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MEDICINAL PLANTS OF BORNEO

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Meekiong Kalu and Mohd Razip Asaruddin

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INTRODUCTION

Arthritis is a common reason for absenteeism from work and can result in a decreased quality of life (OrthoInfo, 2007). According to the National Institute of Arthritis and

Musculoskeletal and Skin Diseases (NIAMS, 2014a), arthritis is a term often used to mean any disorder that affects joints; symptoms generally include joint pain and stiffness. Medically, there are about 100 forms of diseases that represent arthritis (Athanasious *et al.*, 2013). The most common forms are osteoarthritis and rheumatoid arthritis such as gout, lupus, fibromyalgia and septic arthritis (NIAMS, 2014b). The arthritic diseases affect about 15–20% of the population and become more common with age.

Since time immemorial, the indigenous people of Borneo have used various natural remedies such as herbs to treat effectively any form of arthritic diseases with few significant side effects. However, research in the field of natural remedies remains restricted. Scientific studies often use animal models or cell lines to test plant compounds and very few clinical trials exist. In this write-up, several plant species are discussed that are commonly used by the local peoples in Borneo for any form of arthritis diseases. However, many of them are not yet scientifically proven.

Aloe vera (L.) Burm. *f.*

Aloe vera (L.) Burm. *f.* (Figure 13.1) is a succulent plant species of the family Asphodelaceae (previously placed under the family Liliaceae). It is an evergreen

FIGURE 13.1 *Aloe vera* (Photo credit: K. Meekiong).

perennial that originated from the Arabian Peninsula, but it is now cultivated for agricultural and medicinal uses in many countries. This species is also used as an ornamental and indoor potted plant. The generic name of the plant is derived from the Arabic word, alloeh, which means bitter, referring to the taste of the sap or fluid found in the plant, while vera means "true" or "genuine". Known with many vernacular names, such as a plant of immortality, first-aid plant, miracle plant, crocodile tongue, luhui, jadam and lidahbuaya, *A. vera* can adapt to a wide range of soil and weather conditions in tropical and subtropical environments (Siti Fauziah, 2013).

Description

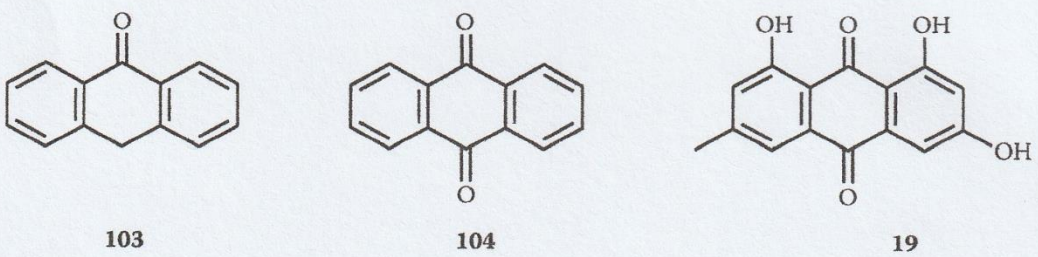
A perennial herb growing to a height of about 50–70 cm tall (sometimes up to 1 m) with a stout or very short stems. The leaves are thick and fleshy, light green to grey-green, lanceolate shaped with a sharp tip and prickly spines along the margin (serrated). The leaves are arranged in a rosette. The flowers are produced on a spike up to 80–100 cm tall, and are yellow, tubular-shaped. They spread by offshoots.

Traditional Uses

A. vera is often planted for commercial purposes. It is found in many consumer products including beverages, skin lotions, cosmetics, or ointments for minor burns and sunburns. Traditionally, *A. vera* is widely used by the folks to treat various skin problem or diseases, ulcer, dysentery, fever, diabetic, arthritis and headache. *A. vera* juice is applied to the abdomen of women after childbirth to give a soothing comfort, to reduce wrinkles and regain its original form. Juice from the leaves of *A. vera* also is used in treating wounds or burns and to relieve symptoms of certain skin disorders, such as rashes, psoriasis and acne.

Chemical Constituents

A. vera leaves contain phytochemicals such as acetylated mannans, polymannans, C-glycosides, anthrones (**103**), anthraquinone (**104**), emodin (**19**) (Figure 13.2) and various lectins. The possible bioactivity, however, remains unstudied.



103 **104** **19**

FIGURE 13.2 Various anthraquinones from *Aloe vera* – anthrone (**103**), anthraquinone (**104**) and emodin (**19**).

