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Transformasi Perkhidmatan Pemprosesan Herba di HTC

Transformation of HTC Herbal Processing Services

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Pusat Teknologi Herba (HTC) ditubuhkan bagi menjalankan penyelidikan dalam pemprosesan dan pembangunan produk herba. Pusat ini bermula pada tahun 2000 sebagai Makmal Ekstraksi dan kemudiannya dinaik taraf untuk memberikan khidmat dan latihan teknikal kepada pengusaha herba dan pelajar institusi pengajian tinggi. Pada tahun 2007 HTC memperoleh perakuan amalan pengilangan baik (GMP) daripada Biro Pengawalan Farmaseutikal Kebangsaan.

HTC pada awalnya menawarkan perkhidmatan pemprosesan herba dan kini turut menyediakan perkhidmatan pengilangan serta perkhidmatan produk berdaftar OEM (pengeluar peralatan asli). Transformasi penawaran khidmat dilaksana bagi memperkasa penguasaan ekonomi dalam bidang herba, terutamanya bagi industri kecil dan sederhana (IKS) menerusi penghasilan produk herba bernilai tinggi yang sedia dikomersialkan. Sehingga 2019 HTC mempunyai perjanjian pengilangan kontrak dengan 18 syarikat IKS dan telah membangunkan 22 produk bernilai tinggi yang didaftar di bawah Agensi Regulatori Farmasi Negara (NPRA). Sebelas produk yang didaftar mendapat pengiktirafan pensijilan halal daripada Jabatan Kemajuan Islam Malaysia.

Transformasi perkhidmatan HTC menyumbang kepada ekonomi industri herba melalui peningkatan ketara nilai pasaran produk berdaftar. Pasaran produk herba hasil output HTC bernilai RM966,541 pada 2016 dan meningkat kepada RM3,716,534 pada 2019. Peningkatan berterusan ini disasarkan dengan pertambahan bilangan pengusaha herba yang dijangka mendapatkan khidmat HTC. Pertambahan nilai pasaran juga menjadi indikator kepada pengusaha herba dalam meningkatkan skala pengeluaran bagi menampung permintaan dan meluaskan pasaran produk syarikat.

Kapasiti pengeluaran fasiliti pemprosesan yang sedia ada di HTC adalah terhad dan dijangka tidak dapat menampung peningkatan permintaan. Pusat ini telah memperoleh peruntukan RM4.5 juta melalui projek pembangunan Rancangan Malaysia ke-11 bermula 2017 sehingga 2020 bagi meningkatkan keupayaan dan kapasiti kemudahan pemprosesan herba bertaraf GMP.

Fasa pertama peningkatan keupayaan dan kapasiti kemudahan HTC bermula dengan pembinaan fasiliti pemprosesan herba tambahan bagi menempatkan kelengkapan peralatan baharu. Fasa kedua melibatkan peningkatan keupayaan fasiliti pemprosesan herba melalui pembelian peralatan berkapasiti tinggi. Fasa yang terakhir adalah penambahbaikan sistem dokumentasi berkaitan tatacara pengendalian piawai (SOP) bagi menyokong sistem kebolehkesanan pemprosesan berasaskan GMP.

Kerja-kerja fasa pertama bagi menaik taraf fasiliti diketuai oleh Jabatan Pengairan dan Saliran (JPS). Pembinaan bermula pada bulan Februari 2018 dan siap pada

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November tahun yang sama. Majlis penyerahan rasmi bangunan tambahan HTC diadakan pada 8 Oktober 2019 dan disempurnakan oleh Dato' Ir. Sabri Abdul Mulok, Timbalan Ketua Pengarah (Sektor Pakar) JPS dan Datuk Dr Abd Latif Mohmod, Ketua Pengarah FRIM.

Penyerahan sijil bangunan tambahan HTC

Fasa kedua yang melibatkan perolehan peralatan pemprosesan berskala komersial dilaksana pada tahun 2018 hingga 2019. Lima buah peralatan berkapasiti tinggi diperoleh iaitu pengering sejuk beku industri, pengekstrak industri, penyejat, penyembur kering industri, dan mesin pengkapsulan separa auto. Peralatan tersebut berfungsi menghasilkan ekstrak dan produk siap pada skala komersial bagi memenuhi permintaan pihak industri. Peralatan pemprosesan berskala industri mampu meningkatkan penghasilan ekstrak daripada 6 hingga 50 kg sebulan. Penghasilan produk siap pula dipertingkatkan daripada 2000 hingga 10,000 botol sebulan. Penggunaan mesin ini membantu menjimatkan masa pemprosesan dan mengurangkan kos operasi.

Fasa 3 pada tahun 2020 memberikan tumpuan kepada penyediaan dokumen SOP bagi peralatan baharu serta menambah baik dokumen pensijilan GMP dan Halal. Permohonan pensijilan kualiti turut dilaksana bagi fasiliti yang dinaik taraf.

Projek menaik taraf bangunan HTC bukan sahaja penting dalam perkembangan penyelidikan bidang pemprosesan herba berskala besar, tetapi ia berfungsi memacu transformasi HTC dalam menyediakan perkhidmatan yang berdaya saing kepada pihak berkepentingan. Pelaksanaan projek dijangka meningkatkan kapasiti pengeluaran produk herba kepada skala komersial, serta melibatkan penjimatan sehingga 90% dari segi kos operasi bagi pengeluaran produk dan masa pemprosesan. Peningkatan keupayaan HTC juga berpotensi memberikan jaminan kualiti produk melalui sistem yang dibangunkan serta menghasilkan sistem kebolehkesanan yang lebih baik dan sistematik.

