

## Current status of Aceh jernang (*Daemonorops* sp.) and its traditional conservation efforts

R Andini<sup>1\*</sup>, F Ismullah<sup>2</sup>, S Bakri<sup>2</sup>, M I Sulaiman<sup>3</sup> and A Anhar<sup>1</sup>

<sup>1</sup> Department of Forestry, Faculty of Agriculture, Syiah Kuala University (Unsyiah), Jalan Tgk. Hasan Krueng Kalee No. 3, Kopelma Darussalam, Syiah Kuala, Banda Aceh 23111, Aceh, Indonesia

<sup>2</sup> Draco Industrial Agribusiness (DIA), Banda Aceh, Indonesia

<sup>3</sup> Department of Agriculture Product Technology, Faculty of Agriculture, Syiah Kuala University (Unsyiah), Jalan Tgk. Hasan Krueng Kalee No. 3, Kopelma Darussalam, Syiah Kuala, Banda Aceh 23111, Aceh, Indonesia

\*E-mail: andinijapan@yahoo.com

**Abstract.** Dragon's blood or 'jernang' (in Indonesian language) is referred to the deep and bright red resin obtained from the seeds of rattan palm (*Daemonorops*). Three species of this genus, i.e. *D. draco* (Willd.) Blume, *D. didymophilla* and *D. Micracantha*, are highly value commodity due to their larger fruits and longer fructescences. Dragon's blood has been known in the traditional ancient Chinese medicines as haemostatic agent, antidiarrheal, antiulcer, antimicrobial and anti-inflammatory. Particularly the dracorhodin, a valuable bioactive substance, is closely associated with antitumour and wound healing activity and other industrial need. The distribution of *Daemonorops* is limited to Malaysia, Thailand and western Indonesia, especially in Sumatra. Harvesting *D. draco* seeds has been served as traditional livelihood for some local tribes and farmers in Aceh Province. Resin extracted from Aceh jernang is classified as excellent due to higher content of dracorhodin, but its processing method is still conducted in a very traditional way. The forests in Aceh are suitable for jernang to thrive, but jernang population is decreasing due to deforestation and inappropriate harvesting. Unless conservation efforts are done, jernang might extinct in the near future. Over the past few years, some local farmers have realized the importance of jernang in their livelihoods, and hence they take part in the conservation. This paper dealt with the efforts between a local jernang company, CV Draco Industrial Agribusiness (DIA Group), with Unsyiah in the traditional jernang conservation program.

Keywords: dragon's blood, genetic diversity, non-timber forest product (NTFP).

### 1. Introduction

Dragon's blood is referred to the deep and bright red resin obtained from the seeds of rattan palm *Daemonorops* as well as from other three distinct plant genera. These genera are (i) *Croton* spp. (Euphorbiaceae), whose dark red sap, known as *Sangre de Drago*, is obtained by cutting the tree trunk. They are mostly grown in Mexico, Venezuela, Ecuador, Peru and Brazil; (ii) *Dracaena* spp., which are mainly distributed in Africa, particularly in Yemen, Somalia and Canary Islands, produce *Dracaena* resin; (iii) *Pterocarpus* spp. or the red sap originated from *Pterocarpusdraco* L., which is mainly found in Jamaica. The name of dragon blood is depicted from an ancient Greek mythology called



'Indian cinnabar' dated back in the first century AD, while other source mentioned from an Indian legend describing a struggle between a hundred-headed dragon and an elephant, which resulted the mixing of the two creatures' blood with a magical substance and is attributed with strong medicinal properties [1]. Dragon's blood was originally produced from *D. cinnabari*, later on from *D. draco*, and recently from *Daemonorops* spp. as some of *Dracaena* sp. like *D. cochincinensis*, which usually inhabits the sunny cliffs with an elevation of 1,300–1,700 m asl is currently in extinction. In China, there are approximately 200,000 of *D. cochincinensis* left in the wild. Thus, since 1987 they have been put in the list as a national endangered species due to over exploitation or excessive collection [2].

Rattan is one of the most economically important non-wood forest products in South East Asia, and mainly used in the construction of diverse furniture as they are well-known for their strength, durability, forming elasticity and lightness. There are 115 species in the genus of rattan palms of *Daemonorops* sp. or 'jernang', although only 10% of them produce the red resin. *Daemonorops draco* (Willd.) Blume, *D. didymophilla*, *D. micracantha*, *D. motleyi*, *D. rubra* and *D. propinqua* are considered as the valuable sources. Particularly, the first three species are the most economically important due to their larger fruits and longer fructescences [1]. In South East Asia, the trees are distributed exclusively in Malaysia, Thailand and Indonesia. In Indonesia, the trees mostly grow well only limited to the western part of Indonesia including in the tropical rain forests of Sumatra, such as Aceh, Jambi, Riau and Bengkulu, and Borneo Islands [3].