FIGURE 13.3 *Alpinia galanga* (Photo credit: K. Meekiong).

Alpinia galanga (L.) Willd.

Alpinia galanga (L.) Willd. (Figure 13.3) is an herbaceous plant in the ginger family of Zingiberaceae. Known as galangal or greater galangal, this species is widely cultivated in many countries for its fragrant and spicy rhizome, rather than its dense inflorescence of small greenish-white flowers (Skornickova and Gallick, 2010). In Borneo, it is called Langkuas, and is commonly planted in the backyard gardens or orchards.

Description

These are rhizomatous plants that form a dense clump, up to 2–2.5 m tall; have conspicuously branched rhizomes, 2–4 cm diameter, light red or pale yellow; and have a pungent smell and strong taste. The leaves are long and narrow, oblong to oblanceolate, 50–60 × 7–10 cm, glossy, nearly hairless. The inflorescence terminal of the leafy shoot appears a large cluster, spike-like or racemose, 10–35 × 4–7.5 cm, yellow-white flowers, fragrant. Fruits are rounded or ellipsoid capsule

(1–2 cm diameter), contain 2–4 seeds, yellow-orange to dark red and turn black at maturity.

Traditional Uses

The rhizome of *A. galanga* is used most often in cooking. The fresh rhizome, flowers and young shoots are eaten raw as *ulam* (raw vegetable). The native peoples in Sarawak regularly use the rhizome of *A. galanga* for treatment of ailments including indigestion, diarrhoea, stomachache, flatulence and skin problems.

Chemical Constituents

The rhizome of *A. galanga* contains the flavanol galangin and essential oil known as galangol. Chouni and Paul (2018) listed several active terpenoid compounds from *A. galanga*, such as *p*-hydroxycinnamaldehyde (**105**) (Figure 13.4), β-pinene, β-sitosteroldiglucoside (Ag-7), 1′-acetoxychavicol acetate (galangal acetate), α-bergamotene and so forth.

Curcuma longa L.

Curcuma longa L. (Figure 13.5) is a flowering plant of the ginger family, Zingiberaceae. Popularly known as turmeric, this herbaceous plant is native to the Indian subcontinent and probably from Southeast Asia (Samy *et al.*, 2014). In Malaysia and Indonesia, its vernacular name is known as kunyit, temukunyit, kunyir or temukuning.

Description

The "kunyit" plant is a perennial herb with a stout or short stem and light green tufted leaves growing up to 1 m tall. The rhizome is thick and ringed with the bases of old leaves. The leaves are large, arranged alternately in two rows, with the leaf sheaths forming a false stem-liked (called as pseudostem). Leaf blades are usually oblong, 70–120 cm (sometimes up to 250 cm) long, dark green on the upper surface, pale green beneath. Inflorescence is from the rootstock or rhizome, upright, up to 30 cm long (or longer). Flowers are yellow-white or green, sometimes tinged reddish-purple and the upper ends are tapered. They are sterile and do not produce viable seeds.

Traditional Uses

Almost every part of *C. longa* is used by the local people of Borneo. The young rhizomes, young shoots and flowers are eaten as *ulam* (raw vegetable). The rhizomes are used fresh or dried, commonly used as a coloring and flavoring agent,

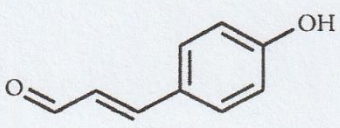


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FIGURE 13.4 *p*-Hydroxycinnamaldehyde (**105**).