Mesin pengekstrakan dan pemekatan berkapasiti tinggi

Mesin pengeringan beku baharu berkapasiti tinggi

TENTANG PENULIS UTAMA

Pegawai penyelidik, Dr Zamree Md Shah bertanggungjawab dalam pengurusan Pusat Teknologi Herba, FRIM. Beliau terlibat dalam penyelidikan pemprosesan herba dan memberi khidmat perundingan dalam pengurusan kualiti produk herba. Beliau memperolehi PhD daripada Universiti Teknologi MARA pada tahun 2019 dalam bidang kajian antikolesterol.

Pengilangan Produk Herba Berkualiti di HTC

Quality Herbal Product Manufacturing at HTC

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Pusat Teknologi Herba (HTC) berperanan mengilang produk berasaskan herba sejak tahun 2012. Penghasilan produk berkualiti melibatkan pemilihan bahan mentah, penggunaan alatan dan kaedah pemprosesan yang sesuai, kawalan kebersihan, sanitasi dan penyimpanan bahan, serta pemeriksaan kualiti produk. Jaminan kualiti, amalan pengilangan baik, dan kawalan kualiti adalah kritikal bagi menghasilkan produk herba yang selamat, tulen dan berkualiti.

Jaminan Kualiti

Jaminan kualiti melibatkan keperluan mewujudkan sistem kualiti yang selari dengan peraturan, keperluan serta garis panduan yang diterima pakai. Penghasilan produk herba di HTC merujuk kepada amalan pengilangan baik bagi ubatan tradisional dan suplemen kesihatan yang dikeluarkan oleh Bahagian Regulatori Farmasi Negara (NPRA), Kementerian Kesihatan Malaysia.

Kawalan Kualiti

Kawalan kualiti dalam APB adalah terhadap pensampelan, spesifikasi, pengujian, dan pengurusan kelulusan produk siap. Produk ekstrak herba bersifat higroskopik dan memerlukan keadaan penyimpanan yang sesuai bagi menjaga kualiti dan kestabilan produk. Produk siap juga perlu diuji bagi memenuhi spesifikasi sebelum dipasarkan.

Jaminan penghasilan produk herba berkualiti di HTC direalisasikan apabila ketiga-tiga aspek kualiti berfungsi dengan berkesan. Aspek kualiti dalam pengilangan juga harus diberikan penekanan agar produk berkualiti tinggi dapat dihasilkan untuk pelanggan HTC.

Amalan Pengilangan Baik

Amalan Pengilangan Baik (APB) memastikan penghasilan produk dikawal bagi menepati piawai serta spesifikasi. Pelaksanaan APB bertujuan mewujudkan persekitaran yang sesuai, bersih, dan kondusif terutamanya bagi mengekang pencemaran mikroorganisma. Perkara yang dikawal di bawah APB ialah premis dan persekitaran, peralatan dan utiliti, proses pengeluaran produk, keperluan pekerja dan kemahiran, serta pembangunan sistem dokumentasi. Mesin dan peralatan perlu menjalani penyelenggaraan secara berkala.

Penyelenggaraan mesin

Aktiviti di HTC adalah berdasarkan amalan pengilangan baik

TENTANG PENULIS

Muhammad Yatimi Othman ialah pegawai penyelidik di Pusat Teknologi Herba, FRIM. Beliau berkelulusan ijazah kejuruteraan daripada Universiti Teknologi Malaysia.

Perkhidmatan Pendaftaran Produk Untuk Pengusaha

Product Registration Services for Entrepreneur

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Kes berkaitan produk kesihatan pelbagai jenama buatan sendiri dan tidak berdaftar kian meningkat saban tahun. Mesyuarat Dewan Rakyat pada 14 November 2019 melaporkan sejumlah 34,787 unit produk kesihatan yang tidak berdaftar dan kosmetik tanpa notifikasi telah dirampas pihak berkuasa pada tahun 2018 dan 2019 melibatkan nilai pasaran berjumlah RM63.1 juta. Nilai rampasan ini menggambarkan betapa seriusnya masalah dan ancaman terhadap orang awam disebabkan penggunaan produk kesihatan dan kosmetik yang tidak diperakui. Pemasaran dalam talian yang popular dan sukar dikawal ketika kini meningkatkan lagi capaian pengguna terhadap produk yang mungkin memudaratkan kesihatan.

Pusat Teknologi Herba (HTC) memperoleh perakuan amalan pengilangan baik (GMP) pada tahun 2007 dan disahkan sebagai pengilang produk kategori ubatan tradisional oleh KKM. Pada tahun 2012 HTC menawarkan perkhidmatan pengilangan kontrak kepada pengusaha herba sektor industri kecil dan sederhana. Produk keluaran HTC didaftar dengan PBKD melalui Bahagian Regulatori Farmasi Negara (NPRA).

Pendaftaran produk secara atas talian dengan NPRA menimbulkan kesukaran bagi pengusaha herba. HTC menawarkan khidmat pendaftaran produk tradisional kepada pengusaha herba pada tahun 2015 yang sekali gus melengkapkan fungsinya sebagai pusat sehenti pemprosesan dan pengeluaran produk ubatan herba. Pengusaha boleh mendapatkan perkhidmatan secara pakej bermula daripada pasca tuai, penghasilan ekstrak, formulasi produk kapsul, pendaftaran produk, pengilangan produk herba, sehingga kawalan kualiti produk.

Pendaftaran produk dengan PBKD melibatkan beberapa keperluan penting yang dinyatakan dalam Dokumen Panduan Pendaftaran Ubat (DRGD) keluaran NPRA. Pendaftaran dilakukan oleh pemegang pendaftaran produk (PRH) yang bertanggungjawab terhadap semua aspek produk, termasuk kualiti dan pematuhan syarat-syarat kebenaran pemasaran produk. Apabila sesuatu ubatan diluluskan pendaftarannya oleh PBKD, produk tersebut dianggap selamat digunakan. Kelulusan produk melibatkan beberapa siri penilaian dan ujian yang menyeluruh. HTC membantu pengusaha herba melalui keseluruhan proses ini sehingga produk berjaya didaftar.

