

Ethnobotany of Mountain Regions

Series Editors:

R. W. Bussmann · N. Y. Paniagua-Zambrana

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F. Merlin Franco *Editor*

Ethnobotany of the Mountain Regions of Southeast Asia

 Springer

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Series Editors

Rainer W. Bussmann
Department of Ethnobotany
Institute of Botany and Bakuriani Alpine Botanical Garden
Ilia State University
Tbilisi, Georgia

Saving Knowledge
La Paz, Bolivia

Narel Y. Paniagua-Zambrana
Department of Ethnobotany
Institute of Botany and Bakuriani Alpine Botanical Garden
Ilia State University
Tbilisi, Georgia

Saving Knowledge
La Paz, Bolivia

Herbario Nacional de Bolivia
Universidad Mayor de San Andrés
La Paz, Bolivia

Ethnobotanical research in recent years has increasingly shifted into applied aspects of the discipline, including climate change research, conservation, and sustainable development. It has by now widely been recognized that “traditional” knowledge is always in flux and adapting to a quickly changing environment. Trends of globalization, especially the globalization of plant markets, have greatly influenced how plant resources are managed nowadays. While ethnobotanical studies are now available from many regions of the world, no comprehensive encyclopedic series focusing on the worlds mountain regions is available in the market. Scholars in plant sciences worldwide will be interested in this website and its dynamic content.

The field (and thus the market) of ethnobotany and ethnopharmacology has grown considerably in recent years. Student interest is on the rise, attendance at professional conferences has grown steadily, and the number of professionals calling themselves ethnobotanists has increased significantly (the various societies—Society for Economic Botany, International Society of Ethnopharmacology, Society of Ethnobiology, International Society for Ethnobiology, and many regional and national societies in the field currently have thousands of members). Growth has been most robust in BRIC countries.

The objective of this new series on Ethnobotany of Mountain Regions is to take advantage of the increasing international interest and scholarship in the field of mountain research. We anticipate including the best and latest research on a full range of descriptive, methodological, theoretical, and applied research on the most important plants for each region. Each contribution will be scientifically rigorous and contribute to the overall field of study.

More information about this series at <http://www.springer.com/series/15885>

F. Merlin Franco
Editor

Ethnobotany of the Mountain Regions of Southeast Asia

With 418 Figures and 1 Table

 Springer

Editor

F. Merlin Franco
Institute of Asian Studies
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Dedicated to the folk healers of Southeast Asia

Preface

Plants assume ethnobotanical importance only when they are associated with human societies. Use of plants as medicine, food, fodder, and cultural purposes all happen in specific cultural and landscape contexts. This is a major factor often ignored by biologists studying human-plant relationship. Touting a plant as an ethnobotanically important one without providing adequate information on the societies that use them, or the context of use, distorts the picture. Chapters included in this volume provide comprehensive information on the medicinal, food, cultural, and phytochemical values of selected plant species, along with the cultural context. Gleaning out these information from published literature was not an easy task as a good percentage of published articles merely mention the plant use without specifying the community and context of its use. Also, most literature do not provide an understanding on how plant use has changed over times. Our authors have taken extra care to ensure that these information are presented, wherever possible. Another highlight of this volume is that majority of our contributing authors are budding ethnobiologists. These youngsters are poised to emerge as torch bearers of ethnobiology in Southeast Asia, and the larger Asian continent. We hope that this volume would serve as an important reference material for academics, plant lovers, and members of local communities of Southeast Asia.

Acknowledgments

This volume took birth with an invitation from Rainer W. Bussmann and Narel Y. Paniagua-Zambrana, series editors of *Ethnobotany of Mountain Regions*. I thank both of them for providing me the opportunity to edit the volume and also the freedom to include sections on biocultural importance of the selected species.

I express my sincere gratitude to all individual authors who have contributed to this volume. However, I should specifically place on record the important role played by Anisatu Z. Wakhidah, a young ethnobiologist from Indonesia. Her entry into the project came at a time when we had suffered a major setback with a few authors dropping out. She had helped me network with other ethnobiologists from Indonesia. Without her, this project would have taken longer to complete.

For this volume, I had the privilege to work with an extremely efficient team at Springer Nature including Eric Stannard, Johanna Klute, and Sylvia Blago. The experience and patience of Johanna and Sylvia helped a lot in troubleshooting various unforeseen glitches that arose especially during the initial stages of the project.