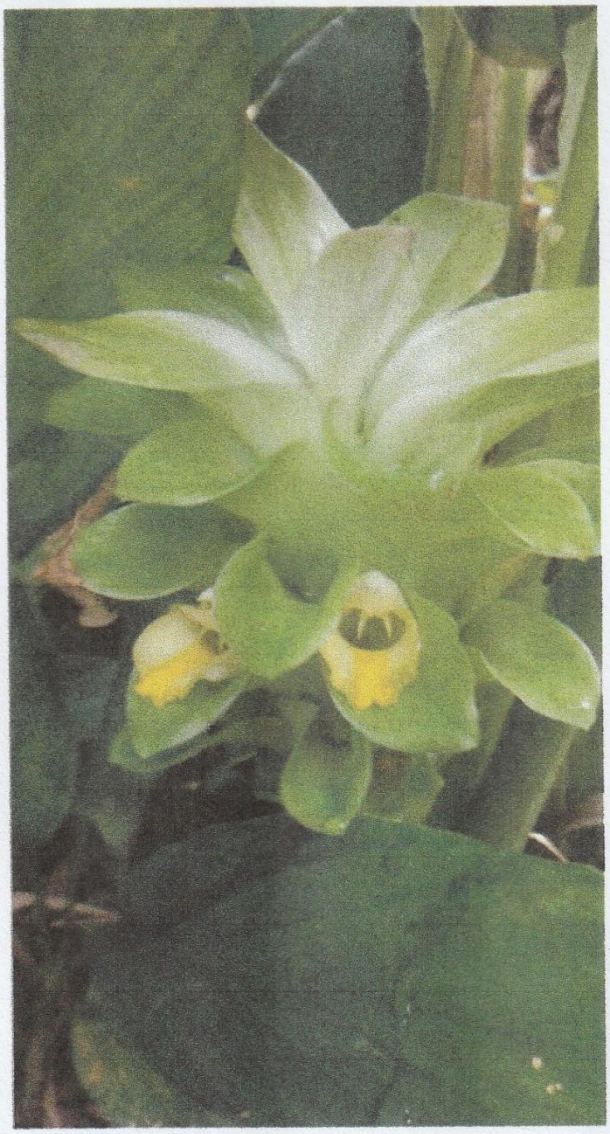
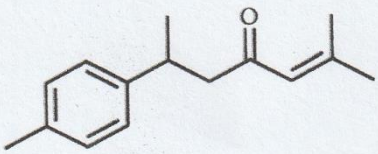


FIGURE 13.5 *Cucurma longa* (Photo credit: K. Meekiong).

especially curries. According to Nelson *et al.* (2017), the turmeric powder is about 60–70% carbohydrates, 6–13% water, 6–8% protein, 5–10% fat, 3–7% dietary minerals, 3–7% essential oils, 2–7% dietary fiber and 1–6% curcuminoids. The Malays and the Melanau peoples in Sarawak use the rhizome as the main ingredient for *jamu* (beautification herb) as well as to treat joint pains.

Chemical Constituents

Phytochemicals known from turmeric are mainly diarylheptanoids including curcurminoids such as curcumin, demethoxycurcumin and bisdemethoxycurcumin. Essential oils such as turmerone (**106**), zingiberene (**107**), curcumin (**108**) and germacrone (**109**) (Figure 13.6) are major constituents present in *C. longa* roots.



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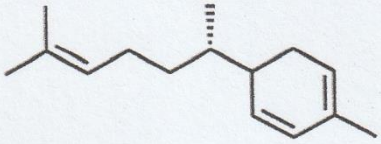

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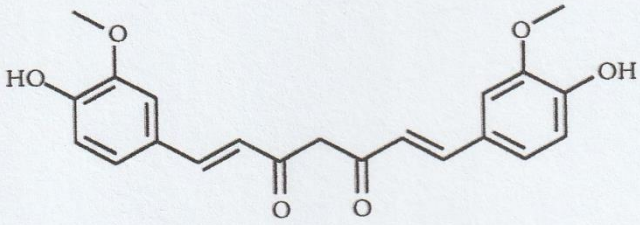

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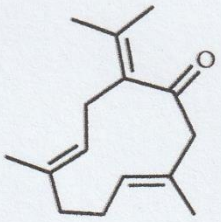

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FIGURE 13.6 Major constituents of essential oil in *C. longa* roots – turmerone (**106**), zingiberene (**107**), curcumin (**108**) and germacrone (**109**).

Hibiscus tiliaceus L.

Hibiscus tiliaceus L. (Figure 13.7) is a species of flowering plant in the mallow family, Malvaceae, is native to tropical Asia and has become naturalized in parts of America and South America. The plant has different vernacular names, such as sea hibiscus, cotton-wood, rosella, kurrajong, sea rosemallow, balibago, malabago (Philippines), waru (Javanese), barulaut (Malay), hau (Hawaiian), fau (Samoan), purau (Tahitian) and vau tree.

Description

It is a large, stout, open-branched shrub or small tree with spreading branches, reaching a height of 4–10 m, with a trunk up to 15 cm in diameter. Leaves are heart-shaped to almost circular, 3–15 cm long. Inflorescences are cymose. Flowers are large, showy, yellow with dark maroon or blackish center, deepening to orange or apricot as they mature. Flowers fade after 1 day and turn orange-red before they are shed.

