Pandanus tectorius

Scientific Name

***Pandanus tectorius* Parkinson ex Du Roi.**

Synonyms

Corypha laevis (Lour.) A.Chev., *Pandanus absonus* H.St.John, *Pandanus adscendens* H.St.John, *Pandanus aequor* H.St.John, *Pandanus aitutakiensis* H.St.John, *Pandanus akiakiensis* H.St.John, *Pandanus alloios* H.St.John, *Pandanus amplexus* H.St.John, *Pandanus angulatus* H.St.John, *Pandanus angulosus* H.St.John, *Pandanus anisos* H.St.John, *Pandanus aoraiensis* H.St.John, *Pandanus apionops* H.St.John, *Pandanus arapepe* H.St.John, *Pandanus asauensis* H.St.John, *Pandanus ater* H.St.John, *Pandanus baptistii* Misonne, *Pandanus bassus* H.St.John, *Pandanus bathys* H.St.John, *Pandanus bergmanii* F.Br., *Pandanus bicurvatus* H.St.John, *Pandanus blakei* H.St.John, *Pandanus boraboraensis* H.St.John, *Pandanus bothreus* H.St.John, *Pandanus bowenensis* H.St.John, *Pandanus brachypodus* Kaneh., *Pandanus brownii* H.St.John, *Pandanus cacuminatus* H.St.John, *Pandanus carolinensis* Martelli, *Pandanus chamissonis* Gaudich., *Pandanus charancanus* Kaneh., *Pandanus chelyon* H.St.John, *Pandanus christophersenii* H.St.John, *Pandanus citraceus* H.St.John, *Pandanus collatus* H.St.John, *Pandanus complanatus* H.St.John, *Pandanus cooperi* (Martelli) H.St.John, *Pandanus coronatus* Martelli, *Pandanus coronatus* f. *minor* Martelli, *Pandanus crassiaculeatus* H.St.John, *Pandanus crassus* H.St.John, *Pandanus cylindricus* Kaneh., *Pandanus cylindricus* var. *sinnau* Kaneh., *Pandanus cymatilis* H.St.John, *Pandanus decorus* K.Koch, *Pandanus dicheres* H.St.John, *Pandanus dilatatus* Kaneh., *Pandanus discolor* auct., *Pandanus distinctus* Martelli, *Pandanus divaricatus* H.St.John, *Pandanus divergens* Kaneh., *Pandanus dotyi* H.St.John, *Pandanus douglasii* Gaudich., *Pandanus drakei* H.St.John, *Pandanus drolletianus* Martelli, *Pandanus duriocarpoides* Kaneh., *Pandanus duriocarpus* Martelli, *Pandanus edwinii* H.St.John, *Pandanus elevatus* H.St.John, *Pandanus enchabiensis* Kaneh., *Pandanus erythrophloeus* Kaneh., *Pandanus extralittoralis* H.St.John, *Pandanus eyesyes* Kaneh., *Pandanus fahina* H.St.John, *Pandanus faramaa* H.St.John, *Pandanus fatuhivaensis* H.St.John, *Pandanus fatyanion* (Kaneh.) Hosok., *Pandanus feruliferus* H.St.John, *Pandanus filiciatilis* H.St.John, *Pandanus fischerianus* Martelli, *Pandanus fischerianus* f. *bergmanii* (F.Br.) B.C.Stone, *Pandanus fischerianus* f. *bryanii* B.C.Stone, *Pandanus fischerianus* f. *compressus* B.C.Stone, *Pandanus fischerianus* var. *bryanii* B.C.Stone, *Pandanus fischerianus* var. *cooperi* (Martelli) B.C.Stone, *Pandanus fischerianus* var. *rockii* (Martelli) B.C.Stone, *Pandanus fragrans* Gaudich., *Pandanus futunaensis* H.St.John, *Pandanus gambierensis* H.St.John, *Pandanus glomerosus* H.St.John, *Pandanus grantii* H.St.John, *Pandanus guamensis* Martelli, *Pandanus haapaiensis* H.St.John, *Pandanus heronensis* H.St.John, *Pandanus hivaoaensis*

T.K. Lim, *Edible Medicinal And Non-Medicinal Plants: Volume 4, Fruits*,
DOI 10.1007/978-94-007-4053-2_20, © Springer Science+Business Media B.V. 2012

