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Research Article

Production of Wood Varnish from Ambalau Resin of *Durio zibethinus* (Murr.): A Preliminary Study

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Abstract

Background and Objective: The resin that is naturally synthesized from the bark of the *Durio zibethinus* (Murr.) plant can be used to prepare the wood varnish. In this study, efforts were made to characterize the Ambalau resin that use to produce the wood varnish and assessed its quality. **Materials and Methods:** The research design of this study was exploratory research design. The properties of extracted Ambalau resin were analyzed and compared with that of Agathis dammara resin as the commercially available resin for varnish production. Moreover, the qualities of produced varnish were also further analyzed and compared with the common standard for wood Varnish. **Results:** As the results, the Ambalau resin as the raw material of varnish has similar properties compared to Agathis dammara but lower in softening point. The varnish produced from Ambalau resin had also met the quality parameter of wood varnish according to the International Standard for wood Varnish, despite the improvement of a better drying time need to be considered. **Conclusion:** Naturally synthesized resin from *Durio zibethinus* (Murr.) bark has been discovered to have basic characteristics for the production of wood varnish with further studies.

Key words: Ambalau, durian, resin, quality, wood varnish

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The varnish is a substance that important for wood protection and decoration. The application of varnish for wood protection is indispensable in Indonesia. Due to the large threat of earthquakes, wood has become the preferred material for construction as well as wood furniture. Unfortunately, wood is susceptible to environmental factors just like other biological materials¹⁻³. Surface treatment of wood with proper substances and impregnation has been suggested among the effective methods to decrease the negative effect of weathering on wood^{4,6}. The application of varnish is the easiest and most common method for protecting wood against natural weathering⁷. Therefore, the study on varnish production is very applicable to support human life.

Varnish can be produced from both natural and synthetic resins. The utilization of synthetic resin derived from fossils has become the main material for commercially wood varnish. Recently, intense efforts are being made to replace fossil resources due to their limited sources and the adverse effects to the environment and humans. The utilization of natural resin has become an alternative solution that offers energy and a variety of chemicals suitable for the synthesis of many materials and products⁸.

The natural resin can be obtained from the bark of tree. Bark is a residue from a wood process without prior suitable application. It has been found that the bark of some tree species is rich in resin which can be extracted and used as raw material in the manufacture of varnishes. To the best of our knowledge, very few studies have studied the production of varnishes from natural materials which may be due to limited raw materials.

In Asian countries, Durian (*Durio zibethinus* Murr.) is an important seasonal plant with a very large distribution^{9,10}. Local people in Indonesia have recognized that Durian bark has been producing a resin called "Ambalau". This resin has not explored yet which it might be has the potentiality to be developed as the raw material for varnish production.

In this study, the effort to produce varnish from the resin from Ambalau resin had conducted. The objective of this study was to characterize the properties of varnished from Ambalau resin and compared to the commercial ones. The findings of this study will be used as preliminary data for the production the varnish from Ambalau resin commercially.

MATERIAL AND METHODS

Study area: The study was carried out during July, 2019 to March, 2020. The study was conducted at the laboratory of crop processing engineering, Department of Crop Technology, Andalas University.

Parameters: The "Ambalau " as the natural resin of durian bark obtained from the local farmer at West Sumatra Indonesia. The preliminary measurements as solubility, moisture content, ash content, density and softening point of Ambalau resin were done according to the method described in Pethe and Joshi¹¹.

Research procedure: For varnish preparation, 15 g of the resin were ground and subsequent sieved. The material that passed a 40-mesh standard sieve was collected and was diluted with organic solvent such as methanol, ethanol and acetone with the ratio (3/7). The mixture was stirred vigorously and carefully for 3 hrs at a temperature of 70°C. The resulting viscous solution was cooled to room temperature to obtain the wood varnish. This solution was stored in a tightly covered bottle. The drying time and physical properties such as color, density and viscosity were tested for following the method described on the International Standard Analysis method.

Gas chromatography: The volatile compounds in the varnish were also analyzed by using gas chromatography method by using mass spectrometer detection¹².