Persetujuan dan lantikan pengilang kontrak antara pemilik dan pengilang merupakan langkah permulaan bagi pendaftaran produk. Permohonan token dan keahlian pengguna melalui sistem atas talian NPRA dilakukan oleh syarikat pembekal yang disahkan oleh NPRA. Selain dokumen pendaftaran, sampel pengujian diperlukan bagi penilaian. Data yang dinilai termasuk kandungan logam berat, ujian mikroorganisma, dan tahap kestabilan produk. Laporan penilaian produk dibincangkan melalui dua siri mesyuarat sebelum diluluskan pendaftarannya oleh PBKD. Tempoh kelulusan pendaftaran produk adalah sekitar lapan bulan. Sehingga akhir tahun 2019, HTC telah menguruskan pendaftaran 24 produk pelanggan yang melibatkan 17 syarikat.

1. Dokumen Panduan Pendaftaran Ubat (DRGD)
2. Token bagi mengakses sistem atas talian NPRA bagi pendaftaran produk
3. Pelekat hologram bagi rujukan pembeli
4. Pelekat hologram tulen pada produk pengilang yang sah

Produk berdaftar mempunyai dua ciri utama iaitu nombor pendaftaran dan pelekat hologram tulen. Nombor pendaftaran bermula dengan 'MAL' diikuti lapan nombor yang diakhiri huruf A, T, N, atau X. A kod ubatan preskripsi, T kod ubatan tradisional, N kod supplemen kesihatan, dan X kod ubatan bukan preskripsi. Produk berdaftar PBKD dirujuk di laman web rasmi NPRA atau secara memuat turun aplikasi 'NPRA Product Status' daripada Google Play Store.

Pendaftaran memperaku produk yang diperoleh pengguna adalah selamat, berkesan, dan berkualiti. Pengguna juga perlu memainkan peranan bagi memastikan ubat-ubatan dan kosmetik adalah yang berdaftar dengan PBKD.

TENTANG PENULIS UTAMA

Adib Zubaidi Rashid ialah pegawai penyelidik daripada Pusat Teknologi Herba, FRIM. Beliau mempunyai Ijazah Sarjana Muda dalam bidang kejuruteraan bioproses daripada Universiti Malaysia Perlis. Beliau merupakan pegawai yang bertanggungjawab menjalankan khidmat perundingan pendaftaran produk di HTC.

Kepentingan Formulasi Produk Kapsul Herba

Importance of Herbal Capsule Product Formulation

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Penyelidikan tentang formulasi bahan penting dalam penghasilan kapsul herba. Formulasi biasanya melibatkan percampuran beberapa komponen bahan mengikut nisbah atau formula yang ditetapkan.

Pusat Teknologi Herba (HTC) menghasilkan produk herba seperti kapsul yang melibatkan penggunaan bahan dalam bentuk serbuk. Dalam proses formulasi kapsul, beberapa perkara yang perlu diberi perhatian adalah bahan aktif dan sifatnya, kesesuaian penggunaan bahan tambahan, serta dos yang tepat bagi kesan yang diinginkan.

Formulasi produk herba

Bahan aktif ialah elemen utama dalam produk kapsul. Saiz partikel, kebolehaliran, ketumpatan serbuk, dan kebolehpadatan adalah beberapa sifat bahan aktif yang memainkan peranan penting dalam formulasi produk. Keputusan ujian terhadap sifat bahan aktif menentukan kesesuaian bahan bagi penghasilan kapsul. Pengubahsuaian sifat bahan aktif dijalankan melalui percampuran dengan bahan tambahan.

Bahan aktif bagi produk herba

Kaedah penggranulan meningkatkan saiz partikel, ketumpatan, dan kadar kebolehaliran serbuk agar dapat melepasi mesin secara jatuhan graviti ke dalam sarung kapsul. Kadar kebolehaliran yang kurang baik menyebabkan serbuk tersekat di corong mesin dan tidak masuk sepenuhnya ke dalam sarung kapsul, menyebabkan kualiti kapsul herba terjejas.

Bahan tambahan mengubah sifat fizikal bahan aktif, namun tidak memberi kesan signifikan kepada pengguna atau mempengaruhi keberkesanan produk kapsul. Terdapat bahan tambahan yang menambah kelinciran serbuk bagi meningkatkan kadar kebolehaliran bahan aktif. Ada bahan tambahan yang mengurangkan kelekitan semula jadi bahan aktif agar dapat dikendali dan diproses dengan baik. Selain itu, terdapat bahan tambahan yang berfungsi sebagai bahan pengisi bagi memenuhi ruang kosong di antara sarung kapsul.

Dos pengambilan bagi mendapatkan kesan yang diinginkan dikenali sebagai dos efektif. Dos efektif serta dos maksimum yang dibenarkan diperoleh melalui hasil penyelidikan terhadap bahan aktif. Berbeza dengan formulasi bagi farmaseutikal, produk tradisional biasanya tidak menitikberatkan dos efektif dan dos maksimum. Walau bagaimanapun, data penyelidikan berkaitan kedua-dua dos memainkan peranan penting bagi menentukan arahan pengambilan produk.

Proses formulasi yang tidak sempurna menyebabkan dos yang tepat tidak dapat ditentukan, menjejaskan keberkesanan, dan mungkin menghasilkan produk kapsul dengan dos berlebihan serta berbahaya. Kegagalan formulasi produk juga menjejaskan penghasilan kapsul di kilang, menyebabkan pembaziran bahan, dan masalah lain berkaitan pengendalian bahan dan produk.