H.St.John, *Pandanus horneinsularum* H.St.John, *Pandanus hosinoi* Kaneh., *Pandanus hosokawae* Kaneh., *Pandanus houmaensis* H.St.John, *Pandanus hubbardii* H.St.John, *Pandanus impar* H.St.John, *Pandanus inarmatus* H.St.John, *Pandanus inermis* Roxb., *Pandanus inflexus* H.St.John, *Pandanus infundibuliformis* H.St.John, *Pandanus insularis* Kaneh., *Pandanus intraconicus* H.St.John, *Pandanus intralaevis* H.St.John, *Pandanus jaluitensis* Kaneh., *Pandanus jonesii* (F.Br.) H.St.John, *Pandanus kafu* Martelli, *Pandanus kamptos* H.St.John, *Pandanus koidzumii* Hosok., *Pandanus korrensis* Kaneh., *Pandanus kraussii* H.St.John, *Pandanus kusaiensis* Kaneh., *Pandanus laculatus* H.St.John, *Pandanus laevis* Kunth, *Pandanus laevis* Lour., *Pandanus lakatwa* Kaneh., *Pandanus lambasaensis* H.St.John, *Pandanus laticanaliculatus* Kaneh., *Pandanus laticanaliculatus* var. *edulis* Kaneh., *Pandanus lauensis* H.St.John, *Pandanus licinus* H.St.John, *Pandanus limitaris* H.St.John, *Pandanus longifolius* H.L.Wendl., *Pandanus macfarlanei* Martelli, *Pandanus macrocephalus* Kaneh., *Pandanus makateaensis* H.St.John, *Pandanus malatensis* Blanco, *Pandanus mangarevaensis* H.St.John, *Pandanus mariaensis* H.St.John, *Pandanus marquesasensis* H.St.John, *Pandanus matukuensis* H.St.John, *Pandanus mbalawa* H.St.John, *Pandanus meetiaensis* H.St.John, *Pandanus menne* Kaneh., *Pandanus menziesii* Gaudich., *Pandanus metius* H.St.John, *Pandanus minysocephalus* H.St.John, *Pandanus mooreaensis* H.St.John, *Pandanus moschatus* Miq., *Pandanus moschatus* Rumph. ex Voigt, *Pandanus motuensis* H.St.John, *Pandanus nandiensis* H.St.John, *Pandanus notialis* H.St.John, *Pandanus oblatiapicalis* H.St.John, *Pandanus oblaticonvexus* H.St.John, *Pandanus obliquus* Kaneh., *Pandanus odontoides* Hosok., *Pandanus odoratissimus* f. *major* Martelli, *Pandanus odoratissimus* var. *laevigatus* Martelli, *Pandanus odoratissimus* var. *laevis* (Warb.), *Pandanus odoratissimus* var. *oahuensis* Martelli, *Pandanus odoratissimus* var. *parksii* Martelli, *Pandanus odoratissimus* var. *pyriformis* Martelli, *Pandanus odoratissimus* var. *savaiensis* (Martelli) Martelli, *Pandanus odoratissimus* var. *setchellii* Martelli, *Pandanus odoratissimus* var. *spurius* Willd., *Pandanus odoratissimus* var. *suvaensis* Martelli, *Pandanus okamotoi* Kaneh., *Pandanus onoilauensis* H.St.John, *Pandanus orarius* H.St.John, *Pandanus otemanuensis* H.St.John, *Pandanus ovalauensis* H.St.John, *Pandanus pachys* H.St.John, *Pandanus palkilensis* Hosok., *Pandanus palmyraensis* H.St.John, *Pandanus pansus* H.St.John, *Pandanus paogo* H.St.John, *Pandanus papeariensis* Martelli, *Pandanus papenooensis* H.St.John, *Pandanus parhamii* H.St. John, *Pandanus parksii* H.St.John, *Pandanus patulior* H.St.John, *Pandanus pedunculatus* R.Br., *Pandanus pedunculatus* var. *insularis* B.C.Stone, *Pandanus pedunculatus* var. *malagunensis* B.C.Stone, *Pandanus pedunculatus* var. *rendovensis* B.C.Stone, *Pandanus planus* H.St.John, *Pandanus politus* Martelli, *Pandanus ponapensis* Martelli, *Pandanus prismaticus* Martelli, *Pandanus prolixus* H.St.John, *Pandanus pseudomenne* Hosok., *Pandanus pulposus* (Warb.) Martelli, *Pandanus pulposus* var. *cooperi* Martelli, *Pandanus pusillus* H.St.John, *Pandanus pyriformis* (Martelli) H.St.John, *Pandanus radiatus* H.St.John, *Pandanus raiateaensis* H.St.John, *Pandanus raivavaensis* Martelli, *Pandanus raroiaensis* H.St.John, *Pandanus rectangulatus* Kaneh., *Pandanus repens* Miq., *Pandanus rhizophorensis* H.St.John, *Pandanus rhombocarpus* Kaneh., *Pandanus rikiteaensis* H.St.John, *Pandanus rimataraensis* H.St.John, *Pandanus rockii* Martelli, *Pandanus rotensis* Hosok., *Pandanus rotundatus* Kaneh., *Pandanus rurutuensis* H.St.John, *Pandanus sabotan* Blanco, *Pandanus saipanensis* Kaneh., *Pandanus saltuarius* H.St.John, *Pandanus samak* Hassk., *Pandanus sanderi* Sander, *Pandanus savaiensis* (Martelli) H.St.John, *Pandanus seruaensis* H.St.John, *Pandanus sinuosus* H.St.John, *Pandanus sinuvadosus* H.St.John, *Pandanus smithii* H.St.John, *Pandanus spurius* (Willd.) Miq., *Pandanus spurius* var. *weteringii* Martelli, *Pandanus stradbrookeensis* H.St.John, *Pandanus subaequalis* H.St.John, *Pandanus subcubicus* H.St.John, *Pandanus subhumerosus* H.St.John, *Pandanus subradiatus* H.St.John, *Pandanus suvaensis* (Martelli) H.St.John, *Pandanus taepa* (F.Br.) H.St.John, *Pandanus tahaaensis* H.St.John, *Pandanus tahitensis* Martelli,

