Ethnobotany of Mountain Regions

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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

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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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About the Editor

F. Merlin Franco is an ethnobiologist working with the Institute of Asian Studies at Universiti Brunei Darussalam. He is passionate about the reciprocal relationship between human culture, language, and biodiversity (biocultural diversity), and the myriad ways in which it manifests. He collaborates with local communities of Asia on topics related to folk medicine, traditional ecological calendars, cultural keystone species, and biocultural landscapes. However, his work lays special emphasis on the cultures and landscapes of Borneo where he is based since 2012.

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Piper betle L.
Piperaceae

Marina Silalahi

Synonyms

Artanthe hexagyna Miq.; *Betela mastica* Raf.; *Chavica betle* (L.) Miq.; *Chavica blumei* Miq.; *Chavica chuvya* Miq.; *Chavica densa* Miq.; *Chavica siriboa* (L.) Miq.; *Cubeba melamiri* Miq.; *Cubeba seriboa* Miq.; *Macropiper potamogetonifolium* (Opiz) Miq.; *Piper anisodorum* Blanco; *Piper bathicarpum* C.DC.; *Piper bidentatum* Stokes; *Piper blancoi* Merr.; *Piper blumei* (Miq.) Backer; *Piper canaliculatum* Opiz; *Piper carnistilum* C.DC.; *Piper densum* Blume; *Piper fenixii* C.DC.; *Piper macgregorii* C.DC.; *Piper malamiri* Blume; *Piper malamiris* L.; *Piper malarayatense* C.DC.; *Piper marianum* Opiz; *Piper philippinense* C.DC.; *Piper pinguispicum* C.DC. & Koord.; *Piper potamogetonifolium* Opiz; *Piper puberulinodum* C.DC.; *Piper rubroglandulosum* Chaveer. & Mokkamul; *Piper saururus* Burm.; *Piper siriboa* L.; *Piperi betlum* (L.) St.-Lag.

Local Names

***Burma*:** kun, kunyoe, kwan, kwanynet, kwonrwet. ***Cambodia*:** mlou (bunong), mlow, phoo kiau (Khmer). ***Indonesia*:** sirih (general), belo (Batak Karo), base (Bali), burangir/siriah (Minang), burangir (Batak Mandailing), deling (Sanger), demban (Simalungun), gapura, siri, sirih (Bugis), napuran (Batak Toba), sirieh, siri, suruh (Palembang), seureuh (Sundanese), utta (Loli). ***Malyasia*:** sirih, serih, sirih, sirih china, siri hudang, siri malaya. **Myanmar:** bu, buru (Kachin), kun, pu (Shan). ***Philippines*:** buyo (Tagabawa), gawed (Luzon), gawet, hapid, lawed (Kalanguya), hojas de buyo, poro, thalon (Subanen), ikmo (Tagalog), samuh (Batan). ***Thailand*:** plu (general). **Vietnam:** trâ'u không (general), trau khong,

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trau, chrau (central Vietnam), trˆau khˆong, trau (Nho Quan). ***English*****:** betel, betel pepper, betel vine (Abe and Ohtani 2013; Angagan et al. 2010; Arambewela and Alagiyawanna 2006; Balangcod and Balangcod 2011; Chaveerach et al. 2006; DeFilipps and Krupnick 2008; Des et al. 2018; Dwinanto et al. 2019; Pandiangan et al. 2019; Pizon et al. 2016; Putri et al. 2014a; Sam et al. 2008; Waay-Juico et al. 2017; Silalahi et al. 2019; Sota and Tetsuo 2011; Trinh et al. 2003; Vlkova et al. 2010).

Botany and Ecology

Description**:** Dioecious, climber. Stem stout with pinkish stripe along, node dilated and rooting. Petiole 2–2.5 cm long; leaf blade fleshy coriaceous, glabrous, greenish or yellowish, broadly ovate, 7–8.5 cm wide, 9–11 cm long; apex acuminate; base cordate; veins 7–9, elevating beneath, two or three pairs basal, one pair arising from midrib. Male spike cylindric, slender, pendulous, 3–12 cm long, ca. 0.5 cm in diameter; peduncle 2–3 cm long; bract orbicular, peltate; stamens 2. Female spike cylindric, pendulous, 2.5–4 cm long, ca. 0.5 cm in diameter; peduncle 2–3 cm long; bract orbicular, peltate; stigmas 4–6, pubescent (Fig. 1). Fruiting spike 3–5 cm long; drupe embedded on rachis (Chaveerach et al. 2006, 2008).