Mesin penggranulan

Produk kapsul herba

Formulasi memainkan peranan penting dalam penghasilan produk herba. Keperluan proses formulasi perlu dititikberatkan bagi memastikan penghasilan produk herba yang berkualiti, berkesan, serta memenuhi kehendak pasaran.

TENTANG PENULIS UTAMA

Khairol Iruwan merupakan pegawai penyelidik yang bertanggungjawab bagi formulasi produk tradisional kapsul herba di Pusat Teknologi Herba (HTC). Beliau terlibat dalam penghasilan produk kapsul bagi pelanggan HTC dan keperluan R&D.

Perladangan Buluh
Bamboo Planting

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Dr Rosdi Koter

Perladangan hutan merupakan satu daripada penyelesaian yang dicadangkan kerajaan bagi mengurangkan tekanan dan eksploitasi bahan mentah daripada hutan di Malaysia. Buluh secara tradisinya dianggap rumpai kerana mengganggu pertumbuhan dan perkembangan pokok balak. Percubaan seperti rawatan silvikultur dilaksana ketika itu untuk mengawal persaingan antara buluh dan pokok balak. Kini persepsi industri terhadap buluh telah berubah dan tumbuhan ini dianggap berpotensi sebagai komoditi bernilai tinggi.

Buluh dibiak menggunakan kaedah seperti biji benih, keratan dahan dan batang, serta kultur tisu. Penanaman menggunakan biji benih jarang dilakukan disebabkan masalah mendapatkan stok yang baik serta penghasilan yang tidak menentu.

Bergantung kepada spesiesnya, sebanyak 300 hingga 400 rumpun buluh mampu ditanam di ladang berkeluasan 1 ha. Jarak tanaman yang disyorkan ialah 5 x 5 m^2 bagi jenis yang besar seperti buluh betung atau beting, manakala jenis sederhana seperti buluh tumpat memerlukan jarak 4 x 4 m^2. Jarak tanaman di kawasan berbukit ialah 9 m antara teres dan 5 m antara pokok buluh. Buluh perlu dijaga dan dibaja bagi mendapatkan hasil serta kualiti yang memuaskan. Penjarangan rumpun buluh dilakukan bagi memudahkan penebangan buluh matang.

Penghasilan buluh bergantung kepada bilangan rebung dalam satu rumpun yang tumbuh menjadi batang buluh. Penebangan batang buluh dilakukan 3–4 tahun selepas penanaman dan jika diuruskan secara sistematik, penghasilan berterusan menjangkau hingga melebihi 20 tahun. Buluh yang matang diproses menjadi pelbagai produk antaranya papan lelantai, produk tekstil seperti pakaian dan tuala, perabot, barang perhiasan, alat muzik, dan kertas.

Cawangan Pengurusan Ladang FRIM menyediakan khidmat nasihat, perundingan, dan teknikal bagi penubuhan dan pengurusan ladang hutan dan aktiviti berkaitan perhutanan tani. FRIM menguruskan projek penanaman buluh di Paya Indah Wetlands, Dengkil dan mempunyai taburan semula jadi buluh yang luas di Stesen Penyelidikan Jeli, Kelantan.

Mohd Khairun Anwar Uyup

Pembiakan buluh menggunakan kaedah keratan

Amir Saaiffudin Kassim

Ladang buluh betung

Amir Saaiffudin Kassim

Keratan rizom buluh aur

TENTANG PENULIS UTAMA

Dasrul Iskandar Darus merupakan pegawai penyelidik di Cawangan Pengurusan Ladang, Bahagian Bioteknologi Perhutanan, FRIM.

Pest and Diseases of Bamboo

Perosak dan Penyakit Buluh

Proliferation of short shoots at the node is a sign of bamboo witches' broom disease

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Wan Muhammad Azrul Wan Azhar

Bamboo is an important natural resource for manufacturing a wide variety of products. Bamboo plant is susceptible to pests and diseases when planted at nurseries and plantations or as natural stands. About 170 bamboo species from 26 genera worldwide are known to be affected by pests and diseases. Witches broom, leaf spot, root rot, and leaf roller are among the types of pests and diseases observed in Malaysia.

Witches Broom

The disease occurs on *Bambusa variegata* is often associated with the fungus *Balansia* sp. The infected bamboo develops a bundle-like structure of short shoots at the nodes of mature culms that imitates a witch's broom. The disease may be controlled by removing and burning infected culms.

Leaf Spot

Bamboo is vulnerable to the leaf spot disease associated with the fungi *Colletotrichum* spp. and *Pestalotiopsis* sp. Early stage of infection is characterised by small water-soaked, greyish brown leaf spots. The spots spread and coalesce to form large irregular necrosis (dead cells) often covering the entire leaf. Infected leaves of some bamboo species become pale yellowish and leathery. The disease is controlled by spraying fungicide such as thiram, benlate, and captan.

Irregular shaped and greyish brown lesion is a sign of leaf spot disease

Root Rot

Root rot disease in bamboo may not be a problem in Malaysia. However, the white root disease caused by *Rigidoporus microporus* was observed to infect *Dendrocalamus giganteus* at FRIM. Infected bamboo leaves discolour, wilt, and defoliate before dying. The disease is evident by the presence of orange brackets or fungal fruiting bodies at the plant base. Control of white root disease is difficult solely by fungicide application. Removal of the entire plant including the roots is highly recommended to avoid further spread of the disease.