RESULT AND DISCUSSION

Table 1 indicates the solubility of Ambalau natural resin in various organic solvents. This information would guide the application of Ambalau natural resin whether can be further utilized to produce natural varnish. In this experiment, methanol and ethanol were used as the representative of polar solvent, acetone as a semi polar solvent and hexane as a non-polar solvent. The obtained data indicated that the solubility of Ambalau resin was predominant in semi-polar and polar organic solvents with the value of more than 90 g/100 mL (90%). However, the solubility of Ambalau resin in hexane was only 10 g mL⁻¹ which mean it could be categorized as a low solubility¹³. It can be suggested that the main compound of Ambalau natural resin consist of organic polar to semi-polar compounds. This result might guide that the prefer extraction system for

Table 1: Solubility of Ambalau natural resin in various organic solvents

Solvent	Solubility (g/100 mL)
Hexane	10.8
Acetone	91.3
Ethanol	92.3
Methanol	91.9

Table 2: Physical properties of natural Ambalau resin

Properties	Unit	Ambalau resin	Agathis dammara resin
Moisture content	%	1.79	0.65-7.02
Ash content	%	0.41	0.01-6.17
Softening point	°C	67-68	88-126

further varnish production from Ambalau natural resin is by utilizing polar or semi polar organic solvents.

Recently, in Indonesia, the natural resin of *Agathis dammara* has been recognized as the source of natural varnish commercially. Therefore the results of this study were compared to the characteristic of the natural resin of *Agathis dammara* and its derived varnish. Table 2 indicates the physical properties of natural Ambalau resin. For the proximate properties such as moisture and ash content, the Ambalau resin was quite similar as *Agathis dammara* resin. However, for the softening point, the Ambalau resin has a lower value compared to *Agathis dammara* resin. The softening is the basic parameters that relate to the properties of produced varnishes. This point is related to the drying time of varnishes which indicated the aldehydes content in the resin¹⁴. The higher softening point would lead the faster drying point of the varnishes product. Although the Ambalau resin indicated lower softening further quality observation of varnish from Ambalau resin should be conducted.

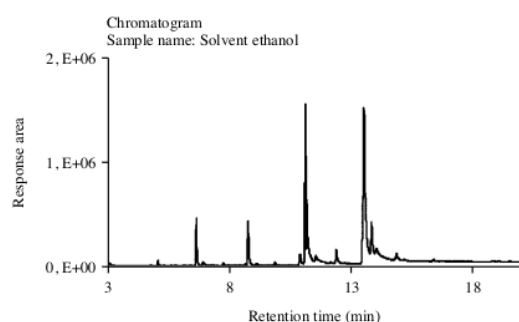
The desirable characteristics of varnish appearances in slightly viscous substances and yellowbrown colored varnish could be achieved. The appearance of produced varnish of three utilized solvent seemed similar to each other (Fig.1a-c). Table 3 shows the quality parameters of produced varnished from Ambalau resin. The observations were done for each extraction solvent (methanol, ethanol and acetone). Based on the results, it can be indicated that the varnish from Ambalau resin has met the standard parameter of wood varnish¹⁵. In addition of the viscosity, density and color parameters of varnish from Ambalau resin that met the quality standard of wood varnish, the main concern to indicate the quality of varnishes is shown by the volatile compound percentage and the drying time. The varnish from Ambalau resin that solved in polar solvents such as methanol and ethanol indicated the volatile compound percentage more that 65%. Although in acetone solution, the volatile compound percentage of produced varnish less than 65%, some further formula improvement could overcome this condition. Based on the



Fig. 1(a-c): Appearance of produced varnish from Ambalau resin extracted with (a) Methanol, (b) Ethanol and (c) Dan acetone

drying time, the time period for the Ambalau resin varnish to dry was less than 10800 sec for all solvents. The drying time is the most important quality of varnish where the desire of drying time is about 7200 sec¹⁶. In this study, although the drying time met the quality requirement, however, the observed drying time was too fast. Therefore further development on the production of varnish from Ambalau resin need to be considered. The utilization of retarder to prolong the drying time should be conducted further.

