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Functional group *Cinnamomum porrectum* wood extractives by Fourier Transform Infrared

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Abstract. Extractive from *Cinnamomum porrectum* wood was obtained using Soxhlet extraction with five different types of solvent, which are distilled water, ethanol, acetone, chloroform, and benzene. From the result, ethanol extraction shows the highest extractives yield which are 2.692%, following by acetone (1.461%), chloroform (0.940%), benzene (0.109%) and distilled water (0.005%). Extractive make a major contribution to the characteristics of wood or non-wood species. These extractives are low-molecular weight compounds, and the different classes of extractives have different chemical behaviours. In this study, the FT-IR was used to analyse the extractive of the *Cinnamomum porrectum* wood with ethanol, distilled water, chloroform, benzene and acetone. From the result shows that, the analysis revealed 5 different types of functional group which are O-H stretching in presence of phenolic group, C-H stretching in presence of alkane group, C-F stretching in presence of alkyl halide group; C-O stretching in presence of aldehyde group and C=C stretching in presence of alkene group.

1. Introduction

Extractives are extraneous components in wood, which means substances other than cellulose, hemicelluloses, and lignin. They do not contribute to the cell wall structure and are soluble in neutral solvents [1]. Extractives are a variety of organic compounds including fats, waxes, alkaloids, proteins, simple and complex phenolics, simple sugars, pectins, mucilages, gums,resins,terpenes, starches, glycosides, saponins, and essential oils. Many of these functions as intermediates in tree metabolisms, as energy reserves, or as part of tree's defense mechanism against microbial attack [2][3]. Mostly these extractive components contribute to wood properties such as colour, odor, and decay resistance. In this study extractive of *Cinnamomum porrectum* were investigated.

Cinnamomum porrectum is Family of Lauraceae. This Family is distributed in tropical and subtropical regions but mostly in tropical South East Asia and tropical America. In Malaysia, it is known as 'Medang Kemangi'[4]. This tree is resistant to insect attack because of its pronounced and persistent smell. This tree is important as sources of medicine, nutritious fruits, perfumes and spices. This species especially on part of the bark and leaves are commonly used as spices in the home kitchen and the synthetic analogs or distilled essential oil are used as flavouring agents in the food and beverage industry [5]. From the previous study [6] this tree has been shown the good antifungal activity. However, the information of extractive contains in compound of *Cinnamomum porrectum* is lacking.

2. Materials and Method

2.1. Materials

Glassware and apparatus like beaker, Soxhlet extractor, Bunsen burner, cork borer and the autoclave ware obtained from Universiti Malaysia Kelantan (UMK). Reagent as ethanol, acetone, chloroform, benzene, and *Cinnamomum porrectum* wood obtained from local suppliers.

2.2. Soxhlet extraction of Cinnamomum porrectum wood

Wood of *Cinnamomum porrectum* was oven-dry in the oven at 105 ± 2 ^{0}C for 24 hours. Then the wood was chipping and grinding to produce powder form. Then, the sample were undergoing extraction process by Soxhlet extractor by adding the 15g of the wood powder into thimble [7][8]. Five different types of solvent were used which are distilled water, ethanol, acetone, chloroform and benzene respectively with volume 250ml in each flask.

Then the yield of extraction was calculated with the *Eq.* 1.

$$Percentage\ (\%) yield = \frac{weight\ of\ wood\ extract}{weight\ of\ wood} \times 100 \ldots\ldots Eq.1$$

2.3. Fourier Transform Infrared Spectroscopy (FTIR)

Fourier Transform Infrared (FTIR) spectroscopy, Nicolet Avatar 360, (USA), was used to examine the functional group present extractive *of Cinnamomum porrectum* wood. Spectra present of each sample was obtained by Perkin Elmer spectrum 1000. 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. [9].

