

Aromatic Plants in Bali Botanic Garden Indonesia

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INTRODUCTION

AROMATIC PLANTS HAVE A PLEASANT, CHARACTERISTIC fragrant smell. The fragrance of these plants is carried in the essential oil fraction. Many aromatic plants are condiment (Okigbo et al., 2009). Chandarana et al. (2005) defined spices as any dried, fragrant, aromatic or pungent vegetables or plant substances in whole, broken or in ground forms that contributes relish or piquancy of foods and beverages. Moreover, aromatherapy is a form of alternative medicine in which healing effects are ascribed to the aromatic compounds in essential oils and other plant extracts (Prabuseenivasan et al., 2006). Aromatic plants are also used for preservation of food and for adding pleasant and exotic flavours, fragrance, color and even texture.

Indonesia - due to its wide range of geographical, ecological and biological diversities - possesses many species that are directly or indirectly used as sources of herbal, allopathic or homeopathic medicines and aromatic. However, many of these plant species are facing threats of extinction due to over and improper exploitation, habitat loss, fragmentation and degradation of land, urbanization pressure and our ignorance about them. On the other hand, the increasing global demand for aromatic and products warrants accelerated cultivation, marketing and conservation of aromatic plants. Hence, the scientific study of aromatic, derivation of essential oil through bioprospecting and systematic conservation of the concerned aromatic plants are of great importance.

The major drawback in this area is scarcity of comprehensive and authoritative information on aromatic plants, which hinders an assessment of their status of availability, implementation activities necessary

for preserving their habitat and monitoring the effect of rehabilitative efforts. Further, aromatic plants have considerable potential both in national and international market. Indonesia could increase its contribution to meet the growing demand by supplying high quality aromatic plant and its products. It contribute significantly to the nation's foreign earnings and strengthen the economy of the country. There remain tremendous possibilities for increasing the production and trade of aromatic plant, both for internal consumption and export, but it calls for an integrated and continuous effort in conservation, sustainable utilization, cultivation, maintenance and production of aromatic plant resources. Currently, Indonesia has not yet initiated any *in-situ* and *ex-situ* conservation efforts of aromatic plants.

Bali Botanic Garden (BBG) has become one of the conservation centers in Indonesia. The BBG is situated in the mountain tourist resort, Bedugul. It is situated on the east slope of Bukit Tapak Hill, at an elevation of 1,250-1,400 m above sea-level, adjacent to the Batukahu Nature Reserve (15,390 ha). The total area of the BBG measures 157.5 ha (Sumantera, 1993). By December 2013 BBG boasted 2693 species in its collection, consisting of 405 families, 1326 genera and including 336 species of medicinal plant and 216 species of ceremonial flora (Bali Botanic Garden, 2014).

The collection and recording of a comprehensive aromatic plants list is important for the categorizing and understanding of the aromatic qualities of these plants that are freely available to interested users. This study provides an overview and discussion of aromatic plants collected by BBG.

METHODS

Literature on Java and Bali Flora published since 1963 was consulted for information about aromatic

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plants. This included several books (e.g., Backer and Van Den Brink 1963, 1965, 1968; Ochse and Van Den Brink, 1977; Van Steenis, 1997; Tengah et al., 1995; Lugrayasa et al., 2009). Information about species and the properties attributed to each plant, the plant part, life form, habitat and propagation technique was compiled (Tab. 1). The information also included plants used as condiments, but excluding beverages such as liqueurs and herbal teas. Scientific nomenclature was updated using databases (The Plant list, 2013). In order to extract information about the bioactive compounds for each plant, we conducted a search in recent international scientific literature, using scientific names to identify and review specific families (e.g., Chauhan, 1999).

RESULTS AND DISCUSSION

Plants of Cupressaceae and Rutaceae are important botanical resources of aromatic properties. This study classified 66 taxa of ethno flora, 56 with aromatic properties and 8 with condiment properties. The 66 species belonged to 50 genera in 31 families. The five most frequently used families are illustrated in Figure 1. All 66 species (100%) identified in this study are also documented in the “*Lontar Usada Bali*”, ancient Balinese scripts that are written on palm leaves and describes forms of healing, medicinal ingredients and methods in traditional Balinese medicine (Sutomo, 2007; Tengah et al., 1995). In the traditional Balinese

Lontar Usada almost 500 different species are described for its aromatic and medicinal properties (Adiputra, 2013; Sutomo, 2007).

