MS ISO 9001:2015 · ISSN 1394-5467
JUNE 2020

# FRIM IN FOCUS

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### VERSATILE BAMBOO MATERIAL



### NEWS



A Quarterly of the FOREST RESEARCH INSTITUTE MALAYSIA

# Bamboo for Construction
## *Buluh untuk Pembinaan*

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Dr Hamdan Husain

Bamboo is a hollow woody plant from the grass family (Gramineae) and sub-family Bambusoideae. There are up to 1500 species of bamboo from all over the world. Bamboo is present on different types of climates, from cold mountains to hot tropical regions and often found across East Asia, Northern Australia, India, and the Himalayas. Bamboo is widely used for making many types of general utilities such as craft, satay stick, basket, toothpick, and water container. Besides consumer items, bamboo has potential as raw material in construction projects for making housing, bridge, scaffolding, resort, and mosque.

In Malaysia, bamboo is becoming a popular choice for construction material. Resorts and mosques are among infrastructures using bamboo material for construction. Preferred bamboos for construction include *Dendrocalamus asper* (buluh betung), *Gigantochloa scortechinii* (buluh semantan), *G. thoii* (buluh beting), and *Bambusa vulgaris* (buluh minyak). Some bamboos are chosen for their large diameter and thick culm walls which are suitable attributes for structural components. Small diameter bamboo with thinner culm wall such as *Schizostachyum grande* (buluh semeliang) is easily flattened thus useful for wall and flooring material.

Using bamboo as raw material for construction is beneficial for promoting sustainable use of material and conserving the forest. Bamboo contributes added value to an architect's design and attracts people to the uniqueness of a particular building. Bamboo as raw material in construction has great potential for a multitude of other construction applications if supported by consumer demand.

*Gambar: Amir Saaiffudin Kassim*

Anatomical features of *B. vulgaris* (inset)

Anatomical features of *G. scortechinii* (inset)

### ABOUT THE MAIN AUTHOR

Dr Nordahlia Abdullah Siam is a research officer at the Wood Anatomy Laboratory, Forest Products Division, FRIM. She conducts research in the field of wood anatomy while providing wood identification services to the industry.



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# Bamboo Structural Material
## *Bahan Binaan Buluh*

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Utilisation of bamboo as manufacturing material is becoming globally attractive in wood and wood product industries today. Bamboo in its natural form is a construction material, traditionally associated with cultures from East Asia to the South Pacific, and to some extent at the Central and South America.

Bamboo gains optimum strength when reaching maturity at three to four years of age. Mature bamboo is carefully selected according to the end use and is ideal for heavy-duty applications. Culms with large diameter are suitable for columns and beams. Large culms are cut into fish-mouth shape for jointing. The joints are reinforced with nails or screws and tightened with rope. Strong knots will strengthen the connecting bamboo culms. Smaller diameter culms are crushed to produce bamboo mats for wall and flooring. For construction purposes bamboo should be treated with preservatives to increase resistance against biodeterioration agents such as insects and fungus.

In Malaysia bamboo is used for building resorts, mosques, and sculptures such as the Perdana Botanical Garden bamboo playhouse. Bamboo is now commonly incorporated to instil an exotic and romantic outlook of a building or structure. Prior to utilising bamboo as a structural material, the performance assessment of round bamboo has to be conducted against weathering especially in hot and humid climates such as Malaysia.

Bamboo harvesting using chainsaw

Fish-mouth joint

Bamboo jointing strengthened by using rope and nails

Bamboo sculptures

### ABOUT THE MAIN AUTHOR

Dr Mohd Khairun Anwar Uyup is a research officer and Head of the Bamboo, Rattan, and Palms Unit at the Forest Products Division, FRIM. His area of specialisation is wood science and technology, particularly wood enhancement and protection, and non-wood forest products.

# Bamboo Charcoal
## *Arang Buluh*

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Puad Elham

Bamboo is a green, sustainable, and renewable resource of energy that is beneficial in reducing the usage of wood mainly for firewood, cooking, heating, and fuel. Bamboo as an alternative may also protect forests against rising demand for energy resources. The entire bamboo plant can be utilised for manufacturing bamboo charcoal making the industry profitable while reducing accumulation of harmful waste to the environment.

Bamboo charcoal is produced by heating carbonaceous material. It is categorised as a solid product with 60–80% carbon content. The process of carbonisation to produce charcoal involves heating bamboo in the absence of oxygen. Thermal decomposition of carbonaceous materials eliminates non-carbon elements to increase the fixed carbon content and energy value. The physical and chemical properties of end product or charcoal depend on the bamboo species and conditions of the carbonisation process, such as temperature and methods used.

Bamboo charcoal can be produced by using transportable metal kiln, pyrolyser, or charcoal kiln. The pyrolyser method used at FRIM requires feedstock of smaller-sized bamboos which are carbonised at high temperatures of 400 to 500 °C for two to three hours. The efficiency of converting raw bamboo to charcoal is between 25 and 45% for various bamboo species. The end product contains high amount of fixed carbon (60–80%) and produces high energy value (26–29 MJ/kg) which is comparable to wood. The large surface area and porous nature is efficient in attracting and absorbing impurities for targeted usages including air purification and water filtration. The charcoal is recyclable whereby each time the adsorbed impurities are burnt off without damaging the charcoal properties.