3. Result and Discussion

3.1. Percentage of extractives of Cinnamomum porrectum wood

The result of the extractives shows that ethanol has a highest yield extractive contains as shown in Figure 1 with 2.692% compare to others. It followed by acetone (1.461%), chloroform (0.940%), benzene (0.190%) and distilled water (0.005%). Ethanol highest in percentage yield because of the polar molecule due to its hydroxyl (OH) group, with the high electronegativity of oxygen allowing hydrogen bonding to take place with other molecules. High in electronegativity of oxygen allowing hydrogen bonding to take place with other molecule. Thus, because of its very polarity and electronegativity of oxygen allowing it to attracting more substance from the wood of *C. porrectum* compare to other solvent.

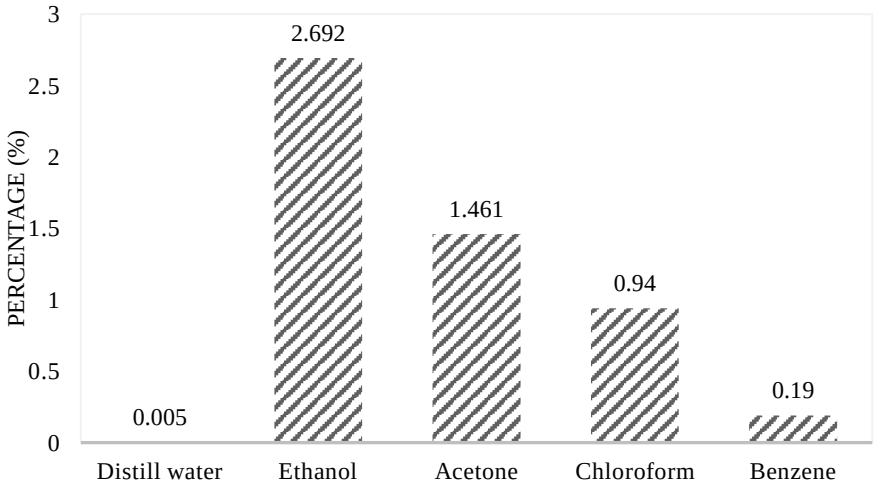

Figure 1. Percentage of extractives contains in *Cinnamomum porrectum* wood

3.2. Analysis FT-IR of Cinnamomum porrectum wood extract

The FT-IR spectrums of wood extractives from five type of solvent extractions is shown in Figure 2. The most important O-H stretching in hydroxyl group was assigned to the 3354-3404 cm^{-1} region. The broad peak is an intermolecular association absorption peak near 3300 cm^{-1}. The analysis revealed 6 different types of functional group.