Pandanus tahitensis var. *exiguus* J.W.Moore, *Pandanus tahitensis* var. *niueana* B.C.Stone, *Pandanus takaroaensis* H.St.John, *Pandanus tamaruensis* J.W.Moore, *Pandanus tapeinos* H.St.John, *Pandanus taravaiensis* H.St.John, *Pandanus tectorius* f. *convexus* B.C.Stone, *Pandanus tectorius* f. *laevis* (Warb.) Masam., *Pandanus tectorius* f. *philippinensis* Martelli, *Pandanus tectorius* var. *acutus* Kaneh., *Pandanus tectorius* var. *angaurensis* Kaneh., *Pandanus tectorius* var. *australianus* Martelli, *Pandanus tectorius* var. *brongniartii* Martelli, *Pandanus tectorius* var. *chamissonis* (Gaudich.) Martelli, *Pandanus tectorius* var. *cocosensis* B.C.Stone, *Pandanus tectorius* var. *douglasii* (Gaudich.) Martelli, *Pandanus tectorius* var. *drolletianus* (Martelli) B.C.Stone, *Pandanus tectorius* var. *exiguus* (J.W.Moore) B.C.Stone, *Pandanus tectorius* var. *fatyanion* Kaneh., *Pandanus tectorius* var. *ferreus* Y.Kimura, *Pandanus tectorius* var. *fragrans* Martelli, *Pandanus tectorius* var. *heronensis* (H.St.John) B.C.Stone, *Pandanus tectorius* var. *incrassatus* B.C.Stone, *Pandanus tectorius* var. *javanicus* Martelli, *Pandanus tectorius* var. *jonesii* F.Br., *Pandanus tectorius* var. *laevigatus* (Martelli) B.C.Stone, *Pandanus tectorius* var. *laevis* Warb., *Pandanus tectorius* var. *menziesii* (Gaudich.) Martelli, *Pandanus tectorius* var. *microcephalus* Martelli, *Pandanus tectorius* var. *novocaledonicus* Martelli, *Pandanus tectorius* var. *novoguineensis* Martelli, *Pandanus tectorius* var. *oahuensis* (Martelli) B.C.Stone, *Pandanus tectorius* var. *ongor* Kaneh., *Pandanus tectorius* var. *parksii* (Martelli) J.W.Moore, *Pandanus tectorius* var. *pedunculatus* (R.Br.) Domin, *Pandanus tectorius* var. *pulposus* Warb., *Pandanus tectorius* var. *samak* (Hassk.) Warb., *Pandanus tectorius* var. *sanderi* (Sander) B.C.Stone, *Pandanus tectorius* var. *sandvicensis* Warb., *Pandanus tectorius* var. *savaiensis* Martelli, *Pandanus tectorius* var. *spiralis* Martelli, *Pandanus tectorius* var. *stradbrookensis* (H.St.John) B.C.Stone, *Pandanus tectorius* var. *sumbavensis* Martelli, *Pandanus tectorius* var. *suringaensis* Martelli, *Pandanus tectorius* var. *taepa* F.Br., *Pandanus tectorius* var. *timorensis* Martelli, *Pandanus tectorius* var. *tubuaiensis* (Martelli) B.C.Stone, *Pandanus tectorius* var. *uapensis* F.Br., *Pandanus tectorius* var. *yorkensis* (H.St.John) B.C.Stone, *Pandanus tectorius* var. *zollingeri* Martelli, *Pandanus temehaniensis* J.W.Moore, *Pandanus terrireginae* H St.John, *Pandanus tessellatus* Martelli, *Pandanus tikeiensis* H.St.John, *Pandanus tima* H.St.John, *Pandanus timoeensis* H.St.John, *Pandanus tolotomensis* Glassman, *Pandanus tomilensis* Kaneh., *Pandanus tongaensis* H.St.John, *Pandanus trapaneus* H.St.John, *Pandanus tritosphaericus* H.St.John, *Pandanus trukensis* Kaneh., *Pandanus tubuaiensis* Martelli, *Pandanus tupaiensis* H.St.John, *Pandanus uea* H.St.John, *Pandanus utiyamae* Kaneh., *Pandanus vahitahiensis* H.St.John, *Pandanus vandra* H.St.John, *Pandanus vangeertii* auct., *Pandanus variegatus* Miq., *Pandanus veitchii* Mast., *Pandanus virginalis* H.St.John, *Pandanus viri* H.St.John, *Pandanus viridinsularis* H.St.John, *Pandanus volkensii* Kaneh., *Pandanus yorkensis* H.St.John, *Pandanus yunckeri* H.St.John.