Although bamboo charcoal is traditionally used for cooking, various aspects of conversion methods may be improved to provide added advantages to the current technology. Other than household cooking, bamboo charcoal may be a promising option to various industrial applications.

Bamboo charcoal was utilised for manufacturing electrode in solar cells to increase favourable properties by increasing solar absorption and improving resistance. For odour control, bamboo charcoal is useful as dehumidifier to absorb excess moisture in the atmosphere with properties such as high adsorption and large surface area.

Pyrolyser

Bamboo

Bamboo charcoal as water filter

Bamboo charcoal

**Industrial and household applications for bamboo charcoal**

- Air purification — *Ideal absorbent*
- Water filtration — *Removing impurities*
- Agriculture — *Soil conditioning*
- Activated carbon — *Specialised pre-cursor*
- Healthcare — *Teeth whitening & detoxification*

### ABOUT THE MAIN AUTHOR

Dr Rafidah Jalil is a research officer at the Biomass Technology Programme, Forest Products Division, FRIM. She obtained her PhD in chemical and process engineering from Universiti Kebangsaan Malaysia. Her areas of specialisation include biomass and bioenergy, biomass processing and pretreatment, solid fuels, liquid fuels, fermentation, and enzyme technology.

# Activated Carbon from Bamboo

## *Arang Teraktif daripada Buluh*

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Dr Rafidah Jalil

Carbonisation process using tubular furnace

Nitrogen adsorption-desorption instrument at FRIM

Bamboo activated carbon from chemical activation method

Bamboo can be used as carbon precursor for producing activated carbon. Bamboo is suitable for manufacturing activated carbon due to its high carbon content. It is abundantly available and the low price makes bamboo an economical option.

Demand for the highly versatile bamboo activated carbon has increased over the years. A wide range of industries utilise activated carbon particularly as an intermediate material to improve water or air filtration system. The wide applications of bamboo activated carbon are mainly due to its specific surface area and porous network structure which enable absorption of chemical contaminants from water and air.

The activated carbon market was reported to exceed more than USD10.50 billion by 2024. One of the major factors driving market growth is increasing demand for purification systems to overcome water and air pollution issues. Bamboo activated carbon is also useful for pharmaceutical applications.

At FRIM, bamboo activated carbon is produced using chemical activation method. The process involves impregnating carbon precursor with chemical activators and carbonising process at specific temperatures under the inert flow of nitrogen gas. Chemical activators include phosphoric acid, sodium hydroxide, and zinc chloride.

Different activation parameters produce different textural and chemical properties of bamboo activated carbon which can be used in a wide range of applications. The quality of bamboo activated carbon particularly in terms of texture and surface chemistry are determined using the nitrogen adsorption -desorption instrument, scanning electron microscope, and Fourier transform infrared spectroscopy, respectively. The simple method for production of bamboo activated carbon developed by FRIM is a potentially good option to the industry and various interested parties.

### ABOUT THE MAIN AUTHOR

Dr Tumirah Khadiran is a chemist at the Wood Preservation Analytical Laboratory, Forest Products Division, FRIM. Her areas of research include timber preservation, analytical and materials chemistry, nanoparticles and nanostructured materials, encapsulation technology, activated carbon, and materials characterisation. Dr Tumirah has five years of experience and more than four published papers on preparation and characterisation of activated carbon from peat soils as framework for energy storage based on phase change materials.

# Bamboo Vinegar
## *Cuka Buluh*

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Vinegar is a crude condensate from the distillation of bamboo smoke generated from charcoal making. Also known as pyroligneous acid, vinegar is a by-product of the pyrolysis process for charcoal production. Generally dark brown in colour and viscous in nature, vinegar is a complex mixture of oxygenated hydrocarbons with more than 200 different chemical components such as organic acids, phenol, formaldehyde, alcohols, and aldehydes. Vinegar is used in various applications depending on its purity and source. It is present as supplementary in products such as pharmaceutical, cosmetic, food, and in agricultural applications such as soil improver, fertiliser, and pesticide.

Biomass is converted into products such as solid char, liquid, and gases via the pyrolysis process. The decomposition biomass is conducted by heating the material in the absence or limited amount of oxygen. During pyrolysis, volatile compounds are released as bamboo decomposes. Char is left as residue while the vapours are partially condensed to vinegar.

Vinegar and tar are condensed in the chimney as a by-product of pyrolysis. Conditions such as heating rate, final temperature, resident time, presence of minerals or catalysts, and initial material composition determine the product yield of gas, liquid, char, and vinegar compositions.

Dried bamboo for loading into pyrolyser

Bamboo vinegar

Bamboo biomass


Fertiliser


### ABOUT THE MAIN AUTHOR

Mahanim Sarif @ Mohd Ali is a research officer at the Biomass Technology Programme, Forest Products Division, FRIM. She is pursuing the PhD in Advance Material at Universiti Putra Malaysia (UPM). Her area of specialisation includes biomass and bioenergy, biomass processing and pretreatment, solid fuels, porous material, and activated carbon for supercapacitor.