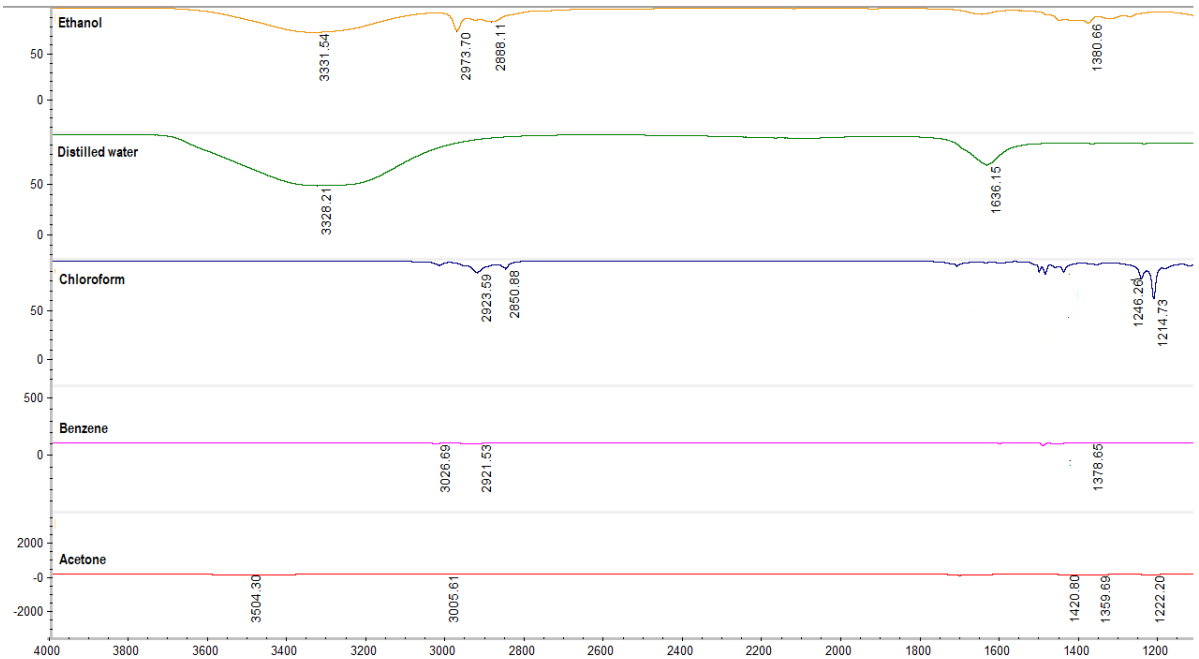

Figure 2. The FT-IR spectra of *Cinnamomum porrectum* wood with ethanol, distilled water, chloroform, benzene and acetone

Ethanol: At 3331 cm^{-1}, 2973 cm^{-1}, 2888 cm^{-1}, 1380 cm^{-1}, were O-H stretching in hydroxyl group, C-H stretching, C-H stretching, C-F stretching; C-H stretching respectively.

Distilled: At 3328 cm^{-1}, 1636 cm^{-1}, were O-H stretching in hydroxyl group, C=C stretching, respectively.

Chloroform: At 2923 cm^{-1}, 2850 cm^{-1}, 1246 cm^{-1}, 1214 cm^{-1}, were C-H_2 stretching, C-H_2 stretching, C-F stretching; C-O stretching, respectively.

Benzene: At 3026 cm^{-1}, 2921 cm^{-1}, 1378 cm^{-1}, were C-H_2 stretching, C-H bending, respectively.

Acetone: At 3504 cm^{-1}, 3005 cm^{-1}, 1359 cm^{-1}, 1420 cm^{-1}, 1222 cm^{-1}, were O-H stretching in hydroxyl group, C-H_2 stretching, C-H bending, C-H bending, C-F stretching respectively.

These results of FTIR peak value and functional groups along with the biological roles are tabulated in Table 1.

Table 1. FTIR peak values and functional groups in leaves of Cinnamomum porrectum wood

Stretching Vibration	Specific Functional Groups	Relevant Chemical Compounds	Uses / Importance (References in Superscripts)
O-H stretching	Phenolic group	Aromatic compound	Helps in defence and used as disinfectant [10]
C-H stretching	Alkanes	Aliphatic compound	Major component of fuel, used as antiseptic [10]
C=C stretching	Alkene	Aliphatic compound	Used in fruit ripening [10]
C-F stretching	Alkyl halide	Alkyl halide	Enhance bioactivity through both steric and electronic effects; used as refrigerants and propellants [10]
C-O stretching	Alcohols, carboxylic acids, esters, ethers	Acid, Alcohol	Important component of some commonly used food [14]

Phenolic compounds play important role in plant lignin biosynthesis and development. Phenolic are aromatic benzene ring compounds with one or more hydroxyl groups produced by plants mainly for protection against stress and pathogen attack [11]. However, phenolic rich plants are good source of antimicrobial agents. Thus, presence of phenolic in any plant sample indicates it as a potent source of therapeutic agents for different human disorders. The antioxidant properties of phenolic in *Cinnamomum porrectum* has already been proved in earlier studies [6].

Presence of alkenes in *Cinnamomum porrectum* shows that this sample having biochemical of alkene group is used as an antiseptic for external use. Presence of alkene group in this sample indicates it might have those good properties. Alkanes, on the other hand are present in plenty in more or less all biological organism. It confers ecological and metabolic functions by proving source of carbon and energy [10].