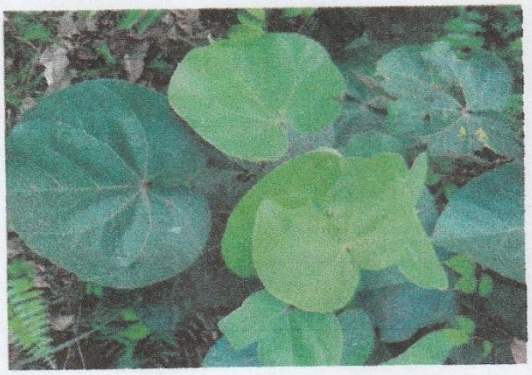
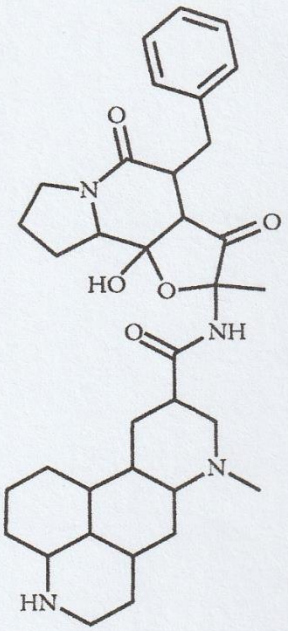


FIGURE 13.7 *Hibiscus tiliaceus* (Photo credit: K. Meekiong).



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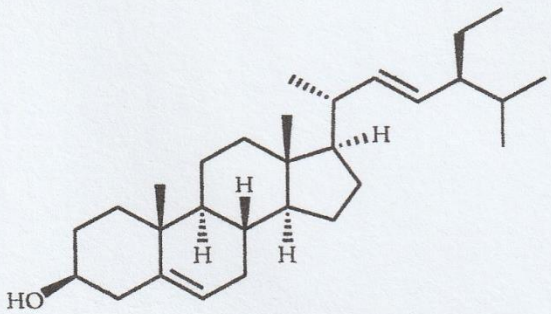

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FIGURE 13.8 Chemical constituents of *Hibiscus tiliaceus* – dihydroxyergostenedione (**110**) and stigmasterol (**111**).

Traditional Uses

H. tiliaceus is widely used in Asian nations in many ways. They are occasionally found as ornamental landscape trees along the road or as the subject for the art of bonsai (especially in Taiwan). The leaves are used for wrapping food or for fermenting tempeh. The wood of *H. tiliaceus* has been used in a variety of applications such as light construction, firewood and carvings. The fibers extracted from the bark or stem have traditionally been used in rope making. The young leafy shoots are eaten as *ulam*. The bark and roots are used as traditional medicine by boiling in water and taken as a drink to cool a fever. The local peoples in coastal areas of Sarawak use the crushed leaves of *H. tiliaceus* and mix with other selected plants (e.g. *Ardisia elliptica, Zingiber officinale, Saccharum officinale*) to treat broken bones or joint pains.

Chemical Constituents

Little *et al.* (1989) noted that leaves of *H. tiliaceus* displayed strong free radical scavenging activity and contain tyrosinase activity, whilst Melecchi *et al.* (2002) reported many compounds have been found in the extraction of *H. tiliaceus* flower that include octadecenoic acid, dihydroxyergostenedione (**110**), dihydrobenzofuran, gynmolutone and stigmasterol (**111**) (Figure 13.8).

Morinda citrifolia L.

Morinda citrifolia L. (Figure 13.9) is a flowering plant of the coffee family, Rubiaceae. It is native to Southeast Asia and Australasia and is cultivated throughout the tropics as an ornamental or for medicinal purposes and has become