In general, its application has been widely known in the traditional ancient chinese medicines for centuries as haemostatic agent, antidiarrhetic, antiulcer, antimicrobial and as anti-inflammatory (Figure 1). Particularly the dracorhodin, a natural biocompound which belongs to the anthocyanin family and distinguished as the valuable pharmacological substance for its antitumour and wound healing activity [2,4]. Besides, it is also applied in artistic applications in most of European churches in the 16<sup>th</sup> centuries as reverse glass paintings or so called *Hinterglasmalerei*; varnishing, or as red lacquer polish in most of expensive art works of furniture, violin or ceramics. It has also been applied as natural dyeing for clothes by some indigenous tribes of Borneo for its vivid color [5,6].

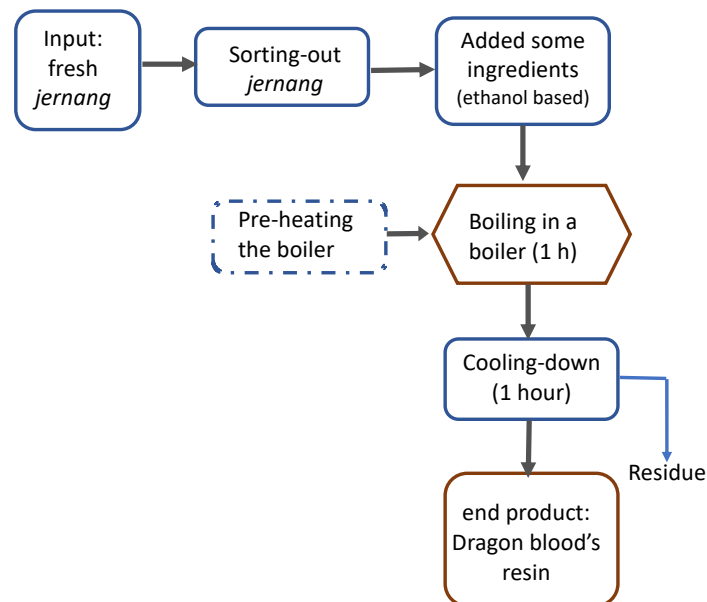


**Figure 1.** Performance of jernang (*Daemonorops* sp.). (A) Tree of jernang. (B) Jernang fruits at the tree branches. (C) Harvested fruits. (D) Jernang powder or dragon blood as primary raw materials applied in pharmacy and industry (DIA Aceh 2018).

Harvesting the seeds of *D. draco* has been served as traditional livelihood for some local tribes, *Suku Dayak* (in Borneo) and *Suku Kubu*, *Anak Dalam*, *Talang Mamak* and *Melayu Tua* mostly on Jambi Province (in Sumatra), and also regarded as quite profitable additional income for some local farmer. Its economic importance, however, has been realized more and more to a wider community

and not only limited to the local tribes mentioned above. An informal source mentioned that a local farmer could earn over IDR 700 million (local currency) or USD up to 45,000 per year on two hectares land. Such high income could be achieved as the plants do not require much agricultural inputs or special care in general.

The soil composition and physical environment of Aceh forests suit well for jernang to thrive. Therefore, jernang is regarded as one of valuable non-timber forest products (NTFPs) and admitted and classified as ‘excellent’ due to the extraordinary amount of dracorhodin (personal communication with F. Ismullah in 2018). Nevertheless, its resin extraction processing or methodology is still conducted in a very traditional way. Local farmer or tribes, principally, harvest the seeds in the pristine forest by picking them up with a special ‘hook’ or cutting down the branches solely instead of the ‘whole tree’ as they used to conduct it in the past. During the process, fruits are being separated physically, mixed with a special liquid from ethanol based, and then cooked for about one hour. After that, the red dragon’s blood resin obtained, is then dried under the sun after the removal of foreign matter, and formed into teardrop-shaped lumps (Figure 2).