Figure 2 indicates the Gas Chromatography-Mass Spectrometry (GCMS) chromatogram of organic compounds contained in the varnish derived from Ambalau resin that was soluble in ethanol solvent. The organic compounds identified by using mass spectrometric analysis. The utilization of mass



No.	RT	Compounds name	Area	m/z	Similarity index (%)
1	6.67	Cyclotetrasiloxane	50139.7	483	95
2	8.54	Benzene	50212.7	78	95
3	10.43	Dodecane	21236.5	171	94
4	10.65	Tetradecane	146283.8	199	95
5	10.97	Disilicic acid	20031.2	174	93
6	12.6	Cyclopentasiloxane	31032.4	231	95
7	13.4	6-Octenal	139281.7	127	97
8	13.8	Cyclohexasiloxane	32076.2	445	95
9	14.0	Cyclopentasiloxane	27232.5	231	95

Fig. 2: GC MS chromatogram of ethanol-soluble Ambalau resin

Table 3: Quality parameters of produced varnished from Ambalau resin

Parameter	Methanol	Ethanol	Acetone	Varnish quality parameters
Volatile compound percentage (%)	65.02±0.87	65.20±1.03	56.99±1.49	0.65
Drying time (sec)	271.33±8.08	334.67±10.26	139.33±3.05	0.10800
Density (g mL ⁻¹)	0.8929±0.001	0.8920±0.0009	0.9066±0.004	0.880
Viscosity (Poise)	0.0827±0.004451	0.0841±0.005865	0.1027±0.002754	0.06-0.07
Color (hue value)	70.6±1.35	69.8±0.8	69.1±0.79	-

spectrometer has recognized as a suitable tool to identify the name of unknown organic compound in natural product materials^{17,18}. It can be shown that most of the compounds as the hydrocarbons that classify as alkane, aldehyde, organic acid and volatile organic compounds. The identification of these identified compounds was according to the comparison of detected m/z of peak chromatograms with the data bases in GCMS library. In this measurement, the database of National Institute Standard and Technology (NIST) that having more than 62,000 patterns was used as a library of GCMS data base. For example, there was a detected peak at retention time of 13,4 min where the peak has m/z as 127. In the mass spectrometry analysis, the m/z of 127 was then fragmented and the fragmentation would be compared automatically to the data bases of many organic compounds in the internal library. As the result, the name of detected peak would be classified according to the highest similarity index between the detected fragmentation and databases. The peak was identified as 6-octenal due the highest similarity index compared to others. Generally, the similarity index value of 90 is reliable¹⁹. These identified organic compounds may relate

to the quality properties of the produced varnish. For development of friendly varnish products, the characteristic of hydrocarbons and volatile organic compounds are essential parameters that need to be further investigated^{20,21}.

Overall, the result of this study could enhance the utility of *Durio zibethinus* (Murr.). Although many studies have conducted to explore the utilization of *Durio zibethinus* (Murr.) for development of natural resources diversity of food and non-food products^{10,22,23}, there are no reports that focused on the potentiality of the bark's resin of *Durio zibethinus* (Murr.). The utilization of natural resin has been recognizing as a potential source as the material of wood varnish^{8,24}. Therefore, strong efforts on experimental activity were performed in order to investigate the characteristics of varnish from Ambalau resin that derived from *Durio zibethinus* (Murr.) in this study. This is the first effort that could provide the valuable data on the production of wood varnish from Ambalau resin. Although some parameters need to be improved for better quality, the presented results might guide the researcher or practitioners to further develop the practical technology for production of varnish from natural resources.

8 The identification of the compounds employed in applicable wood varnish provides valuable information for both the knowledge of researcher, practitioners and commercial user. In particular, identification of terpenoid and fatty acids composition are important for improving the quality of produced varnish^{25,26}.

1 CONCLUSION

It can be concluded that varnish with considerable qualities can be produced from the natural Ambalau resin obtained from the bark of *Durio zibethinus* (Murr.). This result could become the basic data to utilize the natural resource of Ambalau resin as an alternative solution that offers a chemical suitable for the production of beneficial products. Furthermore, the utilization of additional ingredients to improve the quality property such as drying time should also be considered.

SIGNIFICANCE STATEMENT

This study discovered the potentiality of Ambalau resin for the development of wood resin. This result can be beneficial for industries that utilize the raw material from natural resources. This study will help the researchers to further develop the production varnish derived from natural resins that many researchers were not able to explore.

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