Medicinal Plants of Indonesia

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Introduction

The Republic of Indonesia is a culturally diverse archipelago located between Indochina and Australia and consists of over 13 000 islands including the "Spice Islands" (Gils and Cox 1994). Indonesia stretches across 5 100 km and encompasses a wide range of habitats (Whitten and Whitten 1996), and therefore blessed with a vast diversity of plants with medicinal value. In the early part of the 20th century (1913–1922), literature on the curative and preventive uses of plant material of Indonesia entitled as "De Nuttige Planten van Naderlansch-Indie" was published in four volumes by K.Heyne (Hirschhorn 1983). In 1953 van Steenis-Kruseman published *Select Indonesian Medicinal Plants* based largely on historical literature (Elliott and Brimacombe 1987). Much study has been carried out in recent years on Indonesian medicinal plants by distinguished universities around the world. As described by Shibuya and Kitagawa (1996) from Fukuyama University, Hiroshima, Japan, "series of scientific expeditions have been conducted by Japan, in Indonesia for collecting information and materials relating to the pharmacochemical study of locally used medicinal plants and Javanese traditional medicine "jamu" since 1985." Plant derived medicines are not only administered orally, but are widely used in aromatherapy such as herbal steam baths which are used by women recuperating after childbirth (Zumsteg and Weckerle 2007). The use of therapeutic herbal steam baths are not only prevalent among the Thais (Anderson 1993; Wang *et al*., 2003) but are widely practiced in Indonesia and in Sulawesi where it is known as bakera (Siagian 2002; Zumsteg and Weckerle 2007). Although the major focus for drug discovery has recently shifted to high-throughput screening coupled with computational and molecular modeling (Young *et al*., 2002), however working with traditional or local healers still remains a valid method for the identification of potential compounds that may be essential for the development of novel pharmaceuticals (Buenz *et al*., 2005; Martin and Ernst 2003; Ram 2001). These local healers and traditional birth attendants are often referred to as dukun bajis in the local Indonesian language (Hennessy *et al*., 2006; Mahyar *et al*., 1991) and play a very important role as sentinels of the traditional medicinal lore, the knowledge of which is often transmitted orally from generation to generation. Besides providing assistance during delivery

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and advice on fertility related matters, the dukun bajis also make profuse use of the medicinal herbs in their practice and play a role in maintaining the traditional magico-religious customs (Neumann and Lauro 1982). In Bali, Indonesia, there are thousands of palm-leaf manuscripts (known as lontar in Balinese) that have been compiled from ancient times containing valuable healing information and advice, which are still adhered to by the traditional healers of Bali today (McCauley 1988).

In this paper, we describe the key medicinal plants from that are used as traditional medicine in Indonesia.

Medicinal Plants

Aloe vera is a member of the Lilaceae family and is known as jadam in Bahasa Indonesia and Bitter Aloes in English. The genus Aloe belongs to the Asphodelaceae Alooidea sub family, and includes about 420 species mostly of the succulent type (Smith and Van Wyk 1998). The medicinal properties of Aloe vera had been recorded earlier by Heyne (1927) in his De Nuttige Planten van Naderlansch-Indie. The herb is cultivated throughout the tropics and in Indonesia the plant is found to occur in the Alas valley (Elliott and Brimacombe 1987) and in Pontianak city. The herb is however not indigenous to Indonesia. Historically, the Aloe vera plant is held sacred by the Muslims because it is believed to possess the power to ward off malignant influences from entering the homes (Zeilmann *et al*., 2003). Aloe vera is a succulent, cactus like plant and regarded as a typical xerophyte because of its adaptation to grow in areas that are hot and dry (Choi and Chung 2003) with availability of water. The plant is known to possess a large water storage tissue that allows it to adapt to a hot and arid environment (Ni *et al*., 2004). The leaves of Aloe vera are long and pointed and each leaf comprise of two parts, an outer green rind and an inner clear and mucilaginous pulp popular for its therapeutic properties (Ni *et al*., 2004). For the past 3 000 years, from ancient Mesopotamia to Egypt, Aloe vera has been used externally for the treatment of skin infections and wounds, and internally as a cathartic (Vinson et al., 2005). Even today, Aloe vera is commonly used to treat a number of skin complaints, such as dry skin and irritant contact dermatitis (West and Zhu 2003) and for the healing of burns (Visuthikosol *et al*., 1995). In Indonesia, the mucilaginous juice from the leaves (pulp) is used in several medicinal preparations that are either taken orally or rubbed on the skin to treat mental disorders (Elliott and Brimacombe 1987). The pulp extract of Aloe vera is rich in mannan (Ni *et al*., 2004). According to Mayilyan *et al*., (2006) immunological research into mental disorders like Schizophrenia indicates that infectious or autoimmune processes might play a role in causing these disorders. The complement system is the main mediator that regulates innate immune defense and hence plays a role in activating many functions related to the immune defense system such as inflammation and cell lysis. The complement system is activated via three pathways viz. the classical, the alternative and the lectin pathway and Mannan-binding lectin (MBL) is known