# Bamboo as Source for Nanocellulose

## *Buluh sebagai Sumber Nanoselulosa*

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Dr Mohd Khairun Anwar Uyup

Nano-sized cellulosic fibre from biomass has a number of favourable properties in terms of its biodegradable nature, low density, high mechanical properties, renewability, and economic value. Nanocellulose is used in a wide range of applications such as composites, biomedical, and dispersion foams, hence its production and characterisation have become the topic of many investigations.

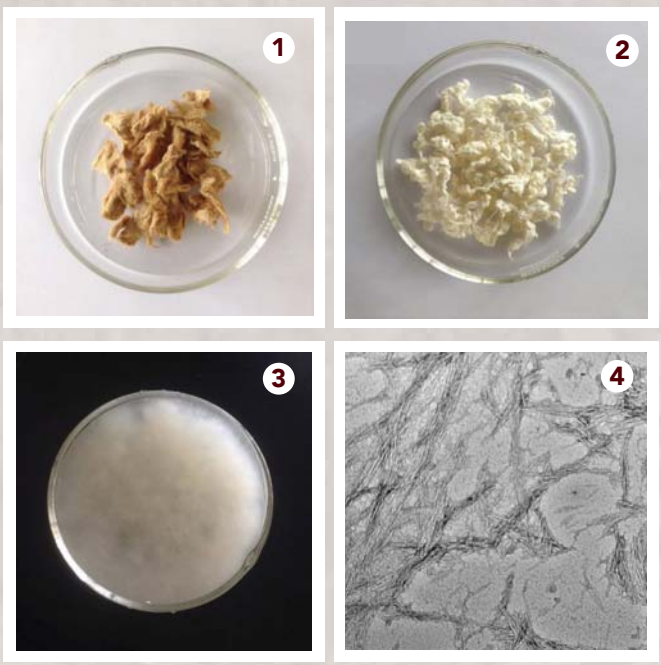
Nanocrystalline cellulose (NCC) and nanofibrillated cellulose (NFC) are two general types of nanocelluloses measuring 1–100 nm in diameter. Both types of cellulose can be distinguished by structure and isolation methods. The main source of nanocellulose is obtained from natural lignocellulosic sources either from non-woody or agrowaste fibres. Being a fast-growing plant and good source of cellulosic fibres, bamboo is an ideal raw material for obtaining nanocellulose.

The outlook of bamboo industry in Malaysia is promising due to increasing demand for bamboo products such as furniture, structural applications, and flooring. The availability of bamboo wastes and residues generated from processing factories will serve as supply to the nano-sized cellulosic fibre manufacturers.

FRIM is studying the merits of using bamboo residue for production of NCC. Three selected Malaysian commercial bamboo species identified to supplement the need for NCC resources are *Gigantochloa scortechinii* (buluh semantan), *G. levis* (buluh beting), and *Dendrocalamus asper* (buluh betung).

Isolation of NCC via chemo-mechanical process combines a series of pre-treatments of fibres such as pulping, bleaching, acid hydrolysis, and homogenisation. Proper isolation techniques will promote fibrillation rate and increases yield of NCC with desired properties. The NCC will be further modified to fulfil the role as suitable alternative reinforcing agent, filler or additive in coatings, and functional composite for various engineering applications.

Bamboo residues




Isolation of nanocrystalline cellulose (NCC)

1. Bamboo pulp
2. Bamboo bleached pulp
3. Colloidal suspension
4. Transmission electron microscopy image of NCC

### ABOUT THE MAIN AUTHOR

Dr Asniza Mustapha is a research officer at the Bamboo, Rattan, and Palms Unit, Forest Products Division, FRIM. Her areas of research includes isolation and characterisation of nanocellulose from various biomass, wood/non-wood lignocellulose biomass characterisation and natural fibre reinforced polymer composites.

# Pulp and Paper from Bamboo

## *Pulpa dan Kertas daripada Buluh*

Dr Latifah Jasmani latifah@frim.gov.my

Paper and paper products are highly consumable daily materials. High demand paper-based products such as tissue, box, diaper, milk carton, and paper cup are derived from fibre-based material. Although many administrative and business functions in this digital era are favouring the paperless business model, the scenario has not hindered the important role of pulp and paper within the society.

For the past few years, e-commerce trend has spurred the growth of pulp and paper industry especially for packaging. The German online portal for statistics, Statista, reported that the pulp and paper global market value is expected to increase from USD63.3 billion in 2019 to USD79.6 billion by 2024. The global market trend towards sustainable, biodegradable, and environmentally friendly products has identified pulp and paper as one of the alternatives to fuel-based products.

Paper can be made from any wood or non-wood materials. Bamboo, a member of the grass family is a fast-growing and evergreen plant which is used to produce pulp and paper in countries like China and India. Having similar properties as hardwood fibre, bamboo has become an attractive raw material option for sustainable manufacturing of paper.

Primary processing is required to prepare bamboo prior to use as feedstock for pulp and papermaking. Bamboo is chipped to reduce its size before pulping process is conducted to obtain the pulp. Pulping methods include chemical, mechanical, and chemi-mechanical. The main difference between the three pulping types is the quality of pulp. Chemical pulping produces stronger pulp compared to mechanical pulping. The selection of pulping methods depends on the end-product applications.

Chemical pulping for acquiring bamboo fibre is conducted using a digester containing chemical and water where pressure and temperature are controlled. The purpose of chemical pulping is to obtain cellulose fibre by removal of lignin. Purification processes such as washing and screening are conducted to remove unwanted products such as waste chemicals and impurities.