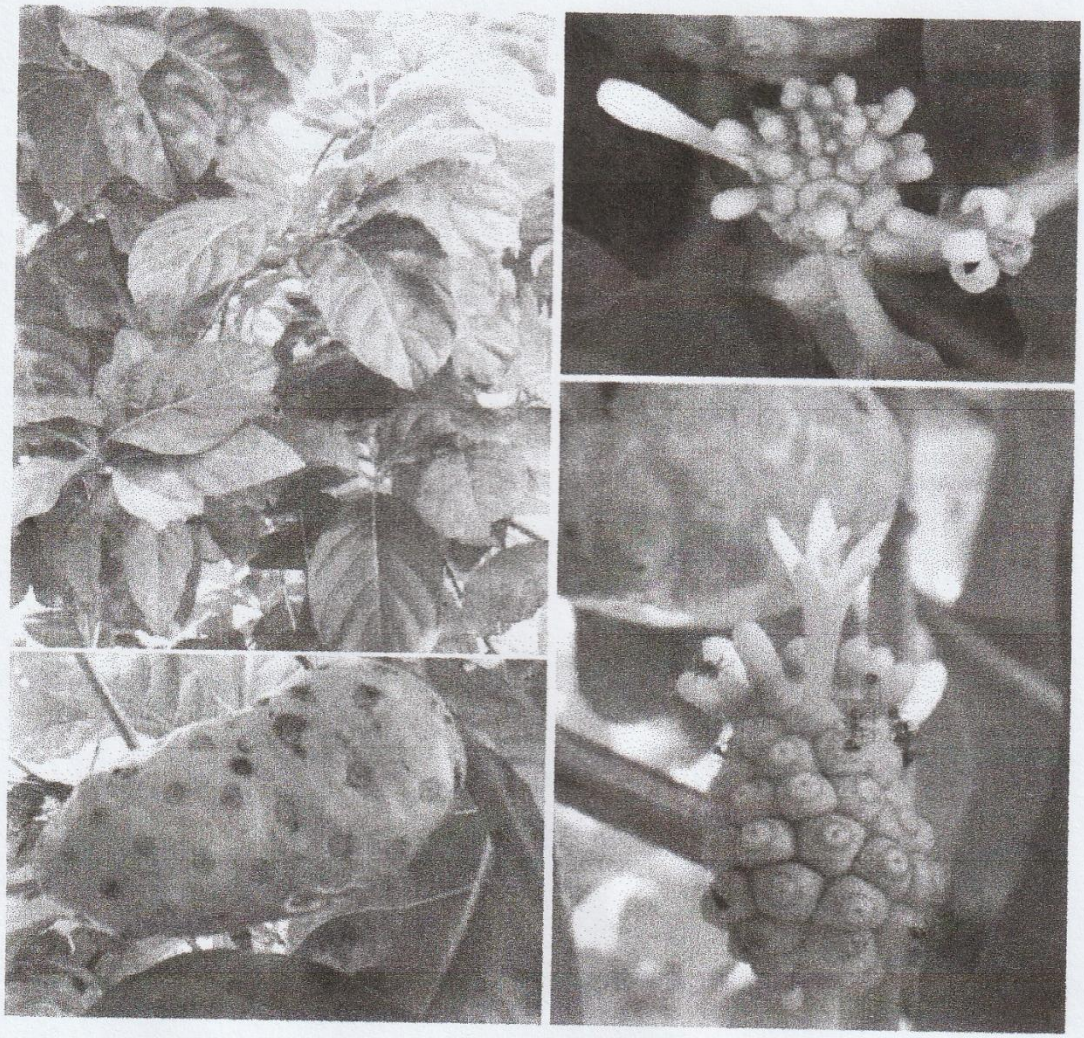


FIGURE 13.9 *Morinda citrifolia* – leaves (top left); ripe fruit; (right) inflorescence of *Morinda citrifolia*. (right) (Photo credit: K. Meekiong).

naturalized. Known by many names across the globe, the common English names are Great morinda, Indian mulberry, noni, cheese fruit and beach mulberry. In Borneo, it is called mengkudu or engkudu.

Description

It is a small evergreen tree or shrub, up to 10 m in height, with spreading branches, and bushy-like. Leaves are large, membranous, 18–50 × 6–30 cm, glabrous, pinnately veined and glossy. Flowers are many, 75–90 in ovoid to globose heads. The corolla is white, 5-lobed. It produces syncarp fruits, yellowish-white, fleshy, 6–12 cm long (sometimes longer), 4–5 cm in diameter, soft and fetid when ripe.

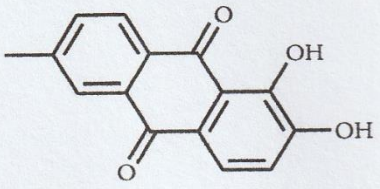
Traditional Uses

Despite its strong smell and bitter taste, the fruits are eaten during famine or as staple food, either raw or cooked. The local people consume the fruit raw with salt or cook it

with curry. The ripe fruits are blended to make juice and a drink to lower the sugar or glucose content in the blood. The fruits and leaves of *M. citrifolia* also are used to cure fever and arthritic diseases. The roots are febrifuge, tonic and antiseptic and used to treat stiffness and tetanus and have been proven to combat arterial tension. An infusion of the root is used in treating urinary disorders and the bark is used in a treatment to aid childbirth (World Health Organization, 1998).