to activate the complement system via the lectin pathway (Mayilyan *et al*. 2006). Perhaps this could account for the use of mucilaginous juice from the leaves (pulp) by Indonesians to treat mental disorders as recorded by Elliott and Brimacombe (1987). Lotions are prepared from the plant and applied to treat musculoskeletal disorders and Aloe vera is also known to serve as a common ingredient in the preparations of traditional shampoos in Indonesia because of its alleged hair-growth promoting ability (Elliott and Brimacombe 1987). The mucilaginous juice from the leaves (pulp) of Aloe vera that is used in several medicinal preparations by the Indonesians is in fact, enriched with polysaccharides (Paes-Leme *et al*., 2005). The refined polysaccharide is known to act as an immunostimulant and enhances the release of cytokines such as interleukin-1, interleukin-6, tumor necrosis factor-a and interferon-c (Peng et al., 1991), all of which are important for the proliferation of fibroblasts. According to Kahlon *et al*. (1991) and Yates *et al*. (1992), proliferation of fibroblasts is responsible for the healing of burns, ulcers and wounds of the skin and gastrointestinal lining. Thus the whole gel extract of Aloe vera has been reported to possess many properties of pharmacological value, specifically in the healing of wounds and burns and even frost-bite, in addition to possessing antifungal, hypoglycemic and gastroprotective properties (Reynolds and Dweck 1999).

Amaranthus spinosus or thorny amaranth is a member of the family Amaranthaceae. In Indonesia, it is known as bayam duri and generally grown near the dwellings of the Indonesians (Elliott and Brimacombe 1987). In an inventory prepared by Elliott and Brimacombe (1987), Amaranthus spinosus has been included amongst the medicinal plants that are known to occur in the Alas valley of Indonesia. However most plants belonging to the genus Amaranthus are regarded as weeds in the cropping system (Ortiz-Ribbing and Williams 2006). This plant is found to occur in South-east Asia, Taiwan, especially in countries with tropical or subtropical climates (Chen 1997). In Indonesia, the leaves are used in a poultice and applied to boils to hasten pus formation (suppuration) (Elliott and Brimacombe 1987). The plant is also extensively used by the people of Mauritius and Rodrigues where they extract the juice for use as a diuretic and prepare poultices from the leaves as emollient (Gurib-Fakim *et al*., 1993). In Malaysia however, all five types of Amaranthus species is found to occur and is usually used as a vegetable namely "bayam putih" (Amaranthus paniculatus), "bayam merah" (Amaranthus gangeticus), "bayam itik" (Amaranthus blitum), "bayam duri" (Amaranthus spinosus), and "bayam panjang" (Amaranthus viridis) (Amin *et al*., 2006). All five species of Amaranthus mentioned above have been reported by Hunter and Fletcher (2002) to possess a high concentration of antioxidant related components. Ths plant is a betalain containing species and is therefore regarded both as an antimalarial and antimicrobial agent (Hilou *et al*., 2006). Also amaranthine from the genus Amaranthus is known to contain quaternary nitrogen in its structures and thereby retains the potential to inhibit Plasmodium growth by blocking the parasite's choline intracellular transport (Ancelin and Vial 1986). Choline is crucial for the biosynthesis of the phosphatidylcholines, which are essential molecules

for the Plasmodium (Hilou *et al*., 2006). The plant is extensively used in traditional Chinese medicine to treat diabetes (Lin *et al*., 2005). Generally, the plant is used as antipyretic, diuretic, laxative and stomachic and the root extract is used to treat gonorrhea (Rahman *et al*., 2004). The boiled roots and leaves are given to children as a laxative, and also to treat constipation and jaundice (Chopra *et al*., 1958; Yusuf *et al*., 1994).