Mechanical pulping is conducted using a refiner mechanical pulping machine which separates the fibre while still retaining most of the lignin. Pulp obtained from chemical or mechanical pulping will be further processed into various types of paper products. Bleaching is conducted to obtain white pulp. Mills produce different types of pulp to suit desired applications. For example, bleached chemical pulp is suitable for printing and writing paper, chemi-mechanical pulp for paperboard, while unbleached pulp is manufactured for packaging material. At the FRIM laboratory bamboo is converted to pulp and paper products via batch process using laboratory scale equipment.


### ABOUT THE MAIN AUTHOR

Dr Latifah Jasmani is a research officer and Head of Technology Biomass Programme, Forest Products Division, FRIM. Her area of specialisation is in pulp and paper technology and nanocellulose.

# Lamboo Plank: A Versatile Building Block for Furniture

## *Papan Lamboo: Blok Binaan Perabot Serba Guna*

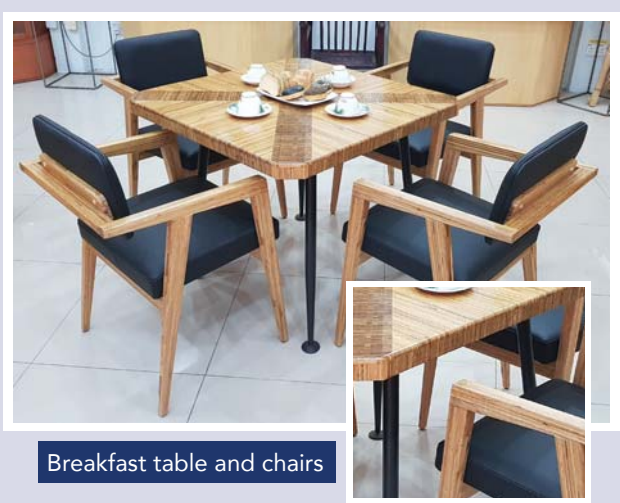
Dr Wan Tarmeze Wan Ariffin tarmeze@frim.gov.my
Mohd Faizul Mohd Shukari

From left to right:
Single layer Lamboo plank, two-layer, and three-layer Lamboo blocks

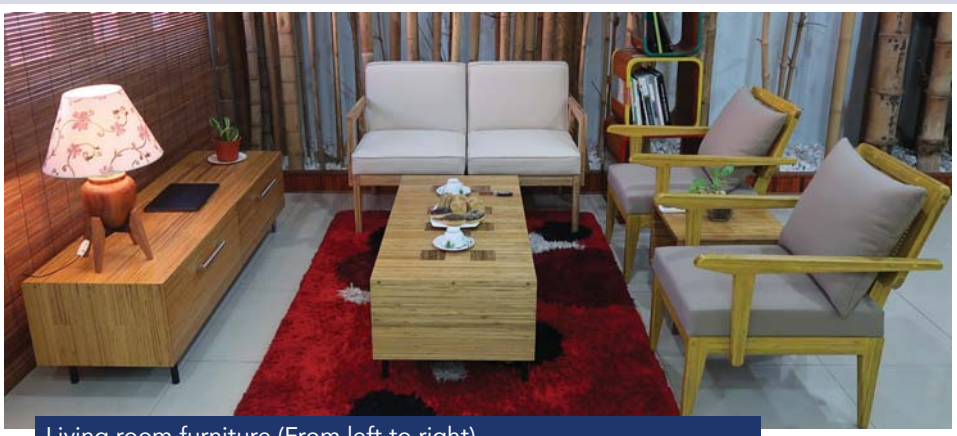
Stools in walnut finishing

In July 2019 Forest Products Division FRIM explored the potential of laminated bamboo strip lumber (Lamboo) plank as material for making furniture. Lamboo planks measuring 1200 × 400 × 15 $mm^3$ were purchased from a local company that manufactures planks for floorboard production.

The planks were stacked and laminated together to form blocks of specific thickness, width, and length optimised for making furniture components. Obtaining desired sizes of furniture component by laminating instead of cutting and machining will facilitate better material planning and utilisation towards higher recovery efficiency. The laminating technique assists in minimising material wastage in a number of furniture production operations. Furniture prototypes developed from Lamboo material include breakfast table and chairs, TV console cabinet, coffee table, bar stool, armchair, and modular sofa. Suitability of Lamboo plank as material for making furniture and other wood-based products will potentially expand its market beyond flooring products.



Breakfast table and chairs



Living room furniture (From left to right)
TV console cabinet, modular sofa, coffee table, and armchair sofa

### ABOUT THE MAIN AUTHOR

Dr Wan Tarmeze Wan Ariffin is the Head of Wood Processing Programme, Forest Products Division. His main R&D interest includes development and utilisation of engineered lumber from sustainable woody resources such as forest plantation trees, oil palm trunks, and bamboo. Dr Wan Tarmeze obtained his PhD degree with the work on numerical analysis of laminated bamboo strip lumber (LBSL).

