This result following the research of Luliana [10] that the method of drying can affect water content and active ingredients of simplicia.

Dracorhodin is a flavylium compound from the anthocyanin family and gives natural color to dragon blood’s resin and has many benefits. Dracorhodin is also the main marker compound of dragon blood's resin, especially from the Daenomonorops species because it is found in almost all dragon blood's resin in various regions of Indonesia [11]. Some of the benefits of dracorhodin are wound healing, bleeding controls, decreased vascular inflammation, and anti-tumor [12].

Furthermore, many studies synthesized dracorhodin analog compounds such as dracorhodin perchlorate for anticancer activity. Therefore, dracorhodin is very important to identify in dragon blood's resin. The identification of dracorhodin levels carried out using the High-Performance Liquid Chromatography (HPLC) method according to SNI (Indonesian National Standard). The result showed that the dracorhodin level in oven-drying resin is higher than from solar drying. It is probably because, in oven drying, the ash and impurity level is smaller than the result of solar drying, so that the oven-dried resin is purer and contains more dracorhodin.

The moisture content will affect the appearance, age, freshness, and taste of a product [13]. Therefore, the simplicia product should have a low moisture content. The lower moisture content will convenient for the next process so that the product will be easier to store and more durable. For a product with low moisture content, microorganisms such as bacteria and molds will be more difficult to develop, but on the other hand, with higher moisture content, the bacteria/microorganisms will easier to grow. Simplicia long-term storage will change the chemical content/active compound into other products that may no longer have pharmacological effects like the original compound. The high moisture content also causes enzymatic processes and damage by microbes, so simplicia is not recommended to have high moisture content.

In this study, the ash content and impurity level of the dragon blood's resin were observed. Ash content is a product parameter influenced by mineral elements in the material, describing the number of minerals that are not burned/left behind when burned in the furnace [14]. The ash content and impurity level in oven-drying of dragon blood's resin is low, so these two components may affect the dracorhodin level or the active compound in oven-produced resin (higher than the solar drying).

The impurity level in the dragon blood's resin probably comes from the dragon blood skin or from the mixture of skin and fruit content (mixed while the extraction process is conducted). In the drying process using an oven at 60°C, the impurity level is small, only 6.41%, while during the solar drying process, the impurity level is very high, reaching 21%. It is probably because, in the oven process, the sample generally gets evenly heated under closed conditions and is protected from disturbing environmental conditions (such as dust particles). Meanwhile, the solar-drying process is carried out fan-assisted, that it is possible for dragon blood's resin covered with dust particles from the environment. These conditions also cause the ash content of the two treatments to be different. In the oven treatment, the minerals or elements from dragon blood’s resin can burn/split when heated, whereas it does not occur in the solar drying process. It is probably causing the calculated ash higher than the oven treatment. This is following [15] which obtained a simplicia ash content less than 8% with oven drying technique at 60°C. From this research, we can conclude that the drying process plays an important role in product quality, and it is a crucial stage for product development.
Table 3. Post-drying quality of dragon blood’s resin.

| No | Drying technique | Dracorhodin (%) | MC | Ash content (%) | Impurity level (%) |
|----|------------------|-----------------|----|-----------------|-------------------|
| 1  | Oven 60°C        | 3.84            | 9.47 | 3.32           | 6.41              |
| 2  | Solar drying     | 2.68            | 8.26 | 10.39          | 21.32             |

Remarks: * MC = moisture content, the MC at this stage was determined using the Auffhauser method.

This drying technique showed better than traditional techniques used by farmers [5]. Physical properties, including impurities level and ash content are better in this study and appear to be more constant.

Table 4. T-Test result to study the post-drying quality of dragon blood’s resin.

| Quality parameter | Techniques | N | Mean | Mean differences | T-value | P-value |
|------------------|------------|---|------|------------------|---------|---------|
| Dracorhodin      | Oven 60°C  | 3 | 3.84 | 1.17             | 33.90   | 0.00    |
|                  | Solar drying | 3 | 2.67 |                  |         |         |
| Moisture content | Oven 60°C  | 3 | 9.47 | 1.21             | 3.40    | 0.00    |
|                  | Solar drying | 3 | 8.26 |                  |         |         |
| Ash content      | Oven 60°C  | 3 | 3.32 | -7.07            | -271.66 | 0.00    |
|                  | Solar drying | 3 | 10.39|                  |         |         |
| Impurity level   | Oven 60°C  | 3 | 6.41 | -14.82           | -19.63  | 0.00    |
|                  | Solar drying | 3 | 21.23|                  |         |         |

The impurity of Dragon's blood dried using an oven was 6.41%, while using solar power was 21.32%. The impurity content indicates the physical parameters of the number of impurities in the jernang resin. Impurities that may be contained in the jernang resin are in the form of rattan skin scales that peeled off during extraction, soil and other impurities that stick to the rattan fruit.

The ash content of the jernang resin, dried using an oven, was 3.32% and 10.39%, which was dried using solar power. Ash content is one of the physical parameters related to the level of impurities, especially in the form of minerals. Ash is an inorganic residue that remains after annealing or complete oxidation of organic matter. Thus, the ash content has something to do with the level of impurity, namely there is a possibility that the higher the level of dirt, the higher the level of ash, especially inorganic dirt.

Drokorhodin is a characteristic compound especially for jernang resin from the genus Daemonorops which mostly grows in Indonesia and parts of the Malaysian peninsula [10], while the characteristic compound for dragon's blood which is derived from the species Dracaena cambodiana is loureirin [16].

The higher the level of jernang resin from the genus Daemonorops, the higher the selling value, therefore in SNI the criteria for dracorhodin determine the quality of the jernang resin.

The levels of dracorhodin in this study indicated that the dried resin with oven drying produced dracorhodin levels of 3.84%. In contrast to the dracorhodin produced by the solar drying method by 2.67%. Dracorhodin levels are very much determined by various factors, including the type of jernang, harvesting techniques and post-harvest processing techniques.

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The higher the level of jernang resin from the genus Daemonorops, the higher the selling value, therefore in SNI the criteria for dracorhodin determine the quality of the jernang resin.
4. Conclusion
The study has shown that the drying process of dragon blood’s resin in the solar dryer developed by CFPRD run faster (210 minutes) that that in the oven (250 minutes). The drying rate of resin exposed in a solar dryer was also higher (0.25%/minute) than that in the oven (0.14%/minute). This drying technique showed better than traditional techniques used by farmers on physical properties, including impurities level and ash content. Majority of the post-drying quality parameters of dragon blood resin from both drying techniques have met the Indonesia standard for trading purpose (SNI 8663:2018), except for the ash content of the solar-dried resin.

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