Leaves are the most cited parts of plants used for aromatic properties and condiments. Of the 66 plants identified in this study, leaves of 31 species, flowers of 16 species, stems, rhizomes, seeds, and roots of 4 species, gum or barks of 2 species, and rind of 1 species were used for aromatic properties and condiment (Fig. 2). A total of 66 species was distributed into different groups with trees (53%) being the most common, followed by herbs (24%), shrubs (17%), and woody climber (6%) (Fig. 3).

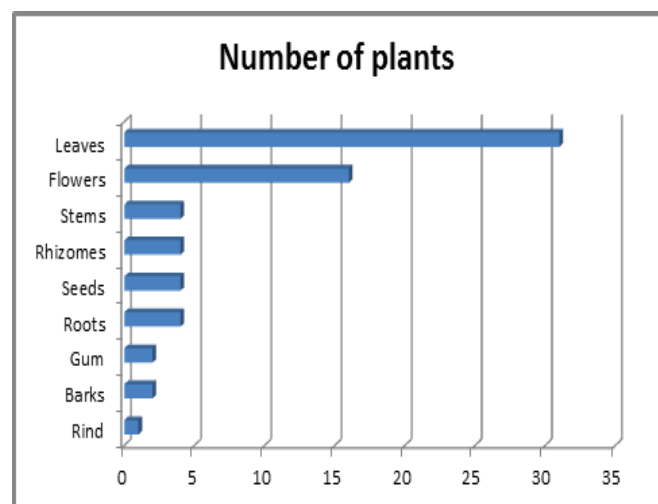


Figure 2. The frequency of use of different aromatic plants divided into parts of the plant.

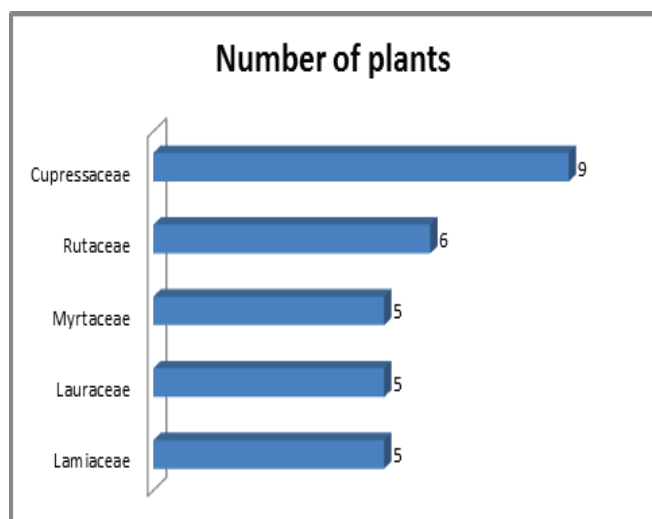


Figure 1. The frequency of use of different aromatic plants divided into families.

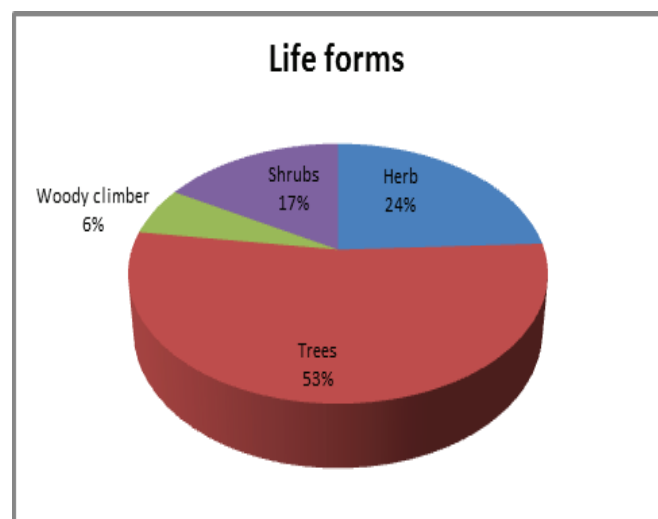


Figure 3. The distribution of aromatic plant taxa arranged by life forms.