The species is very polymorphous. Numerous varieties and forms exist which have been described under a host of names.

Family

Pandanaceae

Common/English Names

Beach Pandan, Hala, Hala Tree, Pandan, Pandanas, Pandanas Palm, Screw Pine, Tahitian Screwpine, Textile Screw-Pine, Thatch Screw-Pine, Veitch Screw-Pine.

Vernacular Names

Andaman Islands: Oro;
Arabic: Kadi;
Burmese: Tsatthapu;
Chinese: Lu Dou Shu;
Chuuk: Deipw, Fach, Far;
Colombia: Palma De Tornillo;
Fiji: Vadra, Voivoi;
French: Pandanus, Baquois, Vacouet, Vacquois;

Danish: Skruepalme;
Dutch: Pandan, Schroefpalm;
Eastonian: Lõhnav Pandan;
Finnish: Kairapalmu;
German: Pandanuspalme, Schraubenbaum, Schraubenpalme;
Guam: Kafu;
Hawai'i: Hala, Pū Hala;
Hebrew: Ha-Pandanus;
Hungarian: Illatos Pandanusz, Pandánusz Víz, Panpung Víz;
India: Ketakiphul, Keteki (Assamese), Keori, Ketaki, Ketaky, Keya (Bengali),Kewoda (Gujerati), Keora, Kevda, Kewda, Kewara, Kewra (Hindu), Kedige, Kedigĕ, Ketake, Ketakĕ, Tāḷe Hū, Tale Hu (Kannada), Kaida, Kaitha, Thala (Malayalam), Kenda, Ketaki, Ketakī, Keura, Kevḍā, Kewda, Kewra (Marathi), Kia (Oriya), Ketaka, Ketaki (Sanskrit), Talai, Tāḷai, Tazhai (Tamil), Mogheli, Mogil Mogli Chettu, Mugali (Telugu), Keora (Urdu);
Indonesia: Pandan Pudak, Pandan Pudak Duri, Pandan Pudak Emprit (Java), Pandan Pudak, Pandan Samk Laut (Sundanese);
Italian: Ananasso Della China, Panda Odorosa, Pandano;
Japanese: Adan, Shima Tako No Ki;
Kiribati: Te Kaina
Korean: A-Dan, Adan;
Kosrae: Mweng;
Lithuanian: Kvapusis Pandanas;
Malaysia: Mengkuang Laut, Mengkuang Duri, Mengkuang Layer, Padan Berdahan, Pandan Laut, Padan Darat, Pandan Todak, Pandan Pudak;
Marshall Islands: Bōb;
Nauruan: Épo;
Norwegian: Skrupalme;
Palauan: Ongor;
Philippines: Baroi (Bikol), Panhakad (Bisaya), Pandin (Ibanag), Panglan, Pandin (Iloko), Laha, Padan, Uhañgo (Ivatan), Alasas (Pampangan), Panglan (Sambali), Laha (Sulu), Pandan-Dagat, Alasas, Dasa, Pandin (Tagalog);
Pohnpei: Binu (Kapingamarangi Atoll), Hala (Nukuoro Atoll), Ajbwirōk, Anewetāk, Kipar (Pingelap Atoll), Kipar, Deipw (Sapwuahfik Atoll), Kipar (Mokil Atoll);
Portuguese: Pândano;
Russian: Pandanus Aromatnejshi;
Samoan: Fala, Lau Fala;
Spanish: Bacua, Pandan, Pandano;
Sri Lanka: Mudukeyiya (Sinhalese),
Swedish: Skruvpalm;
Thai: Karaket, Lamchiek;
Tokelau Islands: Fala;
Tongan: Fa, Fafa, Laufala, Falahola, Kukuvalu, Lou'Akau;
Tuvalu: Fala, Lau Fala;
Vanuatu: Pandanas (Bislama), Xer (Banks, Mosina), Feveo (Maexo, Sungawadaxa), Butsu, Vip (Penteote, Apma), Na- Barau (Tongoa, Namakura), No-Xixo (Torres, Hiu);
Vietnamese: Cay-Jua, Dúa Trô, Dứa Gỗ;
Yapese: Choy, Fach, Far.