Special thanks to D. Narasimhan, former professor of botany at Madras Christian College, Chennai, and Santhana Ganesan of Singapore Botanical Gardens for their moral support and encouragement.

I thank the Institute of Asian Studies at Universiti Brunei Darussalam for supporting me throughout this project. Though ethnobiology is an interdisciplinary subject, in Asia it is often considered as a part of the natural sciences due to the domination of a bioprospecting narrative. I am indebted to my home institute for appreciating the interdisciplinary value of this project and permitting me to work on this.

F. Merlin Franco

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Rina Ratnasih Irwanto

Photographs and Findings 1137



Pandanus conoideus Lam.

PANDANACEAE

Ary Prihardhyanto Keim and Wawan Sujarwo

Synonyms

Bryantia butyrophora Webb; *Pandanus butyrophorus* (Webb) Kurz; *Pandanus ceramicus* Kunth; *Pandanus cominsii* Hemsl.; *Pandanus cominsii* var. *augustus* B. C. Stone; *Pandanus cominsii* var. *micronesicus* B. C. Stone; *Pandanus englerianus* Martelli; *Pandanus erythros* H. St. John; *Pandanus hollrungii* Warb.; *Pandanus latericius* B. C. Stone; *Pandanus macgregorii* F. Muell. ex Solms; *Pandanus magnificus* Martelli; *Pandanus minusculus* B. C. Stone; *Pandanus plicatus* H. St. John; *Pandanus ruber* H. St. John; *Pandanus rubrispicatus* H. St. John; *Pandanus subumbellatus* Becc. ex Solms; *Pandanus sylvestris* Kunth

Local Names

English: Marita, oil pandan, pandanus nut, red fruit, red pandanus; **Indonesia:** *abo* (Yapen-Menawi, for individuals with red cephalia), *awone mangkaki* (Yapen-Menawi, for individuals with yellow cephalia; Yapen-Mantembu, for individuals with yellow cephalia), *awone waransir* (Yapen-Mantembu, for individuals with red cephalia), *goroko ina ngauku* (Moluccas, North Halmahera-Tobias), *kleba* (North Halmahera, Moluccas-Buru), *kobokana* (Yapen-Kerenui), *kuansu* (Papua Barat, Wamena), *sak* (Papua Barat), *pandan buah merah* (Standard Indonesian), *pandan séran* (Malay-Moluccan dialect), *saik* (Papua-Wamena), *saun* (Moluccas-Seran), *siho* (Moluccas, North Halmahera-Galela); **Malay:** *buah merah*; **Papua New Guinea:** *abare* (Foi, Huli), *alakape* (Onabasolo), *anga* (Pole, Samberigi), *aran*, *arang* (Tok Pisin), *apare* (Duna), *buksa* (Wopkaimin), *besbes* (New Ireland-Ugana), *bunam* (New Ireland-Pala), *bunumia* (New Ireland-Kuanua), *dapu*

A. P. Keim · W. Sujarwo (✉)

Ethnobiology Research Group, Research Center for Biology, Indonesian Institute of Sciences, Cibinong, Indonesia

e-mail: ary.prihardhyanto@lipi.go.id; wawan.sujarwo@lipi.go.id

(Kewa), *deg* (New Ireland-Pala), *hase* (Fasu), *kayo* (Etoro), *Kural* (Wopkaimin), *marita* (Tok Pisin), *neka* (Imbongu), *oga* (Hawalisi), *oka* (Kaluli), *opar* (Mendi), *pangu* (Wira), *simaho* (Ankave), *sina* (Podopa), *si-tararak* (New Ireland-Lamekot), *vurume* (New Ireland-Lamekot).