Table 1 presents a comprehensive summary of plants with aromatic and condiment uses described in at least five books (Backer and Van Den Brink, 1963, 1965, 1968; Ochse and Van Den Brink, 1977; Van Steenis, 1997; Tengah et al., 1995; Lugrayasa et al., 2009). A few species, which are not native to tropical southeast Asia but commercialised locally are also included in this table.

All of these species are recorded in Balinese traditional medicine literature as plants with medicinal properties. Usages and dosages differs if they are used for medicinal purposes under the guidance of Balinese traditional medicine theory.

General properties of relevant plant families

The use of traditional Balinese medical treatment can be traced back for centuries, and there is little doubt that guidance described in “*Lontar Usada Bali*” result in positive effects. This does not mean, however, that each guidance and treatment method has been tested in a systematic scientific manner and the following descriptions of the properties and use of various plants reflects only traditional use and beliefs of many Balinese citizens.

Cupressaceae

Species belonging to this family have perfect expectorant qualities that is believed to produce a very effective treatment for a number of respiratory ailments such as coughs and bronchitis. Inhaling the aromatic vapour of these plants is supposed to speed up the healing process of ulcers and other wounds. They are also known to minimize the appearance of any form of cellulite, combat insomnia, stress and nervous tension (Chauhan, 1999).

Rutaceae

These plants are used primarily for pain relief and for the improvement of blood circulation. They contain properties believed to cure acne and contain essential oils that reduce chances of cholesterol related ailments (Chauhan, 1999).

Lauraceae and *Myrtaceae*

Plants such as *Cinnamomum burmanni*, *Cinnamomum camphora*, *Cinnamomum verum* and *Massoi aromatica* are used as tonic, stimulant, bactericide, antiviral and antifungal. They are known to alleviate complications in the respiratory tract and the respiratory system at large (Chauhan, 1999).

Lamiaceae

This group of plants is used in aromatherapy, because they possess chemical components in their leaves that provide aromatherapy properties (Chauhan, 1999). The therapeutic properties of these plants are used to cure headaches, provide relief in case of nasal congestion and suppress any muscular pain.

CONCLUSION

This study constitutes one of few ethno-botanical reviews of aromatic plants used on Bali. Results can be used to check the authenticity and origin of aromatic plants on Bali. It listed 66 aromatic plant species belonging to 50 genera in 31 families that were used in traditional Balinese medicine and aromatherapy. Since many are believed to have beneficial effects on health these plants may be offer good potential for commercialization. Therefore, more resources should be allocated to search for new aromatic products from plants, especially in plants indigenous to the tropical countries.

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Table 1. Aromatic and condiment Plants currently found in Bali Botanic Garden along with descriptions of its basic use.

Scientific name, botanical family	Local names	Part(s) used	Use	Life form	Habitat	Propagation
<i>Abelmoschus moschatus</i> Medik. (Malvaceae)	Gandapura	Seed	Aromatic	Shrub	Full sun	Seed
<i>Acorus calamus</i> L. (Acoraceae)	Jangu	Rhizome	Condiment	Herb	Semi shade	Rhizome
<i>Acronychia trifoliata</i> Zoll. (Rutaceae)	Empag	Leaf	Aromatic	Tree	Full sun	Seed
<i>Agathis dammara</i> (Lamb.) L. C. Rich (Araucariaceae)	Agatis	Gum	Aromatic	Tree	Full sun	Seed
<i>Alyxia reinwardtii</i> Bl. (Apocynaceae)	Pulesari	Stem	Aromatic	Woody climber	Semi shade	Seed
<i>Amomum cardamomum</i> L. (Zingiberaceae)	Kapulago	Rhizome	Aromatic	Herb	Semi shade	Rhizome
<i>Aquilaria malacensis</i> Lam. (Thymelaeaceae)	Garu	Gum	Aromatic	Tree	Semi shade	Seed
<i>Artemisia vulgaris</i> L. (Asteraceae)	Daun sudamala	Root	Aromatic	Herb	Full sun	Stolon
<i>Bixa orellana</i> L. (Bixaceae)	Kesumba	Leaf, root, seed	Aromatic	Shrub	Full sun	Seed
<i>Boeninghausenia albiflora</i> (Hook) Rchb. ex Meissn. (Rutaceae)	Inggung gunung	Leaf	Aromatic	Herb	Semi shade	Seed
<i>Brunfelsia uniflora</i> (Pohl.) D. Don. (Solanaceae)	Kembang pagi sore	Flower	Aromatic	Shrub	Full sun	Seed
<i>Camellia sinensis</i> (L.) O. K. (Theaceae)	Teh	Flower	Aromatic	Shrub	Full sun	Seed
<i>Cananga odorata</i> (Lmk) Hook. F. & Thoms. (Annonaceae)	Cananga	Flower	Aromatic	Tree	Full sun	Seed
<i>Cestrum nocturnum</i> L. (Solanaceae)	Sedap malam	Flower	Aromatic	Shrub	Full sun	Seed