Origin/Distribution

Wild distribution of *Pandanus tectorius* occurs in the exposed coastal headlands beaches and near-coastal forests of south Asia (south India, Sri Lanka), southeast Asia (Myanmar, Thailand, Malaysia, Indonesia, Philippines), eastward through Papua New Guinea and tropical northern Australia (the Port Macquarie area to Cape York and Torres Strait islands in Queensland) and extending throughout the Pacific islands, including Melanesia (Solomon Islands, Vanuatu, New Caledonia, and Fiji), Micronesia (Palau, Northern Marianas, Guam, Federated States of Micronesia, Marshall Islands, Kiribati, Tuvalu, and Nauru), and Polynesia (Wallis and Futuna, Tokelau, Samoa, American Samoa, Tonga, Niue, Cook Islands, French Polynesia, and Hawai'i). It is cultivated in the native areas as well as in Central India and Saudi Arabia.

Agroecology

Pandanus tectorius is a robust, hardy plant for tropical, sub-tropical and warm temperate maritime areas where frost is not a problem. It occurs usually from sea level to 20 m elevation in the Pacific islands and up to 60 m in southeast Asia, but has also been cultivated up to 600 m in

Hawaii. Its native habitats are found in strandline and coastal vegetation, including grassy or swampy woodlands, secondary forests, and scrub thickets developed on makatea (raised fossilized coralline limestone terraces). It commonly occurs on the margins of mangroves and swamps. *Pandanus* also occurs as an understory tree in plantations and forests on atolls and larger islands either planted or naturalized. It thrives in areas with mean annual temperature of 24–28°C with a mean maximum temperature of 28–36°C and mean minimum temperature of 17–25°C. It can tolerate a minimum cool temperature of 12°C. The species is adapted to localities with summer bimodal and uniform rainfall distribution with mean annual rainfall of 1,500–400 mm but is tolerant to short drought periods of a few months. The tree is extremely resistant to strong winds, even tropical cyclonic and salt-laden winds. *Pandanus* prefers a free-draining soil but will tolerate seasonally waterlogged conditions. In its native range, it is found on various littoral soils, especially sandy and rocky beaches, including raised coralline terraces and recent basalt from lava flows. It is adaptable to a wide diversity of soil types from light to heavy-textured soil types, including brackish/saline soils, light-coloured, infertile coralline atoll sands, sodic soils, alkaline sands, thin soils over limestone, and peaty swamps from pH of 4–9. It occurs in open, exposed areas in full sun but will tolerate intermediate partial shading.

Edible Plant Parts and Uses

Pandanus tectorius fruits are edible and it is reported to form a major source of staple food in Micronesia including the Marshall Islands, Federated States of Micronesia, and Kiribati. *Pandanus* are also widely consumed on Tokelau and Tuvalu. In parts of Micronesia, chewing the ripe fruit segments (keys) is a common, pleasurable, and highly social activity. The ripe red segments of the fruit are also roasted and lower fibrous parts are eaten. The seeds found in woody cavities in each segment can also be roasted and eaten. Juice and jam may also be prepared from the fruit. Juice pressed from the fruits is acid-sweet with a pungent flavour (Miller et al. 1956). It is being produced commercially in the Marshall Islands. *Pandanus* can also be made into flour that is consumed in different ways, usually prepared as a drink. Pandanus pulp is preserved in several different ways. A paste, which is compared to dates in taste, texture, and appearance, is made by boiling and baking the ripe segments, followed by extracting, processing, and drying the pulp. Preserved *Pandanus* pulp mixed with coconut cream makes a tasty, sweet food item. Cultivars with large amounts of pulp are preferred, and the taste and flavour differs among cultivars. In Marshall Islands male *Pandanus* flowers are believed to have aphrodisiac properties and are eaten as masticatory.