# Buluh dan Komuniti
## *Bamboo and Community*

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Kediaman Orang Asli yang diperbuat daripada buluh

Tiang bangsal dan pangkin serta pondok berasaskan buluh

Pondok buluh yang dibina komuniti Orang Asli

Buluh mempunyai kepentingan yang tersendiri dalam kehidupan komuniti di sekelilingnya. Tanaman ini tumbuh subur di iklim tropika dan spesies yang tumbuh di Semenanjung Malaysia antaranya ialah semantan, beti, beting, betung, semeliang, dan dinding.

Buluh mendapat permintaan yang tinggi dalam kalangan masyarakat Melayu bagi penghasilan lemang terutamanya ketika menjelang perayaan Hari Raya Aidilfitri. Rebung juga merupakan bahan masakan yang digemari di samping jeruk rebung yang popular sebagai makanan ringan terutamanya dalam kalangan masyarakat Melayu Pahang.

Masyarakat Orang Asli menggunakan buluh melalui pelbagai cara dalam rutin harian mereka. Antaranya adalah menghasilkan sumpitan iaitu alat untuk melepaskan damak. Penggunaan sumpitan oleh Orang Asli bermula sejak lebih daripada 600 tahun yang lalu.

Pangkin dan tempat beristirahat adalah antara perabot yang diperbuat daripada batang buluh. Suku kaum Temiar di kawasan Pos Yum, Sg Siput Perak merupakan antara komuniti Orang Asli yang mengekalkan ciri-ciri rumah tradisi dengan menggunakan buluh sebagai dinding, tiang, dan lantai. Lantai rumah unik dihasilkan daripada bilah-bilah buluh yang diikat menggunakan rotan. Terdapat rumah buluh di Pos Yum yang dibina di tepi sungai untuk disewakan kepada pengunjung.

Masyarakat Melayu dan Orang Asli terutamanya di utara dan barat Semenanjung Malaysia menghasilkan produk berasaskan buluh sebagai jualan. Penghasilan produk buluh buatan tangan yang berkualiti memerlukan kemahiran tinggi.

Alat muzik daripada buluh yang dikenali sebagai angklung

Perabot buluh

Negeri-negeri di selatan Semenanjung Malaysia seperti Negeri Sembilan, Melaka, dan Johor dan di utara seperti Perlis, Kedah, Pulau Pinang, dan Perak merupakan kawasan yang banyak menghasilkan produk buluh seperti wau, perabot, kuda kepang, dan bakul sayur. Sebahagian alat muzik tradisional juga diperbuat daripada buluh seperti seruling, angklung, bangsi (serunai buluh), dan gambang (xilofon).

Pada masa ini, buluh digunakan secara meluas untuk tujuan komersial. Bagi menjaga alam sekitar, buluh juga digunakan untuk menghasilkan penyedut minuman. Perabot berasaskan buluh mendapat permintaan yang menggalakkan daripada pengusaha restoran dan penginapan yang ingin menampilkan kelainan bagi perkhidmatan mereka.

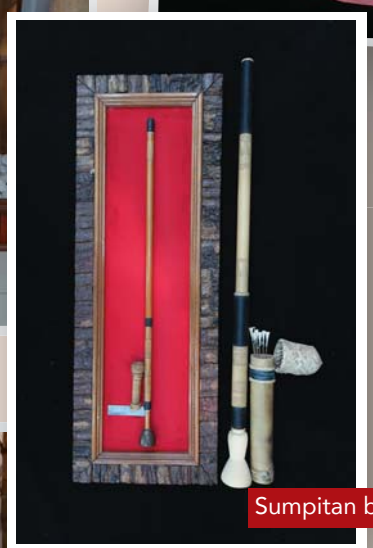
Serkup ayam

Kuda kepang

Rangka badan wau daripada buluh

Bubu untuk menangkap ikan

Tampi dan bakul sayur



Sumpitan buluh

Rebung madu sebagai makanan

*Gambar: Dr. Mohd Khairun Anwar Uyup*

## TENTANG PENULIS

Penulis ialah seorang penyelidik di FRIM sejak 15 tahun yang lalu dan kini bertugas di Program Perhutanan Sosial. Beliau memperoleh ijazah Falsafah Kedoktoran Sains Pelancongan daripada Universiti Metropolitan Tokyo, Jepun. Kajian beliau menjurus kepada ekopelancongan berasaskan komuniti, dimensi manusia–haiwan, dan pemuliharaan biodiversiti bandar, taman rekreasi, dan hutan bandar.

# Natural Products from Bamboo

## *Produk Semula Jadi daripada Buluh*

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Saidatul Husni Saidin

Bamboo is the tallest grass with a wide range of applications from purely decorative as ornamental plant, to an important source of fuel and for construction. Since ancient times traditional medicinal practices in India, China and Japan has been using dried bamboo sap (manna/tabashir), bamboo charcoal and vinegar for beauty and personal healthcare purposes.

FRIM is exploring the potential of bamboo as a natural product ingredient for skin care product development. Several bamboo species were chosen based on abundance, commercial importance, and reported usage in traditional applications. Compounds from bamboo such as vinegar, essential oil, wax, and leaf extracts were evaluated for potential benefits in personal care product manufacturing.