Orange bracket fruiting bodies of *Rigidoporus microporus* on the basal culm of *Dendrocalamus giganteus*

Leaf Roller

Leaf roller is a common bamboo disease in South East Asia. The disease is associated with 15 caterpillar species and the most common is *Crypsiptya coclesalis*. Leaf roller caterpillar curls up and fuses bamboo leaves together with silk webbing to form its feeding shelter. The young caterpillar feeds on the inner surface of the leaves. The rolled up outer surface of the leaves gradually wither and turn pale and later drop off. Control of the pest infestation may be achieved naturally using predators such as birds, spiders, ants, and parasites. Serious infestations may be dealt using systemic insecticide such as dimethoate.

Bamboo leaves infested by *Crypsiptya coclesalis* caterpillar indicated by rolled leaves (right) and pest larva when leaf is split open (left)

ABOUT THE MAIN AUTHOR

Dr Mohd Farid Ahmad is a research officer at the Pathology and Mycology Unit, Biodiversity Division, FRIM. His field of expertise is diagnostic and identification of forest tree diseases. He is an arborist certified by the International Society of Arboriculture.

Durability of Bamboo
Ketahanan Buluh

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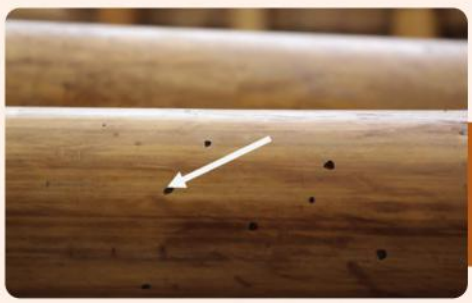
Like wood, bamboo is vulnerable to attack by pests such as powder-post beetles, termites, and fungus. The life span of these pests depends on the bamboo degradation rate. Their attack occasionally results in loss and scarcity of bamboo stands, as well as damage to end products. Chemically treating the bamboo is an effective measure to avoid pest infestations.

Powder post beetles attack bamboo stems mainly to acquire food such as starch and other carbohydrates. The starch content in bamboo is estimated to be between 0.2 and 15%, and varies depending on species, age, and culm height.

Powder post beetle, *Dinoderus minutus*



Exit holes on bamboo damaged by beetle

Felled culms and bamboo products are attacked mainly by *Dinoderus minutus*, the powder post beetle, which is also known by its many names such as bamboo borer, bamboo powder post, and ghoon borer. The bamboo borer attacks felled bamboo culms for their high nutrient content although the damage varies according to species, site, felling time, culm age, as well as transportation and storage methods. During storage, poles and bamboo products are highly susceptible to attack by powder post beetles which eventually degrade the bamboo to dust.

Habitat, cutting time, age, and drying time affect the strength and resistance of bamboo towards any beetle attack. Higher altitude bamboo is stronger compared with lower altitude bamboo. Bamboos harvested during cool temperatures and aged over three to four years are also less likely to be attacked by powder post beetles. Bamboo culms which are not dried immediately after felling will maintain their metabolic activity and have reduced starch content. Delayed drying enables conversion of starch to non-food components, thus, reduces attack by the beetle.

Subterranean termite, *Coptotermes curvignathus*

Cross-section of a termite damaged bamboo

Besides powder post beetle, termite also attacks bamboo stems and finished products. The most destructive is the subterranean termite, *Coptotermes*. Although termites prefer cellulose, the presence of sugar and starch, particularly at the inner bamboo stem occasionally attract attention. Subterranean termites attack above ground bamboo while drywood termites build their nest and attack the inner part of the bamboo culm. Bacteria in the termite's gut digests cellulose and other hard materials. Termite attack is usually non visible until the bamboo breaks apart. The attack typically leaves an intact outer layer which covers a severely damaged layer underneath. Damage to the entire bamboo structure signifies an advanced stage of deterioration.

ABOUT THE AUTHOR

Dr Roszaini Kadir is the Head of the Wood Entomology Laboratory (WEL), Forest Products Division, FRIM. She obtained her Bachelor and Masters degrees from Universiti Putra Malaysia. She also has a Doctor of Philosophy degree from Bangor University, United Kingdom. The author is a researcher at FRIM since 1993 and her research areas include wood and non-wood natural durability and antitermitic properties from natural products.

Susceptibility of Bamboo to Fungi

Kerentanan Buluh Terhadap Kulat

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Bamboo is generally considered as having low natural durability. Its susceptibility to biodegradation is mainly due to high starch content which is also food to fungi and insects. Other factors that influence the durability of bamboo are growth site, age, growth rate, portion of the cut bamboo, and cutting season.

Fungi such as decay fungi, mold, and stain affect bamboo differently. Decay fungi digest bamboo walls using cellulose or lignin degrading enzyme that weakens the physical and mechanical properties of bamboo. Attack of decay fungi is less conspicuous and harder to detect as it occurs internally. Indication of attack from which decay is at an advanced stage, is the appearance of fungal fruiting bodies.

Stain targets sugar and starch in bamboo cavities, while mold utilises simple carbon compounds on bamboo surface. Stain and mold often attack wet bamboo especially after harvest, during which moisture content reaches 80%. Stain causes bamboo to discolour. Although strength may not be adversely affected, it reduces the aesthetic value and appearance of bamboo. Mold grows on the surface of extremely wet bamboo and are observed in various colours of black, grey, green, purple, and red. Unlike decay fungi and stain, mold attack is superficial, does not degrade the bamboo, and may easily be removed from the surface, although there may be health concerns related to mold allergy.

Fungal attack on bamboo can be prevented by eliminating favourable conditions for fungal growth (moisture content above 20% and temperatures 25–30°C), as well as introducing protection using antifungal preservatives such as boron. To avoid stain and mold, freshly felled bamboo are dried to 12% moisture content using the conventional kiln dryer. Bamboo culms are kept dry under the roof and placed elevated and above ground. Mature bamboos, usually three to six years old, are preferable to young bamboos which are susceptible to fungi and insect attacks.