Botany

Pandanus tectorius is a robust, small, laxly and widely branched, dioecious tree usually 5–6 m high but may reach 18 m (Plates 1 and 2). The trunk, 12–25 cm across, is often divided near the base, with or without prop roots, often with aerial roots descending from the branches. The bark is greyish- or reddish-brown and smooth. The stem and branches are ringed with distinct undulating leaf scars (Plate 3) sometimes with rows of prickles. Leaves are glaucous, deep green, sessile, linear 1–3 m long by 11–16 cm wide, acuminate, tapering with sheathing bases and spiny midribs and spiny or smooth margins (Plate 4). Leaves are crowded at the top of stems and arranged in three spirals in a screw-like arrangement which gives rise to the common name (Plate 2). Male and female flowers occur at the shoot apex in separate plants in inflorescence head. Male flowers are fragrant, tiny, white, pendant, arranged in racemes or branched in clusters in cylindric spikes, with large white showy bracts and numerous stamens on short filaments (stemonophore) with basifixed anthers longer than filament. Female flowers occur crowded together in globose, ellipsoid to ovoid heads, each carpel with 5–18 stigmas. Fruit an aggregate fruit, globose, subglobose, ellipsoid to ovoid, pineapple-like,

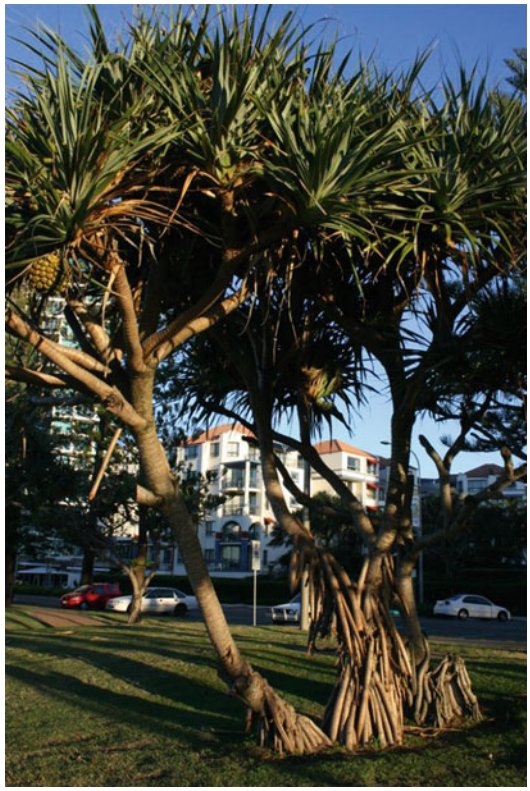

Plate 1 Tree habit with aerial prop roots

Plate 2 Leaves crowded at the apices of branches

Plate 3 Stem and branches with characteristic leaf scars

Plate 4 Cluster of strap-shaped leaves

Plate 5 Immature green fruiting head

large, 10–30 cm long by 8–20 cm across, comprising of tightly crowded, wedge-shaped fleshy drupes or phalanges (keys) (Plates 5, 6, 7 and 8). There are 1–15 carpels per phalange, and these are arranged either radially or in parallel rows. The central apical sinuses range from 1 to 28 mm deep. When ripe, the color of the basal section of the phalanges varies from pale yellow to dark yellow, orange, and orange/red. For intact fruiting heads the visible apical portion of the phalange is typically green with brown markings at

Plate 6 Ripe, orange fruiting head

Plate 7 Fruiting head with some phalanges (drupes) removed

Plate 8 Detached drupes (phalanges or keys)

maturity, turning yellow with age, after falling. The endocarp or pyrene (internal tissue surrounding the seeds) is dark reddish-brown, hard and bony. The mesocarp comprises apical and basal sections. The apical section formed in the apex of each carpel comprises an elongated cavity of aerenchyma cells consisting of a few longitudinal fibres and white membranes. The basal section is fibrous and fleshy, about 10–30 mm long. The seeds are obovoid, ellipsoid, or oblong; 6–20 mm long; red-brown and whitish and jelly-like inside.

Nutritive/Medicinal Properties

Nutrient value of the *Pandanus* fruit per 100 g edible portion was reported as: water 69 g, energy 595 kJ (144 kcal), protein 4.9 g, total fat total fat 8.3 g, available carbohydrate 12 g, dietary fibre 5.4 g, Na traces, K 89 g, Ca 13 g, Fe 0.7 g, total vitamin A equivalent 119 μg, B-carotene equivalent 714 μg, thiamine 0.14 mg, riboflavin 0.03 mg, niacin 1 mg, vitamin C 8 mg (Dignan et al. 1994). Nutrient composition of *Pandanus* paste was reported as: energy 1,350 kJ (326 kcal), protein 2.2 g, total fat 1.4 g, available carbohydrate 76 g, Ca 134 mg, Fe 5.7, total vitamin A equivalent 1,080 μg, thiamine 0.04 mg, riboflavin 0.06 mg, niacin 2 mg, and vitamin C 2 mg (Dignan et al. 1994).