Botany and Ecology

Description: *Pandanus conoideus* is a solitary tree pandan, 3–10 m high. Prop roots present, obvious, 100 cm or more tall. Stem branched, crème greyish brown colored, with nodules. Leaves in a rosette, spirally arranged in three ranks (tristichous); each lanceolate-elongate (belt shaped), c. 180 cm long, 3–5 cm wide, margin armed with spines; adaxial surface dark green, glabrous, adaxial ventral pleats present; abaxial surface pale green, main vein apparent, with minute spines, recurved spines obvious (Fig. 1). Inflorescence terminal, solitary; peduncle 38–44 cm long, c. 5.4 cm diameter (c. 17 cm circumference). Cephalium (composed fruit) terminal, pendulous, hanging, cylindrical (elongated ellipsoidal) trigonal, colors vary from bright yellow to red and crimson, 42–110 cm long, 9.6–11 cm diameter (30–34.5 cm circumference), slightly covered with persistent bracts; pedicel white; composed of numerous single fruits in form of drupes. Drupe obviously trigonal (triangular), pericarp fatty, yellow or red (Fig. 2) (Keim 2009, 2011).

Phenology: Flowering, fruiting and seedling formation are throughout the year; the peak of fruiting season is October–December (personal observation).

Distribution and Habitat: Bismarck Archipelago, Caroline Island, Moluccas, New Guinea, Solomon Island, Vanuatu (POWO 2020). Since the first scientific publication of the species by Rumphius (1743), the species had never been found in the wild. Therefore, the widespread distribution of the species was long been suggested due to human activities rather than to natural causes (Stone 1982; Hyndman 1984;

Fig. 1 *Pandanus conoideus*.
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Fig. 2 *Pandanus conoideus* var. red and yellow fruits. (© Ary P. Keim)

Walter and Sam 2002). The view on the distribution changed when wild type of the species was finally discovered in the Foja-Mamberamo Game Reserve, Indonesian New Guinea (Keim 2011). Although Rumphius (1743) reported the presence and plantation of *P. conoideus* in Halhamera Island, the most recent study conducted in the island did not find the species (Callmander et al. 2015). Nevertheless, *P. conoideus* is almost always found in cultivated condition. The presence of the species in the wild is exceptionally rare.

The relatively easy propagation, by cuttings, has made *P. conoideus* an easy plant to cultivate. The agricultural practices and anthropological aspects of this species became wide spread in New Guinea in amazingly fast ways. It is believed to have reached Moluccas presumably around 8000 BC carried by the islanders of New Guinea such as the Biak people, who are known to have trading connection with the people of various islands in the Moluccas (such as Ambon, Bacan, Obi, Seram, Ternate, and Tidore) for centuries (Malinowski 1922; Grimble 1934; Brass 1941; White et al. 1991; Spriggs 1997; Bellwood et al. 1998; Allaby 2007; Pawley 2007; Walujo et al. 2007).

Pandanus conoideus can be found from sea level up to 3100 m altitude in coastal forests, lowland tropical rainforest up to montane forests (Paijman 1976; Bourke 1996; Keim et al. 2018). It grows best in moist locations, often under shade, and tolerates water-logged soils (Lim 2012).

Local Medicinal Uses

Indonesia: *Pandanus conoideus* has been known to local inhabitants in Papua for many generations as a natural food supplement containing medicinal qualities. The red fruit oil has been used by ethnic tribal communities of Papua for stamina, illnesses and because it is a natural product it does not carry the side effects associated with long term use of medicines for degenerative diseases (Lim 2012). It is traditionally believed to be a good supplement as a skin and eye medicine, and as a vermifuge. Local communities in Indonesia believe that fruit of *P. conoideus* can treat several degenerative diseases such as cancer, arteriosclerosis, rheumatoid arthritis, and stroke (Budi and Paimin 2004). The special usage of the oil is to cure diseases such as cancer, HIV, malaria, cholesterol, and diabetes mellitus (Limbongan and Malik 2009). The most important part of the plant harvested for medicinal purposes is the vegetable fatty sap extracted from the pericarp. The sap looks exceedingly similar to tomato sauce and most of the time is simply called as the sauce. The sauce is believed to have medicinal purposes for degenerative diseases such as high blood pressures, diabetes, coroner cardiac disease, and cancer based on the high antioxidant constituents. Rumphius (1743) also mentioned that the sauce is used for treating skin ailments. **Papua New Guinea:** The sauce is also used by the people of Nokopo to treat skin infections and sore throats (Schmid 1991), the same practice can still be observed throughout the highlands of New Guinea.