### Bamboo vinegar

Bamboo vinegar is a by-product of bamboo pyrolysis for charcoal production. Vinegar from bamboo is generally dark brown, viscous and composed of a complex mixture of oxygenated hydrocarbon, carboxylic acid, alcohol, phenol, aldehyde, and ketone. Despite its strong acidic smell, bamboo vinegar is a beneficial ingredient for antiseptic and disinfectant purposes. Bamboo vinegar from *Gigantochloa scortechinii* (buluh semantan) was formulated into a liquid hand wash which helps reduce itchiness and expel odour. The antimicrobial properties of bamboo hand wash was tested and found as effective against *Staphylococcus auerus*.

### Bamboo essential oils and waxes

Essential oils are fragrant substances in aromatic plants which are widely used in perfumery and cosmetic products. Bamboo culms especially from genus *Schizostachyum* and *Phyllostachys* emit fragrances which is similar to incense aroma. Hydrodistillation of *Gigantochloa wrayi* (buluh beti) leaves produced a type of waxy oil. Identification of the volatile compound revealed the presence of linalool, α-terpineol, *(E)*-ß-damascenone, *(E)*-ß-ionone, *(E)*-nerolidol, hexadecanol, *(5E,9E)*-farnesyl acetone, and methyl hexadecanoate. Buluh beti emits bamboo like aroma which has the potential as a perfumery product. The new and exotic bamboo aroma was incorporated into colonge and several types of personal care products.

### Bamboo extracts

Bamboo leaf extracts from *Bambusa vulgaris* was incorporated into personal care products such as cream, lotion, and shampoo. Phytochemical screening of *B. vulgaris* leaves extract showed the presence of saponin, flavonoid, and phytosteroid. Saponin, a glycosidic plant constituent has foam forming and moisturising properties and suitable as an emulsifying agent. Flavonoids play an important role as antioxidants while steroids help maintain skin homoeostatic equilibrium. Bamboo leaf extract with natural antioxidant properties is a natural choice in formulating skin care and personal care products.

Bamboo may be a new economic resource for the domestic and international markets. There is always a possibility of making new products from bamboo. Much effort is required to obtain comprehensive information on medicinal properties to unlock the potential of bamboo species in Malaysia. Applied research on natural products from bamboo is crucial to assist planters and the industry in offering diversified products to the market.


### ABOUT THE AUTHOR

Dr Nor Azah Mohamad Ali is the Natural Products Division Director. Her areas of specialisation is natural products chemistry and herbal product development. Other researchers involved in exploring bamboo for producing natural products are Mailina Jamil, Mahanim Sarif, Amir Saaiffudin, Dr Mastura Mohtar, and Mohd Faridz Zollpatah.

# Persepsi Industri terhadap Pokok Cepat Tumbuh

## *Industry's Perception towards Fast-Growing Trees*

Noor Hazmira Merous
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Jual beli kayu gergaji dan bahan yang berkaitan menyumbang kepada sebahagian besar hasil pendapatan berasaskan produk kayu di Malaysia. Pada tahun 2018, eksport kayu gergaji, perabot kayu, kayu kumai dan pertukangan, dan produk tanggaman menyumbang kepada 59% (RM13.4 bilion) daripada jumlah keseluruhan bernilai RM22.3 bilion, manakala hasil import ialah 39% (RM 2.1 bilion) daripada RM5.3 bilion nilai keseluruhan import produk berasaskan kayu. Berdasarkan trend selama lima tahun, kayu begergaji dikenal pasti sebagai eksport produk kayu negara yang mempunyai potensi saiz pasaran yang semakin meningkat.

Persepsi industri terhadap bahan mentah daripada pokok cepat tumbuh telah dikaji pada 2018. Penilaian tersebut melibatkan 25 pengilang dan pengeluar produk berasaskan kayu yang menggunakan kayu begergaji sebagai bahan mentah. Hasil kajian menunjukkan spesies yang paling banyak digunakan ialah kayu getah dan diikuti meranti, pain, merbau, keruing, durian, dan akasia.

Para pengilang kayu berpendapat penggunaan spesies cepat tumbuh dapat memelihara hutan di samping memastikan bekalan bahan mentah yang berterusan. Industri kayu juga perlu mencari sumber bahan mentah yang baharu bagi menggantikan yang konvensional. Mereka juga menyatakan bahawa harga bahan mentah kayu cepat tumbuh perlu lebih rendah berbanding kayu daripada hutan asli kerana produk daripada kayu cepat tumbuh tidak dapat menandingi keaslian produk kayu balak premium seperti jati dan cengal.

Secara keseluruhannya penghasilan bahan mentah alternatif daripada pokok cepat tumbuh mempunyai potensi pasaran masa hadapan dan strategi sebegini membantu memastikan kelestarian bekalan sumber kayu.

Kayu begergaji sebagai bahan mentah bagi penghasilan produk papan lantai

Kayu begergaji diproses untuk dijadikan kerusi

### TENTANG PENULIS

Noor Hazmira Merous ialah seorang pegawai penyelidik di Program Ekonomi dan Analisa Strategik, Bahagian Perancangan Penyelidikan FRIM.