<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl. (Cupressaceae)	Keires	Leaf	Aromatic	Tree	Full sun	Seed
<i>Chamaecyparis obtusa</i> (Sieb. & Zucc.) Endl. (Cupressaceae)	Cemara kipas	Leaf	Aromatic	Tree	Full sun	Seed
<i>Chamaecyparis thuyoides</i> (Britton.) Stem & Poggenb (Cupressaceae)	Cemara kipas	Leaf	Aromatic	Tree	Full sun	Seed
<i>Cinnamomum burmanni</i> Nees ex Bl. (Lauraceae)	Kayu manis	Bark	Condiment	Tree	Full sun	Seed
<i>Cinnamomum camphora</i> (L.) Presl. (Lauraceae)	Kamper	Bark	Aromatic	Tree	Full sun	Seed
<i>Cinnamomum sintoc</i> Bl. (Lauraceae)	Sintok	Leaf	Aromatic	Tree	Full sun	Seed
<i>Cinnamomum verum</i> J.S. Presl. (Lauraceae)	Sintok lue	Leaf	Aromatic	Tree	Full sun	Seed
<i>Citrus aurantifolia</i> (Christm. & Panz.) Swingle (Rutaceae)	Jeruk nipis	Fruit	Condiment	Shrub	Full sun	Seed
<i>Citrus grandis</i> (L.) Osbeck (Rutaceae)	Jeruk Bali	Rind	Aromatic	Tree	Full sun	Seed
<i>Citrus hystrix</i> DC. (Rutaceae)	Jeruk purut	Fruit	Condiment	Shrub	Full sun	Seed
<i>Cleome gynandra</i> L. (Capparaceae)	Boangit	Leaf, flower	Aromatic	Herb	Full sun	Seed
<i>Coleus atropurpureus</i> Bth. (Lamiaceae)	Miana	Leaf	Aromatic	Herb	Full sun	Cutting
<i>Cosmos caudatus</i> H.B.K. (Asteraceae)	Kenikir	Leaf	Aromatic	Herb	Full sun	Seed
<i>Cupressus benthamii</i> Endl. (Cupressaceae)	Cemara lilin	Leaf	Aromatic	Tree	Full sun	Seed
<i>Cupressus chasmeriana</i> Royle ex Carriere (Cupressaceae)	Cemara kipas	Leaf	Aromatic	Tree	Full sun	Seed
<i>Cymbopogon citratus</i> (DC.) Stapf. (Poaceae)	See	Leaf	Condiment	Herb	Full sun	Stolon
<i>Cymbopogon winterianus</i> Jowitt (Poaceae)	See wangi	Leaf	Aromatic	Herb	Full sun	Stolon
<i>Dysoxylum caulostachyum</i> Miq. (Meliaceae)	Majagau	Stem	Aromatic	Tree	Full sun	Seed
<i>Eucalyptus alba</i> Reinw. ex. Bl. (Myrtaceae)	Ampupu	Leaf	Aromatic	Tree	Full sun	Seed
<i>Eucalyptus deglupta</i> Bl. (Myrtaceae)	Leda	Leaf	Aromatic	Tree	Full sun	Seed
<i>Eucalyptus urophylla</i> S.T. Blake (Myrtaceae)	Huek	Leaf	Aromatic	Tree	Full sun	Seed
<i>Foeniculum vulgare</i> Mill. (Apiaceae)	Adas	Leaf	Aromatic	Herb	Full sun	Seed
<i>Gardenia jasminoides</i> Ellis (Rubiaceae)	Jempiring	Flower	Aromatic	Shrub	Full sun	Cutting
<i>Jasminum sambac</i> (L.) W.Ait. (Oleaceae)	Menuh	Flower	Aromatic	Woody climber	Semi shade	Cutting
<i>Juniperus procera</i> Hochst. ex Endl. (Cupressaceae)	Cemara natal	Leaf	Aromatic	Tree	Full sun	Seed
<i>Leptospermum amboinense</i> Bl. (Myrtaceae)	Mica bolong	Leaf	Aromatic	Tree	Full sun	Seed