Chemical Constituents and Prospects

According to Inada *et al.* (2017) and Almeida *et al.* (2019), *M. citrifolia* has high nutritional value and almost 200 phytochemical compounds with bioactive properties have already been identified and isolated from different parts of the plant. Su *et al.* (2005) reported 17 common compounds found in the fruits of *M. citrifolia.* Amongst them are americanin A, narcissoside (**112**), asperuloside, borreriagenin, citrifolinin B epimer a, citrifolinin B epimer b and cytidine. Kamiya *et al.* (2010) reported active compounds, damnacantha (**113**), nordamnacanthal, dihydroxy-2-methoxymethylanthraquinone and morindone (**114**) (Figure 13.10)



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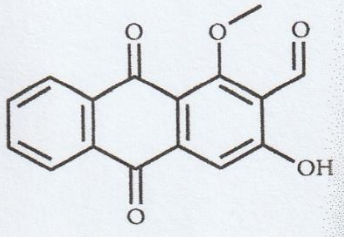

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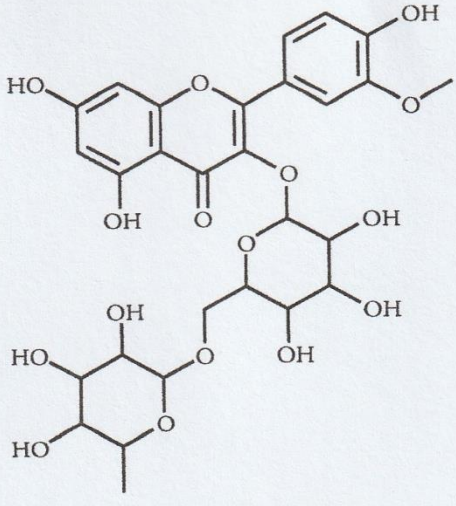

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FIGURE 13.10 Major constituents of *Morinda citrifolia* – narcissoside (**112**), damnacantha (**113**), and moridone (**114**).

that were extracted from the roots of *M. citrifolia* and showed positive results against cancer.

Mimosa pudica L.

Mimosa pudica L. (Figure 13.11) is a creeping perennial flowering plan of the legume family, Fabaceae. The epithet name, pudica, is a Latin word meaning shy, bashful or shrinking, referring to the compound leaves that fold inward and droop when touched or shaken, and recognized as 'sleeping movement' also known as nyctinasty movement. It is known with many vernacular names, viz. sensitive plant, sleepy plant, touch-me-not, shy plant, zombie plant and semalu or malu-malu in Malay. This species is native to the New World (South and Central America) but is now a cosmopolitan weed. It is a pioneer plant species, chiefly found on soils with low nutrient concentrations and rapidly spread over the area.

Description

The stem is slender, branching and sparsely to densely covered with hairs and prickly-like structures; erect in young plants and becomes creeping or trailing with age; growing to a length up to 1.5 m long trailing. Leaves are compound, 10–28 leaflets per pinna. Its inflorescence with flower head arises from the leaf axils. Flowers are pink or purple. The fruits consist of cluster of 2–10 pods, 1–3 cm long; the pods break into 2–5 segments contain pale brown seeds.

Traditional Uses

The Malay people used the boiled water of *M. pudica* to treat fever, insomnia, stress and rheumatism. The Iban from the rural areas of Sarawak the boiled water of *M. pudica* roots was drunk for treatment of asthma, ulcer and malaria. The dried plants of *M. pudica* are mixed with other plants (e.g. *A. galanga, Z. officinale, Glochidion* sp., *S. officinale, A. elliptica*) as a poultice for broken bone treatment.

Chemical Constituents

Genest (2008) and Parasuraman *et al.* (2019) reported that *M. pudica* contains various compounds, including alkaloids, flavonoid C-glycosides, sterols (**115**), terpenoids, tannins, saponin and fatty acids. Additionally, extracts of *M. pudica* have been shown to contain crocetin-dimethylester (**116**), tubulin and green-yellow fatty oils. A new class of phytohormoneturgorines, which are derivatives of gallic acid, gallic acid 4-*O*-(β-D-glucopyranosyl-6′- sulfate) (**117**), have been discovered within the plant (Figure 13.12) (Azmi, 2011).