Bambusa vulgaris is commonly known as bamboo, this species is a giant woody grass (Lu *et al*, 2005), belonging to the family Gramineae and is known by several names in Bahasa Indonesia such as trieng gading, djadjang ampel, bamboe koenieng etc (Hirschhorn 1983). The distribution of bamboo is both tropical and subtropical (Lu et al, 2005), and in Indonesia, bamboo is not only found to occur in natural forests but in plantation forests and in community forest areas as well as in many villages of Indonesia; mostly in Java, Bali, Sumatra, Kalimantan, Sulawesi, Maluku, Irian Jaya, and Nusa Tenggara (Kartodihardjo 2003). The bamboo leaves have been found to possess high medicinal properties and various studies have shown them to contain flavone glycosides, phenolic acids, coumarin lactones, anthraquinones and amino acids (Chen *et al*., 2002; Li *et al*., 2003; Luo and Chen 2003; Lu and Liao, 2003; Meng *et al*., 2002, Zhang and Ding 1996; Zhou 1992). Because of the flavanoid content, the leaf extracts may possess many beneficial biological and therapeutic properties such as the ability to scavenge active oxygen radicals (Zhang and Ding 1996) and the potential of the flavonoids to be used as antiaging factor for skin protection (Zhang *et al*., 2004). Further studies also reveal that the leaves of the bamboo plant are rich in chlorophyll and can be used in food as a potential food antiseptic (Liu and Ding 2000). In Indonesia, bamboo shoots are used in complex medicinal preparations and consumed for treatment against abdominal pain and jaundice (Elliott and Brimacombe 1987). A decoction is also prepared from the shoots of bamboo along with the roots of coconut palm and drunk as a remedy for insomnia (Elliott and Brimacombe 1987). According to Hirschhorn (1983), preparations from bamboo is also used as a clotting agent in Indonesia to stop bleeding. In Trinidad and Tobago, bamboo is used to treat cuts, and injuries a along with Solanum melongena (egg plant) Jatropha curcas (Barbados nut) Jatropha gossypifolia (a weed found in Jamaica / India) Bidens alba (hairy beggar's tick), Bidens pilosa (Spanish needle), Cucurbita pepo (pumpkin), Tournefortia hirsutissima (chiggery grapes), Bixa orellana (annatto plant) and Cocos nucifera (coconut) (Lans 2007). Bamboo shavings (Caulis bamfusae in taeniam), which are the intermediate layer of the stems, have been used in clinical traditional Chinese medicine (TCM) to treat stomachache, diarrhea or vomiting, chest diaphragm inflammation, restlessness and excessive thirst, and its efficacy has been documented in the materia medica of past dynasties in Chinese history (Zhang *et al*., 2004). The antioxidant from the leaves of bamboo (AOB) has also been certificated as a novel and naturally occurring antioxidant by the

Ministry of Health of the People's Republic of China, and has been used in various food systems (Lu *et al*., 2005).

Cassia alata belonging to the family Leguminosae (Elliott and Brimacombe 1987) is a pantropical shrub (Ibrahim and Osman 1995) found at the edges of forests. It is native to Southeast Asia, Fiji, Northern Australia, Africa and Latin America (Parsons and Cuthbertson 1992). The plant has been reported as one among the other medicinal plants that are found to grow in the Riau province of Sumatra that are used by the Talang Mamak and the Orang Melayu people (Grosvenor *et al*., 1995). The plant has conspicuous spikes of bright yellow flowers and thus aptly named as Golden candlesticks (Elliott and Brimacombe 1987). It is known as gelenggang in Malaysia, Mbai Ni Thangi in Fiji, Ringworm bush in Australia, Ketepeng badak in Indonesia and Te'elango in Tonga (Somchit *et al*., 2003). The uses of Cassia alata include that of an antihelminthic and an antimicrobial agent (Ibrahim and Osman 1995). The plant is also used as a laxative and diuretic, for treating snakebites (Palanichamy *et al*., 1988) and as a remedy for uterine disorders (Kirtikar and Basu, 1975). The antimicrobial property of Cassia alata against *Streptococcus mutans*, the causative agent of dental caries have been studied by Limsong *et al*. (2004). Dental caries is caused by the colonization and accumulation of oral microorganisms, with adherence being the initial step in the colonization process (Gibbons1984). From the results obtained by Limsong *et al*., (2004) it was concluded that Cassia alata had the potential to inhibit the adherence of *Streptococcus mutans* in vitro and thus could serve as a useful agent in the control of dental caries. For treatment of scorpion sting, a paste is prepared from any part of the plant and applied externally at the site of sting (Palanichamy *et al*., 1988). The following uses of Cassia alata has been reported by Elliott and Brimacombe (1987) in Indonesian folk medicine (a) the leaves are either macerated with powdered lime and sulphur or mixed with camphor along with the crushed seeds of candlenut tree (Aleurites moluccana) and used for treating rashes related to ringworms (b) for treatment of malaria, a decoction of the leaves mixed with those of Carica papaya (papaya) is drunk (c) for the treatment of lower abdominal pain, the leaves are mashed with coconut oil and boiled (d) a complex preparation from Cassia alata is prepared and applied externally for jaundice associated with upper abdominal pain. According to Grosvenor *et al*. (1995) people of the Riau province in Sumatra also drink a decoction prepared from the roots of the plant to relieve constipation or eat the young leaves with rice as a laxative. Anthraquinones that accumulate in the roots and the aerial parts of the plant (Kelly *et al*., 1994; Yadav and Kalidhar 1994) are responsible for imparting the laxative property to the plant and thus can be used as a purgative to stimulate bowel evacuation (Elujoba *et al*., 1989). Besides anthraquinones, leaves of Cassia alata have been found to possess flavanoids (Rao *et al*.,