A 100 g portion of the raw edible *Pandanus* kernel was found to comprise mainly water (25 g), energy 1,550 kJ (376 kcal), protein 15 g, total fat 30 g, available carbohydrate 11 g, dietary fibre

4.6 g, Na 229 mg, Ca 10 mg, Mg 154 mg, Fe traces, Zn, 2.4 mg, total vitamin A equivalent 302 μg, thiamine 0.38 mg, riboflavin 0.1 mg, niacin 4 mg, and vitamin E 1 mg (Dignan et al. 1994).

The edible cultivars contained a range of carotenoid levels (21–902 μg ß-carotene/100 g), with higher levels in cultivars having deeper yellow-orange coloured fruit; ten cultivars had significant levels that met estimated vitamin A requirements within normal consumption patterns (Englberger et al. 2006); yellow fruited cultivars contained low levels of carotenoids, while the orange fruited ones, which were also well liked as a food in the community, contained higher levels at maxima of 190 μg/100 g and 393 μg/100 g for α- carotene and β-carotene, respectively (Englberger et al. 2003a). The *Pandanus* cultivars contained substantial concentrations of provitamin A carotenoids (β- and α-carotene, β-cryptoxanthin, lutein, zeaxanthin, and lycopene) (110–370 μg β-carotene/100 g) and total carotenoids (990–5,200 μg/100 g) (Englberger et al. 2009). Pandanus paste contained 1,400 μg β-carotene/100 g, 5,620 μg total carotenoids/100 g, and 10 vitamins (including 10.8 mg/100 g vitamin C).

The fruit of these varieties has considerable potential for alleviating vitamin A deficiency in Micronesia (Englberger et al. 2003b). Carotenoid-rich foods protect against vitamin A deficiency, anaemia, and chronic disease, including cancer, heart disease and diabetes, which are serious problems in Micronesia. As carotenoid-rich food may protect against diabetes, heart disease, and cancer, the consumption of *Pandanus* may also alleviate these serious emerging problems of the Pacific.

The essential oil obtained from the ripe fruit of *Pandanus tectorius* was found to have large amounts of isopentenyl and dimethylallyl acetates and cinnamates (Vahirua-lechat et al. 1996).

Pandanus tectorius contained triterpenes and phytosterols which were found to exhibit antituberuclar activity (Tan et al. 2008). The chloroform extract of *Pandanus tectorius* Soland. var. *laevis* leaves afforded a new tirucallane-type triterpene, 24,24-dimethyl-5β-tirucall-9(11), 25-dien-3-one (1), squalene and a mixture of the phytosterols stigmasterol and β-sitosterol. Compound (1) inhibited the growth of *Mycobacterium tuberculosis* H37Rv with a MIC of 64 μg/mL, while squalene and the sterol mixture have MICs of 100 and 128 μg/mL, respectively.

Methanol leaf extract of *P. tectorius* (0.5 mg/ml) exhibited tryrosinase inhibitory activity of 26.7%. Tyrosinase inhibitors are important in preventing the enzymatic oxidation (browning) of food and to prevent inhibition of melanisation in animals (Masuda et al. 2005). Over the years tyrosinase inhibitors have attracted strong interest in both the food and cosmetic industries.

All parts of *P. tectorius* tree has been used in traditional medicine in south and southeast Asia and the Pacific islands (Adam et al. 2003; Del Rosario and Esguerra 2003; Burkill 1966; Kapoor 1989; Miller et al. 1956; Nguyen 1993; Stuart 2010; Thomson et al. 2006). *Pandanus* is a very important medicinal plant, with certain varieties sometimes preferred for particular treatments. In Hawaii, the fruits, male flowers, and aerial are used individually or in combination with other ingredients to treat a wide range of illnesses, including digestive and respiratory disorders. In Kiribati, *Pandanus* leaves are used in treatments for cold, flu, hepatitis, dysuria, asthma, boils and cancer, while the roots are used in a decoction to treat hemorrhoids. In Palau, the leaves are used to alleviate vomiting and the root is used to make a drink that alleviates stomach cramps. In Ayurveda, leaves have been used for leprosy, smallpox, scabies, syphilis and leukoderma; and for filarial disease, leucorrhea and as emmenagogue in traditional Indian systems. In India, the male inflorescence is distilled to make an essence which is medicinal. Anthers of male flowers are used for treating earaches and headaches. Poultice of fresh leaves mixed with oil were used for headaches and a leaf decoction used for arthritis and stomach spasms. Pulverized dried leaves have been used to facilitate wound healing. Poultice of mash of cabbage of plant, mixed with salt and juice of *Citrus microcarpa*, for abscesses. In the Philippines, the leaves are reported to be useful against leprosy, small pox, rabies and heart and brain diseases. In Peninsular Malaysia, it was reported that an infusion of the pith of the plant was taken as antidote for poisoning. In Papua

New Guinea, the bark was scraped into a solution of wild ginger leaf and the solution drank to sedate mental patients. A decoction of fresh or dried prop roots was drank as tea as a diuretic. Decoction of roots was believed to have aphrodisiac and cardiotonic properties. Roots were chewed to strengthen gums. A root decoction was used for arthritis and to prevent spontaneous abortion. Decoction of roots combined with sap of banana plant for urethral injections was used for a variety of urinary complaints. In Vietnam, the roots are regarded as diuretic and used to treat oliguria and other urinary complaints.