# Meneroka Kepelbagaian Flora di Pusat Pemuliharaan Harimau Kebangsaan

## *Exploring Floral Diversity at the National Tiger Conservation Centre*

Hutan bancian di NTCC

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Mohd Aidil Nordin

Pusat Pemuliharaan Harimau Kebangsaan (NTCC) dibangunkan di Lanchang, Pahang dan bertujuan meliarkan semula harimau sebelum dilepaskan di hutan-hutan terpilih. FRIM dipertanggungjawabkan untuk menjalankan kerja-kerja bancian dan penandaan tumbuhan di hutan tapak pusat pemuliharaan harimau yang sedang giat dibina. Pusat berkeluasan 40 hektar tersebut diselia oleh Jabatan Perlindungan Hidupan Liar dan Taman Negara (PERHILITAN) dan terletak berhampiran Pusat Konservasi Gajah Kuala Gandah.

Kerja-kerja inventori dan pemetaan pokok dijalankan pada 2–6 Disember 2019. Pokok dengan diameter minimum 10 cm ditanda menggunakan sistem penempatan global (GPS) dan ketinggian serta diameter dicatatkan. Selain pokok; paku-pakis, tumbuhan renek, tumbuhan tidak berkayu, dan tumbuhan menumpang turut direkod di samping mengambil spesimen baucer untuk pengecaman dan simpanan di Herbarium FRIM.

Sejumlah 219 spesies daripada 155 genus dan 64 famili direkodkan di kawasan bancian. Famili yang mendominasi terdiri daripada Rubiaceae (17 spesies), diikuti Moraceae (13 spesies), Fabaceae (12 spesies), Palmae (11 spesies), dan Melastomataceae (8 spesies). Terdapat 148 pokok matang bersaiz 10 cm serta lebih ditemui di kawasan yang didominasi oleh pokok ludai *(Balakata baccata)*.

Beberapa pokok menarik ditemui di kawasan bancian iaitu pokok nadir, tumbuhan pepanjat, rotan, dan paku-pakis.

Terdapat 17 pokok nadir matang yang ditemui seperti *Archidendron bubalinum* (kerdas), *Parkia speciosa* (petai), dan *Sandoricum koetjape* (sentul). Pokok nadir berfungsi sebagai sumber makanan haiwan.

Tumbuhan pepanjat yang mempunyai nilai ubatan dan kegunaan seharian juga ditemui di tapak bancian iaitu *Fibraurea tinctoria* (akar mengkunyit), *Cnestis palala* (pinang keruh), dan T*etracera scandens* (akar mempelas).

Rotan yang terdapat di tapak kajian termasuk *Calamus javensis* (rotan batu), *Daemonorops verticillaris* (rotan cincin), dan *Korthalsia flagellaris* (rotan udang). Hanya tujuh spesies paku-pakis direkodkan iaitu *Dicranopteris linearis*, *Lygodium flexuosum*, *L. circinnatum*, *Nephrolepis auriculata, Pteris ensiformis, Taenitis blechnoides,* dan *Tectaria singaporean.*

Hasil penemuan spesies penunjuk hutan sekunder seperti *Endospermum diadenum* (sesenduk), dan spesies biasa hutan primer seperti *Dipterocarpus cornutus* (keruing gombang), *Koompassia excelsa* (tualang), *Intsia palembanica* (merbau), dan *Xylopia ferruginea* (jangkang bukit) menunjukkan tapak pusat pemuliharaan harimau didapati sedang mengalami proses regenerasi.

Anak-anak pokok penting bagi membantu proses pemulihan hutan. Di kawasan ini sebanyak 104 spesies daripada 75 genus dan 34 famili anak pokok direkodkan.

Tumbuhan lantai di kawasan bancian

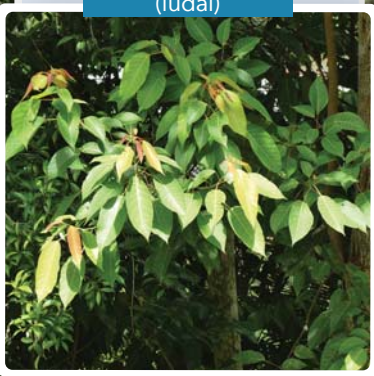
Vegetasi didominasi oleh pokok *Balakata baccata*

Menanda pokok menggunakan GPS

Antaranya ialah *Artocarpus dadah* (tampang), *A. integer* var. *silvestris* (cempedak hutan), *Ochanostachys amentacea* (petaling), *Paropsia vareciformis* (dendulang), dan *Xanthophyllum affine* (minyak beruk).

Kepelbagaian spesies kawasan kajian adalah disebabkan oleh kehadiran anak-anak pokok, pokok matang, paku-pakis, tumbuhan renek, tumbuhan tidak berkayu, tumbuhan menumpang, dan pepanjat. Kepelbagaian adalah penting bagi satu ekosistem yang lengkap untuk persediaan harimau sebelum dilepaskan ke hutan semula jadi.