1975), quinones and sterols (Mulchandani and Hassarajani 1975) and the leaves have been investigated for their laxative (Rai 1978), antibacterial (Fuzellier *et al*., 1981), antifungal (Fuzellier *et al*., 1982), anti-inflammatory and analgesic effects (Palanichamy and Ngarajan 1990a; 1990b). In the roots of Cassia alata however, flavanoids along with quercetin, naringenin and kaempferol have been found to accumulate (Samappito *et al*., 2002). In Malaysia the leaf extract is also used to treat ringworm infection and according to Ibrahim and Osman (1995) a small amount of additional lime is mixed with the extract for maximum effect. The leaves of Cassia alata are not only used as an effective ringworm treatment in India (Dey and Bahadur 1973) but the crushed leaves mixed with black pepper are also used to treat dhobi itch of the head and skin (Dey and Bahadur 1973; Kirtikar and Basu 1975). For the treatment of eczema, the best results are usually obtained by repeatedly washing the affected parts with a strong decoction prepared from the leaves and flowers of Cassia alata (Palanichamy *et al*., 1988).

Coriandrum sativum, which belongs to the Umbelliferae family is an erect annual herb of about 20–70 cm in height (Eguale *et al*., 2007). The plant is a native of the eastern Mediterranean (Elliott and Brimacombe 1987) from where it may have spread to India, China and rest of the world (Coskuner and Karababa 2007). In Bahasa Indonesia, it is known as ketumbar and in English the seed simply known as coriandar (Elliott and Brimacombe 1987) is used as a culinary spice (Elliott and Brimacombe 1987; Gupta *et al*., 1991). The seeds of coriander are almost ovate globular in shape with multiple longitudinal ridges on the surface and possess a sweet, slightly pungent, citrus like flavor with a hint of sage (Coskuner and Karababa 2007). The seeds contain about 1 % essential oil with monoterpenoid and linalool being the main components (Wichtl 1994). In Indonesia, the seeds are used in oral remedies for the treatment of coughs, leprosy, central chest pain and indigestion (Elliott and Brimacombe 1987). The seeds have also been used as a drug for the treatment of indigestion and rheumatism, against worms and also for the treatment of pain in the joints (Wangensteen, *et al*., 2004; Wichtl 1994). According to Elliott and Brimacombe (1987), coriander seeds are included in a pessary and are used by Indonesian women, 4–11 days after childbirth. As an important plant of medicinal value, *Coriandrum sativum* has been credited with a long list of medicinal usage in various forms such as the use of powdered seeds or dry extract, tea, tincture, decoction or infusion and these have been recommended for the treatment of dyspeptic complaints, loss of appetite, convulsion, insomnia and anxiety (Emamghoreishi *et al*., 2005; Msaada *et al*., 2007). Studies have also reveled that the essential oils and various extracts from coriander possess antibacterial activity (Burt, 2004; Cantore *et al*., 2004; Kubo *et al*., 2004). Moreover, it has also been specified that the volatile components that are present in the essential oil of both seeds and leaves actually confer the plant with the potential to inhibit growth of a range of microorganisms (Delaquis *et al*., 2002). Increase in blood insulin level is one of the

mechanisms behind hypoglycemia, which usually occurs when the pancreas is stimulated to secrete insulin from ß-cells (Jain and Vyas 1975). From a study conducted by Chithra and Leelamma (1999) on carbohydrate metabolism in rats maintained on high fat cholesterol diet, the hypoglycemic (antidiabetic) property of *Coriandrum sativum seeds* (Gallagher *et al*., 2003) has been demonstrated. According to Chithra and Leelamma (1999), the hypoglycemic effect could be initiated by the seeds through increased utilization of glucose during liver glycogen synthesis, decreased degradation of glycogen in producing blood sugar, increased rate of glycolysis and decreased rate of gluconeogenesis. The same authors Chithra and Leelamma (2000) have also investigated the biochemical effect of coriander seeds on lipid metabolism in 1,2-methyl hydrazine (DMH) induced colon cancer in rats. In a study conducted by Guerra *et al*. (2005), among the five fractions viz. ß-carotene, ß-cryptoxanthin epoxide, lutein-5,6-epoxide, violaxanthin and neoxanthin that were isolated from a coriander ether extract using column chromatography, ß-carotene was identified as the principal antioxidant component in Coriandrum sativum Garcinia mangostana or Mangosteen (or manggis in Bahasa Indonesia) belongs to the Guttiferae family (Elliott and Brimacombe 1987) and is widely distributed throughout Thailand, India, Sri Lanka, Myanmar, Indonesia, Malaysia, Philippines and China (Yu *et al*., 2007). Mangosteen is a climacteric fruit, often referred to as "the queen of fruits" and the aril which is white, soft, juicy with a pleasant aroma is mostly eaten fresh (Yu *et al*., 2007). Members of the genus Garcinia are a rich source of secondary metabolites, which include the xanthones (Suksamrarn *et al*., 2002) such as ß- and ß-mangostins, mangostenol, mangostenone A, trapezifolixanthone, tovophyllin B, and garcinone B (Chiang *et al*., 2004). Other secondary metabolites, include the flavonoids (isoflavone and flavone), benzophenones, lactones as well as phenolic acids and hence retains the potential to exhibit a wide array of biological and pharmacological activities (Bennet and Lee 1989; Minami *et al*., 1994). Mangosteen is used as a traditional medicine for the treatment of abdominal pain, dysentery, diarrhea, suppuration, infected wound, leucorrhoea and chronic ulcer and gonorrhoea (Jayaprakasha *et al*., 2006). In Indonesia a decoction is prepared from the skin of mangosteen fruits along with the bark of Lansium domesticum (duku in Bahasa Indonesia) and drunk as a remedy for bloody diarrhea (Elliott and Brimacombe 1987). Studies have also revealed that mangosteen possess anti-inflammatory (Gopalakrishnan *et al*., 1997), and antitumor properties (Williams *et al*., 1995). The antileukemic xanthones have been isolated from plants belonging to the Guttiferae family (Balasubramanian and Rajagopalan 1988). The antibacterial activity of the plant against methicillin resistant *Staphylococcus aureus* has been documented by (Sakagami *et al*., 2005) and against *Helicobacter pyroli* by (Mahabusarakum *et al*., 1983). Mangosteen is not only used in the treatment of diarrhea, cystitis, dysentery, eczema, but also as an astringent (Anon1 1956) and an anti-diabetic (Pai *et al*., 1979).

