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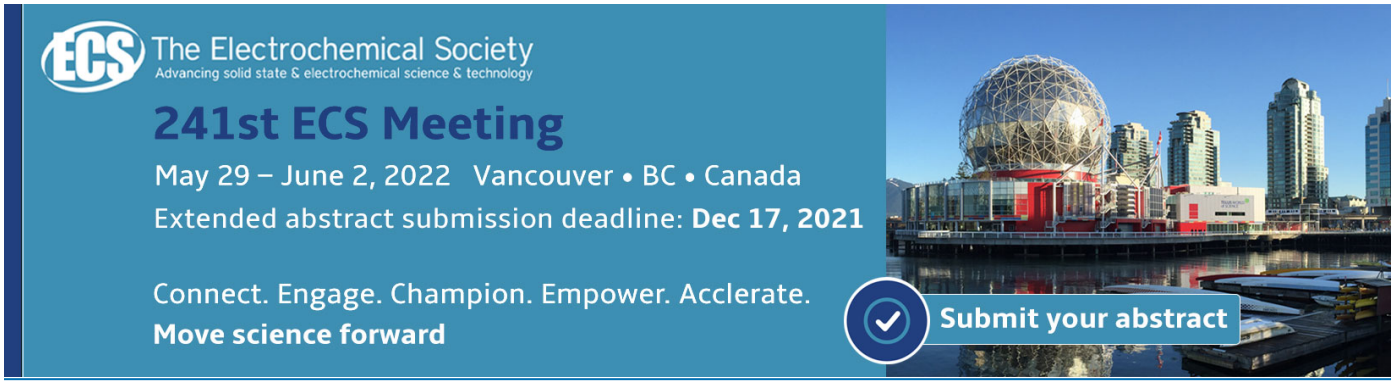

Potential of *Goniothalamus velutinus* wood for agri-food industry

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Abstract. *Goniothalamus velutinus* is from the family of annonaceae and it is native to Borneo. It is also known as "kayu tas" or "kayu hujan panas". This type of wood is rarely encountered and also hard to find in the forest. It grows in the shady primary rainforest of tropical Asia, and approximately 160 species of this genus have been discovered. This plant is also known to have anti-cancer, anti-tumour and many other bioactivities. In this study, the *Goniothalamus velutinus* wood's potentials were explored for the agri-food industry. The objectives of this study are to determine chemical composition of *Goniothalamus velutinus* and the functional group of two samples which are male tas (MT) and female tas (FT). The chemical compositions were determined by the Technical Association of the Pulp and Paper Industry (TAPPI) method, and the functional group analysis were determined by Fourier Transform Infra-red Spectroscopy (FT-IR). The results shows that male tas (MT) showed a higher chemical composition compared to the female tas (FT) such as for extractive; 4.73% and 2.21%, Holocellulose; 92.19% and 88.96%, Cellulose; 57.02% and 55.88%, Hemicellulose; 35.16% and 33.08%, Lignin; 27.48% and 34.46%, respectively. These chemical compositions have good potential for the food sector. For FT-IR analysis, the results revealed five different functional groups related to which chemical composition in the sample, especially cellulose.

1. Introduction

Goniothalamus velutinus is a species from the family Annonaceae, and it is native to Borneo. This wood is a rare species and hard to find in the forest. It is also known as "kayu tas" or "kayu hujan panas [1]. This species also has several names according to the region such as "Kayu Penunduk" and "Kayu Limpanas".In the Peninsular Malaysia, this species can only be found in particular forest areas such as Kelantan, Perak and Terengganu. Abroad, it has been called by the name of God Mountain Stick [2]. *G.velutinus* is a small tree up to 6 m in height.

The young shoots are densely dark-rusty velutinous. The leaves are oblanceolate in shape, rotundate base, papyraceous and covered with dark-rusty hair. The leaves also have unique properties that are distinctive [3]. It was believed that when the leaves are burned, the smoke can repel evil

elements. The indigenous people believe that this species can move rain to other places by burning the wood three times. By drinking water from the boiled tree root, it can also treat people. The roots of the tree can also treat people. The roots will be boiled in water, and the water will be drunk. It is also claimed that the roots could revitalize and strengthen the inner body. It can also treat abdominal pain [4]. The research of *G.velutinus* wood is lack in being publish scientifically. The stories about this magical wood are only told via blogs and oral stories. Therefore, this scientific study is conducted to find the chemical composition and functional group of this wood species in order to determine its potential towards the agri-food industry.