**Figure 2.** Flow chart of jernang processing (DIA Aceh 2018).

## 2. The economic importance of jernang

No exact data of exported number of jernang from Aceh has been collected as most of farmer do not consider it as main income activity and many small companies are involved in the supply chain. Nevertheless, it is being estimated from an internet-based source that up to 5,000 kg of raw fruits are harvested monthly. Up to 400 tones of harvested fruits are further traditionally processed per year with a fixed selling price of only IDR 300,000–500,000 (USD 20–34)/kg. In contrast, the price of jernang resin in powder form (Figure 1D) or already processed could reach up to 10 times higher; depending on the quality of dracorhodin the price is within the range IDR 2.5–5.8 million or USD 167–387. For two decades, they are mainly exported to Singapore and China. The prices in the form of red powder could increase sharply if supply is limited. In a lower quality, a fixed price ranging from IDR 550,00–650,000 (USD 37–43) per branch of jernang is also being traded. A branch bearing many jernang fruits are also sold to local companies, which collect the fruits and further process them. One of them is CV Draco Industrial Agribusiness (DIA Group) which was founded and owned in 2014 by the second author ([http://djpen.kemendag.go.id/-membership/index.php/frontpage/product\\_detail/0/2498](http://djpen.kemendag.go.id/-membership/index.php/frontpage/product_detail/0/2498)). This company is located in Ulee Kareng, Aceh Besar and has been exporting up to 125

kg monthly or only a quarter of the total demand (500 kg). In order to reduce the supply gap, the company has set up its own nursery for growing seedlings and then sell the young plants to local farmers.

As jernang has become rare, the supply could only reach 10% from the market demand. Moreover, the common extraction method still needs to be enhanced in order to achieve a better quality by reducing the water content and at the same time increasing dracorhodin concentration in the powder (DIA Aceh 2018). Therefore, DIA Group has initiated a collaboration with the Faculty of Agriculture, Unsyiah which serves as a think-tank, provides the technical aspects' supports, e.g. analyzing the powder quality, including the interpretation of results delivered by the chromatography.

### 3. Conservation efforts

So far, many local tribes and farmers have only search and find jernang in the jungles. However, the population of jernang trees in the jungle has been decreasing due to deforestation or forest land use changes for other purposes. Thus, active harvesting has been not yet fully supported with proper practices because of wrong, general assumptions hold: (a) it is abundantly present, and therefore, people tend to destroy other neighboring plants when searching the plant deep in the forest, (b) it is naturally grown in the 'wild' and cannot be propagated and cultivated, and (c) the individual male trees are often considered as useless and should be completely cut down. This has made female plant difficult to propagate. Consequently, such inappropriate practice would lead to low genetic diversity in *D. draco* [3]. Unless significant conservation efforts being initiated, this plant might face extinction [6]. Over the past five years, many local farmers have initiated to purchase jernang seedlings from local breeder. The demand is relatively high as one farmer might need seedlings to be planted over a land, which is mostly owned by themselves, ranging from 10 up to 30 hectares.

As it was being highlighted before, DIA could only fulfill a quarter from the total demand inclusive from Aceh, which is about 500 kg monthly. In order to fulfill this, DIA has built partnership with some local farmers located in Aceh Jaya, Singkil and Aceh Tengah. The various aspects related with conservation efforts that have been managed are:

- i) Provision of small young plants to farmer with a lower price (IDR 30,000 instead of IDR 40,000).
- ii) Providing the farmer with a basic know-how in producing seedlings, this includes sharing the basic knowledge of artificial propagation techniques via plant tissue culture mostly from the root parts. The Ministry of Forestry in Jakarta through a program named 'Rumpin' has been initiated providing farmer with free seedlings started from last year.
- iii) Active campaign the importance of jernang's conservation linked with farmer's income. Approximately 20 farmers, who previously grew oil palm from Aceh Jaya and Singkil, have earned a higher income from jernang compared to oil palm. They are benefitted from more rapid revenue, that can be earned after 5–7 years waiting; less money spent for purchasing fertilizer and experienced less floods.
- iv) Active networking with a higher level such as: (a) lobbying the head of sub-district (*bupati*) of Singkil, for proposing *hutan di luar kawasan* with an area over 50 hectares along the local communities. This semi-protected forests will serve as legitimized conservation or sanctuary for jernang and other valuable wood trees, (b) actively involved in the Forum Group Discussion (FGD) in planning the conservation efforts with the National Ministry of Forestry, and (c) actively joining the discussion with the Ministry of Industry regarding the determination of national product standardization (SNI) of dragon blood's powder ready for exports starting from 2018.