Sweet potato or ubi rambat as known in Indonesia is a creeping, tuberous-rooted, perennial herb belonging to the Convolvulaceae family (Mukherjee *et al*., 2006). Plants are widely cultivated in many tropical and subtropical countries especially in India, China, Philippines and the South Seas Islands. (Elliott and Brimacombe 1987; Mukherjee *et al*., 2006). According to food and agriculture organization (FAO), sweet potato (Ipomoea batatas) is the sixth most important food crop in the world (Huang *et al*., 2006). In Indonesia sweet potato is cultivated in Banda Aceh, in north, west and south Sumatra, Riau, Jambi and Bengkulu (Anon2 2000). The Indonesians use the leaves of sweet potato along with the stems of Ipomea aquatica Forsk. (water spinach), powdered lime and Amaranthus spinosus (thorny amaranth) to prepare a paste which is then applied to boils (Elliott and Brimacombe 1987). One of the health benefits of plants (both fruits and vegetables) can be attributed to the presence of antioxidant vitamins that exhibit antioxidant properties (Dimitrios 2006) and studies have shown that the leaves of Ipomoea batatas are rich in flavanols and flavones, the subgroups of flavonoids (Chu *et al*., 2000). Flavanoids are large compounds that possess strong free radical scavenging and antioxidant activities (Rafat et al., 1987; Robak and Gryglewski 1988; Scott and Slater 1981) and tend to occur as glycosides and contain several hydroxyl groups on their ring structures (Chu et al., 2000). Food derived flavonoids such as the flavonols quercetin, kaempferol and myricetin also possess anticancer activity (Verma *et al*., 1988; Yoshida *et al*., 1990). Hypoglycemic effects of sweet potato have been investigated by Matsui *et al*. (2002) in Sprague-Dawley rats and Kusano and Abe (2000) in Zucker fatty rats. Both studies have demonstrated the hypoglycemic effects of the plant i.e. the ability to reduce blood sugar level either by reducing insulin resistance (Kusano and Abe 2000) or by postprandial (after food intake) glucose suppression effect (Matsui *et al*., 2002). In the study conducted by Matsui *et al*. (2002), diacylated anthocyanin isolated from storage roots of sweet potato cv. Ayamurasaki was orally administered in male eight weeks old Sprague-Dawley rats. The beneficial effects of Caiapo, the extract of white-skinned sweet potato on fasting plasma glucose, as well as on total and low-density lipoprotein (LDL) cholesterol in type 2 diabetic patients have been reported by Ludvik *et al*. (2002). Cultivated potato is extremely poor in provitamin A (Diretto *et al*., 2007) however the botanically distant orange-fleshed sweet potato is rich in ß-carotene, which is a provitamin A carotenoid, used by the body to produce vitamin A (de Vries 2000).

Myristica fragrans a member of the Myristicaceae family is a medium-size tree cultivated in the tropical regions (Spricigo *et al*., 1999). The seeds (dried kernels) of Myristica fragrans are known as nutmeg (Holstege 2005) in English and as pala in Bahasa Indonesia (Elliott and Brimacombe 1987). Indonesia and Sri Lanka are among the major producers of nutmeg in the world (Spricigo *et al*., 1999).