FRIM offers durability test for fungi related attack on lignocellulosic material such as bamboo at the Wood Mycology Laboratory. The laboratory is an ISO/IEC17025 accredited testing facility that provides durability tests based on standardised methods. Tests are conducted in controlled laboratory settings, or on field to resemble the actual environment of material installation. Proper application based on durability classification and treatment will ensure longer service life and reduction of biodegradation. The laboratory also offers technical services such as fungal identification and consultation related to good management practices and bamboo handling.

Mold growing on the surface of bamboo

Decayed bamboo strips exposed to outdoor condition

Fungi fruiting bodies on bamboo showing advanced stage of decay

ABOUT THE MAIN AUTHOR

Dr Shahlinney Lipeh is a researcher and Head of the Wood Mycology Laboratory, Forest Products Division. She specialises in biodegradation and protection of wood and other lignocellulosic materials in relation to fungi and insects.

Preservation of Bamboo for Structural Applications

Pengawetan Buluh bagi Kegunaan Berkaitan Struktur

Vacuum-pressure treatment method at FRIM

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Dr Mohamad Nasir Mat Arip

Bamboo culms are susceptible to biodegradation agents such as insects and decay fungi. Degradation agents reduce value and restrict possible applications of bamboo especially for structural purposes. Preservation is an effective solution to increase the durability of bamboo, expand the service life span, and reduce the long term cost of replacement. Preservation increases the safety of bamboo-based structures especially for load-bearing purposes.

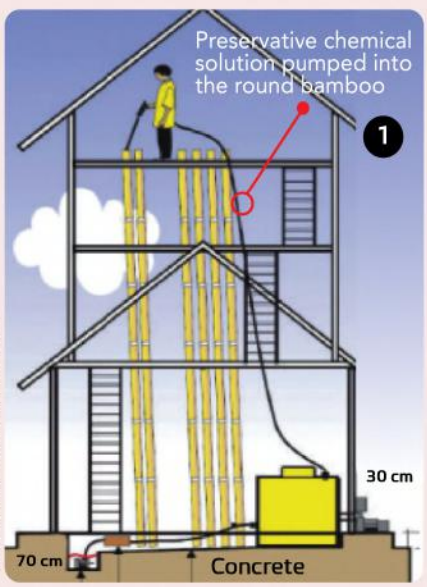
Bamboo is preserved by non-chemical (traditional) and chemical treatments. Traditional treatments include clump curing, water leaching, and smoking. Treatments are conducted to protect bamboo against degradation by reducing moisture content and eliminate starch and sugar. Although to a certain extent traditional methods provide resistance against insects and decay fungal attack, the treatments are more suitable for short-term applications. Long-term durability requires chemical treatment especially for structural applications. Chemical method is well established and provides protection for bamboo even in extreme conditions.

Many types of preservative chemicals are used to preserve bamboo including chromated copper arsenate (CCA), chromated copper boron (CCB), and boron-based compounds such as boric acid and borax. Preservative chemicals are infiltrated into bamboo structure by several methods such as the vertical diffusion, soaking or horizontal diffusion, Boucherie, and vacuum pressure. The diffusion and Boucherie methods are suitable for treatment of green bamboo. Dry bamboo is treated using vacuum-pressure treatment method.

Many chemical treatment methods are available for bamboo preservation but few are suitable for structural uses. Bamboos for indoor applications are treated with a mixture of boric acid and borax while outdoor and ground contact applications require CCA and CCB.

Proper absorption of preservative chemicals is essential for an effective treatment. Round bamboo is subjected to Boucherie or vacuum-pressure treatment method to facilitate absorption and ensure uniform distribution of preservative chemicals.

The quality of treated bamboo is determined in terms of chemical preservative retention in the bamboo structure. FRIM provides two types of quality control for treated bamboo, namely, the qualitative and quantitative tests. Both tests are used to assess the quality of treated bamboo to ensure the material is lasting for structural applications.



1. Vertical diffusion method
2. Horizontal diffusion method
3. Quantitative analysis facility at FRIM

ABOUT THE 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. The author and her team is currently involved in developing nano-preservatives.

Benefits of Nanoparticles on Bamboo

Kelebihan Partikel Nano Terhadap Buluh

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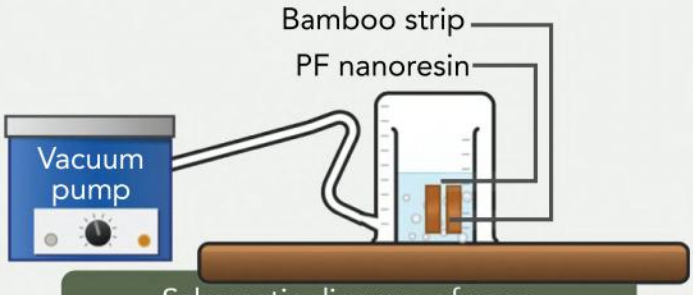
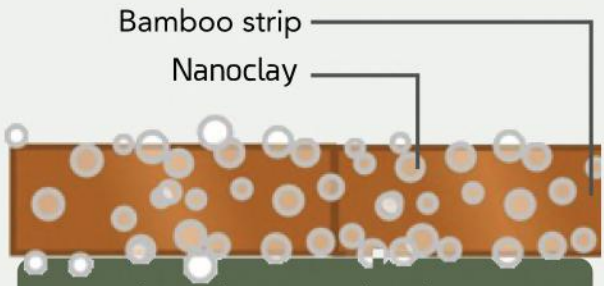
Nanoparticles are ultrafine units with dimensions measured in nanometres, nm (10^{-9} m). According to the International Organization for Standardization (ISO) nanoparticle is a discrete nano object in which dimensions are less than 100 nm. Nanoparticles exist naturally or are created as a result of human activities. Because of their ultrafine size, nanoparticles have unique characteristics, particularly the high surface area that is beneficial in a variety of applications.