4. Conclusion

Ethanol extract shows that highest percentage of extractive on *Cinnamomum porrectum* wood compare to others solvent. The biochemical of *Cinnamomum porrectum* wood generated by FT-IR technique which is very unique and therefore useful as a standard in quality control of the plant drug in its crude form. By attaining IR spectra from *Cinnamomum porrectum* wood, it might be possible to detect the minor changes of primary and secondary metabolites. Further advanced phytochemical studies with this *Cinnamomum porrectum* wood will explore its phytochemical potential and pharmaceutical implications.

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References

[1] Taya, M., I.&II, S., and Kobayashi, T (1985).Monitoring and control for extractive fermentation of Clostridium acetobutylicum. J. Ferment. Technol., **63**, 181-187.

[2] Rowell, R.M., and Konkol, P. (1987). "Treatments that enhance physical properties of wood," FPL, General Technical Report FPL-GTR-55,pp.12.

[3] Gierlinger N, Jacques D, Schwanninger M, Wimmer RP, Paˆques LE (2004a) Heartwood extractives and lignin content of different larch species (Larix sp.) and relationship to brown-rot decay-resistance.

[4] Phongpaichit, S., Kummee, S., Nilrat, L., & Itarat, A. (2007). Antimicrobial activity of oil from the root of Cinnamomum porrectum. Retrieved from http://rdo.psu.ac.th/sjstweb/journal/29-Suppl-1/02Souwalak_11-16.pdf

[5] Li, Q., Wang, X.-X., Lin, J.-G., Liu, J., Jiang, M.-S., & Chu, L.-X. (2014). Chemical Composition and Antifungal Activity of Extracts from the Xylem of Cinnamomum camphora. *BioResources*, **9**(2), 2560–2571. https://doi.org/10.15376/biores.9.2.2560-2571

[6] Kawamura, F., Ramle, S.F.M., Sulaiman, O., Hashim, R., Ohara, S.(2011). Antioxidant and antifungal activities of extracts from 15 selected hardwood species of Malaysian timber. European Journal of Wood and Wood Products

[7] Sitti Fatimah Mhd Ramle, Othman Sulaiman, Rokiah Hashim, Zubaidah Aimi Abdul Hamid, Takamitsu Arai, Akihiko Kosugi and Yoshinori Murata (2019). Chemical characterization from parenchyma and vascular bundle at different parts of oil palm trunk. AIP Conference Proceedings. **2068**. 020039. 10.1063/1.5089338.

[8] Yoshinori Murata, Satoshi Kubob, Eiji Togawa, Sitti Fatimah Binti Mhd Ramle,Othman Sulaiman, Rokiah Hashim, Wan Asma Ibrahim, Akihiko Kosugi,Akiko Hirooka, Hisashi Abe (2015). Detection of vascular bundles using cell wall birefringence on exposure to polarised light. Industrial Crops and Products, 190-197.

[9] Sofiyah Mohd Razali, Mahani Yusoff, Sitti Fatimah Mhd Ramle,Irshad Ul Haq Bhat, Abd Hamid Mar Iman, And Mohd Hasmizam Razali (2016). The Potential of *Donax Grandis Hypodermal Fiber* as reinforcement in Starch-based Composite. J.Polym.Mater. **33**, No.4, 677-684.

[10] Sayani Chandra (2019) Fourier transform infrared (Ft-Ir) spectroscopic analysis *of Nicotiana plumbaginifolia* (Solanaceae). Journal of Medicinal Plants Studies, **7** (1): 82-85.

[11] Derong L, Mengshi X, Jingjing Z, Zhuohao L, Baoshan X, Xindan L et al. An Overview of Plant Phenolic Compounds and Their Importance in Human Nutrition and Management of Type 2 Diabetes. Molecules. 2016; **21**(10).