Phenology**:** *Piper betle* (PB) flowers and fruits throughout the year (Chaveerach et al. 2008).

Distribution and Habitat**:** Found throughout the seven floristic regions of Thailand from 100 to 900 m asl altitude (Chaveerach et al. 2006). Distributed from Thailand to China, Indonesia, Malaysia, Philippines, Sri Lanka, Vietnam, and Madagascar (Chaveerach et al. 2008).

Local Medicinal Uses

Cambodia: The leaves and roots are used by the people in the Mondulkiri Province to cure sprain, backache, burn, postpartum dan sprain. To cure sprain, the leaves and root decoction are soaked in water along with seeds of *Areca catechu* and *Scoparia dulcis,* applied on the affected limb (Chassagne et al. 2016). **Indonesia:** Some ethnic groups such as Batak, Malay, Kupang, and Sanger in Indonesia utilize the species in traditional medicine, for treating various ailments. The decoction of leaves is used for preventing body odor and for treating diarrhea, sore throat, and skin allergies by Bali Aga ethnic (Sujarwo et al. 2014). The Sanger ethnic community uses leaves to treat eye infection, fever, internal disease, and child healthcare (Pandiangan et al. 2019). The Batak Simalungun community uses leaves to treat itching, sores, edema, malnutrition, fever, and eye infections (Silalahi et al. 2015a), whereas the local communities in Kupang use it as an antimalarial (Ihwan and Koda 2017). The Malay ethnic group in Riau Islands use the leaves to treat mouth sores, eliminate bad breath, stop bleeding, cleanse the female genital organs, and ward off evil spirits (Putri et al. 2014b). **Malaysia:** People in Penisular Malaysia chew leaves to treat

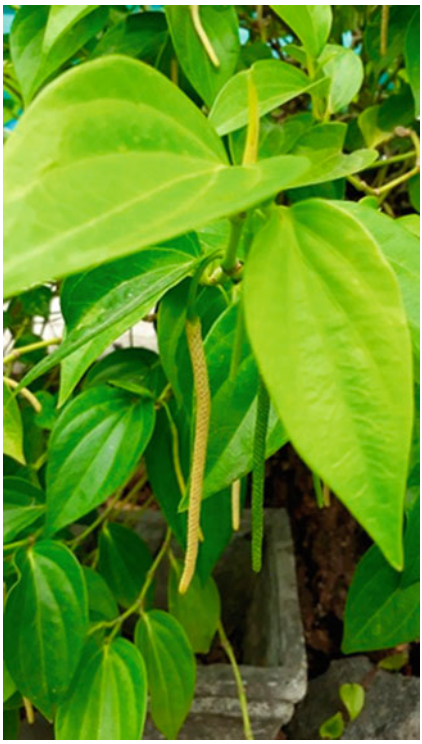

Fig. 1 *Piper betle* L. (PIPERACEAE). JAKARTA, Indonesia. (Photo © M. Silalahi)

malaria (Al-Adhroey et al. 2010). **Myanmar:** *Piper betle* leaves have considered as bitter, astringent, and hot in taste, known for whetting the appetite, reducing phlegm, controlling flatulence, promoting vitality and virility, neutralizing poison, supporting heart and bowel functions, and curing coughs and heart disease. Children are given a mixture of honey and the juice from the crushed leaves to cure indigestion, gas, diarrhea, fevers, and other illnesses. Juice from crushed leaves is consumed with milk for emotional distress related to the menstrual cycle. A mixture of the juice from the crushed leaves, rock salt, and a ginger decoction is used to treat asthma, chest pain, indigestion, and whooping cough. Leaf extract is applied as eyedrops for night blindness, sore or inflamed eyes, and other eye problems. A leaf decoction made with turmeric and a bit of salt is taken for fevers and illnesses. Roasted leaves are applied with coconut oil as compresses on the soft spots of children's heads to cure runny noses. A leaf decoction mixed with jaggery and salt is taken for fever caused by heat stroke. *Apium graveolens* seeds wrapped in *P. betle* leaf, is chewed and held in the mouth to treat both dry coughs and coughs with mucus (DeFilipps and Krupnick 2008). **Philippines:** Local people in Batan Island use leaves to treat abdominal pain, backache, body pain, cough, fever, headache, and in mental health (stunned people) (Abe and Ohtani 2013). Leaves are heated and rubbed over body of the patient to treat jaundice (Fajardo et al. 2017). Local communities in Iloilo use the