Schematic diagram of nano treatment process



Nanoclay as barrier on bamboo strips

Bamboo is a natural and renewable material, fast growing, and offers high mechanical properties. Bamboo can be used for construction purposes such as flooring, decking, or wall panels. When constructing bamboo structures, it is essential that durability and sensitivity to moisture issues are being taken into consideration.

Incorporation of nanoparticles such as nanoclay in bamboo treatment is expected to improve properties by enabling deep penetration of chemicals into bamboo substrates and alteration of their surface chemistry. Bamboo treated with nanoparticles shows improvement in properties especially by reduced moisture and water absorption. Nanoclay particles act as a series of barrier that prevents penetration of water molecules, known as tortuous pathways.

Nanoclay

Establishment of tortuous pathways prevents the swelling tendency of bamboo products, in addition to anti-microbial effect to bamboo surface.

With the low price and availability of nanoclay, nano-treatment of bamboo could be a new and practical method to explore.

ABOUT THE MAIN AUTHOR

Dr Siti Norasmah Surip is an Associate Professor in the Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM) Malaysia. She is currently doing her attachment at Forest Research Institute Malaysia focusing on nano treatment of bamboo. Her research interests are in nano materials, eco/green composites, and hybrid composites.

Protection and Maintenance of Bamboo Structures

Mengawal dan Mengurus Struktur Buluh

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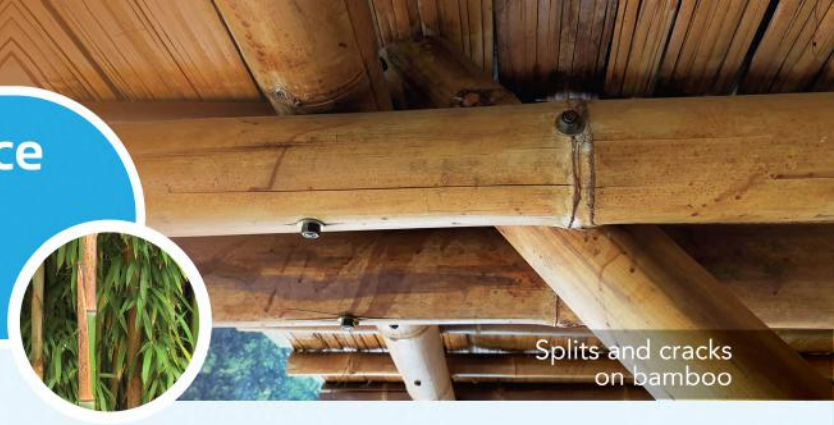

Splits and cracks on bamboo

Bamboo for construction purposes is gaining attention in Malaysia. Bamboo houses, mosque, huts, recreational hall, and resorts are observed at Tadom Hill Resorts in Banting, Bamboo Adventures Villages in Sungai Siput, Kampung Yum Resort, and Masjid Buluh in Kuala Kangsar. Bamboo shrinks and swells in response to changes in temperature and humidity. Exposure to weather damages bamboo construction causing structures to split and crack.

Faded coating on bamboo fence

Cracks and splits from use of nails on bamboo jointing

Pilot holes made before jointing bamboo with nails

Mould, fungi, and algae on bamboo structure

The best option for repairing severely damaged structures is to replace with new bamboo components. For below ground applications, bamboo poles are coated with tar, bitumen, or concrete to prevent rotting. Installation of stone, brick, or concrete footings in construction, and erecting fences at least 2 cm above the ground are beneficial to protect bamboo structures from ground contact. To avoid splitting, pilot holes are established before knocking nails or screws on bamboo jointing.

Like timber, bamboo is subjected to weathering. Coating is applied as a barrier against biodegradation agents and to slow down further deterioration. Transparent or semi-transparent coatings such as varnish and lacquer highlight the natural appearances and texture of outdoor bamboo structures such as fences and decorative features. However, varnish and lacquer have low resistance against moisture and are typically less durable. Continuous exposure to sunlight and rain causes finishing to rapidly fade, degrade, and become vulnerable to mould, fungi, and algae attack.

Brick footings prevent bamboo from direct contact with soil

Borer attack on bamboo bar

Bamboo structures are usually repainted with lacquer after one to two years, or when required. Repainting lacquer reduces moisture absorption, prevents attack by biodegradation agents, and preserves the aesthetic appearance. Proper use, treatment, and maintenance are crucial for the durability of bamboo.

ABOUT THE MAIN AUTHOR

Dr Mohd Fahmi Awalludin is a research officer at the Wood Finishing Laboratory, Forest Products Division, FRIM.

Bamboo Educational Trip

Nur Annissa Anuar
Mohd Faizul Mohd Shukari

Forest Products Division organised a three-day educational trip to Sungai Siput, Perak from 19–21 February 2020. The trip which was led by FRIM researchers Dr Tumirah Khadiran and Dr Mohd Khairun Anwar Uyup was organised to expose participants on usages of bamboo, particularly in the construction industry.

Introduction session to Tadom Hill Resort

Splitting of bamboo culm

The first destination was Tadom Hill Resort, Banting which is known for its bamboo-inspired architectures. The resort was established by Datuk Lai Yeng Fock in 2014 with cooperation of the surrounding Orang Asli villagers. One year after operation, postings on Tadom Hill Resort became viral in the social media with many influencers sharing its beautiful scenery. One of the resort's unique features is their effort to become a zero-waste facility. Discarded bamboos are processed into charcoal for car deodoriser and absorbent to improve the resort's lake water quality.