These efforts are conducted with the intention that jernang can be further conserved and regarded as one of the most significant income source for local tribes and farmer.

### 4. Recommendation to stakeholders

Not all regions in Indonesia are the habitats of jernang. However, the plants are endemic in the seven regions of Aceh, namely Aceh Besar, Aceh Jaya, Southwest and South of Aceh, North Aceh, East Aceh, Aceh Tengah and Singkil (a sub-district located at the border between Aceh and Sibolga in

North Sumatra). Species like *D. draco* and *D. didimophylla* are mainly found specifically in Aceh Jaya and Singkil, respectively. These seven regions, particularly the highland regions of central Aceh in Gayo, are ecogeographically suited well with jernang's plant habits. Usually, the plants are found deeply in the forest in a cluster, and they are not evenly distributed. Over the past five years, the plants have become rare due to forest encroachment and diminishing area of jernang habitats in the forests [7] and these have led to the sharp increase of its price particularly, at the exported destination countries, China and Singapore.

This paper has briefly highlighted how local farmer harvest and conduct the processing method especially in Aceh. Here, we can conclude that most of the methodologies applied are very traditional and have not yet applied high-technology equipment in order to optimize the process as there have been no legal and relevant Standard Operational Procedure (SOP) applied. Moreover, it also mentioned the traditional three party conservation efforts of Aceh jernang, particularly in the provision of seedlings, technical supports by planting and nursery with various farmer groups across Aceh; coordinated and managed by DIA.

In the future, genetic conservation both morphologically or DNA-based marker of local jernang endemic to Aceh forests should be started immediately prior to their extinction. Moreover, an enhanced extraction method by applying advance separation techniques such as spectrophotometric based [8] and ultracentrifugation of harvested fruits, which enables higher yield and purity should be further promoted, especially in the form of competitive grant for local entrepreneur. Further, brand protection in the form of intellectual property right during the patented method should be also secured. Thus, this action should be also supported not only at the community level, but also from multi-stakeholders (higher education, researcher, local authorities and related governmental bodies).

## 5. Concluding remarks

The information of the current status of Aceh jernang (*Daemonorops* sp.) and their economic importance both to indigenous tribes and local farmer, as well as to local company such as DIA described in this paper will be useful for not only researchers and university academics, but also relevant stake holders. Despite of its positive contribution by the livelihood, unfortunately, this is not accompanied either with an enhanced processing methods in order to achieve higher product quality, noted with higher dracorhodin amount or well-managed conservation efforts for a long term. Some common practices that might worsen the existence of Aceh jernang have been also high-lighted.

## 6. Acknowledgement

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## 7. References

- [1] Gupta D, Bleakley B and Gupta R K 2007 Dragon's blood: botany, chemistry and therapeutic uses *J. Ethnopharmacol.* **115** 361–80
- [2] Fan J Y, Yi T, Sze-To C M, Zhu L, Peng W L, Zhang Y Z, Zhao Z Z and Chen H B 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** 10650–69
- [3] Asra R, Syamsuardi, Mansyurdin and Witono J R 2014 Genetic diversity of *Daemonorops draco* (Palmae) using ISSR markers *Biodiversitas* **15** 109–14
- [4] Shi J, Hu R, Lu Y, Sun C and Wu T 2009 Single-step purification of dracorhodin from dragon's blood resin of *Daemonorops draco* using high-speed counter-current chromatography combined with pH modulation *J. Sep. Sci.* **32** 4040–7
- [5] Baumer U and Dietemann P 2010 Identification and differentiation of dragon's blood in works of art using gas chromatography/mass spectrometry *Anal. Bioanal. Chem.* **397** 1363–76
- [6] Matangaran J R and Puspitasari L 2012 Potensi dan pemanenan buah rotan jernang *J. Silvikultur Trop.* **03** 65–70

- [7] Sulasmi I S, Nisyawati, Purwanto Y and Fatimah S 2012 The population of jernang rattan (*Daemonorops draco*) in Jebak village, Batanghari district, Jambi province, Indonesia *Biodiversitas J. Biol. Div.* **13** 205–13
- [8] Edwards H G M, De Oliveira L F C and Prendergast H D V 2004 Raman spectroscopic analysis of dragon's blood resins–Basis for distinguishing between *Dracaena* (Convallariaceae), *Daemonorops* (Palmae) and *Croton* (Euphorbiaceae) *Analyst* **129** 134–8