Prior to European contact nutmeg was found only in the Banda islands of Indonesia (Gils and Cox 1994) because of its heavy annual rainfall of 2210 –3667 mm (Purseglove *et al*., 1981), a tropical climate and rich volcanic soil (Gils and Cox 1994). Essential oil from the seeds of nutmeg is extensively used in flavoring food products such as dehydrated soups, ice creams, sauces, bakery products, processed meat and myristicin, one of the constituents, of the essential oil is responsible for imparting the characteristic aroma of nutmeg (Bauer 1985) Myristicin has been isolated from nutmeg using high-performance liquid chromatography (Holstege 2005). Nutmeg is an important traditional plant of high medicinal value to the Indonesians and is used to treat stomach and kidney disorders as well as to alleviate abdominal cramps, rheumatism, nervousness, vomiting, whooping cough and flatulence (because of its carminative property) (Kloppenburgh-Versteegh 1934). To treat abdominal cramps, teaspoonful of nuts are taken with salt (Hirschhorn 1983). Nutmeg seeds are used as a stimulant, digestive, aphrodisiac and post childbirth tonic in Mohammedan and Malay medicine (Burkill 1935). The plant is a native of east Malaysia where it is a major constituent of medicinal preparation that are used as oral remedy for cough and vomiting, for the treatment of disorders related to the urinary tract, indigestion and infertility in women (Elliott and Brimacombe 1987). In China, the nuts are crushed into a powder and used as a warming and astringent remedy for dysentery in both children and the aged whilst in IndoChina the powdered seeds are boiled with rice and consumed as a treatment against dysentery, anorexia and colic (Janssens *et al*., 1990). The kernel of nutmeg contains volatile oil, fats, starch, and mucilage (Sonavane *et al*., 2002). The fixed oil (fatty oil, total fatty acid composition) contains myristicin, myristic acid (straight-chain saturated fatty acid first isolated from nutmeg in 1926) while the volatile oil component contains pinene, sabinene, camphene, elemicin, isoelemicin, eugenol, methoxyeugenol, isoeugenol, safrole, etc. (Evans 1996; Isogai *et al*., 1973; Janssen *et al*.,1990). The seeds of Myristica fragrans are attributed with psychotomimetic properties and known to possess both stimulatory and depressant activities (Sonavane *et al*., 2002). According to Truitt *et al*. (1961), nutmeg devoid of its volatile oil may retain the gastrointestinal properties but may loose the psychotropic properties. Perhaps the psychotropic characteristic of the plant imparted by volatile oils may be one of the reasons for its frequent use both as a stimulator and energizer in aromatherapy (Spricigo 1998). Nutmeg is also abused for its narcotic and hallucinogenic properties — one to three seeds or 5–30 g of the ground nut are used to attain psychogenic effects (Holstege 2005). Eugenol a methoxyphenol with a short hydrocarbon chain (Ito *et al*., 2005) found in aromatic plants like cloves, cinnamon and ocimum is also found to occur as the major constituent of volatile oil in nutmeg (Kumarvelu *et al*., 1996). Eugenol inhibits the accumulation of lipid peroxidation products in erythrocytes and maintains activities of antioxidant enzymes such

as superoxide dismutase, catalase, glutathione peroxidase, glutamine transferase, and glucose 6-phosphate dehydrogenase (Kumarvelu *et al*., 1996). The oil is also used to treat malarial debility (Perry 1980). In dentistry, eugenol is used both as root canal sealers as it is very effective for its antibacterial activity against oral bacteria (Lai *et al*., 2001), as an analgesic (Maralhas *et al*., 2006) and as a local anaesthetic for treatment of post-operative pain after gingivectomy (Skoglund and Jorkjend 1991). In the Unani system of medicine, some spices are usually considered as sexual invigorators (aphrodisiacs) and studies by Tajuddin *et al*. (2003) showed that ethanolic extracts of both nutmeg and clove could not only arouse the mounting behaviour of male Swiss mice, but also significantly increase their mating performance. Due to niacin content (1.4mg/100g) in nutmeg it tends to exhibit hypolipidaemic activity (Ram *et al*., 1996) and therefore benign to the body system because hyperlipidaemia is associated with the initiation and progression of atherosclerosis (Brown *et al*., 1981; Kennel *et al*., 1971). Nutmeg is a plant with high medicinal value such as astringent, antithrombotic (Olajide *et al*., 1999), antiplatelet aggregation, antifungal, and anti-inflammatory activities (Nadkarni 1998; Olajide *et al*., 1999).