2. Materials and Methods

In this research, two types of *Goniothalamus velutinus*,as shown in Figure 1, were used. Locals believe that this species can be distinguished into two parts, male and female. It can be differentiated through the colour of the bark and its scent. The colour of the bark for the male is darker, while the female is lighter in colour. The smell of the male is similar for both Peninsular and Borneo [4]. However, it is different for the female. In Borneo, the female has the scent of a fragrant aroma like the smell of spices compared to the peninsular samples, labelled with female tas (FT) and male tas (MT).

Figure 1. *Goniothalamus velutinus;* a-female tas (FT); b-male tas (FT).

2.1. Soxhlet extraction of Goniothalamus velutinus wood

Goniothalamus velutinus was oven-dried at 105 ± 2 °C for 24 hours, then chipped and ground to produce powder before undergoing the extraction process [5]. The samples were ground, and 40-50 mesh fractions were selected to get the extractive [6]. The extractives were kept in the fridge for further use.

2.2. Chemical composition analysis of Goniothalamus velutinus wood

The chemical composition analysis was performed according to TAPPI standard test method T264 om-88. The samples were first submitted to Soxhlet extract with ethanol/toluene (2:1 (v/v)) for 6 hours [7]. The cellulose and lignin were determined by using T212 om-93, T203 os-74, and T211 om-93, respectively. Holocelulloses were determined as reported in a previous study by Lim & Gan [7].

2.3. FT-IR analysis of Goniothalamus velutinus wood

Fourier Transform Infrared (FTIR) spectroscopy, Nicolet Avatar 360, (USA), was used to examine the functional group's presence in the extractive of *Goniothalamus velutinus* wood. Perkin Elmer spectrum 1000 was used to obtain the spectra of each sample. FT-IR spectra of each sample were obtained in the range of 4000-400 cm^{-1}. Spectral outputs were recorded in the transmittance mode as a function of wave number [8].

3. Results and Discussion

3.1. FT-IR analysis of Goniothalamus velutinus wood

The FT-IR spectrums of *Goniothalamus velutinus* wood are shown in Figure 2. The most important O-H stretching in the hydroxyl group was assigned to the 3330-3368 cm^{-1} region. The broad peak is an intermolecular association absorption peak near 3300 cm^{-1}. The analysis revealed five different types

of functional group, as shown in Table 1. The result of FTIR peak value, and functional groups and the types of polymer are tabulated in Table 2.

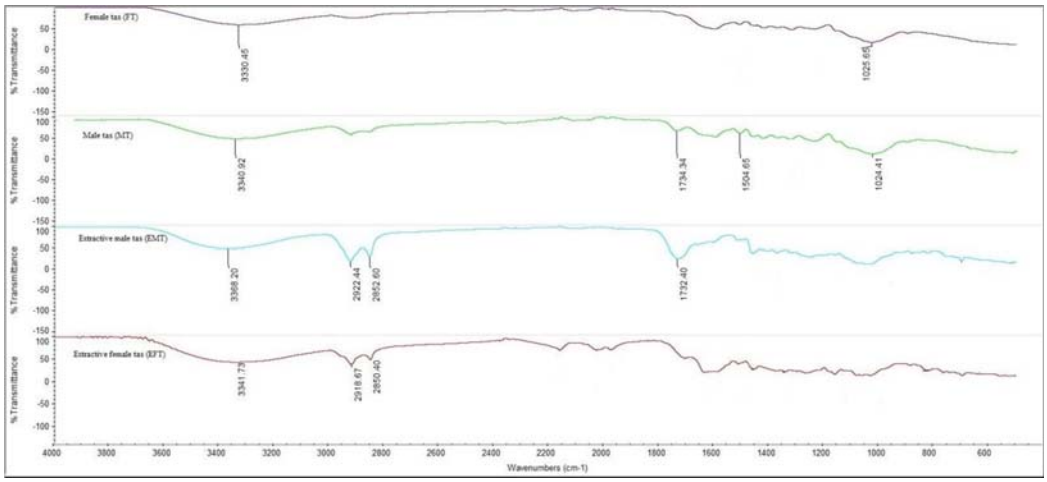

Figure 2.The FT-IR spectra of male tas (MT), female tas (FT), extractive male tas (EMT).

Table 1. FTIR peak values with five different types of functional group.