<i>Libocedrus formosana</i> Florin (Cupressaceae)	Kipres pormosa	Leaf	Aromatic	Tree	Full sun	Seed
<i>Lophopetalum javanicum</i> (Zoll.) Turcz. (Celastraceae)	Tahlan	Stem	Aromatic	Tree	Full sun	Seed
<i>Massoi aromatica</i> Becc. (Lauraceae)	Mesui	Stem	Aromatic	Tree	Full sun	Seed
<i>Melaleuca leucadendra</i> (L.) L. (Myrtaceae)	Kayu putih	Leaf	Aromatic	Tree	Full sun	Seed
<i>Mentha arvensis</i> L. (Lamiaceae)	Poo	Leaf	Aromatic	Herb	Full sun	Stolon
<i>Mesua ferrea</i> L. (Clusiaceae)	Nagasari	Seed	Aromatic	Tree	Full sun	Seed
<i>Michelia champaca</i> L. (Magnoliaceae)	Cempaka	Flower	Aromatic	Tree	Full sun	Seed
<i>Michelia montana</i> Bl. (Magnoliaceae)	Kayu base	Flower	Aromatic	Tree	Full sun	Seed
<i>Mimosops elengi</i> L. (Sapotaceae)	Tanjung	Flower	Aromatic	Tree	Full sun	Seed
<i>Moringa pterygosperma</i> Gaertn. (Moringaceae)	Kelor	Root, leaf	Aromatic	Tree	Full sun	Seed
<i>Murraya paniculata</i> (L.) Jack. (Rutaceae)	Kemuning	Flower	Aromatic	Tree	Full sun	Seed
<i>Ocimum basilicum</i> L. (Lamiaceae)	Kencarum	Flower	Aromatic	Herb	Full sun	Seed
<i>Orthosiphon aristatus</i> (Bl.) Miq. (Lamiaceae)	Kumis kucing	Flower	Aromatic	Herb	Full sun	Seed
<i>Pandanus amaryllifolius</i> Roxb. (Pandanaceae)	Pandan arum	Leaf	Aromatic	Shrub	Semi shade	Stolon
<i>Pandanus inermis</i> Reinw. (Pandanaceae)	Pudak	Flower	Aromatic	Shrub	Semi shade	Stolon
<i>Piper cubeba</i> L.f. (Piperaceae)	Kemukus	Leaf	Aromatic	Woody climber	Semi shade	Cutting
<i>Piper nigrum</i> L. (Piperaceae)	Merica	Seed	Condiment	Woody climber	Semi shade	Seed
<i>Pittosporum ferrugineum</i> W. Ait. (Pittoporaceae)	Belalang puak	Root	Aromatic	Tree	Full sun	Seed
<i>Pogostemon cablin</i> Bth. (Lamiaceae)	Dondelem	Leaf	Aromatic	Herb	Full sun	Cutting
<i>Protium javanicum</i> Burm. f. (Burseraceae)	Tenggulun	Leaf	Condiment	Tree	Full sun	Seed
<i>Schima wallichii</i> (DC.) Korth (Theaceae)	Puspa	Flower	Aromatic	Tree	Full sun	Seed
<i>Talauma candollii</i> Bl. (Magnoliaceae)	Cempaka gondok	Flower	Aromatic	Shrub	Semi shade	Seed
<i>Thuja occidentalis</i> L. (Cupressaceae)	Cemara kipas	Leaf	Aromatic	Tree	Full sun	Seed
<i>Thuja orientalis</i> L. (Cupressaceae)	Cemara kipas	Leaf	Aromatic	Tree	Full sun	Seed
<i>Zingiber casummunar</i> Roxb. (Zingiberaceae)	Bangle	Rhizome	Aromatic	Herb	Semi shade	Rhizome
<i>Zingiber officinale</i> Roxb. (Zingiberaceae)	Jahe	Rhizome	Condiment	Herb	Semi shade	Rhizome