Nigella sativa is an annual herbaceous, dicotyledon belonging to the Ranunculaceae family (Al-Gaby 1998; Atta 2003) and widely distributed in Asian and Mediterranean countries (Nair *et al*., 2005) as well as in Europe and northern Africa (Salem 2005). The plant is bushy, self-branching with white or pale to dark blue flowers (Salem 2005) The numerous white trigonal seeds are contained within a fruit capsule which on maturation opens up and the seeds are consequently exposed to the air thus turning black in color (Schleicher and Saleh 1998). In Bahasa Indonesia, it is known as jira hitam or black cumin (Elliott and Brimacombe 1987). The plant has a rich historical and religious background and was referred to by the prophet Mohammed for its healing powers (Goreja 2003) and has been mentioned in the Holy Bible as "the curative black cumin" (Junemann 1998). Jira hitam, or black cumin seed oil extract, has been used for thousands of years as a spice, condiment, carminative and food preservative, as well as a protective and curative treatment for numerous disorders in traditional and Indian folk medicine (Aboutabl *et al*., 1986; El-Sayed *et al*., 1996; Merfort *et al*., 1997; Nadkarni 1976; Nair *et al*., 2005). In Indonesia, the seeds of Nigella sativa are ground with white cumin (Cuminum cyminum) seeds or jira putih and the leaves of Citrus aurantium (bitter orange – an important Chinese herb) and applied to the forehead to relieve headaches (Elliott and Brimacombe 1987). The seeds are also used as an ingredient for an oral remedy that is used for the treatment of arthritis and other joint diseases (Elliott and Brimacombe 1987). The ability of the black cumin seeds to relieve the effects of arthritis can be attributed to the anti-inflammatory properties of the seeds (Ali and Blunden 2003). Morsi (2000) also used both the crude alkaloid extract and the water extract prepared from the seeds of *Nigella sativa* to screen the efficacy of the extracts against a variety of organisms isolated from human patients suffering from septic arthritis and noted that (a) the Gram negative isolates were affected more than the Gram positive isolates and (b) also

the antibacterial action was concentration dependent. The antifungal activity of *Nigella sativa* has been assessed against the yeast Candida albicans (Khan *et al*., 2003) and the dermatophytes (Aljabre *et al*., 2005). One of the major components of the essential oil from Nigella sativa is the thymoquinone (Ali and Blunden 2003) that readily dimerizes to form dithymoquinone (El-Dakhakhny 1963). From a study carried out by Aljabre et al. (2005) against eight species of dermatophytes, four species of *Trichophyton rubrum* and one each of Trichophyton mentagrophytes, *Epidermophyton floccosum* and *Microsporum canis* using ether extract of *Nigella sativa* and its active principle thymoquinone it was apparent that *Nigella sativa* retains the potential to be used as a source in the development of antidermatophyte drugs. Other than antimicrobial activity, studies have shown that thymoquinone from *Nigella sativa* is also attributed with many other therapeutic properties for e.g. it protects the hepatocytes and therefore the liver from exogenous toxins (Badary *et al*., 2000; Daba and Abdel-Rahman 1998), it also protects the liver from the toxic effects of cisplatin and carbon tetrachlorides (El-Daly 1998; Nagi *et al*., 1999), enhances the antitumor effect of ifosfamide on induced ascites carcinomas (Badary 1999) and increases the resistance of mixed lymphocytes in culture against mitogens and exerts additional immunomodulatory effects by influencing the production of interleukin IL 1ß, IL-8 and TNF-α (Haq *et al*., 1995). The efficacy of the plant in the treatment of skin conditions such as eczema has also been recognized worldwide (Goreja 2003). Moreover studies carried out by Kalus *et al*. (2003) have also proved that the oil of Nigella sativa is capable of relieving symptoms of allergic diseases such as allergic rhinitis, atopic eczema and bronchial asthma. Thus in the traditional folk medicine of the Middle and Far East, black cumin seeds have been used to treat a wide range of illnesses, encompassing bronchial asthma, headache, dysentery, infections, obesity, back pain, hypertension and gastrointestinal problems (El-Dakhakhny 1965; Schleicher and Saleh 1998). According to Salem (2005), the seeds are also ground to a powder, mixed with a little flour as a binder, and applied externally to treat abscesses, nasal ulcers and rheumatism. Black seed extract or oil has also been reported to possess (a) antioxidant activity by Burtis and Bucar (2000), (b) antitumor activity by Worthen *et al*., (1998), and (c) the potential to induce stimulatory effect on the immune system by Salem and Hossain (2000).