Mengambil ukuran diameter



*Balakata baccata* (ludai)

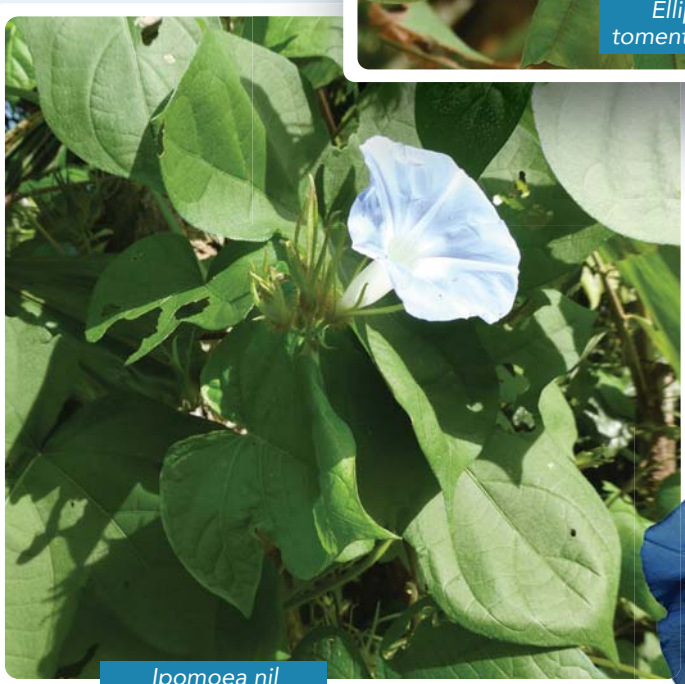
*Dipterocarpus cornutus* (keruing gombang)

*Sandoricum koetjape* (sentul)

*Archidendron bubalinum* (kerdas)

*Elatriospermum tapos* (perah)

*Ellipanthus tomentosus* (kelin)



*Ipomoea nil* (Morning glory nil)

*Thottea piperiformis* (hempedu beruang)

## TENTANG PENULIS UTAMA

Siti Eryani Suterisno merupakan pegawai penyelidik di Program Flora, Cawangan Botani, Bahagian Biodiversiti Hutan, FRIM. Beliau terlibat menjalankan projek inventori flora di Pusat Pemuliharaan Harimau Kebangsaan (NTCC), Lanchang, Pahang.

# PENGALAMAN MENANGANI PENULARAN COVID-19 DI FRIM

*COVID-19 TRANSMISSION HANDLING EXPERIENCE AT FRIM*

Suharti Samod suharti@frim.gov.my
& Liza Ismail

Perintah Kawalan Pergerakan (PKP) telah dikuatkuasakan di seluruh Malaysia pada 18 Mac 2020. Semua negeri dan Wilayah Persekutuan di Malaysia telah diwartakan sebagai kawasan tempatan jangkitan. FRIM turut serta dalam pelaksanaan arahan daripada Majlis Keselamatan Negara dan Kementerian Kesihatan Malaysia bagi membendung penularan virus COVID-19.

Kemasukan melalui pintu masuk utama kampus FRIM telah dihadkan. Pihak yang diberikan kebenaran perlu mencatat tarikh, nama, nombor telefon, serta waktu keluar masuk sebelum memasuki kawasan FRIM. Pintu masuk melalui Taman Botani Kepong dan rumah kediaman Meranti ditutup sepenuhnya sepanjang tempoh PKP.

Kerja-kerja pembersihan seperti nyahkuman dan sanitasi dijalankan dan pekerja kebersihan dikehendaki memakai pelitup muka, mengamalkan penjarakan sosial, dan kerap mencuci tangan.


Bermula Fasa 1 hingga 4, penjawat awam FRIM yang mendapat kelulusan Ketua Pengarah dibenarkan hadir bertugas selama empat jam sehari iaitu dari jam 9.00 pagi hingga 1.00 petang. Tabung Khas COVID-19 yang diselaraskan oleh Kelab FRIM dan dibantu oleh Masjid Jamek dan Badan Kebajikan FRIM telah dilancarkan bagi membantu warga FRIM yang memerlukan.

FRIM bekerjasama dengan Kementerian Perdagangan Antarabangsa dan Industri dalam membangunkan SOP bagi pembukaan ekonomi sektor penyelidikan dan pembangunan perhutanan serta pelaksanaan normal baharu. Penghasilan poster tentang pembudayaan norma baharu pencegahan COVID-19 di kampus FRIM turut dilaksana bagi meningkatkan kesedaran warga FRIM.

FRIM bertuah kerana sehingga artikel ini ditulis tiada kes COVID-19 yang dikesan melibatkan kampus dan kakitangannya. Amalan mematuhi SOP yang dikeluarkan oleh KKM menyumbang kepada penularan sifar COVID-19. Kerjasama dan komitmen semua pihak ternyata memainkan peranan dalam memastikan kampus FRIM kekal bebas daripada jangkitan COVID-19.


Ketua Pengarah FRIM (dua dari kiri) dengan wakil MBR bersama-sama penyelidik FRIM

# FRIM TERIMA DUA LAGI SIJIL MALAYSIA BOOK OF RECORDS (MBR)

*FRIM Receives Two More Malaysia Book of Records Certificates*

Malaysia Book of Records (MBR) telah menyampaikan dua lagi sijil rekod baharu bagi FRIM kepada Datuk Dr Abd Latif Mohmod, Ketua Pengarah FRIM.

Dua rekod berkenaan iaitu 'First to Establish Tongkat Ali Hairy Root Culture in the Bioreactor' dan 'Most Number of Sub-Ethnic Orang Asli Traditional Knowledge (TK) Documented on Medicinal & Aromatic Plants' telah disampaikan oleh Jwan Heah Yeow Hooi, Pengarah Pembangunan Perniagaan MBR.