Briefing on charcoal production

Demonstration on bamboo culm jointing

Talk on introduction and current situation of bamboo industry

Participants were later brought to the Bamboo Jungle Adventure premises at Sungai Siput, Perak. This company provides training programmes for workers involved in bamboo-based construction and furniture industries. At the workshops, participants observed bamboo cutting and treatment processes in preparation for final product manufacturing. Participants were later brought to a fairly remote Orang Asli settlement from which bamboo was sourced. The area has various unique patterned Orang Asli houses and clean, unpolluted rivers.

Participants at Bamboo Mosque in Kuala Kangsar

Talk on bamboo treatment

Making bicycle frame using bamboo

Monopodial bamboo at Forestry Department, Cameron Highlands

Masjid Buluh Kuala Kangsar was the next destination. The Masjid was built in 2016 and designed by volunteers of the Bamboo Jungle Adventure. The last stop was at the Forestry Department, Cameron Highlands where participants were introduced to the running monopodial bamboo species. Monopodial bamboo grows singularly, unlike the clumped bamboo species, generally observed on the lowlands. Monopodial bamboo is an invasive plant that can penetrate many types of structures. The visit concluded in Cameron Highlands before the participants made their way back to FRIM.

ABOUT THE MAIN AUTHOR

Nur Annissa Anuar is a practical student at FRIM. She is pursuing a degree in industrial chemistry at Universiti Sains Islam Malaysia (USIM).

Smart Stand di Rumah, Pejabat, dan Taman

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Yanti Abd Kadir

Smart Stand dicipta disebabkan keinginan penulis untuk memiliki taman yang dihiasi pelbagai pasu tumbuhan dalam ruang yang terhad. Smart Stand dicipta bagi membantu penyusunan pokok hiasan agar ruang nampak luas, cantik, dan kemas.

Ciptaan ini berkonsep moden dan diinspirasi berdasarkan reka bentuk Scandinavia yang unik, ringkas, kemas, minimalis, dan cantik. Reka bentuk Scandinavia diterima umum bagi mengurangkan gangguan susunan ruang dan menekankan bahawa setiap objek mempunyai tempatnya.

Smart Stand berfungsi dalam pelbagai bentuk ruang daripada sudut hinggalah ke kawasan rata yang luas. Strukturnya yang terdiri daripada beberapa lapisan mampu menampung sehingga 13 pasu tumbuhan malah boleh digunakan untuk menyimpan pelbagai barangan seperti payung, tongkat, dan pelan. Ruang penyimpanan Smart stand adalah kecil dan muat di atas troli dan bonet kereta.

Smart Stand

Rekaan ini mudah dikendalikan dan mesra pengguna kerana sifatnya yang ringan, mudah alih, dan boleh diulang guna. Struktur ini sesuai digunakan bagi pasu pelbagai corak dan warna yang terdapat di pasaran. Struktur ciptaan ini diperbuat daripada kayu dengan penyokong daripada besi supaya tahan lasak dan stabil.

Smart Stand memenangi pingat perak di Ekspo Teknologi Malaysia 2020 (MTE) Pada 20–22 Februari 2020 di Pusat Dagangan Dunia Putra (PWTC), Kuala Lumpur. Selain Smart Stand, empat lagi inovasi FRIM turut bertanding dalam MTE 2020.

Pingat yang dimenangi FRIM dalam MTE 2020

- Pingat Perak (IIA): 'Active Ingredient Seel30 with Anti-Ovarian Cancer and Energy Booster Potential' yang diketuai Dr Nurhanan Murni Yunoh
- Pingat Perak (IIA): 'KLL092 Standardised Extract: Development of Antidiabetic Agent from Medicinal Plant based on Orang Asli Kensiu Traditional Knowledge yang diketuai Dr Fadzureena Jamal
- Pingat Perak (IIA): 'Producing Mechanical Pulp for the Moulded Products from Mixed Tropical Hardwood Timber Waste' yang diketuai Dr Rushdan Ibrahim
- Pingat Perak (IIA): 'Jus Laris' yang diketuai Noor Rasyila Mohd Nor
- Pingat Perak (PSIA): 'Smart Stand' yang diketuai Norain Mohd Arif

* IIA : Anugerah Inovasi dan Reka Cipta PSIA : Anugerah Inovasi Khidmat Awam

FRIM Anjur Kursus Pengeringan Kayu

FRIM Organises Timber Drying Course

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20 Februari 2020–Makmal Pengeringan Kayu dengan kerjasama Cawangan Latihan FRIM menganjurkan kursus pengeringan kayu dari 17-20 Februari 2020. Kursus dihadiri oleh pegawai penguat kuasa daripada Lembaga Perindustrian Kayu Malaysia (MTIB). Peserta didedahkan kepada prinsip asas dan teknologi pengeringan kayu di Malaysia. Antara topik yang dibincangkan adalah kaedah pemprosesan balak, pemeringkatan kayu bergergaji, sifat mekanik kayu dan penggunaannya, sifat-sifat kayu berkaitan pengeringan, kaedah penentuan kandungan lembapan dalam kayu, operasi tanur pengeringan dan dandang stim, serta kaedah mengatasi kecacatan pengeringan. Peserta kursus kemudiannya melawat kemudahan pengeringan kayu di FRIM, loji pengeringan tanur Persatuan Pengusaha Kayu-Kayan dan Perabot Bumiputra (PEKA), dan pemprosesan kayu getah di Karak, Pahang. Kursus disampaikan dalam bentuk ceramah, demonstrasi, dan amali oleh pegawai penyelidik FRIM iaitu Zairul Amin Rabidin dan Mohd Jamil Abdul Wahab.

Peserta Kursus Pengeringan Kayu