Solanum torvum or Turkey berry belonging to the Solanaceae family is a cultivated relative of eggplant Solanum melongena L. (Gousset *et al*., 2005). It is a prickly creeping shrub native to India (Deb 1979), and distributed in most pantropical areas, particularly South East Asia, the Mascarene and the Pacific islands as well as the West Indies (Gousset et al., 2005). In Indonesia it is known as rimbang pahit or ungke pahit (Elliott and Brimacombe 1987). The fruits are edible and are used as vegetables (Sivapriya and Leela 2007). In Malaysia, the plant is categorized as an ulam – the traditional vegetables of the Malays that encompass more than 120 species from various families, and includes

shrubs as well as large trees (Mansor 1988). The berries, that are bitter to taste, are used in Indonesia for the treatment of malaria and other fevers. The berries are first pounded together with the fruits of *Artocarpus integra* (jack fruit) which is cultivated in the Alas valley in Indonesia and the rhizomes of *Curcuma sp*. and the juice is subsequently drunk (Elliott and Brimacombe 1987). The berries are mashed together with the leaves of Curcuma domestica (Turmeric) and applied to the eyes to treat trachoma or are mixed with the fruits of Gmelina elliptica (Parrot's beak) and are taken as a cure for beri-beri (Elliott and Brimacombe 1987). In Malaysia, Solanum torvum is applied to cracks in the feet for its antimicrobial property (Wiart *et al*., 2004). From a study conducted by Wiart *et al*. (2004) in which methanol extracts from leaves, barks and roots of 50 medicinal plants including *Solanum torvum* from the state of Perak, Malaysia were screened for their antibacterial and antifungal activity, it was apparent that *Solanum torvum* displayed a high degree of activity, against at least four out of the six microorganisms thus tested (*Bacillus cereus, Bacillus subtilis*, *Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*). From the results, thus obtained Wiart *et al*. (2004) concluded most of the plants including *Solanum torvum* would serve as good sources of antimicrobial agents and was worthwhile to carry out further investigations. Because of its antimicrobial activity the fruit juice of Solanum torvum is used in many parts of the North-West Province of Cameroon for the treatment of abscesses, jigger wounds, skin infections such as ringworm, athlete's foot in humans and dermatophilosis in animals (Chah *et al*., 2000). Besides antibacterial and antifungal activity the plant is also endowed with antiviral activity and an antiviral isoflavonoid sulfate and a steroidal glycoside have been isolated from the fruits of Solanum torvum (Arthan *et al*., 2002). In Africa, it is used as a tonic and a hemopoietic agent and is also used for the treatment of pains (Daziel 1937; Watt and Breyer-Brandwijk 1962). In India, the juice extracted from leaves of Solanum torvum is used to reduce body heat and unripe fruits are used to strengthen the body (Muthu *et al*., 2006). Decoction prepared from the fruits is used as a remedy for cough related ailments and is considered useful in cases of liver and spleen enlargement (Siemonsma and Piluek 1994). The plant is both a sedative and diuretic and the leaves are used as a haemostatic to prevent excess bleeding during hemorrhages. The ripened fruits are used in the preparation of tonics and haemopoietic agents and also as a treatment for pain (Kala 2005).

Conclusion

Botanically Indonesia is among one of the richest countries in the world with a highly diversified distribution of different plant species. This vast diversity has been partly attributed to the size of the country and partly to Indonesia's complex geological past. The breakup of the single supercontinent Pangea, the collision of the two land masses, Laurasia and Gondwana and consequently the unique topographical

characteristics it acquired as a result, which has greatly influenced the floral diversity of the archipelago (Whitten and Whitten 1996). The rain forests of Indonesia that occur in Java, Sumatra, Maluku and Lesser Sundas may abound in medicinal plants, containing untapped natural products especially the secondary metabolites that are still unknown to the modern pharmaceutical industries. Sadly the traditional knowledge of the medicinal plants in most parts of the world stands at the brink of a ruinous course today. In Indonesia for example, the demand for space to accommodate the briskly growing population has led to extensive clearing of the rainforests on one hand. Whilst on the other, with every increasing day, the age-old traditions of the indigenous medicine practitioners like the dukuns bajis and balians of Bali are being challenged by the more scientifically sound and hospital/health clinic based approach of modern medicine.

The use of herbal medicines has been deemed to be both therapeutic (for curing) and prophylactic (for prevention) and the use of the latter has been more aptly attributed to animals such as the chimpanzees (Pan troglodytes). (Hart 2005). Ethnomedicine has long been scorned for its dearth of sound scientific reasoning, a practice in which the "traditional healers" with its charms and herbs is more often disposed towards the psychological healing of a "person" as an individual, while biomedicine on the other hand, has been criticized by many for its more impersonal outlook where the doctors tend to be more focused on diagnosing and treating the "disease" rather than the person (Neumann and Lauro 1982). Today, research in the area of medicinal plants is undergoing a more profound shift towards the investigation of the molecular mechanisms, the unraveling of signaling pathways with its many receptor-ligand complexes, numerous regulatory proteins and their specific binding sites, development of transgenic plants with high medicinal values as well as in unveiling the biochemistry behind both the aetiology of the disease and the healing properties of the plant. In this article, wherever possible, attempts have been made to address the biochemical aspects of the healing properties of medicinal plants that have been used by traditional healers and medicine men of Indonesia from ancient times and to whom both religion and healing, the physical and the spiritual dimension are intertwined into an integrated whole.

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