	Stretching vibration and wavenumber (cm^{-1})				
	O-H stretching	C-H stretching	N-O stretching	C=O stretching	C-O stretching
Female Tas (FT)	3330 cm^{-1}	-	-	-	1025 cm^{-1}
Male Tas (MT)	3340 cm^{-1}	-	1504 cm^{-1}	1734 cm^{-1}	1024 cm^{-1}
Extractive male tas (EMT)	3368 cm^{-1}	2922 cm^{-1} 2852 cm^{-1}	-	1732 cm^{-1}	-
Extractive female tas (EFT)	3341 cm^{-1}	2918 cm^{-1} 2850 cm^{-1}	-	-	-

Table 2. FTIR peak values and functional groups of *Goniothalamus velutinus* wood.

Wavenumber (cm^{-1})	Stretching Vibration	Compound class	Type of polymer
3330, 3340, 3368, 3341	O-H stretching	Alcohol	Polymer [9]
2922, 2852, 2918, 2850	C-H stretching	Alkane	Polymer [9]
1504	N-O stretching	Nitro compound	Lignin [9]
1732, 1734	C=O stretching	Aldehyde	Oil, cellulose and hemicellulose [9]
1024, 1025	C-O stretching	Alcohol	Cellulose and hemicellulose [9]

Table 3 shows the list of matches in *Goniothalamus velutinus* wood. The index matches show that the cellulose and lignin compounds are higher in male tas (MT) with 68.4% compared to female tas (FT) with 67.46%. In extractive male tas (EMT) and extractive female tas (EFT), the cellulose and lignin compound did not appear in index match [8]. This is because the extractives are extraneous components in wood, which means substances other than cellulose, hemicelluloses, and lignin [10].

Table 3. List of matches in *Goniothalamus velutinus* wood.

Sample	Index	Match (%)	Compound name
Male tas (MT)	103	68.40	Cellulose + Lignin
Female tas (FT)	103	67.46	Cellulose + Lignin
Extractive male tas (EMT)	-	-	-
Extractive female tas (EFT)	-	-	-

3.2. Chemical compositions of Goniothalamus velutinus wood

Figure 3 shows the chemical composition of *Goniothalamus velutinus* wood for MT and FT species including the percentage of extractive, holocellulose, cellulose and lignin. MT displayed a higher chemical composition compared to the FT, as shown in Figure 3, for extractive; 4.73% and 2.21%, Holocellulose; 92.19% and 88.96%, Alpha cellulose; 57.02% and 55.88%, Hemicellulose; 35.16% and 33.08%, Lignin; 27.48% and 34.46%.

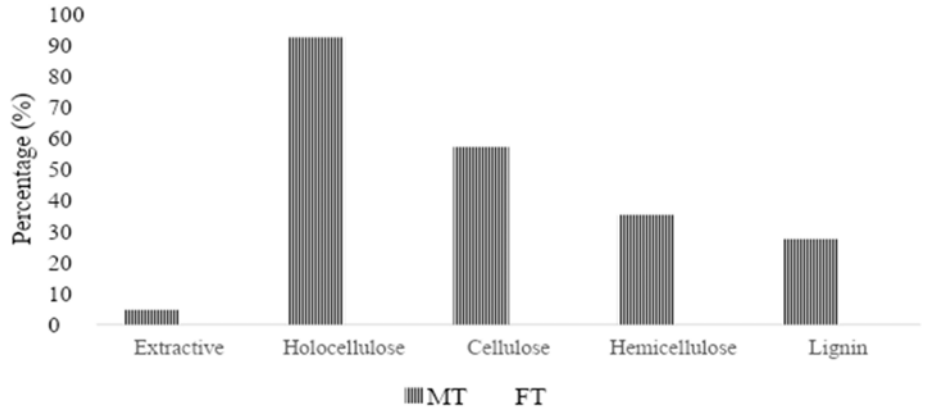

Figure 3. Chemical composition of male tas (MT) and female tas (FT).

Table 4. List of chemical composition in *Goniothalamus velutinus* wood for food usage.

Chemical composition	Uses in food
Extractive	Functional properties for food stuff such as for antioxidant, texturizer, etc. [10].
Hollocellulose	Carbohydrate portions with the combination of cellulose and hemicellulose with minor amount of starch and pectin [11].
Cellulose	Thickening/emulsifying. When combined with water, the gelling action of cellulose provides both thickening and stabilizing qualities in the food to which it is added [12]. Cellulose gel acts similarly to an emulsion, suspending ingredients within a solution and preventing water from separating. Cellulose is often added to sauces for thickening and emulsifying action [13].
Hemicellulose	As a food additive, added fibre, thickener, emulsifier or stabilizer [14].
Lignin	Therapeutic [15]. Rich in antioxidants, antimicrobial, anti-carcinogenic, anti-diabetic properties [16].