Other Uses

Besides the edible and medicinal uses of *Pandanus tectorius*, various parts of the tree have a myriad of other important uses (Burkill 1966; Little and Skolmen 1989; Meilleur et al. 1997; Thomson et al. 2006; Panda et al. 2009; Quisumbing 1978).

Tree

Pandanus is widely planted as an ornamental in home gardens, especially as a boundary hedge along front fences in the Pacific islands. When established on the seaward slopes and crests of frontal dunes, *Pandanus* helps to stabilise soil by binding the sand and prevent wind and water erosion. All parts of the tree may be used for production of compost, as well as in mulching and improving fertility and organic matter levels in sandy, coralline soils. In Kiribati, *Pandanus* leaves are used for mulching in giant swamp taro pits.

Roots

Dried aerial prop roots are used in making slats used for walls of houses and food cupboards, cordage, skipping ropes, paint brushes and basket handles. In Kiribati, fish traps are made out of the aerial roots and A black dye from the roots used in weaving.

Trunk/Wood

The stems provide timber that are used in house construction, making ladders in the Marshall Islands, The trunk of one variety is used to make the masts of traditional canoes. Erstwhile, the wood was used to make lances and batons. The wood has many uses that include as headrests, pillows, vases and as aid for string making and implement for extracting coconut cream. The trunk and branches are occasionally used as fuelwood where other fuelwood is scarce. The trunk provides a source of glue or caulking for canoes. *Pandanus* charcoal was employed in various mixtures to dye and waterproof canoes. The trunk of female trees have been used to make water pipes after removal of the soft core.

Leaves

In Hawaii, *Pandanus* leaves were the traditionally employed as the main material for making canoe sails. *Pandanus* leaves are used to weave traditional floor mats, baskets (including for ladies and to keep valuables), sugar bags, hats, fans, pillows as well as other plaited wares in Mauritius, Peninsular Malaysia and the Pacific islands. In the Philippines, the very strong and durable "sabutan hats" are made from young leaves, mats are also made from leaves. They are commonly used as thatching materials for walls and roofing in traditional houses. Young leaves, are reportedly used as fodder for domestic animals such as pigs and horses. In Kiribati and the Marshall Islands, the leaves are formed into a ball for use in a kicking game. In Micronesia, the leaves are used as wrappings for tobacco and cigarettes. In many Pacific islands *Pandanus* leaves are used to weave traditional items of attire, including mats for wearing around the waist in Tonga, as well as hats, fans and various types of baskets. Leaves, often neatly cut are used for making leis and garlands.

Flowers

In South Asia, Southeast Asia and Polynesia, the male flowers and preparations derived from them

are used to scent clothes, coconut oil and incorporated into cosmetics, soaps, hair oils, and incense sticks. Male flowers picked from uncultivated *Pandanus* are used alone or in combination with other flowers to perfume coconut oil in Polynesia. In Hawai'i, the male flowers were used to scent tapa. The highly fragrant male flowers are widely used for decoration, and used in making garlands or leis. *Pandanus* constitutes one of the major bioresources of Ganjam coast, Orissa in India; used mainly in small scale perfume industry for aromatic compound extracted from the male inflorescences. *P. tectorius* produce aroma of high quality and yield, composed of primarily phenyl ethyl methyl ether (66.8–83%) and terpinen-4-ol (5–12%) along with a number of other phyto-chemical compounds. In Indonesia, the male flowers are used in religious and social ceremonies.

Fruit

In the northern Pacific, the discarded, dried keys are much appreciated as fuelwood for cooking because they are slow burning and therefore preferred for barbecues. The dried, exposed fibrous bristles of a dried key are used as a brush for decorating tapa, with the hard, woody outer end acting as a handle. A high quality, uniquely Pacific perfume is made from the aromatic fruits of selected traditional cultivated varieties in the Cook Islands. Fragrant fruits are also used in garlands and leis.

Comments

Pandanas tectorius is usually grown from seeds or large stem cuttings. Plants grown from cuttings fruit in 4–6 years, earlier than those from seeds.

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