Phytochemistry

Fruit: Anticancer (Achadiyani et al. 2016; Astirin et al. 2009; Kurnijasanti and I'tisom 2008; Mun'im et al. 2006; Nishigaki et al. 2010; Oeij and Khiong 2010; Waspodo and Nishigaki 2007), Anti-inflammatory (Sukandar et al. 2005; Khiong et al. 2010), Antioxidant (Rohman et al. 2010).

Local Food Uses

Indonesia: The fruit is eaten by directly sucking off the edible mesocarp. The fruit is also cut into pieces and boiled, roasted, or cooked in a stone oven. The pulp and seeds are removed from the core, mashed with water, and strained to produce a thick, rich red sauce (Fig. 3). This pleasant-tasting, oily, vitamin-A-rich, ketchup-like sauce is used to flavor other foods such as banana, green vegetables, pumpkin, sago, and sweet potato. Oil extracted from the fruit is used as valuable food flavoring because it is rich in nutrients such as β -carotene. It is also utilized as natural colorant that does not contain heavy metals and pathogenic microorganisms (Limbongan and Malik 2009). In the Moluccas, the sauce was also mixed with rice as reported by Rumphius (1743). **Papua New Guinea:** The practice of mixing the sauce with rice is also observed in New Guinea and adjacent islands. The sauce is applied as a substitute for

Fig. 3 Local people in Indonesia New Guinea produce sauce from *Pandanus conoideus* var. red. (© Ary P. Keim)



coconut milk in the areas where coconuts cannot grow well or absent such as in the highlands of New Guinea (Walter and Sam 2002; Keim et al. 2018).

Biocultural Importance

Indonesia and Papua New Guinea: The biocultural importance of *P. conoideus* in the Melanesian civilization can be seen in one of their significant cultural ceremonies, the baked stone ceremony (Stone 1982; Jebb 1992). The cultural ceremony, which is widely performed throughout New Guinea and still survives to the present day can be observed in the Baliem Valley, practiced by the Dani tribe (Hyndman 1984; Rappaport 1968; Haberle 1991; Milliken 2006; Ea and Octivia 2006; Keim et al. 2018). The importance of *P. conoideus* is also shown by the highest number of morphological varieties (i.e., cultivars) known to the species, which ranges from 10 to 35 (Walter and Sam 2002). In highlands of Indonesian New Guinea such as in Arfak Mountains and Jayawijaya Range, at least three to four cultivars are found to be widely planted: the “yellow fruit,” “brownish red fruit,” “long red fruit,” and “short red fruit” cultivars (Walujo et al. 2007; Zebua 2009; Keim et al. 2018). The Dani people in Baliem Valley, especially around the vicinity of Wamena believe that the “yellow fruit” variety can only be consumed by the wife or wives of the chiefs or heads of the tribe, a custom, which is not shared by the rest of the New Guineans. This is a new discovery that has not been reported before. The explanation given by the Dani people in Wamena regarding the strict consumption of the variety exclusively by the wives of the chiefs is related to fertility (personal observation). So far, there has been no report on the chemical constituents of the fatty sauce harvested from the “yellow fruit” variety.

Economic Importance

Indonesia: The Dani of the Baliem Valley use the sauce for coloring their traditional dress, especially the *sali*, a kind of dress made from grasses worn by women. Leaves are used for mats and roof thatching, especially in highlands (Stone 1982). Despite being firstly reported scientifically from the Moluccas (Rumphius 1743), *Pandanus conoideus* today is not regarded as an important commercial plant there and very rarely planted for economic related purposes. The Moluccans prefer to cultivate indigenous spices such as cloves, nutmegs, cajuputs, and candlenuts that bring higher economic returns. Nevertheless, in the Moluccas, *P. conoideus* is still sparsely planted in Seram Island, especially by the indigenous Nuaulu people, and the fruits are occasionally sold in the traditional markets both in Papua and Seram (Fig. 4) (Ellen 1993; Keim et al. 2009). **Papua New Guinea:** The compound fruit is the most economic important part of the plant. They are highly praised and sold in the local markets throughout New Guinea, particularly in the highlands, where *P. conoideus* are still widely planted. The Wola people (Papua New Guinea) use the fatty-oily sap as a cosmetic (Sillitoe 1983). The sap is also used as a dye (Powell 1976a, b) in various localities of New Guinea.



Fig. 4 *Pandanus conoideus* is sold in a traditional market in Wamena, Indonesian New Guinea. (© Ary P. Keim)

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