leaves use to cure fever, headache, and musculoskeletal disorders (Tantiado 2012). The local communities in Benguet province use leaves to treat respiratory ailments such as cough, fever, cold, sore throat, and asthma. Leaves are heated, mixed with coconut oil and applied over upper back to treat cough (Balangcod and Balangcod 2011). People in Batan Island use leaves to treat cough (rubbed fresh or leaves steamed with coconut oil and then applied over the chest and back), body pain, backache (applied fresh, heated or steamed leaves), fever, and headache (applied on forehead as a cool compress) (Abe and Ohtani 2013). Local people in Agusan del Sur use the leaves to treat asthma, flatulence and associated pains, cough, colic, ulcer, and injury (Arquion et al. 2015). Fruits, leaves and root decoction are used by the Tagabawa tribe of Barangay Jose Rizal Sta. Cruz, Davao del Sur, to cure cough, hypertension, fever, and gastrointestinal ailments (Waay-Juico et al. 2017). Kalanguya tribe in Luzon heat the leaves, mix it with coconut oil and apply on chest and back during cough and fever to loosen phlegm (Balangcod and Balangcod 2011). **Thailand:** Throughout Thailand, leaves are believed to act as stomach tonic, expectorant for coughs, and efficient to treat asthma, bronchitis, and flatulence (Chaveerach et al. 2006). **Vietnam:** Leaves are crushed, and the paste is applied on affected parts to treat cuts and wounds by the local communities around the Ben En National Park (Sam et al. 2008).

Phytochemistry

***Leaves*:** Betel leaves are rich in essential oil, especially eugenol and acetyl eugenol (Prakash et al. 2010). Rekha et al. (2014) reported the presence of chavibetol, chavibetol acetate, caryophyllene, allylpyrocatechol diacetate, campene, chavibetol methyl ether, eugenol, α-pinene, β-pinene, ɤ-limonene, sapo, 1–8-cineol, and allylpyrocatechol monoacetate in leaves. Leaves contain pipercerebrosides A and B (Chen et al. 2013). The chloroform extract of leaves contain hydroxyclavol (Ali et al. 2010), while chloroform and ethyl acetate extracts contain phenolic, fatty acids, amino acids, sugars, and polyols (Karak et al. 2019). Hossain et al. (2017) found the leaves to contain vitamins, minerals, and enzymes that help in digestion and also act as mouth freshener. **Roots:** The root contains dimer hydroxychavicol, 2-(γ′-hydroxychavicol)-hydroxychavicol, hydroxychavicol, aristololactam A II, aristololactam B II, piperolactam A, and cepharadione A (Lin et al. 2013).

Leaf eugenol has anti-aflatoxin (Prakash et al. 2010), and apoptotic activities (Chakraborty et al. 2012), while hydroxichaviol has antifungal activity against *Candida* and *Aspergillus* (Ali et al. 2010). Leaf extract inhibits the growth of *Aspergillus flavus* (Prakash et al. 2010), *Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus pumalis, Candida albicans,* and *Escherichia coli* (Tin 2011). Ethanol extract shows activity against skin disease causing microbes such as *Microsporum canis, Microsporum gypseum, Trichophyton mentagrophyte,* and *Candida albicans* (Trakranrungsie et al. 2008). Ethanol extracts inhibit the growth of *Candida albicans, Candida tropicalis, Candida glabrata, Candida*

dubliniensis, Candida lusitaniae, Candida krusei and *Candida parapsilosis* (Himratul-Aznita et al. 2011). The minimum inhibitory concentration (MIC) of betel leaves hydroxicavicol is 15.62–500 μg/ml for *Candida* and 125–500 μg/ml for *Aspergillus* (Ali et al. 2010). Methanol extract of leaves show anti-leishmanial activity against *Leishmania donovani* (Misra et al. 2009). Ethanol extract of leaves is active against bacteria that are resistant to methicillin (*Staphylococcus aureus, Enterococcus*), vancomycin (*Klebsiella pneumoniae*), and carbapenems (*Acinetobacter baumannii*) (Valle et al. 2016)).