Zingiber officinale Roscoe

Zingiber officinale Roscoe (Figure 13.13) is an herbaceous plant of the flowering family Zingiberaceae. Known as the true ginger, *Z. officinale* has been grown in Asia since ancient time. Although the origin is still vastly debated, many believe that this species originated in India and was taken to Europe and East Africa by the

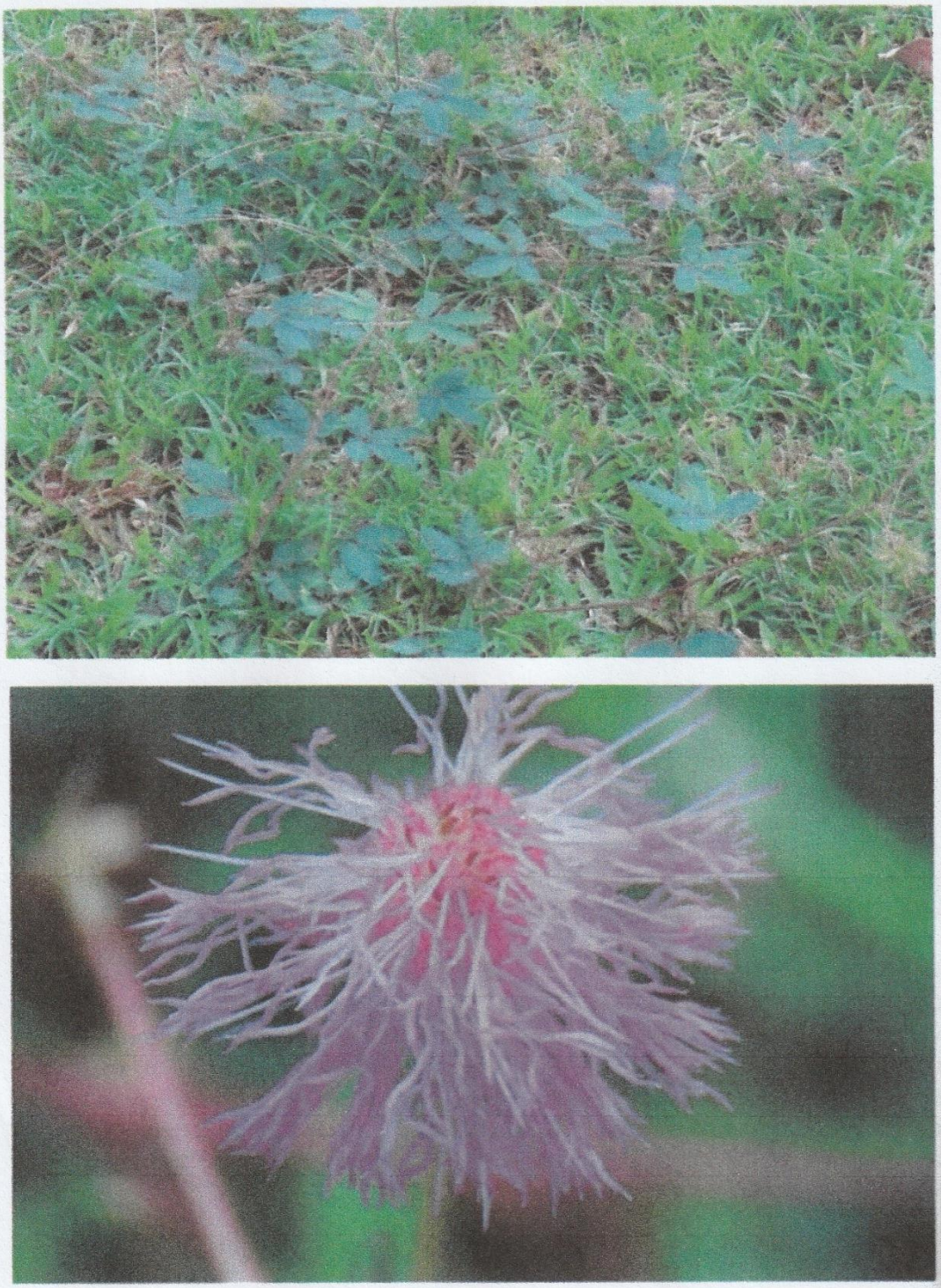
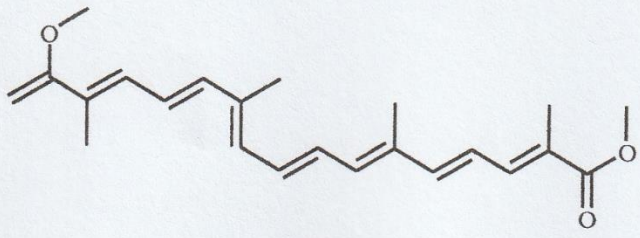


FIGURE 13.11 Creeping plants of *Mimosa pudica* (Photo credit: K. Meekiong).