Each chemical composition can be used for a particular purpose in various sectors of activities. It can be used as an antioxidant, emulsifier, and texturizer in food. These compositions can also be used for processing aids, additives in pharmaceutical for therapeutic properties for preventive or curative. The uses of each chemical content are tabulated in Table 4.

4. Conclusion

The results show that *Goniothalamus velutinus* male (MT) species has high chemical compositions compared to *Goniothalamus velutinus* female species (FT). This finding is valuable, particularly for specific purposes in the agri-food industry. The high chemical compositions, mainly cellulose content, may be of great benefit to the industry. This is due to the fact that substances useful for the food industry such as thecco/emulsify, fibre-supplement, calorie reducer and anti-caking agent can be produced with high cellulose content plant.

Acknowledgements

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References

[1] Chatrou L W, Pirie M D, Erkens R H J, Couvreur T L P, Neubig K M, Abbott J R, Mols J B, Maas J W, Saunders R M K and Chase M W 2012 A New Subfamilial and Tribal Classification of the Pantropical Flowering Plant Family Annonaceae Informed by Molecular Phylogenetics *Botanical J. Linnean Soc., London* **169** 5–40

[2] Waterman P G 1984 Chemistry of the Annonaceae Structures of uvarindoles A—D, four new benzylated indole alkaloids from Uvaria angolensis *J. Chem. Soc., Cambridge* **19** 1280–81

[3] Cronquist A 1981 An integrated system of classification of flowering plants. *New York: Columbia University Press* 1262

[4] Lian G E C 1996 Larvicidal Principles From Some lnsecticidal Plants of Sarawak *Doctoral dissertation*, Universiti Malaya

[5] Soxhlet F 1879 Die gewichtsanalytische Bestimmung des Milchfettes, *Polytechnisches J. Dingler's* **232** 461

[6] Javad S R, Seyedeh M H A, Abdolhossein M, Majid S R, Leila S, Marzieh S R, William N S, Masoumeh H, Mehdi S R and Mehrad R 2015 Phytochemical analysis, antioxidant and antibacterial activities of various extracts from leaves and stems of *Chrozaphora tinctoria Environ. Experimen. Biol.* **13** 169–75

[7] Sitti Fatimah M R, Sulaiman O, Hashim R, Hamid Z A A, Arai T, Kosugi A and Murata Y 2019 Chemical characterization from parenchyma and vascular bundle at different parts of oil palm trunk *AIP Conf. Proc.* 2068. 020039. 10.1063/1.5089338

[8] Omar S, Sitti Fatimah M R, Mohd Adenam N, Mohamad Rawi N F, Che Zaudin N A, Hamid Z A A and Ibrahim N I 2020 Functional group *Cinnamomum porrectum* wood extractives by Fourier Transform Infrared *IOP Conf. Series: Earth Environ. Sci.* **596**

[9] Juliana D O L, Rosilei A G, Natalia D D S 2018 Infrared spectroscopy of the surface of thermally-modified teak juvenile wood *Maderas Ciencia y technol.* **20** 737–46

[10] Murata Y, Kubob S, Togawa E, Sitti Fatimah M R, Sulaiman O, Hashim R, Ibrahim W A, Kosugi A, Hirooka A and Abe H 2015 Detection of vascular bundles using cell wall birefringence on exposure to polarised light *Indust. Crops Products* 190–97

[11] Razali S M, Yusoff M, Sitti Fatimah M R, Bhat I U H, Iman A H M and Razali M H 2016 The potential of *Donax grandis* hypodermal fiber as reinforcement in starch-based composite *J. Polym. Mater* **33** 677–84

[12] Diego M S O and Cristina C 2018 Cellulose Application in Food Industry: A Review *IGI Global*

[13] Nicholas H 2006 Cellulose for medical applications: Past, Present, and Future *Bioresources*

[14] Iuliana S V and Popa I 2008 Chapter 13 - Hemicelluloses: Major Sources, Properties and Applications *Monomer, Polymer and Composites from Renewable Resources*

[15] Rajeev B 2020 Application of Lignin in the Agri-Food Industry *Springer Link*

[16] Boon J G, Hashim R, Sulaiman O, Sugimoto T, Sato M, Salim N, Amini M H M, Nor Izaida I and Sitti Fatimah M R 2017 Importance of lignin on the properties of binderless particleboard made from oil palm trunk *ARPN J. Engin. Appl. Sci.* **12**