Local Food Uses

Cambodia: Ethnic people in Prey Veng province use dried leaves as starter for rice fermentation (Sota and Tetsuo 2011). **Indonesia:** Balinese cook the leaves and add to vegetable soups (Sujarwo et al. 2014). **Thailand:** The local communities in Samut Songkram province use leaves as vegetable (Sudjaroen 2012). **Vietnam:** Local people in Phong leaves use leaves as spice and vegetable (Vlkova et al. 2010)

Biocultural Importance

Piper betle is a culturally important plant for all countries of South East Asia. The habitual chewing of betel quid (areca nut, betel leaf, tobacco) is estimated to occur among 600 million persons in Asia and the Asia-Pacific Region (Singh et al. 2012). The preparation of a betel quid generally involves the combination of slaked lime with two plant products: the seed of *Areca catechu* and the leaf of *P. betle*. The betel chew carries deep symbolic connotations and has long played a role in the social fabric of many Asian cultures. The ingredient common to almost all masticatory mixtures referred to as "betel chew" is the fruit of *A. catechu*, slaked lime (calcium hydroxide, $Ca(OH)_2$) is the second essential ingredient of the betel chew (Zumbroich 2007–2008). **Laos:** *P. betle* leaf has been used by most ethnic group in Laos in betel chewing and ceremonies. The Laotian betel quid (package) commonly consists of betel leaves, areca nut, slaked lime, astringent bark, and tobacco. In Luang Prabang, betel chewers from affluent families color their lime with curcuma (*Curcuma longa*). The astringent matter used in the betel quid is the bark of *Pentace burmanica*, *Careva arborea*, *Artocarpus rigidus*, and *Artocarpus asperulus*. It is believed that without the offering of a betel quid, the effectiveness of the prayers of Mo masters (a kind of medium) evaporates completely. Wedding go-betweens of the P'unoi people usually bring a jar of raw rice beer, betel leaves, whole areca nuts, and *Artocarpu*s (puo'c hát) bark slices as presents for the bridal family (Hiên and Reichart 2011). **Indonesia:** Various ethnic groups in Indonesia such as "Ngadha" (Sada and Jumari 2018), Malays (Putri et al. 2014b), Palembang (Mubarat 2016), Loli (Dwinanto et al. 2019), and Karo Batak ethnics (Silalahi 2014) have betel chewing traditions (Fig. 2). The seed of *A. catechu* and betel leaf are the main ingredients in betel chewing with diverse other ingredients. Indonesian heritage

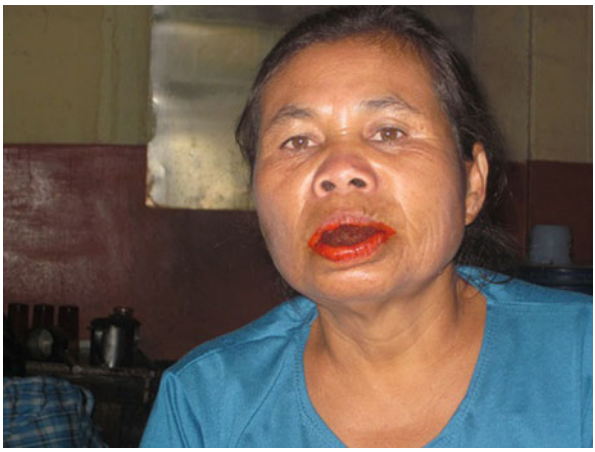

Fig. 2 For the Karo ethnic woman, chewing betel is a cultural practice NORTH SUMATRA. Indonesia. (Photo © M. Silalahi)

related to the tradition of betel chewing includes *tepak sirih* (Salleh 2014; Mubarat 2016), *tari makan sirih*/betel chewing dance (Putri et al. 2014b), *naha nafo* (Diansyah and Harefa 2019), and *kuolaka* (Dwinanto et al. 2019). The *tepak sirih* is a place or container (like a box) made from gold, copper, or carved wood (Salleh 2014), for placing betel chewing materials during traditional Malay ethnic ceremonies (Putri et al. 2014b; Mubarat 2016). *Tari makan sirih* or betel chewing dance is a dance of ethnic Malay to welcome distinguished guests (Putri et al. 2014b). The *naha nofo* is a container of Nias ethnic community (North Sumatra) to store betel material; it is one of the historical objects displayed in the Nias Heritage Museum (Diansyah and Harefa 2019). The *kuolaka* is a container for betel used during Loli traditional ceremonies in West Sumba, which is made of woven *Pandanus* or palm (*Borassus flabellifer*) leaves (Dwinanto et al. 2019). The Ngadha ethnic community in East Nusa Tenggara Province use *P. betle* leaves for betel chewing and in offering during traditional ceremonies along with *Areca catechu* seeds as a symbol of kinship and brotherhood (Sada and Jumari 2018). For the Malay community in Palembang, betel is a compulsory dish to welcome guests during traditional ceremonies (Mubarat 2016). Malays people in Riau Islands use betel leaf in various ceremonies such as marriage, engagements, and 7-month ceremonies for pregnant women (ceremonies leading to childbirth) (Putri et al. 2014b). In Malay wedding ceremony, betel leaf is one of the materials that must be given by the groom's family to the bride's family (Putri et al. 2014b). The local community of Sobawawi, Loli, in West Sumba use betel inflorescence as an ingredient for betel chewing. The inflorescence, areca nuts and lime are placed in the *kuolaka* as main ingredient in traditional ceremonies (Dwinanto et al. 2019). *P. betle* leaves are irreplaceable in the *Panca Yadnya* ceremonies of Balinese Hindus (Fig. 3). The *Panca* (five) *Yadnya* (holy offerings) is a ceremony offered to the Gods, fellow humans, deceased humans, Hindu saints, and to the elements of nature (Surata et al. 2015). The Batak Simalungun sub-ethnic in North Sumatra use leaves uses as a cultural symbol for Gereja Kristen Protestan