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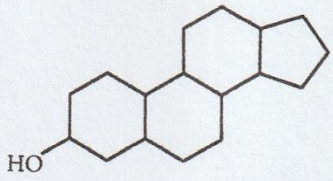

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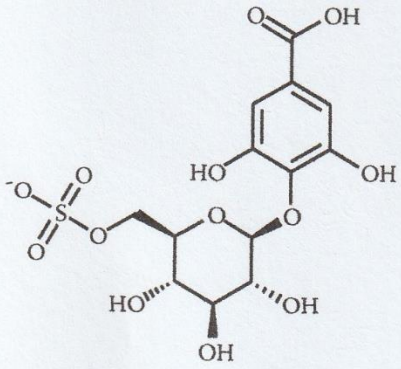

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FIGURE 13.12 Major constituents of *Mimosa pudica* – sterol (**115**), crocetin-dimethylester (**116**) and gallic acid 4-*O*-(β-D-glucopyranosyl-6′-sulfate) (**117**).

Arab traders as a precious item of trade. The generic name might be derived from the Sanskrit word, meaning "body with horn", referring to the shape of the root, and the epithet name *officinale* is a Latin word, mean medicinal. In Malaysia and Indonesia, it is popularly known as halia.

Description

True ginger is an aromatic small herb with underground rhizome, erect, up to 75 cm tall. The leaf sheaths are overlapping, rolled and clasping to develop a false stem or pseudostem. Leaves are simple, sheathing at the base, linear-lanceolate, 15–20 × 3–4 cm, glabrous, green or dark green above and pale green beneath. Its inflorescence from rootstock or rhizome is erect, with a spike on a distinct scape. Flowers are densely arranged, irregular, yellow or yellowish-green with purplish spots. The fruit is an oblong capsule, with many seeds.

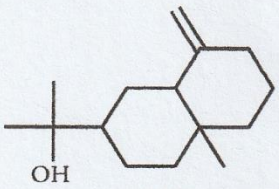
Traditional Uses

True ginger is a fragrant kitchen spice, regularly used as an ingredient in many dishes. The roots can be made into candy or ginger wine or can be steeped in boiling water to make ginger herb tea. The Malay and the Melanau peoples in the central part of Sarawak commonly use ginger as the main ingredients to make poultices to treat arthritis. The rhizomes of *ginger* are boiled and taken as a drink to relieve wind in the body.

FIGURE 13.13 *Zingiber officinale* (Photo credit: K. Meekiong).

Chemical Constituents

Many studies have been conducted to identify and isolate the active compounds from different parts of *Z. officinale*. Among the studies were those by Liu *et al.* (2019), Bhattarai *et al.* (2018), Sharma *et al.* (2016), Pilerood and Prakash (2011), Charles *et al.* (2000), Connell and McLachlan (1972) and so forth. There are more than 400 chemical constituents isolated and identified from the *Z. officinale* including volatile oils e.g. zingerol (**118**), borneol (**119**), cineole, citronellol, nerol, terpinolene, gingerols (e.g. gingerol (**120**), acetoxy-4-gingerol, 10-gingerdione, paradol, shogaol, zingerine, zingerone and so forth and diarylheptanoid (e.g. 1,7-bis (4′hydroxy-3′-methoxyphenyl)-4-heptene-3-one, 1,7-bis (4′-hydroxy-3′-methoxyphenyl)3,5-heptadione and so forth). Some examples of these compound structures are shown in Figure 13.14.



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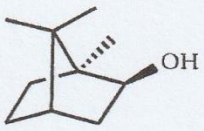

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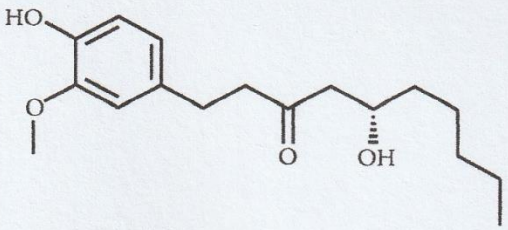

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FIGURE 13.14 Chemical constituents of *Zingiber officinale* – zingiberol (**118**), borneol (**119**) and gingerol (**120**).