Fig. 3 *Piper betle* L. (PIPERACEAE) is used in offerings at Hindu rituals in Bali Island, Indonesia. (Photo © IGA. Sawitri)

Simalungun (GKPS), their local church (Silalahi et al. 2015a). Leaves used in religious rituals by Balinese communities (Putri et al. 2014a). Leaves are used in birth and wedding ceremonies, which have philosophical values such as brotherhood and strong kinship, and love by Mandailing, Minangkabau (Des et al. 2018), whereas the Bugis, Palembang and Batak ethnic communities use the leaves in wedding ceremonies (Aziz et al. 2019). **Malaysia:** Betel chewing (*kunyah sireh*) used to be an essential part of social intercourse and ceremonies. The local people in Malaysia used to have special *tepak sirih* (betel chewing containers) that are essential part of material heritage (Ahmad 2010). Other materials used in betel chewing originating in the seventeenth and eighteenth century include betel bowls, betel slicer, and bowls to store lime. Serving *sireh* (*P. betle*) was an essential part of almost all ceremonies including royal feastings (Ahmad 2010). **Thailand:** *Piper betle* leaf is one of the most important materials used in Thai ceremonies. This stems from the popularity of betel chewing among Thai people. Elder people in Thailand chew the leaves with betel nut and lime as a gentle stimulant and exhilarant. In weddings, the bridegroom's family participates in a parade which includes placing money with betel leaves in a bowl called as *khan maak/kan maak,* meaning "bowl of betel nuts." This is given to the bride's parents. It is also used in "spirit dancing" among the Kui ethnic group of southern part of the northeastern Thailand by the name *raam phi taan*. (Chaveerach et al. 2006). The Thai ethnic group living along

Fig. 4 *Piper betle* L. (PIPERACEAE) is traded in local markets. NORTH SUMATRA, Indonesia. (Photo © RH. Siregar (Permitted))

the Mekong riverside also burn mollusk shells in order to produce the raw lime, and the slaked lime (pun), used in betel chewing (Hiên and Reichart 2011). **Vietnam:** Chewing of *Artocarpus tonkinensis* bark together with leaves of betel, and fruits of *Areca catechu* is a traditional custom in Vietnam (Sam 2009). The local people in Nho Quan chew betel leaves with fruits of *A. catechu*, and limestone during traditional wedding ceremony, to remind the new couple that husband, wife, and relatives should love and understand each other (Trinh et al. 2003). The areca nuts and betel leaves play still a significant role in modern weddings and rituals and are also used in medicine and in diverse industries. The Vietnamese were familiar with the areca palm tree (*A. catechu*) and its alliance, the betel vine (*P. betle*), from time immemorial.

Economic Importance

Indonesia: Betel leaves have been traded in traditional markets of North Sumatra province as medicinal materials, betel chew, and for traditional rituals (Silalahi et al. 2015b) (Figs. 4, 5, and 6). In the past, the peddlers of herbal medicine went around selling *jamu gendong*, an herbal formulation that contained betel (Sumarni et al.

Fig. 5 *Piper betle* L. (PIPERACEAE) is an ingredient of the *jamu gendong* (Javanese herbal drink). Indonesia. (Photo © M. Silalahi)

Fig. 6 *Jamu gendong* is an herbal drink of Javanese of Indonesia. (Photo © M. Silalahi)

2019). **Philippines:** The Sambal-Bolinao community use leaves for cleaning (Fajardo et al. 2017).

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